Health systems recovery in the context of COVID-19 and protracted conflict

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Health systems recovery in the context of COVID-19 and protracted conflict

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Editorial: Health systems recovery in the context of COVID-19 and protracted conflict

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Editorial on the Research Topic
Health systems recovery in the context of COVID-19 and protracted conflict

The COVID-19 pandemic has revealed a lack of resilience in national health systems and flaws in the global coordination required for tackling a rapidly escalating emergency. This is against a background of chronic underinvestment in public health, encompassing emergency preparedness, and a fragmented approach to health system planning, financing and services. While some countries managed to limit the direct impacts of COVID-19, as reflected in case numbers and mortality rates, this came with significant costs including restrictions in movement, interruptions in trade, social unrest and unprecedented spending in health (1). The diversion of health system resources to COVID-19 response led to protracted disruptions of essential health services (2). The true extent of the impact on population health in many countries cannot be reliably ascertained due to basic gaps in health information systems and reporting. As we enter what has been coined a "new age of pandemics," we must accept that even wealthy countries cannot afford to repeat this experience again (3).

The consequences of the COVID-19 pandemic have been amplified by pre-existing weaknesses in public health and health system capacities, with the greatest impact felt by the most vulnerable within our societies. The fact that the vulnerable and marginalized among us have been disproportionately affected, both physically and economically, is unacceptable (4–6). At the same time it is important to acknowledge that the vulnerable and marginalized were shouldering a greater share of the burden of disease prior to the pandemic, with higher rates of ill health coupled with greater difficulties in accessing health care (7, 8). Pre-existing austerity, high out of pocket payments for health services and reduced spending on public health have diminished the ability of our health systems to reach people most in need with the services necessary to prevent as well as treat disease. Vertical investment and programming within the health sector and across sectors have been proven to be ineffective in maintaining health services and responding to disruptive public health events. And, despite much rhetoric around social participation, the public's voice is often excluded from decisions around policy, planning and equitable investment in health services.

COVID-19 has once again laid bare what previous public health emergencies have demonstrated with painful clarity, that health is at the heart of social and economic prosperity. It has also reinforced that emergency preparedness and response needs to be integrated and delivered in synergy with other essential public health functions (9–11). As the world looks to recover from COVID-19, we must reimagine our health systems to ensure that the limited resources available can not only provide health systems capable of responding to the challenges presented by climate change, war and conflicts, emerging infectious threats, and rising rates of antimicrobial resistance and non-communicable disease, but also create systems for health that keep the most vulnerable among us well.

This Research Topic aims to consolidate global perspectives and experiences from the COVID-19 pandemic and protracted conflicts and to inform a different approach to policy, planning and practice to "build back better." The majority of authors' teams are *not* affiliated with academic institutions. Instead, they represent actors whose primary responsibility has been to make the high-risk, high-stakes, real-world decisions that have impacted all our lives. They are offering their experiences to inform and strengthen recovery for all. Representing the learning captured from more than 60 countries during the acute phase of a global pandemic, this Research Topic demonstrates that difficult circumstances can and do create opportunities for change, both organizationally and at the service delivery level. As is clearly articulated by the varied approaches within the country case studies shared in *The use of innovative approaches to strengthen health system resilience during the COVID-19 pandemic: case studies from selected Commonwealth countries* (Mghamba et al.), there is no "one size fits all solution" to the development of health system resilience. However, the Research Topic also demonstrates that there are a number of common areas for action in support of this aim.

The importance of the Primary Health Care (PHC) approach,[1] encompassing comprehensive integrated health services that embrace primary care and essential public health functions (EPHFs),[2] multisectoral action for health and community engagement, in supporting health systems resilience and responding to emergencies, is a strong and common thread across many articles in the Research Topic. At the global level*, Developing technical support and strategic dialogue at the country level to achieve Primary Health Care-based health systems beyond the COVID-19 era* (Cheong Chi Mo et al.) presents the existing platform of the UHC-Partnership, which supports technical capacities in countries to strengthen primary health care. *From fragility to resilience: A systems approach to strengthen primary health care* (Lugten et al.), an article by USAID experts, presents an approach to strengthening PHC in countries using a systems approach. At the country level, *Learning from pandemic responses: informing a resilient and*

equitable health system recovery in Thailand (Tangcharoensathien et al.) and *An overview of Iran's actions in response to the COVID-19 pandemic and in building health system resilience* (Gouya et al.) highlight the contribution of pre-existing investments in primary health care to resilience by creating the opportunity to leverage primary health care structures and platforms to promote more effective and, importantly, more equitable response efforts in Thailand and the I.R. of Iran respectively. These articles, as well another from Iran, *Risk communication and community engagement as an emerging pillar of health emergency management in Iran: achievements and the way forward* (Senga et al.), also highlight the importance of community engagement in supporting emergency response and building resilience.

The use of multisectoral collaboration to reach the most vulnerable is demonstrated in *"Beyond just the four walls of the clinic": The roles of health systems caring for refugee, immigrant and migrant communities in the United States* (Abudiab et al.), while leveraging allied sectors to support COVID-19 response is a feature of *Lessons from inter-disciplinary collaboration to mitigate SARS-CoV-2 transmission in schools, Ireland, 2020/2021, to inform health systems and multisectoral recovery* (Naughton et al.).

The role of the essential public health functions is articulated in a number of articles. *Toward applying the essential public health functions for building health systems resilience: A renewed list and key enablers for operationalization* (Zhang et al.) discusses the development of a renewed list of essential public health functions for 21st century public health challenges, while exploring a number of key enablers to support operationalization. *A synthesis of concepts of resilience to inform operationalization of health systems resilience in recovery from disruptive public health events including COVID-19* (McDarby et al.) identifies the essential public health functions alongside learning systems and integrated health systems strengthening as a key action area to build resilience in recovery efforts. The application of the essential public health functions to strengthen public health capacities at the national level is explored in *A novel approach to utilizing the essential public health functions in Ireland's health system recovery and reform* (McNicholas et al.).

The development and use of health information to drive innovation and change from policy to service delivery levels was also a prominent theme. *Perspective: Lessons from COVID-19 of countries in the European region in light of findings from the health system response monitor* (Tille et al.) outlines how developing a repository to support policy knowledge transfer at the European level early in the pandemic helped to inform government policies to support and finance public health interventions. *Assessing capacities and resilience of health services during the COVID-19 pandemic: Lessons learned from use of rapid key informant surveys* (Rivas-Morello et al.) presents a low cost yet effective way to augment national health information systems to inform response and recovery that can be integrated into operational planning. *The provision and utilization of essential health services in Afghanistan during COVID-19 pandemic* (Neyazi et al.) discusses the use of health information to inform changes in service delivery, reorganizing care in response to the pandemic in Afghanistan.

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1 Primary health care is a whole-of-society approach to effectively organize and strengthen national health systems to bring services for health and wellbeing closer to communities.

2 The essential public health functions are a set of fundamental, interconnected and interdependent activities, both within and beyond the health sector, required to ensure effective public health actions and services.

Despite the title of the Research Topic, fragile, conflict and violence affected settings are under-represented. While this likely represents the difficulties in obtaining data from these regions, as articulated in *Early effects of COVID-19 on maternal and child health service disruption in Mozambique* (Augusto et al.), the lack of clear attention to these contexts with the greatest need must be addressed.

Similar to past public health emergencies and humanitarian responses, the recovery from COVID-19 presents us with a narrow opportunity to do things differently. The widespread impacts of COVID-19 have created an understandable drive to bolster emergency response capacities to ensure this never happens again. However, this drive could be better harnessed to ensure a renewed recognition of the broader responsibility of health systems—to provide quality and equitable services in routine times. For example, the role of primary health care for essential public health functions and the provision of public health services is critical to ensure timely detection, reporting and response.

This Research Topic calls us to innovate and learn in order to deliver essential health services in the most difficult of contexts. For any of this to translate into a resilient recovery, we must move beyond the empty rhetoric of "lessons learned" from past experience with emergencies. This requires an active approach to recovery that allows us to sustain and develop what has served us, rather than the passive free fall back to pre-existing levels of system and service delivery—a baseline that, if we are honest, was not really serving us.

While investment will be required, it is as much about making smarter and better choices including:

- Drawing on and aligning all available resources to support integrated health system strengthening;
- Investing in cost effective and sustainable approaches like primary health care and the essential public health functions;
- Breaking down the siloes within and beyond the health system and the barriers between people and systems to ensure a whole-of-society approach to health in routine and emergency contexts including fragile, conflict affected settings;
- Developing public health leadership and institutions including at national and subnational levels based on lessons and best practices identified.

This active, evidence-informed approach to recovery is the only way for us to escape the chronic panic and neglect cycle of past public health emergencies and build a resilient and sustainable future for all. The window of opportunity for change is, once again, closing. How we act today will determine the costs that will be paid by us all, when the next, inevitable pandemic strikes.

Author contributions

SS provided overall stewardship of conception as well as the acquisition of significant data informing the work as well as contributing to manuscript revision. DS and ZJ provided approval for conceptualization and design of the work including approval for publication of content. GM provided substantial contributions to the drafting and revising of the manuscript from conception to delivery. RS provided substantial contributions to the intellectual content of the manuscript and contributed to the revising of the manuscript and was responsible for the acquisition of significant data informing the work. YZ, SM, and MP provided substantial contributions to the intellectual content of the manuscript and contributed to the revising of the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Section I: Country-level overviews

There are a total of 12 papers in this section. The first three papers offer overviews of country responses to recent public health emergencies, including COVID-19 and Ebola. They focus primarily on what worked and how challenges were overcome within national contexts. The two COVID-19- related papers discuss both the emergency response and features of the pre-existing health system organisation which were leveraged for a robust and effective response. The paper focusing also on Ebola describes the recovery of the health system following the public health event.

The remaining papers in this section provide country-level data and learning on specific aspects of the COVID-19 response, health system resilience or recovery. Broad themes include: planning; essential services and functions and their disruption; multisectoral collaboration and whole-of-society approaches; and education and capacity building. Within those broad themes, a number of further issues relevant to health systems resilience and recovery are discussed, ranging from health information systems, through risk communication and community engagement, to care for refugee, immigrant and migrant communities.

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Learning from pandemic responses: Informing a resilient and equitable health system recovery in Thailand

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This article is part of the Research Topic 'Health Systems Recovery in the Context
of COVID-19 and Protracted Conflict'. The third quarter of 2022 saw COVID-19
cases and deaths in Thailand reduced significantly, and high levels of COVID-19
vaccine coverage. COVID-19 was declared an "endemic" disease, and economic
activities resumed. This paper reviews pre-pandemic health systems capacity and
identifies pandemic response strengths, weaknesses and lessons that guided resilient
and equitable health system recovery. Robust health systems and adaptive strategies
drive an effective pandemic response. To support health system recovery Thailand
should (1) minimize vulnerability and extend universal health coverage to include
migrant workers and dependents; (2) sustain provincial primary healthcare (PHC)
capacity and strengthen PHC in greater Bangkok; (3) leverage information technology
for telemedicine and teleconsultation; (4) enhance and extend case and event-
based surveillance of notifiable diseases, and for public health threats, including
pathogens with pandemic potential in wildlife and domesticated animals. This requires
policy and financial commitment across successive governments, adequate numbers
of committed and competent health workforce at all levels supported by over a
million village health volunteers, strong social capital and community resilience. A
strengthened global health architecture and international collaboration also have
critical roles in establishing local capacities to develop and manufacture pandemic
response products through transfer of technology and know-how. Countries should
engage in the ongoing Inter-government Negotiating Body to ensure a legally binding
instrument to safeguard the world from catastrophic impacts of future pandemics.

KEYWORDS

COVID-19, pandemic response, equitable health system recovery, resilient, adaptive
strategies, Thailand

1. Introduction

As of 25 September 2022, Thailand reported 4.7 million COVID-19 cases, and 32,721 deaths;
equivalent to 65,329 cases and 456.8 deaths per million population (1). Thailand ranks 142nd and
137th globally in terms of cases and deaths per million population. COVID-19 vaccine rollout
began in May 2021; by September 2022, 79.6% of the Thai population were fully vaccinated and
44.7% had received booster doses (2).

Wilasang et al. (3) estimated excess deaths in 2021 at 14.3% (95%CI: 8.6–18.8%) higher than
the expected mortality projected from the last five years. Another study estimated excess deaths
between 2020 and 2021 at 24.9 per 100,000 population, compared with reported deaths of 15.3
per 100,000 population (4). This rate is considerably lower than the global all-age rate of 120.3.

In 2021, Thailand ranked fifth out of 195 countries and territories for the Global Health Security Index (GHSI), with an index score of 68.5 after US, Australia, Finland and Canada. Though the six domains of GHSI, namely prevention capacity, detection and reporting, rapid response, health system capacity, compliance with international norms and risk environment are useful for analysis of pandemic preparedness and response capacity, higher GHSI scores do not consistently predict better control outcome. For example, a study has shown a positive association between GHSI and COVID-19 cases and deaths, but this is not related to the COVID-19 testing rate ($r = 0.35$, $P < 0.001$) [5]. This counter-intuitive outcome is also confirmed by another study on discrepancies between the GHSI and the actual performance in OECD countries; probably the effect of leadership was not adequately covered by the index [6]. Governance and leadership are keys for effective pandemic management [7]. Further, domains often viewed as external to the health sector are central determinants of health system resilience in pandemic response including governance, finance, collaboration across sectors and community engagement [8]. None of these are elements of the GHSI.

The third quarter of 2022 saw a significant reduction in the number of COVID-19 cases, and high levels of vaccine coverage in Thailand. The government declared COVID-19 an "endemic" disease, fully resumed economic activity and initiated a plan for health system recovery.

Figure 1 shows COVID-19 case numbers and deaths, together with policy interventions, i.e. elimination in wave 1, suppression in wave 2 and 3 and mitigation in wave 4 (the peak of Delta strain transmission) when home and community isolation policies were introduced [9]. In wave 5 (Omicron variant), the country endorsed a "living with COVID" strategy. Vaccine rollout was expedited in early 2021.

This paper is based on the experience of policy actors from Thailand's Ministry of Public Health and the WHO Country Office. In this paper, we argue that a leading reason for Thailand's success in dealing with COVID-19 was the country's robust pre-pandemic health system. This was supported by an effective pandemic response, through whole-of-government and whole-of-society approaches, and decisive decision-making informed by science, agility, and adaptivity. Response challenges included significant vulnerable populations (especially migrant workers), poverty and sub-optimal primary health care in Bangkok, and politicization of the pandemic, and particularly of the vaccine debate.

These experience-based observations were further complemented by focused Google literature searches in three areas: (1) pre-pandemic health system resilience including primary healthcare, health workforce and universal health coverage; (2) enabling factors, and (3) challenges faced during the 3-year pandemic.

2. Pre-pandemic: Robust health systems

A robust health system is a critical foundation for pandemic response. A study further proposes health-system integration across UHC and global health security, innovative and unified health financing, cross-sector resilience and equity as core values [10].

Thailand's health system is dominated by the public sector. In 2021, the Ministry of Public Health (MOPH) was the major healthcare provider in the country, maintaining 68% and 67% respectively of the 1,367 hospitals and 167,563 beds nation-wide, and providing for 64% and 71% of all outpatient visits and inpatient cases. Other public sector providers such as Defense, Universities and local government had a very limited healthcare provision role. The private sector had a correspondingly smaller role, with a 24% and 20% shared of hospitals and beds; and a 23% and 21% shared of total outpatient visits and inpatient cases in 2021 [11].

Robust government health systems were achieved through four decades of investment in health infrastructure until full geographical coverage of health centers, district hospitals and provincial hospitals in all sub-districts, districts and provinces, respectively was achieved. District health systems provide a comprehensive range of services including integrated public health functions, and are the foundation for UHC with favorable access outcomes [12].

Since 2002, the whole population is covered by one of three public health insurance schemes. Benefit packages are comprehensive, resulting in high financial risk protection [13]; which together with geographical coverage of health services results in a low level of unmet healthcare needs [14, 15]. The UHC service coverage index increased from 41% in 2000 to 83% in 2019 [16], while the proportion of the population spending more than 10% of their household consumption on out-of-pocket health care expenditure reduced from 5.63% in 2002 (prior to UHC) to 1.87% in 2019 [17].

Scaling up and diversifying training has increased the health workforce density. The number of physicians, nurses and midwives per 1,000 population increased from 0.93 in 1991 to 4.07 in 2019 against the target of 4.45 physicians, nurses and midwives per 1,000 population by 2030 [18]. Since 1974, Thailand has had special tracks to recruit rural students into medical and nursing careers, later extended to dentistry and pharmacy, with the expectation that they return to work in their communities after graduation [19]. Evidence suggests this initiative achieves better results in terms of fulfilling a 3-year mandatory rural service requirement, and higher clinical competencies [20].

In 1980, MOPH launched a 2-year Field Epidemiology Training Programme for medical, veterinary and other health science graduates. Joint training between human and animal health sectors has improved surveillance and control of zoonotic diseases, and improved collaboration among One Health partners [21]. Further, 1-4 weeks short courses on basic epidemiology are also provided to health officers as well as a 6–12 month intermediate level course. MOPH also oversees 1,030 Surveillance and Rapid Response Teams (SRRTs) in districts, provinces and centrally.

3. Pandemic responses: Key enabling factors

An inter-country study demonstrated that in Thailand, cross-sectoral coordinated action, an effective test, trace, quarantine, treatment system and effective governance to ensure adherence to public health and social measures were all important factors that contributed to the national pandemic response [22].

A Joint Intra-action Review of Thailand's responses to COVID-19 by WHO and the MOPH also identified decisive leadership
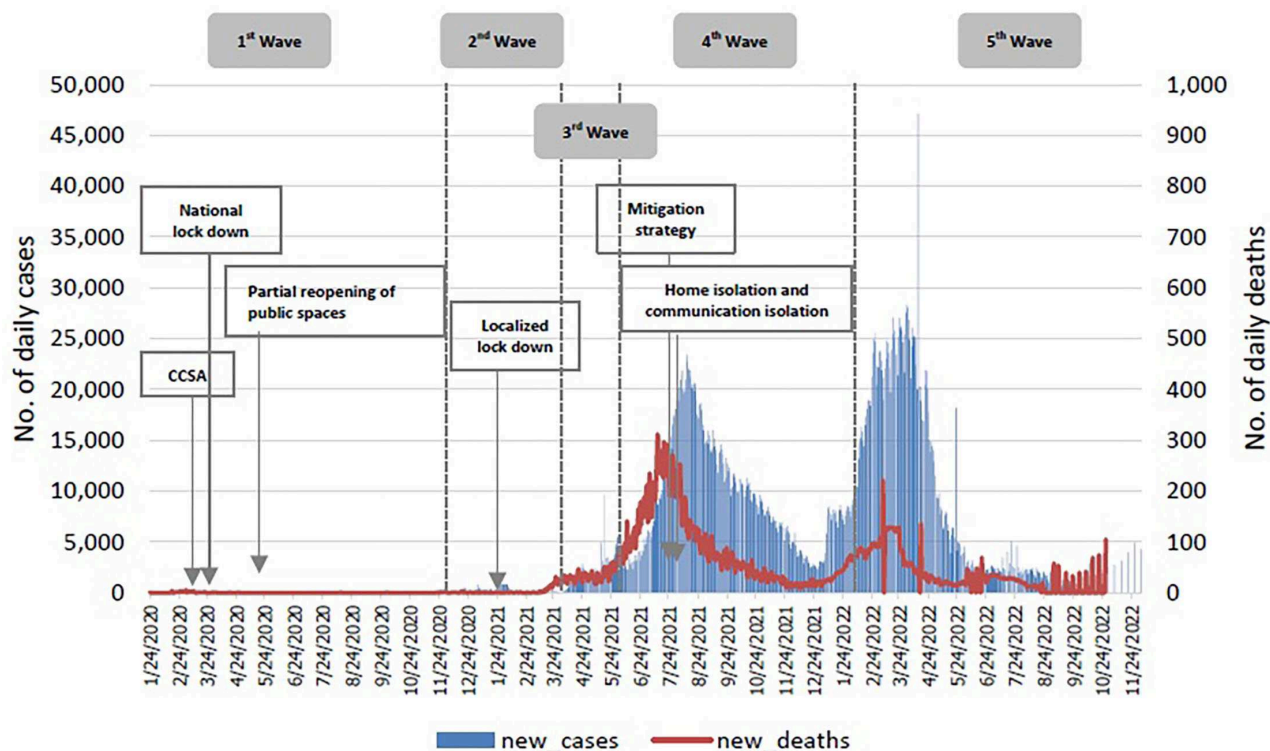
FIGURE 1
Thailand COVID-19 daily reported cases, February 2010 to September 25, 2022. Source: COVID-19 Corona Virus Pandemic (1).
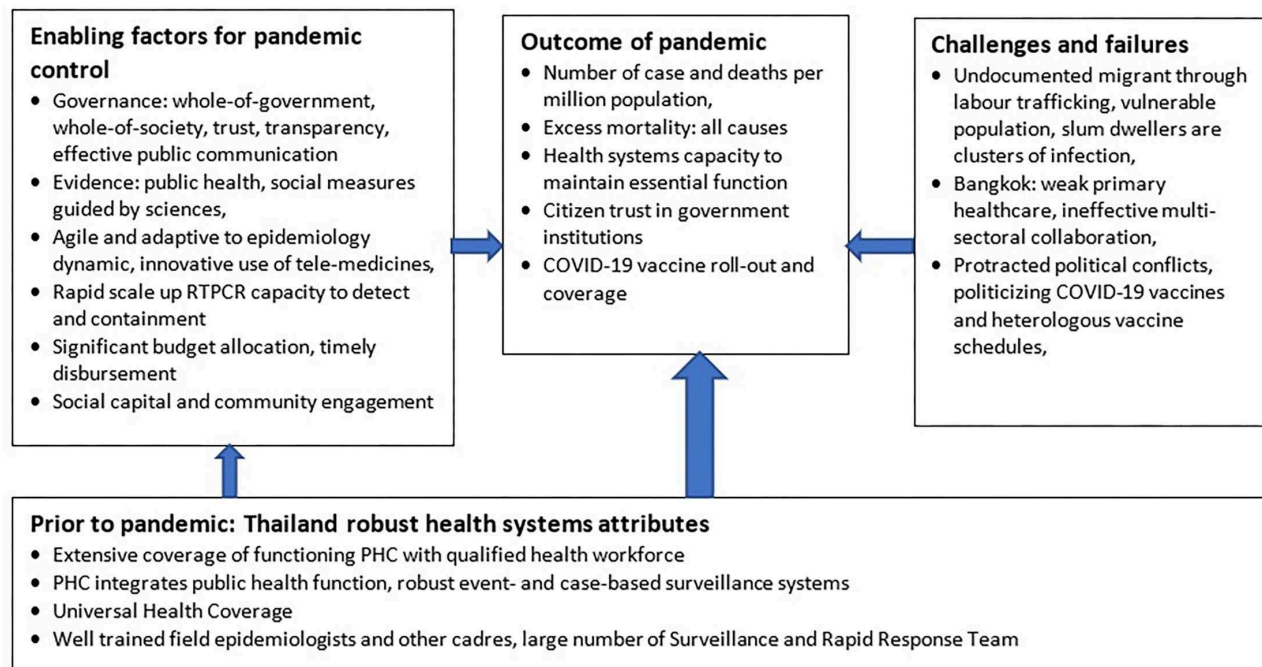
FIGURE 2
Factors contributing to pandemic outcomes.

informed by science, agility and adaptivity, and adequate numbers of qualified and committed cadres of health professionals as enabling factors (23).

A whole-of-government approach to pandemic response was facilitated through the establishment in April 2020 of the Center for COVID-19 Situation Administration (CCSA). The CCSA was

chaired by the Prime Minister, supported by various Ministry Emergency Operation Centers and led by respective permanent secretaries. The MOPH oversaw epidemiological monitoring, introduced public health and social measures and supported healthcare delivery. The Ministry of Labor dealt with unemployment and migrant workers. The Ministry of Finance mobilized budget for pandemic containment and support to affected populations. The CCSA delegated authority for COVID-19 management to provincial governors, supported by multi-sectoral provincial disease control committees.

Containment strategies ranging from elimination, suppression and mitigation were guided by the rapidly evolving situation. An initial goal in April 2020 to achieve elimination through a "nation-wide lock-down" significantly interrupted transmission, but with a corresponding negative economic impact. In response to the larger subsequent wave in December 2020, the government instead aimed at suppressing localized transmission through "targeted lock-downs," so that the number of severe cases was kept within the total Intensive Care Unit bed capacity; while in unaffected areas, economic activities continued (9). Later evolution of the pandemic, including emergence of the Delta variant in the third quarter of 2021, led to a very large surge of daily cases and deaths, requiring the adoption of mitigation and triage strategies to prevent hospitals from becoming overwhelmed. This meant that severe cases were allocated to hospital with ICUs, while mild cases were treated at home or in the community. The moderately unwell cases received care in field hospitals, some equipped with oxygen generators and ventilators. In addition, with support from government, the private sector and communities, an adequate number of small to large-scale field hospitals (data on number of field hospitals was incomplete) were established, with basic equipment and treatment capacities.

To ensure access to care, the government approved funds to provide COVID-19 related services to all people, including the non-Thai population by purchasing services from public and private healthcare providers using the same rules, regulations and payment rates (24). Treatment and provision of food at home, in community isolation facilities and field hospitals were subsidized by the government. Budget was rapidly disbursed for frontline pandemic control while ensuring accountability and transparency of budget execution (25).

A whole-of-society approach was adopted, whereby citizens, the private sector and civil society worked together to mitigate the impact on vulnerable populations. Strong social capital was demonstrated by a voluntary "food pantry" initiative, through which individuals, communities, temples and mosques would fill and refill food and essential items into community-based "pantries" to support individuals who had been made redundant or were unemployed (26, 27). This societal fabric and the spirit of helping others reflects the generosity and hospitality seen among Thais. Frontline health workers, ICU staff and public health officers all contributed significantly during the pandemic, especially during the roll out of vaccination nation-wide (28), and their roles are fully recognized and appreciated (29).

Starting in 2020, Surveillance and Rapid Response Teams working at local level were complemented and supported by 1.04 million village health volunteers (VHVs) in communities. These volunteers are the unsung heroes of the pandemic response and continue to play a significant role in supporting surveillance (30), mitigating impact and supporting pandemic control (31). VHVs

have created pluralistic "socio-political networks" with community stakeholders, local officials and private sector actors to support COVID-19 mitigation measures (32). Since 2009, each volunteer has received a monthly honorarium of 600 Thai Baht for their contribution; this was adjusted up to 1,000 Thai baht (US$ 32) in 2019. During the time of COVID, the government subsequently approved an additional monthly payment of 500 baht in recognition of their contribution. Other incentives include compensation to their families if VHVs die from COVID-19.

Teleconsultation was applied to support patients under home isolation, to provide counseling on self-care and treatment and ensure confidence for their return to the community after recovery (33). Clinical pharmacists also provided telemonitoring, counseling and pharmaceutical care for COVID-19 patients (34). Telehealth was applied to support compliance and continuation of antiretroviral therapy among people living with HIV/AIDS (35). In order to maintain essential health services, notably NCDs, face-to-face outpatient visits that could increase the risk of COVID-19 infection were replaced by telemedicine, teleconsultation and postal delivery of medicines.

4. Pandemic response: Challenges and failures

Some fundamental pandemic response challenges and vulnerabilities were exposed, especially in urban areas, including many unregistered migrants; the complexity of managing urban slums; a political culture of polarization and conflict; and an imbalance between public health capacity and needs in a metropolis like Bangkok. Bangkok has a significant level of autonomy and is densely populated, with pockets of extreme deprivation. While the pandemic response aimed to deal with these enormous challenges, entrenchment in bureaucracy meant that they hampered and undermined the response. It remains to be seen whether well-intentioned attempts to overcome these challenges may have triggered long overdue positive changes.

Labor trafficking results in a large proportion of unregistered migrants in Thailand, mostly from neighboring countries. A lack of coherent policy on migrant health insurance (36), tightly packed accommodation that makes physical distancing impractical (37), and challenges in access to healthcare (38), all likely played a role in these communities becoming amplifiers of outbreaks that proved difficult to control (39).

In 2018, 23.7% of Thai urban populations were living in slums (40). A survey in 2018 reported 638 slum communities in Bangkok with 0.579 million residents living in 146,462 households (41). These figures exclude an unknown number of internal Thai migrants from other provinces, and unregistered non-Thai migrants.

A study in urban slums reported that during the pandemic, a significant proportion of residents had to limit their food and nutrient consumption. Almost one-tenth of the participants relied on donated food only. The majority of them (61.1%) could not access an income compensation scheme. As a result, COVID-19 forced Bangkok slums residents to live below the subsistence level in multiple ways, with limited access to social protection (42).

Political conflict during the pandemic presented significant challenges. Four Parliamentary "Distrust Debates" were organized by opposition parties against the Prime Minister and selected Ministers.

Distrust Debates can lead to resignations of distrusted Minister(s), or dissolution of the Cabinet if the Prime Minister was "distrusted." The first distrust debate was convened on 24 to 27 February 2020, the second from 16 to 19 February 2021, the third from 31 August to 3 September 2021, and the most recent from 19 to 22 July 2022. For all these four debates, a vote in favor of distrust was defeated. Two general debates were also convened, during which vaccine-related issues were hot topics.

COVID-19 vaccination started in May 2021 (initially with limited supplies) and was significantly scaled up in the last quarter of 2021. Concerns raised by opposition parties during the distrust and general debates referred to pandemic control, socio-economic impact and vaccines. Criticism included the use of inactivated vaccines (Sinovac and Sinopharm) despite WHO Emergency Use Authorization, and issues related to immunogenicity and safety of heterogeneous vaccine schedules. Key accusations made included that Thai people were being used as guinea pigs for testing heterologous vaccine schedules (43). Accusations were addressed through the presentation of evidence but this increased the burden of MOPH communication activities, and led to both public confusion and a lack of confidence in vaccine quality and effectiveness. Dis-information and fake news about mortality from adverse events associated with vaccination further complicated the situation (44).

Evidence also emerged after these debates that further disproved opposition party claims: for example, the WHO Strategic Advisory Group of Experts on Immunization (SAGE) subsequently recommended heterologous vaccine schedules based on published evidence, including four studies by Thai scientists that were cited as SAGE references (45). Recent evidence from real-world surveillance data has also confirmed that heterologous vaccination schedules provided significant benefit in reducing cases and deaths comparable to, or even greater than some homologous vaccine schedules (46).

Pandemic responses also faced challenges in urban settings. Bangkok has a registered population of 5.5 million, as well as 2.35 million non-registered individuals and a daily-commuter population of 0.55 million (47). The Bangkok Metropolitan Administration (BMA), has a legal mandate for health, but sub-optimal public health capacity with relatively few Surveillance and Rapid Response Teams, only 69 primary health care centers and just 10,577 health volunteers. This proved insufficient for pandemic response when compounded by ineffective collaboration across government agencies and contributed to Bangkok being an epi-center of poorly controlled COVID-19 infection, and on occasions contributing to nation-wide spread of infection.

Figure 2 summarizes the key findings. Despite political conflict and challenges to healthcare in urban settings, the pre-existing robust health system in Thailand synergized with key enabling factors led to an effective pandemic response.

5. Thailand's next steps in building back better, fairer and more resilient health systems

5.1. Strengthen capacities to generate evidence to inform policies

Three priorities for evidence generation have been identified and relevant actions taken in collaboration with the scientific community

and the social welfare sector: these are long COVID, orphanhood and health threats at the human-animal interface.

A systematic review reports the most common post COVID symptoms as weakness, general malaise and fatigue; while 37% of patients reported reduced quality of life and reduced pulmonary function (48). The research community should establish prospective cohorts to assess post COVID symptoms, and mortality outcomes.

Global estimates of COVID-19 related orphanhood exist (49), but Thailand lacks data. The International Health Policy Programme, a research arm of MOPH, is working with stakeholders to directly estimate the number of parental orphans from the Civil Registration system. Support is critical because consequences can include abuse, traumatic grief, mental health problems, adolescent pregnancy and poor educational outcomes, especially in young orphans (50). Findings will inform a financial assistance policy by the Ministry of Social Development and Human Security.

Further, with support from the WHO Country Cooperation Strategy, the MOPH is developing a provincial One Health Capacity self-assessment tool (51, 52) to support identification of threats at the human-animal-environment interface.

5.2. Maximize use of information technology

The use of telemedicine should be maximized to reduce the need for outpatient services (notably for NCDs) and support virtual consultations with primary healthcare workers. The National Health Security Office has financed refills of medications by certified private pharmacies in the community. Mobile applications for outpatient appointments can reduce waiting times, minimize overcrowding and increase client satisfaction (53).

5.3. Minimize vulnerability: Universal health coverage and access

We recommend extending UHC from the Thai population to everyone including migrant workers and their dependants. The estimated economic contribution of immigrant workers was 4.3%−6.6% of Thailand's gross domestic product in 2010, while they represented 4.7% of the employed population (54). Vaccines covered by the National Immunization Programme should be available to all children regardless of nationality, as the cost of outbreak response and containment in the community is higher if they are not fully immunized (55, 56). The MOPH should ensure funding to achieve this end. Migrants also have higher prevalence of tuberculosis (57). Although detection and treatment of tuberculosis for the non-Thai population is fully subsidized, either by the government or through Migrant Health Insurance schemes, performance of tuberculosis case detection has yet to improve.

5.4. Strengthen urban primary healthcare

There is an urgent need to strengthen urban primary healthcare and related public health functions including detection and reporting of notifiable diseases to facilitate timely risk assessment and response actions.

The newly elected Bangkok Metropolitan governor, Dr. Chatchart Sittipunt, has committed to strengthen primary health care in Bangkok in his policy portfolio. A Civil Society Organization's white paper on comprehensive measures to strengthen health, education, welfare and safety in Bangkok was also well received (58). Closer collaboration between the National Health Security Office and the BMA Health Department in strengthening UCS budget execution is underway (59). We also recommend extending health volunteer schemes beyond congested urban communities to cover condominiums and middle-class residential areas.

These recommendations are in line with suggestions by other organizations. For example, OECD advocates for the systematic application of science to inform policies in times of COVID-19 (60). The International Consortium of Primary Care Big Data Researchers supports continued use of virtual visit modalities in the pandemic recovery phase (61). The UCL Institute of Health Equity advocates for reducing structural inequality and vulnerability not only for a future pandemic, but for a fairer, healthier society (62). The need to strengthen urban PHC has been advocated for in a variety of country settings (63, 64).

6. Conclusion

The framing of this paper, see Figure 2, may have missed literature that identifies pandemic control determinants, both positive and negative. However, this policy and practice review paper summarizes tacit knowledge and hands-on experience among policy actors from the MOPH and WHO through 3 years of supporting Thailand's COVID-19 response. While any set of policies and practices is likely to be incomplete, the one offered here should be considered when evaluating national COVID-19 responses, and when steps toward health systems recovery are advanced by low- and middle-income countries. The descriptions of both good practices and challenges will, hopefully, support policy and decision makers from other countries and the global community in dealing with future public health emergencies and in building back better, fairer and more resilient health systems.

Country level actions to improve preparedness for future pandemic and public health emergencies are essential but not sufficient. A robust global health architecture and meaningful international collaboration are critical both to strengthen local manufacturing capacity of pandemic response products through transfer of technology and know-how, and to address the inequitable access seen in the global COVID-19 pandemic response. All WHO member states need to actively engage in the ongoing Inter-government Negotiating Body and negotiate for a legally binding instrument to better safeguard the world from catastrophic impacts of future pandemics.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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An overview of Iran's actions in response to the COVID-19 pandemic and in building health system resilience

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'. The considerable human, social, and economic impacts of COVID-19 have demonstrated a global lack of health system resilience, highlighting gaps in health system capacities due to fragmented approaches to health system financing, planning, and implementation. One of the key actions for ensuring equitable essential health services in all countries in normal situations as well as emergencies is through strengthening the primary healthcare (PHC) system. In the context of the unfolding pandemic, the Iranian Ministry of Health and Medical Education (MoHME) undertook a variety of strategic actions to ensure the sustainability of health services during the current health emergency and to promote health system resilience against future shocks. Right after the Alma-Ata declaration in 1978, MoHME pursued the PHC philosophy incorporating the principles within the WHO health system framework and its six building blocks. In response to the evolving pandemic, MoHME put in place several interventions to ensure the maintenance of essential health services in addition to the provision of response. Some interventions were new, informed by global experience with COVID-19, while others leveraged existing strengths within the existing health system. Those were taking a whole-of-government approach; leveraging the PHC capacity; supporting the workforce; strengthening preparedness and response; improving access to medicines, vaccines, and health products; and leveraging the health information system into the pandemic response. Health system strengthening that promotes resilience is imperative for governments as health systems are fundamental to sustainable socioeconomic development. In recognition of this, the WHO Eastern Mediterranean Regional Office (EMRO) has recently outlined regional priorities for advancing universal health coverage (UHC) and ensuring health security. Iran's approach both prior to and during the pandemic is strongly aligned with those regional priorities, which are "*primary health care-oriented models; enhancing health workforce; promoting equity; enabling environment for research; improving access to countermeasures; and fostering health system resilience.*"

KEYWORDS

Iran, health system, resilience, COVID-19, health emergencies, equity, pandemic, primary health care (PHC)

Introduction

The considerable human, social, and economic impacts of COVID-19 have demonstrated a global lack of health system resilience, highlighting gaps in health system capacities due to fragmented approaches to health system investment, planning, and implementation. Widespread and prolonged disruptions to essential health services were seen in virtually all countries, regardless of their income status or their level of development (1). It has been demonstrated that reducing both individual and population vulnerability to health threats is a key factor in ensuring sustainable economic development (2). There is global recognition of the need to strengthen health systems to support universal health coverage (UHC) and health security in order to build resilience against future public health emergencies (PHEs) (3). One of the key actions for ensuring equitable essential health services in all countries in normal situations as well as emergencies is through strengthening the primary healthcare (PHC) system. This requires governance, advocacy, planning, and financing at national, regional, and global levels. The Islamic Republic of Iran (IR Iran) has pursued the PHC approach since 1979, shortly after the Alma-Ata Declaration was adopted in 1978 (4).[1] The country has conceptualized its approach to strengthening primary healthcare in terms of the WHO health system framework and its six building blocks, i.e., leadership, financing, health workforce, medical products, vaccines, and technologies, service delivery, and health information system (5).

In the context of the unfolding pandemic, the Ministry of Health and Medical Education (MoHME) undertook a variety of strategic actions to respond to the pandemic, to ensure the sustainability of health services during the current health emergency, and to promote health system resilience against future shocks.

Context

Iran is the seventeenth largest country in the world with an area of 1.648 million square kilometers (6), with diverse climatic conditions, vegetation, and animal species, and a variety of ethnicities, languages, cultural practices, and levels of socioeconomic advancement. Consequently, different provinces in the country are facing diverse environmental and socioeconomic conditions. The country's population is ∼86 million people (7) of which about 61 million live in urban areas.

Overview of Iran's health system prior to the pandemic

The health system falls under the mandates of the MoHME in Iran which is responsible for the provision of health services as well as medical education, research, and health policy (8). Iran has a long history of investment in PHC, which began immediately after the Alma-Ata declaration in 1979. Since its establishment, there has been a steady improvement in health indicators (9). The system has expanded countrywide with more than 500 district health centers and 4,600 rural and urban health centers titled "comprehensive health care centers (CHC)," which are present even in remote rural areas.

There are ∼18,000 community-based "health houses" in rural areas where community health workers (Behvarz) provide essential health services as well as referral for diagnosis and treatment of public health issues to higher levels, i.e., CHCs where required (refer to Figure 1). There are ∼5,000 health posts in urban areas countrywide. Each urban CHC covers a population of 37,500 and each health post, which is affiliated to an urban CHC, covers 12,500 people, whereas a rural CHC covers a population of 8,000 and every affiliated health house covers 1,000 people. Service delivery intends to provide quality interventions through the PHC system. As of 2005, MoHME established the "Family Physician Program" in rural areas, which introduced the role of the family physician, with the latter providing public health, diagnosis, and treatment services. This has been helpful in decreasing the burden on hospitals by treating patients at the early stages of illness. There are ongoing efforts to expand the program in urban areas (10).

There are more than 5 million non-Iranian nationals (asylum seekers, refugees, and migrants) currently living in Iran. This is an enormous challenge for the country's health system and one, which Iran has taken seriously and systematically. The country has an established refugee health extension program through which refugee-specific CHCs (Behdasht-Sara) are constructed within refugee camps. Peer physicians and community health workers (Behbakhsh) from the refugee population, who have received training in Iran, are recruited to provide services in the camps. The United Nations High Commissioner for Refugees (UNHCR) supports the construction of specific CHCs and the recruitment of those according to the health extension program. Each refugee-specific CHC is affiliated with the nearest CHC. In addition, if a refugee attends any urban or rural CHC, they are entitled to receive the same level of public health services at no cost as Iranian residents. Peer health workers selected from the migrant population are recruited in health houses in refugee/migrant camps and serve as assistants of health staff in the PHC system. Some of these health houses are established and recruited through UNHCR support as an international partner; however, given the expanding refugee population, demand is greater than the current capacity.

As of 2017, there were 981 hospitals with 129,604 ordinary beds and 8,264 adult Intensive Care Unit (ICU) beds in the country. The hospital bed-population ratio was lower compared with developed countries, and their distribution varied by geographical area.

While there are two sectors for the delivery of clinical services within Iran, i.e., public and private, all public health services such as immunization, children and maternal health, mental health, etc., are provided free of charge. In the public sector, 70% of treatment service fees are covered by the national health insurance system. The MoHME operates public hospitals, both general and special ones, throughout Iran. Public hospitals are typically under the direct management of universities, while private hospitals are regulated and supervised by MoHME.

The national electronic health record (EHR) system has been operating since 2007 following the Open-EHR reference model. For each patient or family who comes to CHCs, health posts and houses in urban and rural areas an EHR[2] is filed. Each family member/or patient has their own EHR. For approximately 65% of people, their EHRs are linked to the EHRs of their first degree relatives. After the

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1 https://en.wikipedia.org/wiki/Alma_Ata_Declaration

2 https://sib.behdasht.gov.ir/
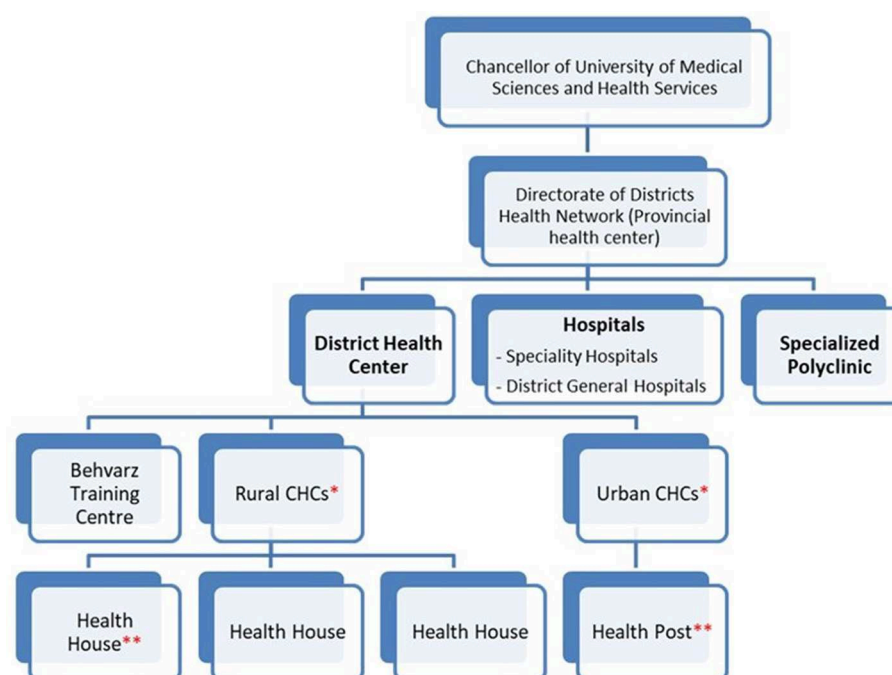
FIGURE 1
The structure of Iran's health system in each province. *Each rural CHC covers almost 8,000 people, whereas an Urban CHC covers ~37,500 people.
**Each Health House serves almost 1,000 rural people, while each Health Post provides services for 12,500 city dwellers.

COVID-19 vaccination campaign, the share of Iran's population has been registered in the national EHR system reached over 90%. There are four different EHR systems countrywide. More than 800 public hospitals transfer inpatient data to the EHR infrastructure every day.

The Iranian integrated disease surveillance and response system (IDSR) was established in 2016. Although called a "syndromic surveillance system" (Triple S or SSS) with its original early warning (EWAR) component based on a syndromic approach, Triple S is a broad-based four-module system including modules on early warning, case-based epidemiological surveillance, lab-based surveillance, and automated reports (11). It was developed with WHO support. The study phase was started in 2011 and concluded with the first version of the electronic platform in 2016. Currently, a variety of IT solutions are offered to incorporate SSS in the EHR system as a built-in module, which is an effort to integrate SSS with evolving EHR platforms. The SSS early warning component is based on 17 syndromes and their minimum datasets, which is the country's EWAR mechanism for health emergencies. Currently, the system has integrated ~40 communicable diseases of acute respiratory and food-and-water-borne nature under acute respiratory and acute diarrhea syndromes.

The COVID-19 pandemic period

Iran was one of the first countries to experience the rapid progression of the COVID-19 pandemic. The first peak occurred at the end of March 2020, with around 3,200 daily cases, which created a very challenging situation for the people and officials (4).

Iran faced constraints in relation to personal protective equipment as well as hospital and laboratory equipment as a result of the global supply shortage due to the rapid and high demand exacerbated by delayed delivery timeframes at the beginning of the pandemic. Restrictions on the international transfer of payments from Iran's banking system to international banks added to this challenge.

Key interventions in Iran's response to the COVID-19 pandemic

In response to the evolving pandemic, Iran put in place several interventions to ensure the maintenance of essential health services in addition to the provision of response. Some interventions were new, informed by global experience with COVID-19 while others leveraged existing strengths within the existing health system.

Whole-of-government approach

In response to the pandemic, the government established several mechanisms to support a whole-of-government, whole-of-society approach including the National Steering Committee (NSC) of COVID-19. This committee is led by the President and as of late summer 2022, this committee continues to meet, each Saturday, with different cabinet ministers and high-ranking national authorities (Box 1).

Another whole-of-government mechanism called the National Committee for COVID-19 management has been established by the Ministry of Interior, which is in charge of the implementation of policies set by the NSC. All the executive officials of the counterpart ministries of the NSC are members of this committee.

> **BOX 1 Illustrative example of ministries and sectors represented in the National Steering Committee.**
>
> - The President
> - Ministry of Interior
> - Ministry of Health and Medical Education
> - Ministry of Cooperatives, Labour and Social Welfare
> - Ministry of Economic Affairs and Finance
> - Ministry of Culture and Islamic Guidance
> - Ministry of Foreign Affairs
> - Ministry of Education
> - Ministry of Industry, Mine and Trade
> - Ministry of Science, Research and Technology
> - Ministry of Petroleum
> - Ministry of Roads and Urban Development
> - Ministry of Information and Communications Technology (ICT)
>
> - The Judiciary System of I.R. Iran
> - National Security Council
> - Central Bank of Iran (CBI)
> - The Islamic Consultative Assembly (Parliament)
> - Police
> - I.R. Iran Medical Council

As of late summer 2022, when the seventh wave of the pandemic had just ended, provincial health authorities were continuing to hold weekly virtual meetings with health authorities at the national level to review the pandemic situation, discuss the challenges, exchange lessons learned, and address any issues identified (2).

Leveraging the PHC capacity

Before COVID-19, Iran had invested heavily in PHC with the current flagship program. "Each home acts like one health post"[3] being rolled out, with a focus on systematically strengthening PHC in terms of disease prevention and health promotion (7). From the very beginning of the COVID-19 pandemic, this existing PHC capacity was leveraged with the MoHME designating some CHCs as selected 16-h COVID-19 centers in each district. Routine health services continued to be offered in the other CHCs as a mechanism to achieve a more resilient PHC system. This mechanism helped to maintain essential services (UHC) while necessary care was given to mild cases of COVID-19 in selected centers as part of the response to a health emergency. This strategy also follows the principle of infection and prevention control in health facilities. MoHME designated ∼1,050 COVID-19-selected health centers among 4,600 CHCs countrywide. Those designated centers have been operating during successive pandemic waves and have had a significant impact in reducing the burden on hospitals as a load of patients presenting for a consultation to those PHC centers was almost 10 times more than those presenting to hospitals. This difference demonstrates the potential of the PHC system to safeguard secondary and tertiary care and has made the hospitals more resilient to this burdensome pandemic. All selected

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3 It means that one family member of a household can be linked to the community health worker of the neighborhood's health post and she/he can help advocate public health measures to her/his family members.

COVID-19 centers and CHCs were active in contact tracing with the aid of military forces and volunteers.

Community-based nursing care centers were expanded during COVID-19 to deliver services at home to support the early discharge of patients from hospitals and to secure the continuity of care in the community. Standard packages of nursing services at home were developed for several priority conditions to standardize and systematize quality and harness cost-effective nursing services at home. While the expansion of community-based nursing care was welcome, it was also necessary to ensure the provision of other occupational categories including midwives, physiotherapists, clinical psychologists, and social workers in such centers. Thus, MoHME has made an effort to connect the centers for counseling and nursing care at home with CHCs with the aim of increasing access to these services while reducing the visits to emergency rooms, as well as reducing the health system's costs and hospital bed occupancy rate.

In order to protect elective and routine operations and treatment services, MoHME designated some hospitals for COVID-19 inpatients at the beginning of the pandemic. In addition, in the last year, the ministry has increased acute hospital bed capacity by 10,000 hospital beds, bringing the current total to 155,000 (12). During the recovery phase, these recent developments join the routine service capacities for the normal situation.

Supporting the workforce

The Iranian health system has a mix of healthcare staff including doctors, nurses, midwives, nutritionists, mental health experts, dentists, environmental and occupational health workers, communicable disease experts, lab technicians, and scientists, which is well-distributed in the country. On average, there are ∼1.6 physicians for every 1,000 population (13). According to the World Bank, the physician per population rate has been 1.4, 1.7, 2.6, and 4.9 in the Middle East and North Africa, the globe, North America, and European Union, respectively, in 2017.

The country's health system undertook several innovative approaches to expand the capacity of the workforce in response to COVID-19 including the use of military staff and volunteers in COVID-19 centers and CHCs, especially for active case finding and contact tracing of COVID-19 cases. Many post-graduate students (clinical residents) from other clinical disciplines received short-course training and were redeployed during the pandemic to provide assistance to infectious disease specialists, pulmonologists, internists, pediatricians, and ICU specialists who were on the frontline of providing care to patients with COVID-19. During the peak of the pandemic, a national database of nurses was established to enable the recruitment and redeployment of nurses across provinces.

Regarding surge capacity, the workforce has been strengthened by hiring through 90-day contracts and by extending the time of the contract. In addition to this, one of the measures taken by MoHME has been the periodic assessment of health system capacity in each province, especially during the peak of pandemic waves to support the redeployment of staff. For example, when the delta wave hit the country from July till the end of September 2021, the clinical sector of some provinces was overwhelmed, using the periodic assessment to identify workforce capacity. The Ministry was able to mobilize reserve

physicians and nurses to the hospitals of severely affected provinces (surge capacity) to maintain clinical services for hospitalized patients.

Recognizing the serious risk of burnout among frontline healthcare workers (HCWs), Iran has followed a variety of actions to support and empower HCWs in the clinical sector including the development of a program for improving their psychosocial wellbeing, to address mental health issues and prevent burnout during COVID-19.

Looking to ensure future capacity, capacity-building for online teaching was addressed in schools of Medicine and Nursing since 2020, by equipping these with the necessary infrastructure, planning, and conducting training of trainers (TOTs) courses for faculty staff. Thus, it was possible to hold online classes for the students. In addition, many webinars were held during the pandemic to support the training of the healthcare workforce and exchange experiences and learning.

Strengthening preparedness and response through multisectoral and multidisciplinary working and partnerships with international agencies

In late June 2022, we conducted a multisectorial multidisciplinary workshop in Tabriz city, Iran, attended by 175 stakeholders of all relevant MoHME departments, ministries, and organizations to reach a consensus and consolidate an integrated Pandemic Influenza, COVID-19, preparedness, response, and recovery plan (IPICPRP), which has also integrated acute respiratory infections with epidemic potential. The attendance rate was high (just two invitees were absent). The three back-to-back multidisciplinary workshops helped gather perspectives and feedback on the draft plan, which followed WHO recommendations (14, 15).

The updated pandemic plan was developed in light of the COVID-19 response. In the plan, strategic actions are categorized according to four phases (inter-pandemic, alert, pandemic, and recovery phases), and respective activities for each action with timelines, responsible agency, partners, and budget are included with the aid of extensive multidisciplinary and multisectoral deliberations.

New strategies taken by the Global Fund and Gavi to improve service coverage and address inequities in Iran demonstrate how the partnership of international agencies can improve some building blocks of the health system and secure health system functions including better access to health commodities and integrated communicable disease surveillance. Recent reclassification as a lower-middle income country (LMIC) by the World Bank will enable Iran to benefit from Gavi support as a beneficiary of COVID-19 and other vaccines. Gavi supports Advance Market Commitment (AMC) countries, which are mostly LMIC ones. This is important to combat pandemics and epidemics and can empower the health system of many countries against health emergencies. Iran received more than 10 million doses of COVID-19 vaccines from Gavi through the COVAX mechanism as a non-AMC country. However, as of 18 December 2022, the total vaccine shots received by the Iranian population reached approximately 155 million doses,[4] which MoHME supplied mostly *via* bilateral contracts and domestic production.

During the pandemic, the Global Fund supported the COVID-19 response by providing personal protective equipments (PPEs), RT-PCR machines, and cold-chain equipment in support of COVID-19 vaccine deployment. After the pandemic, such equipment can continue to be leveraged to support health system infrastructures and improve service delivery, especially surveillance and response functions. Therefore, these partnerships are important in achieving a more resilient health system (16). Also, the Global Fund and Gavi have built effective mechanisms for market shaping, procurement, and supply chains of vaccines and health commodities, with the aid of the UNICEF supply division to deploy COVID-19 vaccines to many countries including Iran. This mechanism can leverage to procure affordable quality health commodities for the next health emergencies.

Improving access to medicines, vaccines, and health products

COVID-19 medications and vaccines were distributed all over the country based on population size and provincial needs. The MoHME leveraged the already existing supply chain of the PHC system as shown in Figure 1. The first batch of COVID-19 vaccines became available in Iran in March 2021 and was distributed following a prioritization system that in the initial phase targeted frontline HCWs combating COVID-19, high-risk people in long-term care including the disabled and the elderly as well as veterans who had been affected by chemical weapons during the Iran–Iraq war in the 1980s and highly-disabled veterans residing at home.

As sufficient vaccines became available in the summer of 2021, vaccination was expanded to include all people regardless of nationality, religion, or ethnicity. Leveraging the existing countrywide PHC including its vaccine-distribution capacity, the Iranian MoHME established roughly 1,200 mass vaccination centers in stadiums, museums, schools, and so forth as an adjunct to PHC. This enabled Iran to achieve a COVID-19 primary vaccination coverage rate of around 75% up until January 2022.

In addition, Iran has developed a local production capacity for seven domestic COVID-19 vaccines, which can be regarded as one of the key lessons from the pandemic and has established the country's capacity for the production of medical countermeasures for epidemic-prone diseases. These include vaccines across different technology platforms such as protein-based, inactivated, and adenoviral vector vaccines. Local production of an mRNA-based vaccine is currently under investigation (December 2022). Efforts are ongoing to receive the WHO emergency use listing (EUL) of the locally produced vaccines with the support of Iran's Food and Drug Administration (FDA). Many clinical trials were designed and implemented in different phases on locally produced vaccines[5] (17, 18) by Iranian research institutes and Clinical Research Organizations (CROs) during COVID-19 under the supervision and support of Iran's FDA, National Committee for COVID-19 Vaccine, and the Undersecretary for Research and Technology of MoHME.

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4 https://behdasht.gov.ir/

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5 Mostafavi E, Eybpoosh S, Karamouzian M, et al. Efficacy and safety of protein-based SARS-CoV2 vaccine (SOBERANA 02 and SOBERANA Plus): a double-blind randomized, placebo-controlled, phase 3 trial in Iran (2022).

The current capacity can be leveraged to produce other vaccines, improve response capacities for other communicable diseases, and achieve a more resilient health system against the next health emergency. However, more support from WHO and WHO/EMRO is needed for technology transfer and assisting local producers in receiving WHO/EULs and prequalification in order to leverage currently existing capacities.

Some medications for treating COVID-19 were also produced locally, and Iran produced PPE locally to overcome the shortages, which were apparent at the beginning of the pandemic.

Health information system

The Electronic Health Record (EHR), which was in place several years before the pandemic, was adapted to register suspected cases of COVID-19 and their contacts and to record delivered services including testing and treatments. Leveraging the existing EHR capacity, an electronic registry was added to support the national vaccination campaign against COVID-19.

The syndromic surveillance system (SSS) platform was adapted by adding COVID-19 under respiratory syndromes, i.e., ILI (influenza-like illness), SARI (Severe Acute Respiratory infection), and ARI (acute respiratory infection) in addition to the differentials of acute respiratory illness previously included such as Influenza types and subtypes.

Discussion

Health system strengthening that promotes resilience is imperative for governments as resilient health systems are fundamental to improving, achieving, and maintaining equity in populations' health and wellbeing; responding to public health emergencies, and enabling sustainable socioeconomic development. In recognition of this, the 69th regional committee of WHO/EMRO published a technical article in September 2022 outlining regional priorities for advancing UHC and ensuring health security (preventing and controlling future health emergencies in the Eastern Mediterranean Region) by building health system resilience. These priorities include:

- Establishing primary healthcare-oriented models of care.
- Enhancing fit-for-purpose, fit-to-practice health workforce.
- Promoting equity and enhancing financial protection.
- Enabling an environment for research, innovation, and learning.
- Improving access to medicines, vaccines, and health products.
- Fostering an integrated approach in policy, planning, and investments for long-term health system resilience.

Iran's approach both prior to and during the pandemic is strongly aligned with these regional priorities. For example, the IPICPRP promotes an integrated approach in preparedness, response, and recovery planning for long-term resilience while strengthening health and emergency and disaster risk management by creating platforms to tackle multi-hazards. The multisectoral national committees established to support the COVID-19 response represent a whole-of-government approach to health that strengthens emergency management. Such structures can be maintained within the recovery phase to provide a holistic government approach to health, not just during emergencies. This multisectoralism was also apparent in the

development of local capacities for the delivery of PPE, medicines, and vaccines and is aligned with improving access to medicines and technologies and securing supply chains in support of emergency preparedness and response. The multiple innovative approaches applied to ensure workforce capacities including redeployment and additional training are aligned with a fit-for-practice workforce.

By leveraging existing PHC capacities and infrastructure, Iran has been able to achieve, as of November 2022, a first-dose vaccination coverage of 73.8%. This rivals the figures for many developed countries such as Germany, France, and the USA with vaccination coverage of 77.74%, 80.51%, and 80.43%, respectively [19]. With the aid of the PHC approach and the peer vaccination program for vulnerable populations, vaccine uptake in first- and second-doses is estimated to reach 91% and 68%, respectively, among the eligible refugees for vaccination. The targeted refugee population was approximately 4.3 million, which included both registered refugees and undocumented migrants. A total of 2.7 out of 4.3 million were older than 12 years, thus, they were considered eligible for immunization against COVID-19. Undocumented migrants were disproportionately affected by COVID-19 globally due to a combination of socioeconomic and cultural vulnerabilities, a population recognized as particularly hard to reach globally [20, 21]. The high COVID-19 vaccination coverage among refugees and migrants in Iran was possible because of the pre-existing foundation of trust between this often hard-to-reach population and existing services. Trust has been identified as a key to effective emergency response.

The MoHME is currently planning to further build on this in support of health systems resilience by applying the approach to vulnerable populations pursued with COVID-19 vaccination to routine immunization. This will involve integrating routine immunization of refugee populations to fill the gaps in TB detection rate and COVID-19 vaccination.

Existing capacities in PHC and HIS were also leveraged to support the maintenance of services and to promote high uptake of COVID-19 vaccination. Disruptions to essential services were seen globally according to the 3rd report of pulse surveys, with an average decrease of 36% and 49% in communicable disease services and immunization coverage worldwide, respectively [1]. In Iran, there was a 28% decrease in the TB detection rate during the COVID-19 pandemic and no drop in routine vaccination coverage in 2020–2021 [22].

During the COVID-19 peak, a guideline issued by the MoHME states that in case of a regular bed occupancy rate beyond 50% and ICU bed occupancy beyond 60%, the admission of patients for elective operations could be canceled by the chancellor board of the university. In the recovery phase of the pandemic, those beds have returned to routine healthcare services, e.g., devotion to elective procedures and operations [23].

According to World Bank data, Iran's GDP per capita stood at 2,756.7 in 2020 far below that recorded for Germany, France, and the USA which reached 50,801.8, 43,518.5, and 69,287.5 respectively [24]. When placed in the context of the economic realities facing Iran, the approach taken demonstrates that it is not the absolute availability of resources but political will and the leveraging of all investments, including those focused on response efforts to strengthen health system foundations with PHC that builds resilient health systems. This approach ensures that investments yield long-term dividends and provides an example of the value of investing in PHC in routine times in support of health security during emergencies.

In spite of efforts made to integrate between different health information systems such as different EHR systems and surveillance platforms, e.g., SSS, the COVID-19 pandemic demonstrated that further work is needed in the area of integrated and interoperable health information systems to address the issue of data fragmentation.

Regarding technology transfer and local vaccine production, this is a cumbersome area that needs much more support from WHO and investment from global partners. Challenges in the electronic wiring between Iranian and international banking systems to supply medical countermeasures and support technology transfer is another constraint, which negatively affects health system resilience, and those need to be addressed before the hit of the next health emergency or pandemic.

Strengths and limitations

The immense variety of strategic actions and activities taken by Iran in responding to the COVID-19 pandemic means that the picture we have drawn here is, inevitably, incomplete. Some of the omissions concern major initiatives, for instance, the establishment of a laboratory network of more than 500 labs with molecular diagnostics and/or viral sequencing capacities. The authors' own involvement in certain aspects of the COVID-19 response and not others is also likely to have biased the representation. Nonetheless, the article prioritized and synthesized a vast amount of evidence and experience of policy and decision-makers and academics from Iran's MoHME and leading Iranian universities and institutes. It can suggest ideas and lessons for other countries in responding to and recovering from future public health emergencies, particularly in demonstrating PHC-oriented models of care, mass vaccination centers, and building capacity in domestic vaccine production.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

Acknowledgments

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Liberia health system's journey to long-term recovery and resilience post-Ebola: a case study of an exemplary multi-year collaboration

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Liberia is one of the three countries worst hit by the 2014–2016 West Africa Ebola Virus disease (EVD) outbreak, during which it recorded over 10,000 cases, including health workers. Estimates suggest that the non-EVD morbidity and mortality resulting from the collapse of the health system exceeded the direct impact of EVD. Lessons from the outbreak were clear, not only for Liberia but also for the regional and global communities: that building health system resilience through an integrated approach is an investment in population health and wellbeing, as well as economic security and national development. It is therefore no surprise that Liberia made recovery and resilience a national priority from the time the outbreak waned in 2015. The recovery agenda provided the platform for stakeholders to work toward the restoration of the pre-outbreak baseline of health system functions while aiming to build a higher level of resilience, informed by lessons from the Ebola crises. Based on the co-authors' experiences of on-the-ground country-support work, this study sought to provide an overview of the Liberia Health Service Resilience project (2018–2023) funded by KOICA, and propose a set of recommendations for national authorities and donors, derived from the authors' perceptions of best practices and key challenges associated with the project. We used both quantitative and qualitative approaches to generate the data represented in this study by reviewing published and unpublished technical and operational documents, and datasets derived through situational and needs assessments and routine monitoring and evaluation activities. This project has contributed to the implementation of the Liberia Investment Plan for Building a Resilient Health System and the successful response to the COVID-19 outbreak in Liberia. Although limited in scope, the Health Service Resilience project has demonstrated that health system resilience could be operationalized by applying a catchment and integrated approach and encouraging multi-sectoral collaboration, partnership, local ownership, and promoting the Primary Health Care approach. Principles applied in this pilot could guide the operationalization of health system resilience efforts in other resource-limited settings similar to Liberia and beyond.

KEYWORDS

health systems, resilience, integration, catchment approach, emergency preparedness and response, healthcare quality, recovery, COVID-19

Introduction

Liberia is one of the three countries worst hit by the 2014–2016 West Africa Ebola Virus disease (EVD) outbreak, during which it recorded over 10,000 cases, including health workers. Estimates suggest that the non-EVD morbidity and mortality resulting from the collapse of the health system exceeded the direct impact of EVD (1). The health and socioeconomic impacts of the outbreak were felt by individuals, communities, governments, and organizations long after the outbreak. Lessons from the outbreak were clear, not only for Liberia but also for the regional and global communities: that building health system resilience through an integrated approach (2) is an investment in population health and wellbeing, as well as in economic security and national development. It is, therefore, no surprise that Liberia made recovery and resilience a national priority in 2015 when the outbreak began to wane (3). The recovery agenda provided the platform for stakeholders to work toward the restoration of the pre-outbreak baseline of health system functions while aiming to build a higher level of resilience, informed by lessons from the Ebola crises.

The health system was ill-equipped to effectively respond to EVD with the necessary occupational health, safety, infection prevention, and control (IPC) measures for safe and effective health services. As a result, health workers suffered a 30 times higher risk of infection compared to the general population. As of April 8, 2015, 372 health workers had been infected, of whom 184 died (3). Pre-existing (pre-EVD) system vulnerabilities, partly due to the impact of a 14-year civil war in Liberia, contributed to the aftermath of EVD. Such vulnerabilities included inadequate and poorly motivated health workers, insufficient and unsuitable infrastructure and equipment, a weak supply chain system, and poor overall quality of care. These contributed to around 50% disruption in the delivery of routine health services during EVD due to health facility closures, fears and refusal of health workers to provide routine health services, and community distrust and fears (3). Coverage of life-saving maternal and child health interventions, in particular, declined dramatically, from already low levels (3).

Table 1 presents key health system indicators in the pre- and post-EVD era (4, 5).

Liberia's 2015–2021 Investment Plan for Building a Resilient Health System (3) was developed to support the transition of the health system from EVD response to recovery and the "building back better" of a health system that provided quality routine services while also remaining resilient to future outbreaks. More specifically, the plan aimed to improve the health of Liberians and achieve equitable health outcomes by improving access to safe and quality services, establishing a robust Health Emergency Risk Management System, and building an enabling environment that restored trust in the health system's ability to provide services (3). The plan identified nine key investment areas, namely, building a fit-for-purpose health workforce, re-engineering the health infrastructure, strengthening Emergency Preparedness and Response (EPR) and surveillance, restoring and enhancing service delivery systems, enhancing capacity for essential medicines and supplies, strengthening information and research systems, expanding capacity for leadership and governance, establishing sustainable financing systems, and establishing a professional community workforce (3).

TABLE 1 Health system indicators pre- and post-EVD.

Health indicators	LDHS*, 2007	LDHS, 2019–20
Total Fertility Rate (TFR), children per woman	5.2	4.2
Use of modern family planning method by married women (15–49 years)	10%	24%
Antenatal care provided by skilled health workers	79%	98%
Skilled assistance during delivery	46%	84%
Institutional deliveries	37%	80%
Children 12–23 months with full immunization coverage	39%	51%
Stunting in under-five children	39%	30%
Wasting in under-five children	8%	3%%
Insecticide-treated nets ownership (household)	47%	55%
Insecticide-treated Net use (pregnant women 15–49 years)	47%	78%
Insecticide-treated Net use (children under five)	26%	44%
Children under-5 with fever receiving malaria treatment	45%	85%
Pregnant women receiving intermittent preventive therapy (IPT)	58%	90%
Comprehensive knowledge of HIV/AIDS (female)	19%	33%
Comprehensive knowledge of HIV/AIDS (male)	32%	35%
Pregnancy-related mortality ratio (100,000 live births)	994	913
Maternal mortality ratio (maternal deaths per 100,000 live births)	1,072	742
Under-five mortality rate (deaths per 1000 live births)	110	93
Infant mortality (per 1000 births)	71	63
Child mortality (per 1000 births)	41	33

*Source: Liberia Demographic Health Survey (LDHS) 2019–2020.

The ultimate goal of the Investment Plan was to enhance health system resilience. The resilience of a health system is the capacity of health actors, institutions, and populations to prepare for and effectively respond to crises; maintain core functions when a crisis hits; and informed by lessons learned during the crisis, reorganize if conditions require (2). An integrated approach (6) to develop and sustain the quality of routine services and emergency preparedness in tandem was emphasized in the Investment Plan. However, operationalizing this integrated approach in the Liberia health system remained a gap (7).

A 5-year (2018–2023) Health Services Resilience (HSR) project, funded by the Korea International Corporation Agency (KOICA) through the Global Disease Eradication Fund (GDEF), was approved for implementation in Liberia in October 2018 with the aim of "Making Health Services Resilient with Quality and

Preparedness for Emergency Response in Liberia". A parallel project, also funded by KOICA, is implemented in Ethiopia. Liberia's project sought to contribute to the implementation of priority activities of the Investment Plan, especially building a fit-for-purpose health workforce that equitably and optimally delivers quality services (Investment Plan Area A and Project Outcome 3). The project leveraged the momentum for focusing on resilience; structures established post-Ebola through the Investment Plan, such as the establishment of the Quality Management Unit within the Ministry of Health (MoH); and aspirations to finalize and roll out a National Quality Strategy.

An in-depth situational assessment (SA) of the state of quality and resilience in Liberia post-EVD (7) foregrounded work on the HSR project. The SA revealed a general weakness in human resource capacity in healthcare quality and resilience and a paucity of associated technical tools (guidelines, plans, strategies, and sets of indicators). It also found a lack of integration of the metrics used for healthcare quality and emergency preparedness in health services. The SA equally highlighted the need for a systematic and integrated approach to improving the capacity of health workers and health system leaders in quality and resilience by ensuring their active participation in activities related to health service quality and preparedness for public health emergencies.

The Health Services Resilience project set out to provide catalytic support (financial and technical) to the Ministry of Health (MoH), the National Public Health Institute of Liberia (NPHIL), and other relevant institutions, coordinated by the World Health Organization (WHO), to address the gaps identified from the SA and enhance the implementation of the Investment Plan. The project also aimed to operationalize the concept of resilience at the policy and operational levels of the health system by applying the key lessons learned from shock experiences, with such lessons essential for the recovery and transformation of a health system post-crisis (6).

Aims and objectives

This study aims to:

- Provide an overview of the Liberia HSR project (2018–2023) funded by KOICA, with a focus on its guiding principles, key features of its set-up, main activities, achievements, best practices, and challenges.
- Explore the contribution of the HSR project to the implementation of the Investment Plan for Building a Resilient Health System in Liberia and broader health system and population health outcomes in Liberia.
- Propose a set of recommendations for national authorities and donors, derived from the authors' perceptions of best practices and key challenges associated with the project, with a focus on "building back better" health systems post-COVID-19 and on strengthening preparedness for future public health events.

Insights from this case study would be useful for learning from Liberia's experience in long-term recovery efforts and the benefits of investing in more integrated, system-strengthening, resilience-focused initiatives. This is particularly timely as many countries

are embarking on recovery from the ongoing COVID-19 pandemic and other health system shocks.

Methods

The sources of data represented in this study comprise official reports from the HSR project, published and unpublished technical and operational documents from it, and datasets generated through situational and needs assessments and routine monitoring and evaluation activities. In this section, we describe the methodological steps specific to the current study, namely how we identified documents for review and how findings from them were extracted and synthesized. Sections "Approach to developing and refining the project goals, tools and activities" and "Monitoring and Evaluation" under "Overview of the HSR project" provide detail on data collection methods used to serve the needs of the HSR project development, implementation, and monitoring and evaluation. Relative to the current study, these processes fed in ready data which we only synthesized. As the original goals served by such data were strongly operational, and also somewhat different from the goals of the current study, the pre-existing data we use have significant limitations. These are discussed under the Section *Study strengths and limitations* at the end of the article.

Identification and prioritization of documents and data sources

To identify the richest and most reliable documents that can be used to construct an overview of Liberia's HSR project (study goal 1), LA and RS first reviewed all major project folders and developed a draft list of key project-generated documents (Table 2). The list was supplemented by titles of documents concerning the Investment Plan for Building a Resilient Health System and broader health system and population health outcomes (3, 4, 8–13) in Liberia (study goal 2). These were identified through online searches in PubMed, Google Scholar and Google by using search terms such as "public health emergency," "health care quality," "service resilience," "health system resilience," and "resilience capacities," and through soliciting advice from MoH colleagues. The combined draft list was then enriched with recommendations made by stakeholders at MoH, NPHIL, WHO, and further relevant institutions and partners [United Nations International Children's Emergency Funds-UNICEF, USAID-supported John Hopkins Program for International Education in Gynecology and Obstetrics-, Jhpiego and Last Mile Health (LMH)]. The process was iterative and resulted in the final list presented in Table 2. All documents from the list were then retrieved, including the most recent drafts of un-finalized policies and plans.

Approach to data extraction and synthesis

LA and RS independently reviewed the selected documents for data that can serve to address the study objectives. Data were extracted in Microsoft Word. Table 1 (third column) shows what types of data were extracted from the different categories

TABLE 2 List of documents consulted for the desk review.

Documents retrieved	Year of publication	Data extracted
National policies, plans, strategies, and guidelines		
1. Liberia National Health Policy, 2022–2031 2. National Health Sector Strategic Plan: A Roadmap to Universal Health Coverage, 2022–2026 3. Essential Package of Health Services for Universal Health Coverage, Liberia 2022 4. Liberia Essential Package of Health Services (EPHS II) 5. Investment Plan for Building a Resilient Health System in Liberia, 2015–2021 6. Liberia Demographic and Health Survey, 2019–2020 7. Liberia Harmonized Health Facility Assessment Report, October 2022 8. Liberia National Health Quality Strategy (draft) 2023–2027	2022 2022 2022 2015 2021 2023	- Health system profile of Liberia - Health system indicators and demographic characteristics - Health system priorities, including investment areas for building a resilient health system - Objectives of the Investment Plan for Building a Resilient Health System in Liberia
Project technical documents		
1. Operational Framework and Technical Guide. Korean International Cooperation Agency (KOICA)-Funded Project: Making Health Services Resilient with Quality and Preparedness for Emergency Response in Ethiopia and Liberia 2. Liberia Situational Assessment Report. KOICA-Funded Project: Making Health Services Resilient with Quality and Preparedness for Emergency Response 3. KOICA-Funded Project work plan and Monitoring and Evaluation Framework 4. Off-The-Shelf Exercise Handbook. Health Systems Resilience Exercises 5. Training Package on Integrated Approach to Health System Resilience Focusing on Services 6. Health Service Resilience Indicators (Including Adaptation for Primary Health Care Monitoring and Evaluation) 7. Stakeholders' Consultative Meeting Report Korea International Cooperation Agency (KOICA)-Funded Health Service Resilient Project, 8–10 October 2029	2019 2019 2019 2019 2020 2020 2019	- Project guiding principles - Project catchment approach - Project pilot sites (counties, districts, and facilities) - Project outcomes, outputs, activities, and indicators - Health Service resilience indicators
Project activity reports		
1. Health Service Resilience (KOICA-Funded) Project: Making Health Services Resilient with Quality for Emergency Preparedness and Response in Liberia. Mid-term Review Workshop Report (2–3 September 2021) 2. Integrated training in IPC, WASH, and COVID-19 Case Management for Frontline Healthcare Workers in Lofa, Bong, and Grand Cape Mount Counties (28–30 April 2020) 3. Training of border parties to strengthen disease surveillance and referral pathways at Ground Crossing Points of Entry in Lofa and Grand Cape Mount Counties (21–23 April 2020) 4. Progress Report. Application of the HS SimEx Package to review the functionality of sub-national Health System to respond to COVID-19 and continue Essential Health Services 5. Strengthening maternal newborn and child health QoC in health facilities through training and supportive supervision in 3 project counties (8–14 November 2020) 6. Strengthening health facility Quality Management Teams to enhance routine health services and during outbreaks (COVID-19): Montserrado, Bomi, Gbarpolu, Grand Cape Mount, Margibi, and Nimba Counties (14–20 February 2021) 7. Strengthening Infection Prevention and Control Standards and Practices in Health Facilities through Supportive Supervision/on-site Mentorship to promote Quality Healthcare Delivery, September 2020 8. Health Workforce Competency Assessment on Quality and Resilience, August 2020 9. MoH Annual Operational Plan for Fiscal Year 2020/2021 10. Progress Report. Strengthening the Quality of Care in routine service delivery for public health emergency and response through teleconference with National and County Quality Management Teams, November 2020 11. Baseline assessment of Antibiotic Consumption and Resistance using the Point Prevalence Survey. Assessment in seven hospitals from four counties in Liberia 12. Mentorship on safe healthcare waste management and restoration of water supply for quality and health service delivery at Tellewoyan hospital, September 2020 13. Training of Frontline Healthcare Workers and Health Systems Managers in Healthcare Quality and Resilience for Emergency Preparedness and Response in Lofa and Bong Counties, 12–16 December 2022 and 19–23 January 2023 14. Pre-validation Workshop for WISN Results for Clinics and Health Centers, 12–13 December 2022 15. Pre-validation Workshop for the National Health Quality Strategy (2022–2026) for Liberia, 24–25 November 2023	2021 2020 2020 2021 2020 2020 2020 2020 2020 2020 2020 2022 2022	- Project achievements and results - Project best practices, strengths, challenges, and limitations

of documents. The process of considering the relevance of data and representing and prioritizing it was iterative, with key stages involving all co-authors. Data were synthesized

following recommendations made by Lin et al. (14) on using health system data in combination with systematic reviews to support decision-making.

Findings

Overview of the HSR project

Liberia's Health Services Resilience project was designed for implementation over 5 years (October 2018–October 2023) and had a clear work plan comprising five outcomes and 15 outputs as well as a monitoring and evaluation framework (Box 1) (15). These were all agreed upon and jointly implemented by key stakeholders from global, national, sub-national, and service delivery levels. This section offers an overview of the project in terms of its guiding principles; key stakeholders; settings; approaches to the development and implementation of goals, tools, and activities; and monitoring and evaluation framework.

The Korean International Cooperation Agency (KOICA) funded the project, through the Global Disease Eradication Fund (GDEF).

Guiding principles

The following key principles underpinned all project activities and tools:

- **Government ownership and leadership**. All project activities are implemented with the leadership of responsible local and national health authorities. This includes the participation of the Minister of Health and Director General (DG) of NPHIL in project workshops and their guidance on the implementation of project activities.
- **Local, national, and international stakeholders' participation and collaboration**. The project team applies a collaborative and coordinated approach with national and international stakeholders at all administrative levels to avoid duplication and fragmentation of efforts. A "One work plan, One budget" approach is used to enhance collaboration, transparency, and efficiency in project implementation.
- **"One WHO" support**. The skills and experience at all three levels of WHO (Country Office, Regional Office for Africa, and Headquarters) have been harnessed in the project development and implementation.
- **Catchment approach**. Project implementation involves actors responsible for strengthening service delivery and emergency preparedness and response at the four levels of the health system (community/health facility, health district, county, and national levels) and from the animal and environmental health sectors, in addition to the human health one (One-Health umbrella) (16).
- **Primary healthcare focus**. The project prioritizes high-impact activities at the community and primary health facility level in line with the Essential Package of Health Services (EPHS) (8).
- **Integration/system approach**. Synergies between health system strengthening and public health emergency efforts are sought, including enabling health services and multi-sectoral participation across all levels (national to sub-national) toward Universal Health Coverage (UHC) and health security as interdependent goals. The project bridged health systems and health security efforts during health sector planning, COVID-19 preparedness and response, After Action Reviews

(AAR), and Simulation Exercise (SimEx) by promoting the participation of stakeholders from health services, animal health, and environmental health.
- **Multi-sectorial engagement**. The project fosters joint working among MoH, NPHIL, and other relevant sectors, such as the Ministry of Agriculture (MoA), Environmental Protection Agency (EPA), Ministry of Internal Affairs (MIA), Port Health Authorities, and academia, especially at the sub-national level.
- **Partnership and sustainability**. Collaboration with health sector partners is paramount. For example, collaboration with the USAID-funded STAIP (Strategic Technical Assistance for Improved Health System Performance and Health Outcomes) and BRIDGE-U (Bringing Research to Impact for Development, Global Engagement and Utilization) projects resulted in the implementation of county operational planning and completion of the national Guideline for Continuing Professional Development (CPD). In addition, partnership with Jhpiego (the John Hopkins Program for International Education in Gynecology and Obstetrics) and Last Mile Health (LMH) led to the development of the new National Health Quality Strategy.

Key stakeholders

The country-based project team comprises two dedicated project staff from the WHO country office and two project focal persons from MoH (health systems) and NPHIL (health security), jointly implementing the project with support from the WHO Headquarters and Regional Office team. The two dedicated project officers from WHO Liberia Country Office are qualified and experienced public health practitioners and quality improvement specialists. The national focal person from the MoH is an experienced physician and director of the Health Quality Management Unit, while that from NPHIL is the director of training for the institute. Table 3 lists key stakeholders working closely with the WHO project team and national focal points.

Sites and their selection

The selection of project sites was done through the catchment approach, which resulted in the selection of 19 health facilities (10 clinics, four health centers, and five hospitals) in three counties. Figure 1 below illustrates how this approach linked responsible entities in public health emergency management, health service delivery, and animal-environmental health across the 4 levels of the health system [national, county, district, and health facility—public and private—and community) within specified catchment areas. Implementation of the project was carried out in three counties—Bong, Lofa, and Grand Cape Mount, strategically selected in view of their geopolitical location, with significant internal and external borders (see map in Figure 2). Beyond the three pilot counties, the project activities have benefitted other counties prioritized by national authorities, for example, Montserrado, Nimba, and Gbarpolu.

TABLE 3 Examples of key stakeholders working closely with the WHO project team to implement the project.

Level	Stakeholders/organization	Position and role
National	- MoH: Health Quality Management Unit (HQMU) and related departments such as Health Monitoring, Evaluation and Research (HMER), Policy and Planning Unit, Family Health Division, Information Communication and Technology (ICT), and Human Resource for Health (HRH) units. - Ministry of Agriculture (MoA) - Environmental Protection Agency (EPA)	Leadership (Assistant Ministers and Directors) and technical focal points
	National Public Health Institute of Liberia (NPHIL)	Leadership (DGs) and technical focal points
	WHO country office (Health Systems and Health emergency clusters)	Leadership (WHO Country Representative (WR), Health Systems Strengthening (HSS), and WHO Health Emergency (WHE) team leads and technical focal points
	Health professional councils (in charge of continuous education, licensing, accreditation, and registration)	Nursing and midwifery board officers
	NGOs/Partners implementing quality and emergency initiatives such as Last Mile Health (LMH), Johns Hopkins Program for International Education in Gynecology and Obstetrics (Jhpiego), GIZ, USAID, UNICEF, and UNFPA	Leadership and technical focal points
Sub-national	County health teams	County Health Officer, Community Health Department Director, County Surveillance Officer, other technical officers (Infection Prevention and Control (IPC), Child Health Survivor, Maternal health), County authorities, and County Veterinary Officers
	District health teams	District Health Officer, District Surveillance Officer, and Leads and technical officers (IPC, Child Health Survivor Environmental Health Technician)
Health facility and community	County/district hospitals Health centers Primary health clinics (public, private, and faith-based)	Heads or focal persons responsible for the quality and public health emergency activities and collaboration, community leaders, and community health workers

FIGURE 1
Health Service Resilience project catchment approach in Liberia.
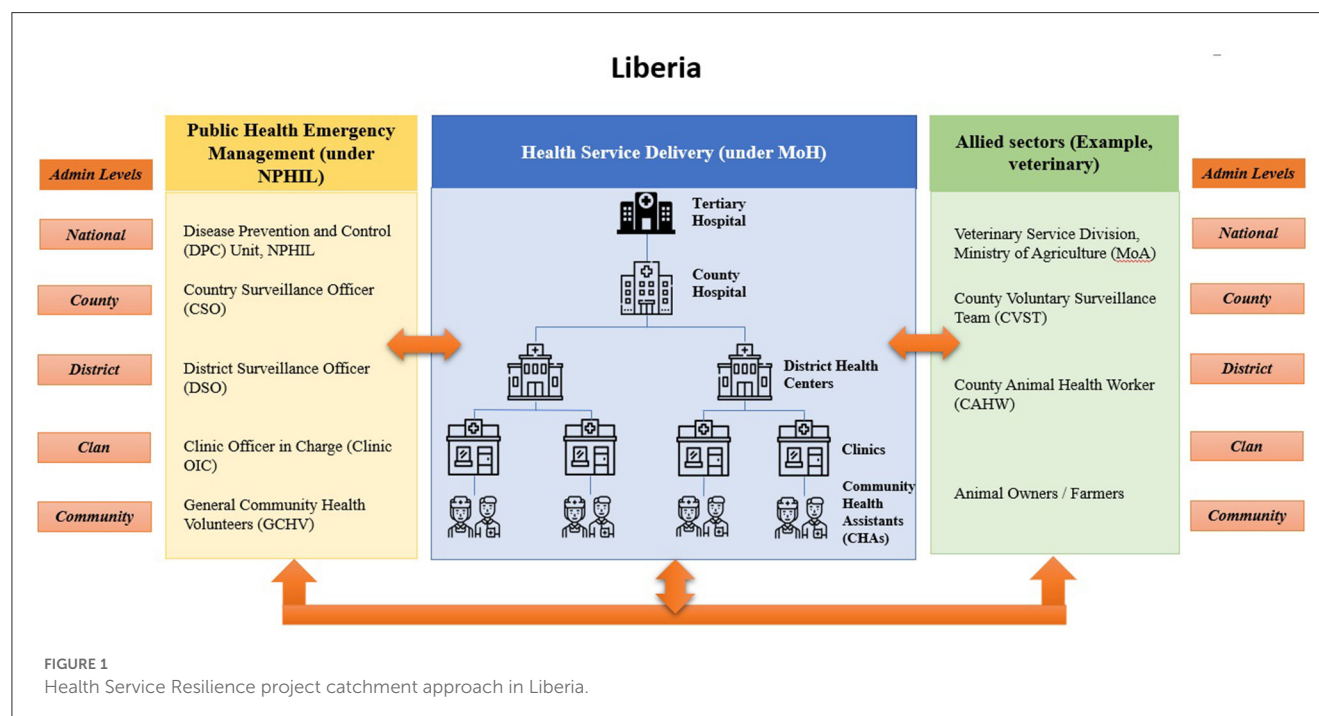
Approach to developing and refining the project goals, tools, and activities

The project applied a mixed methods approach to assess the health system, develop project tools, implement project activities, and evaluate the level of progress. The methods included: (i) Literature review, (ii) Key Informant Interviews, and (iii) Project site assessment (county and facility visits) during the country situational assessment and project mid-term review.

FIGURE 2
Map of Liberia showing project sites.

- The literature review was conducted to identify existing tools to support health system resilience, for example, dedicated health system SimEx tools. Medical and health research databases (PubMed and Embase) as well as Google Scholar were searched. Search terms (e.g., health emergency, quality of care, health system resilience, etc.) were combined using Boolean Operators (AND and OR), quotation marks, and spelling variants, as applicable (17). Gray literature was identified mainly through key stakeholders' recommendations. In total, 79 documents (from both the literature search and stakeholders' recommendations) met the inclusion criteria at initial screening; 60 of them were retained for review. From the latter, 11 were peer-reviewed articles (Google Scholar-5, PubMed-4; Embase-2) and the remaining 49 documents were gray literature. Table 4 summarizes the types of documents which were reviewed.
- Key informant interviews were conducted with national (10) and sub-national (5) stakeholders (Table 3), including leadership and technical officers from relevant units within MoH and NPHIL; Environmental Protection Agency (EPA); Ministry of Agriculture (Veterinary division); WHO Country Office; Health professional training institutions; Health professional boards; Health regulatory bodies; Partner organizations; county health teams; district health teams; health facility management teams; community leaders, and healthcare workers (clinicians and community health workers). In addition, a similar group of stakeholders was consulted during an inter-country engagement meeting held in Bishoftu, Ethiopia (April 2019), and an in-country consultative workshop in Gbarnga, Bong County Liberia, in September 2019.

The consultations resulted in the elaboration of the project work plan, selection of project pilot counties and facilities, validation of the SA findings, and approval of the project support package.

- Health facility and county assessments were carried out in 19 health facilities (10 clinics, five hospitals, and four health centers) in 10 health districts and 3 counties (Bong, Lofa, and Grand Cape Mount), as represented in Figure 2. Fifteen (79%) of the health facilities were public. The assessment was done using a structured questionnaire developed by the project team. The respondents included County and District Health Officers, medical directors and officers in charge, heads of units/programs, and community leaders.

Project support package and implementation

Based on the project plan and country SA, the project team developed an operational guide for project implementation (18). The operational guide offered practical guidance on the implementation of 10 interconnected components: training and mentoring of the health workforce; health services quality

TABLE 4 Summary of reviewed documents for Liberia SA.

Category	Reviewed
Policies and legislations	21
Plans and strategies	16
Technical reports	24
Other technical documents (manuals, SOPs and guidelines)	18

interventions; measuring health system resilience; risk registering and profiling; emergency management with service continuity planning and policies; advocacy; local resilience fora; simulation exercises (SimEx); after-action reviews (AAR); and knowledge sharing (Figure 3). Each of these areas served as an opportunity to integrate emergency management capacities in routine service delivery (at primary, secondary, and tertiary levels of care) and overall strengthening of all health system building blocks (18, 19).

Monitoring and evaluation

Routine monitoring and evaluation (M&E) of the project uses a framework of five expected outcomes, 15 outputs with specified activities, and the status of implementation.

The M&E mechanism for the project involves all stakeholders at both national and global levels. It includes monthly reports to the national and WHO country office leadership and technical teams; quarterly meetings to provide updates to the KOICA regional team and review progress and challenges encountered; and bi-annual teleconferences with the KOICA-GDEF team, during which WHO provides an update on activities implemented and next steps.

In addition, a project mid-term review (MTR) was conducted in Monrovia in September 2021 involving national and sub-national institutions and stakeholders (see Table 3), with support from the WHO team and participation of KOICA Nigeria country office and other partners (20). The MTR assessed the status of project implementation and identified challenges and opportunities for continuity and scale-up. Data were collected through (1) a field assessment tool exploring the implementation of activities in the 10 technical support areas of the project, including versions for national, county, district, and health facility levels, (2) an online survey administered before the MTR meeting to all participants invited to it (26 out of 36 invited participants completed it), and (3) three focus group discussions (FDGs) (three groups of 12 participants each). The survey and FDGs aimed at gathering a more nuanced and in-depth understanding of the contributions of the HSR project to enhancing collaboration, integration, and health service resilience. Data from the field assessment, online survey, and focus group discussion are reported in the Section Overall evaluation by stakeholders.

Project achievements and contributions to long-term recovery and building back better agenda in Liberia

The HSR project supported the MoH and NPHIL to strengthen Liberia's health system to deliver quality routine health services

before, during, and after the COVID-19 pandemic. During the COVID-19 outbreak, project activities were re-aligned and adapted to meet the pandemic-driven priorities of the health system. The HSR project contributed to policymaking, strategic planning, surveillance, measurement of quality and resilience, human resource planning, and capacity building (in-service and pre-service) according to the 5 project outcomes.

Overall evaluation by stakeholders

From stakeholders' consultations conducted as part of the project's mid-term review, most key stakeholders (n = 26 respondents) at national and sub-national levels agreed that the project has: (1) contributed to health service improvement (85%), (2) has the potential to strengthen resilience in the health system of Liberia (88%), and therefore (3) advocated for project continuity and scale-up (96%) (see Figure 4). The project approach was appreciated particularly for its uniqueness in promoting the integration of quality health services and emergency preparedness and response (85%), promoting inter-sectoral and multi-disciplinary collaboration (81%), and encouraging ownership and sustainability of Quality improvement interventions (QI) carried out (85%).

The quotes below are the feedback received from the administrator of Kolahun Hospital, Lofa County, and the IPC focal person for Grand Cape Mount County concerning their impression of the Integrated approach used by the KOICA-funded project during health sector operational planning in Lofa and Grand Cape Mount counties.

> *"This integrated approach of supervising clinicians with administrators, cleaners and security officers in hospitals is very unique and need to be encouraged. It gives us the opportunity to understand challenges in service delivery and how we can jointly find feasible solutions".*
> **Mr John Kawala**, *Administrator Kolahun District hospital, Lofa county*
> *"This approach of jointly reviewing the health system and planning together with colleagues of the animal, agriculture and environmental sectors is the first of its kind. The discussions were very rich & comprehensive due to the diversity of the group and the application of the novel Health System SimEx tool developed by the KOICA project".*
> **Victoria Railey**, *IPC Focal Point, Grand Cape Mount county*
> *"The project has ensured participation of various stakeholders. Activities are conducted through the MoH and NPHIL making the entities to assume ownership and for long-term sustainability"*
> **Mr Garrison Kerwillain**, *IPC coordinator, MoH*

Improvements in key resilience indicators

Table 5 below summarizes progress made in key Health System Resilience indicators (developed by the HSR project) between 2019 (project start year) and December 2022, across the building

FIGURE 3
Health Service Resilience project support package.

FIGURE 4
Stakeholders' appraisal of the Health Service Resilience project in Liberia.
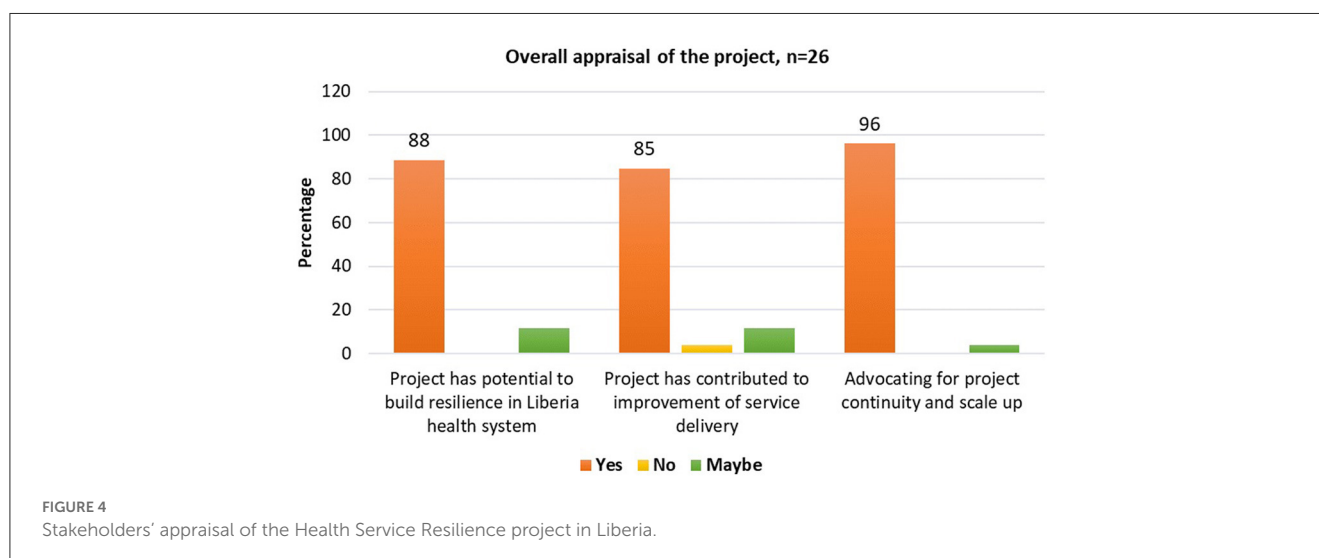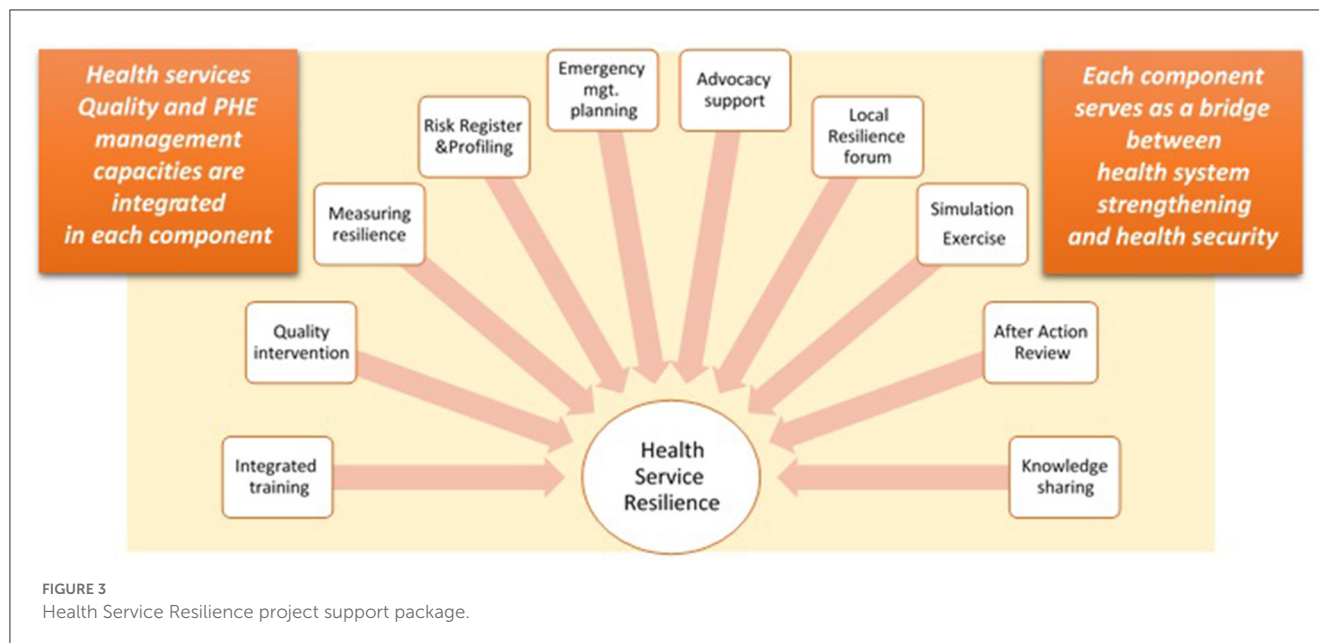
blocks and levels of the health system. This progress also includes some of the weak areas identified during the Liberia SA on the state of quality and resilience. Overall, the project has contributed to the advancement of key resilience indicators in Liberia.

Progress in project implementation

As of December 2022, 95% of the project activities were estimated as completed (see Figure 5). The delay in achieving 100% completion has resulted from: delays in commencing implementation due to administrative and operational bottlenecks; disruptions and re-prioritization of project interventions due to the COVID-19 outbreak; and the longer than predicted time required to develop, adapt, and roll out the project support package at sub-national level. Despite the above delays, the project implementation would be completed within the set timeline of October 2023.

Pending interventions are related to the roll out of key project tools such as the HSR training package and the Health System SimEx package.

Achievements relative to Liberia Investment Plan for Resilience

The project has also contributed to the implementation of the Liberia Investment Plan for Resilience, especially in building resilient capacities that enhanced preparedness, response, and recovery from the COVID-19 outbreak. For example, the project supported NPHIL and MoH to conduct a Vulnerability Risk Assessment and Mapping (VRAM) in 2021 (in line with the "awareness" feature of a resilient health system); implement a package of activities with a focus on primary healthcare ("diversity" feature of a resilient health system); enhance surge capacity by supporting integrated training for health workers to ensure

TABLE 5 Progress in the attainment of key HSR indicators in Liberia (especially project counties).

Level of health system	HSR indicator	HS building block	Baseline (2019)	Current (2022)
All	Availability of a protocol for prioritization of services to be maintained during emergencies	Leadership	No	Yes
County	Proportion of counties that have conducted/updated vulnerability and risk analysis and mapping	Leadership	0%	100%
National	Availability of a designated authority for health service/system resilience functions	Leadership	No	Yes
National	Availability of a designated health system focal person or team responsible for providing input in the SPAR C9 assessment process	Leadership	No	Yes
National	SPAR health service provision capacity (C9) score	Leadership	33%	Level 3* (50–75%)
All	Availability of a platform to share good practices and lessons learned from healthcare facility perspectives in the context of emergencies	Leadership	No	Yes (Monthly QoC TC)
Facility	Availability of clinical protocols for priority public health emergency case management	Service delivery	Yes	Yes (COVID-19)
County	Simulation exercise conducted in the last 12 months that includes testing operational capacity at the county level for EPR	Service delivery	No	Yes
Facility	Number of health facilities in Liberia reporting adverse events in care delivery	Service delivery	0	2
All	Availability of an all-hazard EPR plan (or equivalent) which includes planning for the continuity of routine health services in the event of PHE	Leadership	No	Yes
Facility	Percentage of facilities in project sites with a dedicated IPC focal person	Service delivery	53%	100%
Facility	System in place to assess community trust (patient-reported experiences/outcomes)	Community engagement	74%	100%
Facility	Percentage of facilities in project sites with a designated team or focal persons for emergency management and service continuity	Workforce	37%	100%
Facility	Percentage of facilities in project counties with personnel that have received training with a focus on Health Service Resilience	Workforce	63%	100%
All	Monitoring and evaluation mechanism established for measuring the resilience of health services to PHE as part of routine health information system	HIS	95%	100%
National	Availability of HS SimEx package to test HS capacity for EPR and MEHS	Leadership	No	Yes
All	Availability of functional Quality Management Teams with ToR	Leadership	No	Yes

* Liberia SPAR 2022.

rapid detection of outbreaks and minimize disruption of essential services ("self-regulation"); strengthen joint working between health systems and health security ("integration") and develop tools for testing health system functionality (e.g., Health System SimEx); and planning for health service continuity during public health events ("transformation").

Further research is needed to explore the relative contribution of this project to resilience outcomes as opposed to processes and structures, but there are some indicative data in this respect. For example, outpatient consultations in public and private primary healthcare facilities increased from 3.4 million (2020) to 3.6 million (2021) across the country (16), with a similar trend observed in two of the project counties (Bong and Grand Cape Mount) as depicted in Figure 6.

Table 6 summarizes the achievements of the project across the package of support components, the Liberia Investment Plan for Building a Resilient Health System, and the strategic areas for improving health system resilience during COVID-19 (22).

Achievements in mobilizing and supporting the health workforce

The project contributed to the mapping of technical competencies among healthcare workers. It also supported integrated training in COVID-19 prevention and control for over 1,000 health workers (clinicians, health system managers, surveillance officers, administrators, environmental and veterinary officers, and community health workers) in Bong, Lofa, and Grand Cape Mount counties. Key elements of this training addressed Water, Sanitation, and Hygiene (WASH), case management, and the application of maternal and newborn quality of care standards in the context of an infectious disease pandemic. These efforts
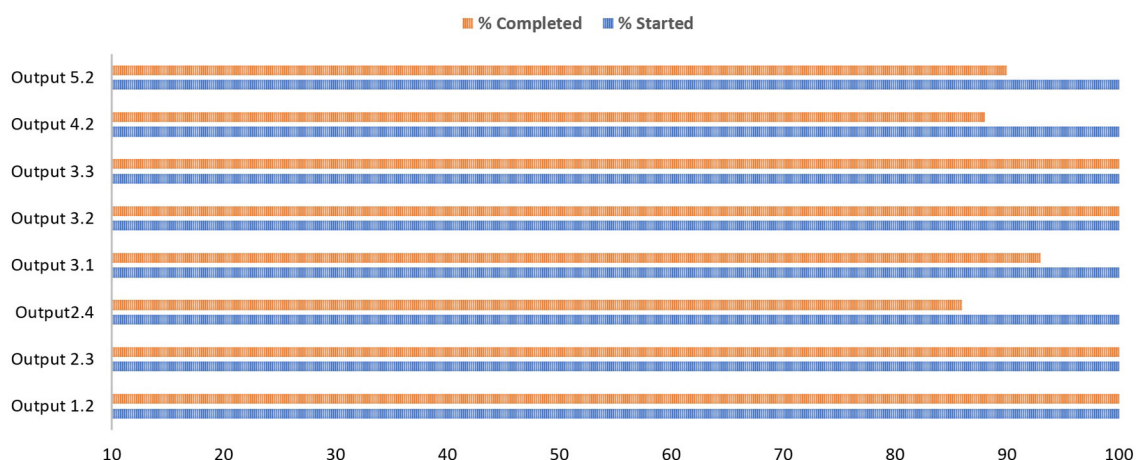
FIGURE 5
Implementation status of the Health Service Resilience project in Liberia.

FIGURE 6
Primary healthcare head counts in project counties during COVID-19 pandemic.

contributed to zero COVID-19-related death and zero maternal mortality in Grand Cape Mount County between March 2020 and September 2021 (20).

The project has supported long-term improvement in workforce capacity by contributing to the establishment of an integrated learning platform on healthcare quality and a program for Continuing Professional Development (CPD).

Achievements in strengthening public health capacities

Having learned from the EVD outbreak and other emergencies, the project tailored emergency preparedness and response activities to also support and allow the continuity of essential health services during emergencies. For example, following advice from the project team and in coordination with responsible stakeholders, the monitoring and maintenance of essential routine health services were incorporated as a response priority of the COVID-19 Incident Management System. Adopting a catchment approach (such as during stakeholders' workshops) facilitated the cross-pollination of knowledge and skills across the human, animal, and environmental sectors. Involving health facilities at the various levels across the referral system (clinics, health centers, and hospitals), the strengthening of the roles of actors at each level (2), and the creation of interlinkages between and within the different levels and sectors strengthened resilient capacities at service delivery levels to create sustainable impact and foster efficiency.

TABLE 6 Summary of HSR project achievements aligned with the health system building blocks.

Examples of achievements by components of the project's package of support—cutting across all health system building blocks	Liberia investment plan priority mainly contributed to/HS resilience assessment framework (strategic areas)

1. Advocacy—Governance
• Continuous advocacy at all levels national and sub-national has led to
  ○ High-level political buy-in and commitment to project implementation and institutionalization of the integrated health system strengthening approach promoted by the project as key for making health systems resilient, especially during the COVID-19 outbreak, e.g., participation of the Minister of Health and DG for NPHIL during project consultative meeting and national workshops to validate the Health System SimEx package and set of resilience indicators.
  ○ strengthened joint working between stakeholders focusing on health security and those focusing on health system strengthening as well as those from service delivery levels (public and private) and allied sectors, e.g., animal, environmental health, and education. Example: joint planning for emergency preparedness and response and joint simulation exercises to test the resilience of the system.
	• Expand capacity for leadership and governance to ensure effective guidance of health actions (Strategy 1–9)

2. Integrated training—Human Resource for Health Increased health workforce competency in building health system resilience through an integrated approach with awareness of their roles at leadership and service delivery levels. For example, through • Developing and making available (for in-person and online training) a training course on an integrated approach to health system resilience with a focus on services [21]. • Developing and launching the Continuous Professional Development (CPD) guideline and program (including integration of the HSR training course) for in-service training of health workers in the country • Integrated training for over 1,000 health workers, including policymakers, managers, and health service providers (including those at primary care levels and port health officers, at national and sub-national levels) to build capacities in various technical areas required for health system strengthening and resilience, e.g., application of health system resilience concepts, health services quality including safety requirements for building resilience [e.g., infection Prevention and Control (IPC) and Water Sanitation and Hygiene (WASH), Antimicrobial Resistance, and healthcare-associated infection (HAI) surveillance], detection and management of priority public health threats like COVID-19 and ensuring continuity of quality routine health services in routine and emergency contexts. • Incorporation of the HSR concept in pre-service education curriculum for long-term capacity building among physicians, nurses, and midwives. For example, contributed to the reforming of the A.M Dogliotti Medical training curriculum of the University of Liberia, in collaboration with Yale University.	• Build a fit-for-purpose productive and motivated health workforce that equitably and optimally delivers quality services • Strengthen epidemic preparedness, and surveillance and response (Strategy 13, 14, 15)
3. Risk profiling • Contribution to and facilitating capacity building for vulnerability and risk profiling, e.g., supporting the development of the VRAM data collection tool • Updated risk profiled with awareness of key stakeholders—not only emergency teams	• Strengthen epidemic preparedness, and surveillance and response (Strategy 3)

4. Policies, strategies, and plans for emergency management with routing health services continuity—Governance
• Informing and supporting national policies, planning, regulations, and other strategic actions to prioritize, enable, and mainstream resilience-focused activities adapted from the project's package of support and technical tools. Examples include:
  ○ Adaptation of the projects' handbook to develop a National Guideline for Health Services Continuity Planning against the disruptive impact of public health emergencies in Liberia.
  ○ Incorporation of integrated HSR considerations in the development of key documents such as the emergency preparedness and response plans, new Essential Package of Health Services (EPHS II), National Health Policy and Plan (NHPP) 2022-31, Health Sector Strategy and National Health Quality Strategy (NHQS) 2022-26, and facilitation of the development of the national health financing strategy and the consolidation of the National Health Accounts for FY2019
• Development of health facility accreditation standards in collaboration with Liberia Medical and Dental Council (LMDC) with an increased focus on the quality of health services and emergency preparedness as requirements for resilience-building
	• Expand capacity for leadership and governance to ensure effective guidance of health actions
	• Establish sustainable health financing systems that will ensure efficiency and equity in the use of health resources (Strategy 16, 17, 18, 19, 20)

5. Quality (including safety) health services—Service Delivery
• Strengthening health services delivery with quality improvement measures in routine and emergency contexts example through the
  ○ Reactivation and strengthening of quality management teams (QMTs) to oversee quality improvement interventions in 11 county public hospitals, with a focus on building resilience
  ○ Prioritization of routine health services continuity as an incident management system (IMS) pillar in coordination with teams responsible for service delivery, e.g., in the COVID-19 response.
  ○ Incorporating considerations for routine health services continuity in the development of national and county-level outbreak preparedness and response plans
  ○ Facilitating the participation of service providers at various service delivery levels, including those at primary care levels to actively participate in emergency preparedness and response including planning, simulation exercises, trainings, etc.
  ○ Provision of ICT equipment and laboratory reagents to seven referral hospitals to enhance AMR surveillance and Antimicrobial Stewardship (AMS) activities in collaboration with WHO-AFRO, including the development of the AMS guideline.
	• Restore and enhance service delivery systems to ensure the quality of care for patients and safe working environment for health staff
	• Strengthen epidemic preparedness, surveillance, and response
	• Build adequate capacity for the management of essential medicines and supplies at all levels (Strategy 19, 20)

(Continued)

TABLE 6 (Continued)

Examples of achievements by components of the project's package of support—cutting across all health system building blocks	Liberia investment plan priority mainly contributed to/HS resilience assessment framework (strategic areas)
6. Measuring health services and system resilience—Health Information System • Development of a set of indicators for measuring health services quality and resilience for adaptation and application at country levels in alignment with existing measurement tools, including SPAR C9 • Application of selected indicators in need assessments to understand the level of competency among healthcare workers in health services quality and system resilience • Assessment of health facilities' performance in quality of health services to identify and address gaps and build capacity for improvement ○ Example: assessment of 40 healthcare facilities assessed for IPC and WASH practices using the WHO IPC Score Card and WASH-FIT tool, assessment of the status of implementation of maternal and new-born quality of care standards in 12 healthcare facilities, and utilization of the Harmonized Health Facility Assessment (HHFA) tool for health facility surveys on areas of quality and resilience • Establishment of the baseline data on antimicrobial consumption and use in seven referral hospitals through adaptation and application of the WHO Point Prevalence Survey (PPS) • Facilitated the national case management pillar to conduct an assessment of county capacity for EVD case isolation and treatment in five counties	• Strengthen the health information, research, and communication systems • Restore and enhance service delivery systems to ensure quality of care for patients and safe working environment for health staff (Strategy 20)
7. Testing the resilience of services and the system through simulation exercises—Health Information System • Adaptation and application of the HSR SimEx package (using a multi-sectoral approach—Human and public health, Agriculture, and Environmental sectors) to test and review health system functionality and resilience to proactively identify and address gaps; for example, in reviewing the functional capacity in six counties for emergency preparedness and response and routine service provision, and in reviewing of the functionality of Rapid Response Teams for COVID-19 in 15 counties • 150 multidisciplinary stakeholders in six counties trained in the application of the health system resilience SimEx package • Utilization of HSR simulation exercises results to guide six County-level health sector operational planning (Bong, Lofa, Grand Cape Mount, Nimba, Bomi, and Gbarpolu)	• Strengthen the health information, research, and communication systems (Strategy 3)
8. After and Intra Action Reviews from a health system perspective—Health Information System • Review of traditional approaches after action reviews which identified gaps and provided recommendations for the application of more integrated, system-focused approaches in conducting intra and after-action reviews • Application of health system perspectives in reviewing health system performance in the context of real public health events to enable learning and improvements as key aspects of resilience example intra-action reviews of COVID-19 response in three Counties, which informed the national Transition Plan	• Strengthen the health information, research, and communication systems (Strategy 4)
9. Local resilience forum—Governance • Establishment of multi-sectoral and multi-disciplinary working groups on resilience with the integration of health services quality and health security aspects. For example, the project has promoted the One Health Platform • **Establishment of working groups** on resilience with the integration of quality and health security aspects, e.g., Quality Management Teams, Teleconference on quality, and instituted a monthly teleconference that brings stakeholders from all levels of the health system to discuss issues around quality of care and resilience	• Restore and enhance service delivery systems to ensure quality of care for patients and safe working environment for health staff • Strengthen epidemic preparedness, and surveillance and response (Strategy 1, 8)
10. Knowledge sharing—Health Information System • Enabling institutionalized knowledge and experience sharing as a means of building health system resilience capacities, for example, establishing and sustaining a quality-of-care virtual platform (QoC Teleconference) for knowledge sharing and learning within and between cadres and administrative levels from 15 counties to promote quality improvement activities as a requirement for resilience • Publishing project case example to contribute to evidence and global learning on operationalizing health system resilience at the country level, e.g., as part of WHO Health System Resilience Toolkit, and Health Services Learning Hub and Action Brief to share best practices in quality improvement during the COVID-19 pandemic response	• Strengthen the health information, research, and communication systems (Strategy 4, 7)

The HSR project catalyzed Liberia's efforts of building back better from EVD, COVID-19, and beyond, by embedding public health capacities in health system functions based on lessons from past and current public health events. Examples include the prioritization of routine health services continuity and the inclusion of a new response pillar called Maintenance of Essential Health Services (MEHS) during the COVID-19 pandemic (23). This has supported the strengthening of routine health services during COVID-19 as well as the roll out of COVID-19 vaccination, integration of clinical care for COVID-19 patients into routine

healthcare, and revision of the essential package of health services (EPHS II, 2022–2026) to include concepts of emergency response and healthcare quality improvement.

In addition, the concept of sustainability has been embodied in the implementation of the project by leveraging and supporting existing partners' efforts to strengthen the health system in Liberia. The project team also facilitated the development of the new National Health Quality Strategy (NHQS 2023–2027) and is supporting the Liberian Medical and Dental Council (LMDC) to draft quality standards for the assessment and accreditation

of health facilities in Liberia. These documents will guide the provision of quality healthcare services in the post-COVID-19 era.

Project contributions to the COVID-19 response

The ability to quickly reallocate available funding to support the COVID-19 response was necessary to provide a swift response (24). At the peak of the pandemic, some project activities were revised to re-align with COVID-19 response activities, and project funding was rapidly repurposed to address these needs. Such activities included integrated training in COVID-19 prevention/IPC, detection, isolation, and case management (including home-based care and specific interventions for maternal, newborn, and child health services) in the three project counties. Funding from the project was also used to support surge capacity through the repurposing of project staff to support COVID-19 response in non-project counties.

Technical officers for the project were repurposed to support the COVID-19 response in Montserrado and Grand Kru counties. This support resulted in the development of specific county response plans for COVID and the successful containment of the outbreak. The HSR project personnel contributed to the adaptation, validation, and roll out of the interim guidelines for COVID-19 clinical care and the Handbook for COVID-19 Treatment, which facilitated the management of COVID-19 patients in Treatment Units and county referral hospitals. The project focal point also facilitated the development of the national guideline for home-based isolation and care for COVID-19 patients, which facilitated the treatment and recovery of over 2,000 patients during the response (25).

In addition, through the HSR project, WHO procured and donated laptop computers and printers to eight referral hospitals to improve data collection and reporting on AMR during the COVID-19 outbreak and beyond. The water supply at Tellewoyan Memorial Hospital (Lofa County) was rehabilitated through the procurement and installation of a submersible water pump under the HSR project. This enhanced the quality of care for COVID-19 case management and other patients in routine care for the population of Lofa and the neighboring communities in Guinea and Sierra Leone.

Project challenges and limitations

Early on, there was a 6-month delay in the onset of project implementation due to administrative and operational challenges such as delay in the recruitment of project staff and transfer of project funds to the country office. In addition, project implementation was disrupted by the COVID-19 pandemic response and restrictions, and competing priorities related to ongoing and potential outbreaks, including threats of EVD. However, the lost time was recovered by careful work planning, re-sequencing, and streamlining of activities in line with national and sub-national priorities while maintaining the project's ethos of fostering an integrated approach to health system strengthening for resilience even while adapting activities to support response to various emergencies.

A key limitation of the project was its relatively limited scope. The project was implemented in 19 public and private health facilities in three out of 15 counties in Liberia. However, there were spillovers of project activities in non-pilot counties, such as Montserrado, Nimba, Bomi, and Gbarpolu. Some activities were also implemented at a national level, benefitting stakeholders from MoH, NPHIL, MoA, EPA, National Disaster Management Agency (NDMA), and academia, and are likely to have had an impact on other activities involving the same stakeholders. Importantly, the health system challenges are similar in all 15 counties of Liberia, which will facilitate the transfer of lessons learned from the 3^+ pilot counties across the health system.

Discussion and recommendations

To support Liberia in building resilience in its health system, WHO partnered with KOICA to work with the MoH, NPHIL, and other relevant institutions to implement a health system resilience initiative. The project, though catalytic in nature and limited in scope, made a significant contribution toward the realization of the national ambition of building a resilient health system, especially in the three project counties.

Below we highlight what we perceive as the greatest strengths and persistent challenges for the Health Service Resilience project as implemented in Liberia and, based on these, recommend priorities in working toward health systems resilience. Highlights of the achievements of the parallel project in Ethiopia are included in Box 2.

Health systems strengthening for resilience needs an integrated approach and multi-partner, multi-sectoral collaboration

Fragmented and siloed approaches have often hampered efforts to make health systems more resilient (26), by prioritizing disease-specific objectives over health system strengthening and clinical care over public health and by not making the most of limited resources. The HSR project, in contrast, mainstreamed the joint working of key stakeholders across various disciplines

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BOX 1 Overall goal and summary of expected outcomes of the HSR project.

To build resilience in health systems to enable quality health services in all contexts, along with preparedness.

✓ Build health service resilience with systematic consideration of quality and emergency preparedness for response including health services continuity

✓ Develop bridges between work on health systems (primarily MoH responsibility) and health security (primarily NPHIL responsibility) as well as between the human health sector and allied sectors (such as animal health).

✓ Promote effective health system participation in emergency preparedness and response

BOX 2 Highlights of project implementation in Ethiopia.

This resilience building project model is also being successfully implemented in Ethiopia with positive feedback from stakeholders acknowledging its role in promoting and operationalizing the concept of resilience in the health system as important in the context of recovery from various public health events. This demonstrates the relevance, adaptability, and applicability of the project to different contexts.

Examples of achievements from project support in Ethiopia include establishment of an institutional focus on health system resilience in the Ethiopian Public Health Institute (EPHI) and institutionalizing resilience-focused activities from the project in national public health activities as planning, Public Health Emergency Management (PHEM) guidelines. Emergency response efforts such as the COVID-19 incident management structure incorporated essential health service continuity as a priority, with active participation of health system and services-focused teams for a comprehensive response and timely prevention and mitigation of routine health services disruptions. National universities in Ethiopia have also embedded the concept and application of health systems resilience in their pre-service and advanced degree programs for health professionals, based on the training package from this initiative for long-term impact in health workforce competencies. These are especially timely to further position and expand considerations for integrated health system strengthening and resilience in recovery efforts from COVID-19, conflict-related humanitarian response and other system strengthening initiatives building on the projects best practices and achievements.

and sectors at policy, planning, and operational, including service delivery, levels.

The project strengthened the integration of health systems and health security work. It ensured that each project-supported activity contributed to strengthening the capacity of the health system to equally prioritize and serve routine and emergency-related population health needs during and between small- and large-scale emergencies. High-level political buy-in and participation from the top leadership of the MoH and NPHIL was secured. This included the participation of the Minister of Health and Director General of NPHIL during the project stakeholders' consultative meeting in Gbarnga and during the launch of the project toolkit (as shown in Table 6).

The principle of integration also guided the development of national and county health sector and health security plans and policy documents, as well as technical resources developed or supported by the project. Key among these was the integrated Health Sector Operational Plans that included emergency preparedness activities, the integrated health system SimEx package (which was used to test the functionality of the Rapid Response Teams for COVID-19), COVID-19 Preparedness and Response Plans (23) (national and county), and the national guideline for health service continuity planning in emergency context (27) (further detail in Table 6). Health system reporting and programming documents, such as the State Party Self-Assessment Annual Reporting (SPAR) and the antimicrobial resistance (AMR) stewardship programming, were also developed using the integrated approach.

The project achieved significant successes in institutionalizing joint working within and between the health sector and other sectors, such as education, academia, administration, security, internal affairs, agriculture, animal and environmental health,

and civil society. Among the most successful examples of such institutionalized joint working and multi-sectoral collaboration were the project activities on public health emergency preparedness; the promotion of the One-Health platform to improve coordination with the animal and environmental sectors; and the national workshop to review and adapt the Health System SimEx package and set of indicators for resilience (Tables 5, 6). The collaboration between the private and public sectors was also strengthened, with the critical role of the private sector becoming evident during the COVID-19 pandemic.

Last, but not least, as far as integration and collaboration are concerned, the project achieved a high level of partner engagement, benefiting from the technical knowledge and skills of partners and driving the agenda for sustainability. As shown in Table 6, the project team has collaborated with Last Mile Health to develop the NHQS2023-27, USAID-STAIP project to conduct integrated training for healthcare workers and conduct health sector operational planning at the county level and the USAID-funded BRIDGE-U project to develop and launch the CPD guideline.

Liberia's successes in improving integration and multi-partner, multi-sectoral collaboration for resilience offer a broad range of steps for other countries to choose from. Within the country, there is a need to further institutionalize integrated health system resilience efforts, including linkages with funding streams and accountability mechanisms (28). The Ministry of Health and NPHIL need to work together to steer available and potential internal and external health investments to promote and operationalize an integrated approach to health system strengthening toward resilience, even when targeting specific health problems such as emergencies, specific diseases, or life-course issues. This would build the capacity of the system to effectively address the various health issues faced by populations served with better efficiency and sustainability.

Health system resilience requires continuous learning and capacity building

The project's package of support (18) remains relevant and timely before, during, and between public health emergencies, thereby allowing continuous learning and improvement even as the health system goes from one public health event to the next. This continuous learning is core to the concept of recovery and long-term resilience building (2) promoted by the project. It contributes to making the health system more adaptive as illustrated by Falope et al. (29). Building on lessons from EVD, COVID-19, and other smaller events, the project established the multi-sector/multi-disciplinary learning platform for regular experience sharing on healthcare quality and resilience between health workers, managers, policymakers, community stakeholders, and partners (Table 6, rows 2 and 10). It also developed and launched the first national guideline for CPD, in collaboration with the University of Liberia and health professional boards (Table 6). Enhancing the competencies of medical directors, CHOs, and other managers and decision-makers through project activities has also enabled a trickle-down effect on frontline health professionals and

non-health actors (at both national and sub-national levels) and has enhanced the application of systems thinking for resilience at frontline levels.

Despite the frequent use of the term "health systems resilience", the understanding of the concept of integrating resilience building in routine health emergency and system functions and service delivery, particularly at sub-national levels and service delivery levels, is generally still growing (30). There is a need to cover more health professionals (especially from the frontline) in training and orientation on the required integrated approach to the concept of resilience, e.g., through more pre-service curricula reviews and CPD programs beyond the current project sites.

Health system resilience requires the promotion of ownership and sustainability

The project has been intentional and systematic in creating a sense of ownership among national stakeholders and in enabling long-term sustainability. As described under *Guiding principles*, it used a "One-plan One-budget approach" from planning through implementation. Its overall work plan was jointly elaborated by national stakeholders from the MoH, NPHIL, EPA, and MoA during an inception meeting held in Bishoftu Ethiopia, and a stakeholders' consultation meeting in Gbarnga, Bong County in Liberia in 2019. Budgets for the implementation of activities were jointly reviewed and updated with the national counterparts, particularly the two project focal points, and approved by the Minister of Health or Director General of NPHIL before each activity was implemented. In addition, the planning and coordination of some key activities have been handed over to the national teams. For example, the Healthcare Quality Management Unit (HQMU) of the MoH leads the coordination of monthly teleconferences on quality of care (29) (Table 6).

Health system resilience efforts must be further decentralized (28) and owned by key actors within the system, especially at the sub-national levels with a focus on strengthening primary healthcare (22, 28, 31).

Health system resilience requires new investment mechanisms to promote research and innovation

The "panic and neglect" cycle has been a major challenge in building resilience in health systems sustainably, using the recovery phase as a platform for applying learning and improving the quality of health services (6). Most donor funding disappears when the acute phase of an emergency is over. Foundational health issues remain unaddressed and under-prioritized. After the EVD response in Liberia, the country experienced a decline in external support to take forward the lessons from the outbreak. Among the current partners working on aspects of quality and preparedness with national authorities in Liberia, there are very limited resources and support available for promoting and scaling-up an integrated health system strengthening with health security in tandem, in the context of the decline in external support and economic contraction. This

is further compounded by the global economic impacts of the COVID-19 pandemic and geo-political crisis.

The occurrence of public health events (PHE) such as the COVID-19 pandemic and the threat of the Ebola outbreak, while disruptive, provide increased momentum to work toward resilience, learning, and strengthening of the health system. The HSR project is an example of a health system initiative implemented from lessons learned from previous PHE, has piloted a series of technical tools to build health system resilience, one of which is the set of resilience indicators (Tables 5, 6). However, there is an increasing need to test this package of tools on a large scale, but also to prioritize the development of robust assessment tools and monitoring and evaluation systems through research.

National and sub-national stakeholders have been calling for the extension and scale-up for the wider impact of Liberia's Health Services Resilience project. The project team and their collaborators are continuing to advocate for the expansion of the project within and beyond the three pilot counties and focused investments beyond the current project scope and the COVID-19 pandemic. One of the major investment priorities identified is addressing the fragmentation in health information systems and enabling integrated and interoperable tracking of quality and resilience indicators at both national and operational levels.

Challenges

Even though the project applies a system approach, there are fundamental health system challenges that have remained outside of its scope, for example, the availability of basic infrastructure for water, sanitation, and hygiene, the procurement of medical supplies, or the retention of health workers. At the same time, the lack of such infrastructure affects both the implementation of the project and the preservation of its legacy. The project's advocacy and technical support for system-wide strengthening can be enhanced by pulling together wider health sector inputs and resources and by broadening partnerships in this area of work. The project team continues to scope out relevant options for collaboration with other partners in supporting the national authorities. Sector-wide and inter-sectoral planning and linking the plans with funding are also essential.

Study strengths and limitations

Strengths

This study presented ongoing, practical work on the operationalization of resilience in a health system of a resource-limited setting, a genre of studies that continues to be seriously under-represented in the academic literature. The operationalization of the concept of resilience in the health system has been limited partly by the limited progress made in developing standardized metrics (32), but also by the multitude of frameworks that have been proposed (30). The pre-existing evidence synthesized here was generated through a mixed methods approach, including a literature review (quantitative and qualitative findings), online survey and focus group discussions (primarily qualitative findings), and health facility assessments (observations,

giving rise to both quantitative and qualitative findings). This was complemented by considerations and learnings arising from the study authors' direct involvement in the project. The evidence and learnings presented here are thus rich and multifaceted and have sufficient rigor and credibility, even if also limited in important ways (see below). The lessons shared in this paper can be applied to enhance resilience in similar health systems recovering from COVID-19 and seeking to build back a better health system, which continuously improves how it serves the needs of local populations and its capacity to withstand future pandemics.

Limitations

A substantial part of the data summarized in this study has been collected from key informants, selected for their roles in the health system and by applying the catchment approach. This makes such data amenable to many biases, including sampling, recall, social desirability, and overall reporting bias. This was, to a degree, offset by data triangulation using other methods, including literature reviews and observations in health facilities. Overall, a breadth of evidence was synthesized. However, this was not done by applying a sufficiently structured and transparent research synthesis method. The prioritization of findings and lessons learned was made based on the co-authors' expertise as opposed to using a systematic approach to data extraction and synthesis. Finally, the public health intervention the study describes is still in its implementation phase. Follow-up studies are needed to explore the degree to which the reported achievements and impact are lasting and sustainable.

Conclusion

The Health Service Resilience project as implemented in Liberia has demonstrated that it is possible to operationalize health system resilience in a low-income country and under resource constraints. It has also shown that the priorities of health security and universal health coverage can be advanced in tandem at policy, management, and service delivery levels. This has been achieved by ensuring national ownership and leveraging existing strengths and opportunities such as strong political will at national and sub-national levels and the existence of NPHIL and the Quality Management Unit of the MoH, which are products of the EVD experience.

The project was mainly implemented in three out of 15 countries of Liberia, and the nature of the support has been catalytic as opposed to transformative. However, the HSR project has made a valuable contribution to national efforts for building a resilient health system inspired by the EVD experience. These achievements from the project implementation supported the national preparedness and response efforts for COVID-19 that led to the successful containment of the COVID-19 outbreak in Liberia and are contributing to the gradual restoration of essential health services in the post-COVID-19 era. The project has generated a lot of momentum and enthusiasm among the beneficiary institutions and populations, especially with its integrated, catchment, and multi-sectoral approach.

The principles applied in this pilot and the best practices shared could guide the operationalization of resilience efforts in health systems in other resource-limited settings similar to Liberia.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1137865/full#supplementary-material

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Policy implementation challenges and the ritualization of public health emergency plans: An investigation of urban communities in Jiangsu Province, China

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Introduction: The COVID-19 pandemic has been a global public health emergency, and countries worldwide have responded to it through a vast array of pre-planned, adaptively devised and *ad-hoc* measures. In China, public health emergency plans - the plans expected to drive the response to epidemics or pandemics - demonstrated a concerning tendency towards "ritualization." "Ritualization" denotes the practice of public health emergency plans to be reliably developed so that a formal requirement is met, while being implemented selectively or not at all in the emergency response.

Methods: This study explored the phenomenon of ritualization by analyzing data from 1485 questionnaires, 60 in-depth interviews and 85 actual public health emergency plans. It used the Smith Policy-Implementation-Processing pattern as its conceptual framework.

Results: The study found that the infeasibility of plans, their ineffective implementation by emergency management agencies, the obstructive behaviors of community residents, and the lack of an appropriate policy environment all contributed to the practice of ritualization.

Discussion: As China seeks to better respond to COVID-19 and accelerate the recovery of its health system, it is essential to ensure that its public health emergency plans are effectively developed and implemented.

KEYWORDS

public health emergency plans, smith policy-implementation-processing pattern, ritualization, emergencies, public health systems research

1. Introduction

The phrase "public health emergency" refers to major infectious disease outbreaks, unexplained mass diseases, primary food and occupational poisoning, and other events that seriously affect public health, which occur suddenly and cause

or may cause severe damage to public health.[1] Since 2020, the COVID-19 pandemic has been a global public health emergency that has seriously affected national economies and the livelihoods of people. Although the epidemiological situation in many countries is still not effectively controlled, an increasing number of countries are beginning to change their health policies and seek to move into a normative stage of coexistence with COVID-19. Following the 20th National Congress of the Communist Party of China, China announced that it would continue to adhere to its "dynamic zero" policy,[2] which means that China will continue to adopt a high standard of response to COVID-19.

An emergency plan is a policy tool used in emergency management to keep the emergency response procedures on track. The effective implementation of public health emergency plans not only improves the accuracy of the emergency response, but also accelerates the recovery of a health system from the impact of COVID-19 (1). According to statistics from the Ministry of Emergency Management of the People's Republic of China, as of 2019, China has prepared more than 7.8 million emergency plans, of which more than 2 million were newly developed or revised in 2019 alone.[3] Nonetheless, after the outbreak of COVID-19, some regions in China experienced "failures" in implementing their public health emergency plans, many of which tended to be "ritualized."

Wang and Tang propose the concept of "ritualized law" to refer to systems that have virtually symbolic meaning and do not perform effectively in the practical application of the policy (2). In this study, "ritualization" is used to denote a pattern of behaviors concerning public health emergency planning whereby: new public health emergency plans are constantly being developed at all levels; emergency plan drills are conducted as required; emergency response subjects declare that they will activate the emergency plan during an emergency; yet emergency plans are not implemented or are selectively implemented during the emergency response. Ultimately, a public health emergency plan becomes a "decoration." Implementing the plan becomes a "ritual," with the plan failing to guide the practical application of a policy in the emergency response and during the recovery of the health system.

Since the outbreak of COVID-19, there has been a proliferation of research on implementing public health emergency plans. Wisniewski evaluated the effectiveness of crisis management plans (CMPs) in addressing threat risks in Poland and identified the integrity of multi-hazard plans as central to their effective implementation (3). Wolf-Fordham suggested that the development, response, and local management of emergency plans should be strengthened by promoting cooperation between emergency management departments (4). Wang et al. analyzed the implementation of public health plans in rural areas in China, classifying four types of scenarios (functional-failure, functional-delay, functional-vacancy, and functional-devaluation) in which the implementation of emergency plans fails and suggesting that "governance by law" should be vigorously strengthened (5). Li et al. analyzed the problems of community public health emergency management systems from the perspective of resilience and found that public health emergency plans at the community level were homogenized and boilerplate and that their practicality and effectiveness were poor (6). Guo and Zhao used social network analysis to study emergency plans for public health emergencies in China and found that problems such as poor linkages and generalized organizational functions made it difficult to implement them effectively (7). Overall, the existing literature suggests that features internal to a public health emergency plan and/or reflecting its fit with the environment in which it is applied, such as the plan's integrity, relevance, and pertinence, are crucial for a plan's effective implementation. Once the implementation is in progress, external factors such as legal protection, social culture, and financial support, as well as internal factors such as characteristics of the implementing organization, shape further the actual implementation of public health emergency plans. Most existing studies, however, focus on the internal factors affecting the implementation of public health emergency plans. They do not offer a comprehensive, multidimensional exploration of internal and external factors affecting a plan's implementation.

In order to explore the factors that lead to the abandonment or selective implementation of public health emergency plans, and thus help avoid their ritualization, this study proposes a framework for exploring the implementation of public health emergency plans based on Smith Policy-Implementation-Processing pattern. It represents a comprehensive model of both internal and external factors that influence the implementation of public health emergency plans. The framework informed the collection and analysis of data from 13 cities in Jiangsu province. The data were analyzed through the lens of ritualization of public health emergency plans. Recommendations are given on how to avoid the ritualization of public health emergency plans so that they can enable a more effective emergency response and contribute to an accelerated health system recovery.

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1 According to the "Law of the People's Republic of China on Emergency Response". Available online: http://www.gov.cn/ziliao/flfg/2007–08/30/content_732593.htm.

2 https://www.mfa.gov.cn/web/wjbz_673089/xghd_673097/202205/t20220519_10689621.shtml

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2. Study setting and methods

2.1. Study setting

The study was conducted in Jiangsu Province, China. Jiangsu covers an area of 107,200 square kilometers and has 13 prefecture-level cities under its jurisdiction. By the end of 2021, the gross regional product of Jiangsu has reached 11,636.42 billion yuan, with a permanent resident population of 85 million.[4] It is not only the province in China with the most significant population density, but also one of its most economically developed provinces. By way of comparison, Jiangsu province has a larger economy than South Korea (ranked 10th in the world) and a total population of about 30 million more than South Korea. Public health emergencies are frequent in Jiangsu due to its large and densely distributed population. In 2021, 229 public health emergencies were reported in Jiangsu (excluding the aggregated outbreak of COVID-19), with 8,490 reported cases.[5] This makes Jiangsu an informative case study in examining the implementation of public health emergency plans in the context of COVID-19 outbreak, including the risks of their degradation into ritualized forms (location of Jiangsu Province in China and the distribution of respondents is shown in Figure 1).

2.2. Methods

2.2.1. Smith policy-implementation-processing pattern

The Smith Policy-Implementation-Processing pattern is a theoretical model that analyzes policy implementation factors and their relationships. Smith categorized the significant factors involved in implementing a policy into four components: ideal policy, implementing organization, target group, and environmental factors [8]. These four variables interact to create tensions that affect the effectiveness of policy implementation and promote or hinder the policy effects through feedback. The greatest strength of the model is its comprehensiveness and attention to tensions between the four elements.

In China, the requirements for an emergency response plan's preparation, approval, publication, exercise, evaluation, publicity and education, and organizational safeguards are specified in the Measures for the Management of Emergency Response Plans formulated by the General Office of the State Council of the People's Republic of China.[6] The Smith Policy-Implementation-Processing pattern accounts for the variety of emergency plan management standards proposed by the Chinese government better than any alternative framework we are aware of. This study retains most of the elements of the Smith Policy-Implementation-Processing pattern, but adapts the elements included in IDEAL POLICY and TARGET GROUP. The adaptations to IDEAL POLICY concerned the features of public health emergency plans. The adaptations to TARGET GROUP concerned the group characteristics exhibited by the Chinese population (the diagram of the research framework is shown in Figure 2).

2.2.2. Questionnaire

The study questionnaire was designed using constructs and their operationalization in the Smith Policy-Implementation-Processing pattern, namely the emergency plans, the implementing agents, community residents, and environmental factors (a translation of the questionnaire is available in Appendix A in Supplementary material). A total of 1,560 questionnaires were distributed, and 1,485 valid questionnaires were returned, for a response rate of 95% (details about the sampling can be found in Appendix B in Supplementary material). Researchers from China University of Mining and Technology distributed the questionnaires to respondents in face-to-face interactions. Respondents completed the questionnaires by themselves, while a researcher was available to explain items and/or response options if these were perceived to be unclear (basic information about the respondents is available in Table 1).

2.2.3. In-depth interviews

Findings from the questionnaire were complemented by in-depth interviews with 30 community emergency staff and 30 community residents. The interviews sought rich, contextualized descriptions of the work and daily lives of respondents in relation to public health emergency plans. They allowed us to develop a more comprehensive understanding of the implementation process. Respondents were recruited during the process of questionnaire administration. If brief communications with them revealed that they could be considered "key informants," the researcher explored their willingness to be interviewed and, if such willingness was expressed and consent given, the interview was conducted right after the questionnaire was completed. Twenty-four interviews were audio-recorded, with participants' consent. Notes were taken during the remaining interviews,

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4 The data comes from the People's Government of Jiangsu Province, People's Republic of China. Available online: http://www.jiangsu.gov.cn/art/2022/3/3/art_34151_10363589.html.

5 Data from the official website of Jiangsu Provincial Health and Wellness Commission. http://wjw.jiangsu.gov.cn/art/2022/4/25/art_7309_10427106.html.

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6 According to the official document of the General Office of the State Council of the People's Republic of China. http://www.gov.cn/zhengce/zhengceku/2013-11/08/content_1077.htm.
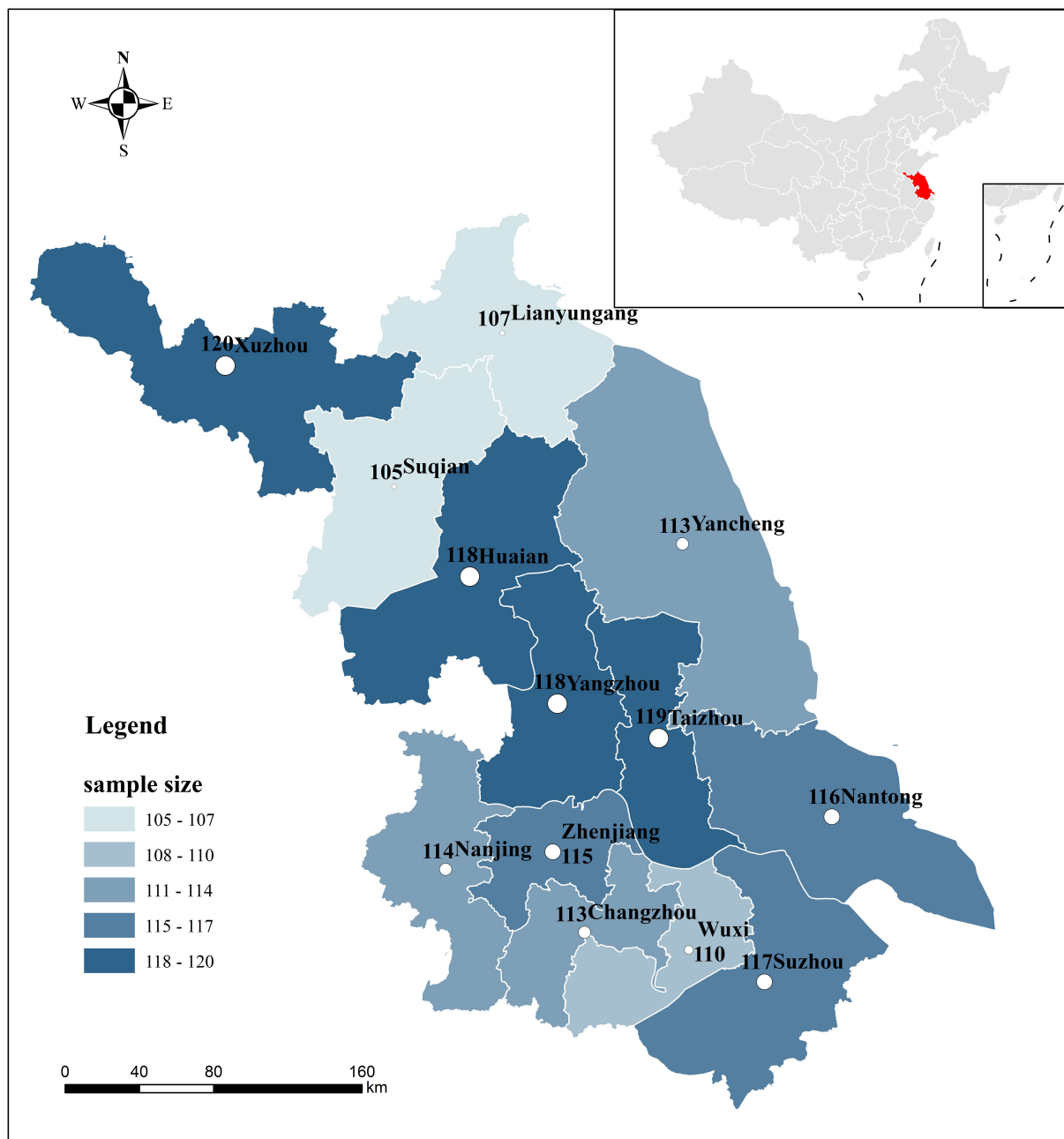
FIGURE 1
Map of the study setting (Jiangsu province and its 13 prefecture-level cities) and distribution of survey responses. The figure accompanying the name of a city represents the exact number of study participants from that city.

as most community emergency staff preferred not to be recorded.

2.2.4. Document analysis

We collected 20 emergency plans at the municipal district level and 65 community emergency plans. The analysis focused on inappropriate procedures recommended or mandated by the public health emergency plans. In particular, through comparing the textual content of plans and the actual implementation process, with the latter elucidated by questionnaire and interview findings, we could analyze the reasons for the degradation of public health emergency plans toward ritualization.

FIGURE 2
Analysis framework based on the Smith Policy-Implementation-Processing pattern.
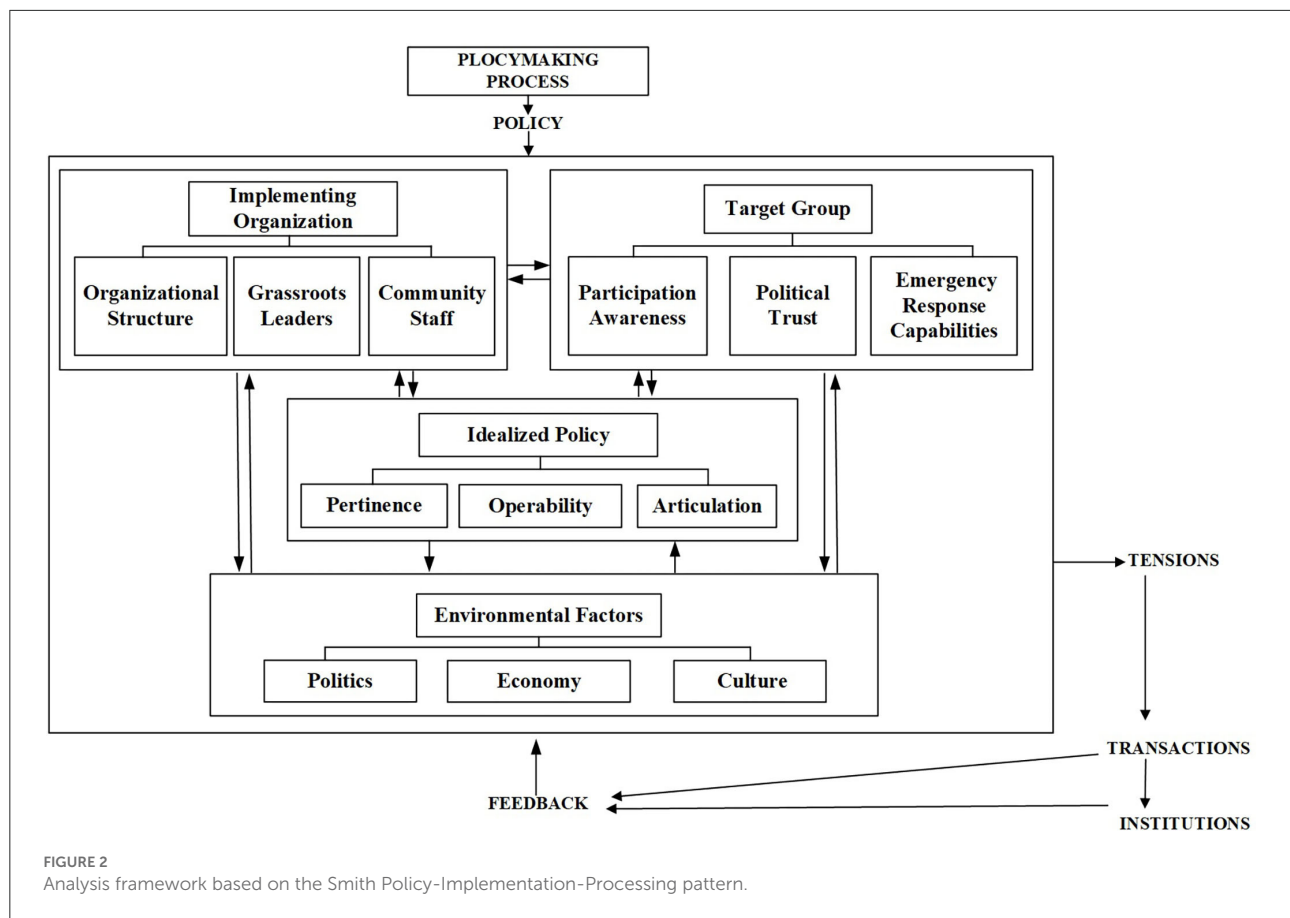
3. Findings

Following the analytical framework used in this study, we represent the findings in terms of the ideal policy, implementation group, target group, and policy environment.

3.1. Infeasibility of the public health emergency plans

Eight questionnaire items concerned the ideal policy (see Table 2).

67.3% of questionnaire respondents perceived the emergency plan in their community as unfeasible. Of the 65 public health emergency plans reviewed during the document analysis stage, 27 were found to be highly similar. They copied the general measures of equivalent emergency plans, ignoring factors such as the community's geographical location, population status, and emergency supplies stocks. 60.2% of respondents felt that the distribution of primary responsibility in the public health emergency plans was unclear. 56.1% did not consider the emergency response procedures stipulated in the plan to be detailed enough. Below we provide an illustration of the vagueness of emergency response procedures, using Plan DZ

from the document analysis process. The plan does not specify who would complete each step of the emergency response and how it would be done. This not only obstructs the development of an effective emergency response but may, in fact, exacerbate aspects of the emergency situation.

DZ Community Emergency Plan (Excerpt)

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Emergency response

1. Response procedures

1.1 In case of an emergency, the main person in charge of the community should immediately lead the members of the emergency leading team to the scene and quickly call the emergency team for early emergency treatment.

1.2 The community shall immediately report to the higher authorities and request additional emergency teams and supplies for on-site rescue.

1.3 The community should carry out the early rescue.

1.4 The community should provide information related to emergencies for the proximity of the senior leader once he or she arrives on the scene.

2. Aftermath response

2.1 The community shall stabilize the life of the people after the accident or disaster and report the implementation of the community emergency plan and the post-treatment plan.

TABLE 1 Basic information of respondents.

Variables	Options	N	Percentage (%)
Gender*	Male	963	64.85
	Female	522	35.15
Age	18–29	467	31.45
	30–44	684	46.06
	45–59	319	21.48
	Over 60 years old	15	1.01
Education	Elementary school and below	5	0.34
	Junior high school	43	2.9
	High school	155	10.44
	Graduate	1,089	73.33
	Postgraduate and above	193	13

*Respondents were randomly selected, yet there was a significant difference in the proportion of male and female respondents in the final sample.

TABLE 2 Questionnaire responses to items about the "ideal policy."

Item N	Feature of emergency plans addressed by an item	Yes	No
		N (%)	N (%)
Item8	Feasibility	486 (32.7)	999 (67.3)
Item26	Effectiveness	555 (37.4)	930 (62.6)
Item9	Clear division of responsibility	591 (39.8)	894 (60.2)
Item10	Clear emergency warning process	673 (45.3)	812 (54.7)
Item11	Detailed emergency response procedures	652 (43.9)	833 (56.1)
Item12	Strong links between the different emergency plans	630 (42.4)	855 (57.6)
Item13	Consistency with higher level plans	642 (43.2)	843 (56.8)
Item14	Updated regularly	887 (59.7)	598 (40.3)

2.2 The community shall be responsible for dealing with the aftermath of the dead and injured and providing compensation to their families.

2.3 The community shall assist the superior government and relevant departments in disaster relief work.

2.4 The community shall promptly undertake post-disaster recovery and reconstruction.

2.5 The community shall conduct disaster investigation and assessment.

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3.2. Ineffective implementation by emergency management agencies

Seven questionnaire items concerned the "implementation group" (see Table 3).

63.6% of the questionnaire respondents experienced the community emergency management organization as "not normative," in the sense of not adhering to formal rules and good practices. 30.2% of respondents believed that community leaders prioritized emergency management. 35.5% of respondents believed that community leaders were strictly checking and dynamically managing public health emergency plans and drills. In the words of *Mr. Z1, a manager at Community A:*

> *"All of us know that emergency plans are important, but few of us follow them in emergency response. On the one hand, leaders do not pay attention to community emergency plans, and some of them are not feasible for leaders to implement. On the other hand, we have to do our job according to what the leaders have arranged. What do we do if the leader's proximity command is different from the emergency plan? We can't go against the leaders' ideas."*

Even when areas have a normative emergency management organization and a well-developed emergency plan, the lack of attention from community leaders can prevent emergency

TABLE 3 Questionnaire responses to items about the "implementation group."

Item N	Feature of the emergency management agencies addressed by an item	Yes N (%)	No N (%)
Item15	Dedicated personnel for emergency management	1,032 (69.5)	453 (30.5)
Item16	Normative emergency management organizational structure	541 (36.4)	944 (63.6)
Item17	Implementing emergency plans according to regulations	670 (45.1)	815 (54.9)
Item18	Leaders make emergency management a priority	448 (30.2)	1,037 (69.8)
Item19	Leaders carefully check and manage emergency plans drills	527 (35.5)	958 (64.5)
Item20	Leaders prefer to take command on the spot in an emergency rather than follow the emergency plan	1,097 (73.9)	388 (26.1)
Item21	Staff have the required emergency response knowledge and skills	771 (51.9)	714 (48.1)

management work from being carried out effectively. Yet more worryingly, most community workers cannot effectively implement public health emergency plans in emergency response. 48.1% of questionnaire respondents thought that community workers did not have the expertise and skills for emergency management. Mr. S3, a staff member in charge of preparing emergency plans in B Street, reflected on the lack of professional emergency knowledge and skills of some staff members:

> "Most of my colleagues are not familiar with emergency work including emergency plans, but that can't be helped. I used to work in a related organization (Changed for anonymity), so I know a little about the preparation of earthquake emergency plan and disaster disposal, while some colleagues have no experience in emergency management before. There are prepared emergency plans in the community, but most colleagues do not have the professional knowledge and skills to implement emergency plans."

3.3. Negative impacts of target groups on the implementation of emergency plans

Six questionnaire items sought to capture the knowledge, attitudes and behaviors of the target groups (Table 4).

Only 31.8% of respondents were willing to participate in emergency plan drills organized by community organizations. Ms. L1, a community resident, commented:

> "There are few disasters here, so why waste time and money doing those drills? In my community, only when the drills or promotional activities send out gifts, everyone will be more enthusiastic about participating."

A significant proportion of residents lack awareness of the need to participate in emergency preparation activities and are unwilling to actively cooperate with public health emergency

plan drills, which inevitably affects the community's proficiency and effectiveness in implementing plans in the emergency response. Only 35.9% of community residents believed they had basic emergency knowledge and skills.

> Ms. S2, a community resident, said, "Without COVID-19, I didn't even know we had a public health emergency plan. When it comes to emergency response capabilities, all I know is that I need to run to the open field when an earthquake happens. I don't know what emergency response knowledge and capabilities related to public health emergency plans include."

Community residents are the target group of public health emergency plans. Their lack of awareness of the need to participate in the emergency response and emergency management capacity limits the implementation of the plan. The emergency plan implementation group either cannot rely on the cooperation of target group members or its work is obstructed by them in the emergency response. This dramatically weakens the effectiveness of the public health emergency plan.

3.4. Restrictions of the policy environment on the implementation of emergency plans

Seven questionnaire items focused on the "policy environment" (Table 5).

73.4% of community emergency workers felt that community leaders tended to direct on the spot rather than follow emergency plans.

In the words of L4, a community leader:

> 'Emergency plans are developed in response to inspections by superiors. I believe that I am successful as long as I deal with the emergency effectively, and there is no need to follow the emergency plan."

TABLE 4 Questionnaire responses to items about the "target group."

Item N	Features of community residents addressed by an item	Yes N (%)	No N (%)
Item22	Willingness to cooperate with community emergency management	472 (31.8)	1,013 (68.2)
Item23	Participated in community emergency plans drills	748 (50.4)	737 (49.6)
Item24	Willingness to actively participate in community emergency plans drills	440 (29.6)	1,045 (70.4)
Item25	Participated in the development of community emergency plans	272 (18.3)	1,213 (81.7)
Item27	Basic emergency knowledge and skills	533 (35.9)	952 (64.1)
Item28	Stocked up on basic emergency equipment or supplies at home	382 (25.7)	1,103 (74.3)

TABLE 5 Questionnaire responses to items about the "policy environment."

Item N	Features of the policy environment addressed by an item	Yes N (%)	No N (%)
Item29	Political environment conducive to emergency planning	793 (53.4)	692 (46.6)
Item30	Community leaders place more emphasis on quantifiably assessable work	867 (58.4)	618 (41.6)
Item31	Community emergency management is adequately funded	499 (33.6)	986 (66.4)
Item32	The community is well stocked with emergency equipment and supplies	324 (21.8)	1,161 (78.2)
Item33	Adequate funding is available for emergency plans exercises and publicity	561 (37.8)	924 (62.2)
Item34	Participation in the development, implementation and rehearsal of community emergency plans is not necessary	931 (62.7)	554 (37.3)
Item35	Waiting passively for government assistance in emergencies	508 (34.2)	977 (65.8)

Regardless of whether or not the leader's knowledge, skills and proximity to the scene makes the emergency response successful, a public health emergency plan is infinitely weakened and rendered ineffective if leaders perceive its use as optional or, worse, unnecessary. This dismissive attitude was not confined to leaders. 62.7% of respondents believed that participation in developing, implementing, and rehearsing public health emergency plans was unnecessary. The sampled community residents believed that emergency management was the government's responsibility and that they did not need to be involved. In emergency response, they were more inclined to wait for rescue from the government rather than actively cooperate with the emergency response procedures. Such a social culture is, undoubtedly, a serious hindrance to the implementation of public health emergency response plans.

In terms of community emergency management resources, only 21.8% of the community emergency workers believed their communities had essential emergency equipment and reserves. 37.8% of respondents perceived the funds for emergency planning exercises and publicity as adequate. Chinese communities do not have an independent financial support system, and the funds mainly come from higher-level allocations and social donations. The lack of funds makes it difficult for communities to build disaster prevention facilities and stockpile emergency supplies.

4. Discussion

4.1. Ritualization of public health emergency plans

Our findings suggest that four main families of factors contributed to the ritualization of public health emergency plans.

Firstly, the public health emergency plan lacks pertinence, operability and articulation, which makes it unfeasible and difficult to implement. China's public health emergency plans are established forcibly based on administrative orders, and the process of plan formulation is exceptionally efficient (9). This hyper-efficiency, however, means that many of the millions of public health emergency plans are formulated quickly to cope with an inspection by a superior. These plans copy content from higher levels or other areas at the same level and tend to become the same at higher and lower levels, with no adaptation to local realities. As a result, the emergency response procedures in these plans are lacking in operability and articulation.

Second, unprofessionalism and contempt of the implementing groups leads to the abandonment or selective implementation of public health emergency plans. According to China's administrative structure, there are few civil servants at the community level dedicated to emergency management

(10). Increasing the number of staff is one solution to ensure that emergency management work is undertaken by dedicated personnel. However, with more than 628,000 communities in China, every additional administrative position in a community means an enormous burden on the state. As a result, some local civil servants who do not have the knowledge and capability for emergency response are required to carry out emergency management work. In addition, in China's performance appraisal system, it is clear that community leaders place greater emphasis on quantifiable work (11). Emergency response is difficult to quantify in daily work. As a result, leaders rarely give much attention to the development, exercise, and implementation of public health emergency response plans.

Thirdly, the target group's lack of awareness of the need to participate in the emergency response and emergency response capacity increases the difficulty of implementing public health emergency plans. Activities such as emergency plan drills and self-rescue knowledge popularization need to occupy residents' non-working days. The improvement of risk prevention awareness and ability brought by these activities to residents is intangible; it cannot be quantified and cannot show immediate benefits (12). Community residents need greater awareness and motivation to participate in community emergency response activities. Indeed, some community residents do not have the knowledge and skills to participate in emergency response, even if they are willing to do so. China's previous civic education has focused more on ideological content, such as political participation, and less on emergency response skills (13). This education pattern has resulted in a lack of emergency response knowledge and skills among the general public.

Finally, the policy environment limits the implementation of public health emergency plans. Chinese community is a society of acquaintances with relatively frequent interactions and rich sharing norms, among which the most important is "Li." According to Fei's definition, "Li is a socially accepted and appropriate code of conduct." The so-called "Li" is "the obedience to traditional rules (14)." "Li" requires that the logic of action in dealing with affairs be carried out following the traditional established path. As an informal rule in Chinese society, "Li" obviously conflicts with the formal system. For policy executors, the implicit pursuit of the "rule of man", which had been applied and refined in Chinese feudal society for thousands of years, makes them naturally reject implementing the established action plan. For the public, they are naturally dependent on "centralization" and tend to wait for the government to make decisions on all public matters. This has led to a tendency for emergency managers to take command on the spot during emergencies and for community residents to refrain from actively cooperating in the implementation of public health emergency plans.

4.2. Comparison with existing literature

This study validates some of the findings of previous studies of public health emergency plans, while also offering a more multidimensional analytical perspective. We found that the lack of feasibility was a key barrier to the effective implementation of public health emergency plans. Li proposed that China's public health emergency plan system needs to be improved and dynamically revised to connect public health emergency plans and departmental emergency plans at all levels (15). Wei et al. found that China's public health emergency plans for libraries need to be improved in relevance and operability (16). In the aftermath of SARS, Tam et al. described the success of the Canadian Pandemic Influenza Program (CPIP), which illustrated the importance of including specific, feasible, and professional emergency response procedures in emergency response plans (17). The findings of these studies are consistent with those of our study.

We found that the ineffective implementation by emergency management agencies drove the degradation of public health emergency response plans toward ritualization. Han and Zhou, in an analysis of China's public health emergency management system, found that a lack of interdepartmental collaboration combined with staff without professional competence limited the functioning of the public health system (18). Lin and Jiang, who analyzed China's public health emergency system from the perspective of safety redundancy, found that China's "pyramidal" section structure leads to poor information transfer and less efficient decision-making in emergency response (19). Changyun and Huichen provided a comprehensive review of China's emergency management capabilities during the COVID-19 pandemic and suggested that emergency management awareness and capabilities should be enhanced among local leaders (20). In contrast, this study found that the inattention of community leaders hindered the implementation of public health emergency plans. This lack of attention by community leaders stems from the political environment in China and is influenced by the cultural environment.

Several scholars have already demonstrated the importance of individuals' emergency response capabilities for emergency response. In a study of 1,252 rural residents of Jiangsu province, Zhang found that people's lack of self-rescue knowledge affects the efficiency of emergency response, and that mobilization by the Chinese government is more likely to increase the emergency response capacity of the population than advocacy by social organizations (21). Yang and Wang proposed to improve the emergency response capacity of the public by strengthening publicity and education, enhancing drills and training, and establishing cooperation mechanisms, thereby enhancing the effectiveness of the government's emergency response (22). The present study offered further insights into how target group factors and socio-cultural factors interact and impact on the implementation of public health emergency plans.

The impact of the policy environment on policy implementation has been extensively explored in classic public policy studies. However, China has a feudal history of several thousand years and a GDP growth rate of about 10% in recent decades.[7] Its long-standing feudal culture and rapidly growing social wealth have created a unique political, economic, and cultural environment. This study provides a more comprehensive analysis of the environmental factors that have a subtle impact on the implementation of public health emergency plans than other studies. In addition, this study illustrates the influence of "Li" in Chinese society and culture. "Li" is well-suited to explain the counter-normative behavior of implementing and target groups.

4.3. Implications for policy, practice, and research

The ritualization issues highlighted in the COVID-19 outbreak reveal the concerning status of public health emergency response plans. China's executive order-driven emergency response planning system is gradually deviating from its original design at the community level. The COVID-19 pandemic has been ongoing for about three years, and China's public health system is gradually recovering from the severe shock it received in the early stages of the pandemic. Then, with each wave of COVID-19, the Chinese public health system was hit once again by the failure of public health emergency plans to function. This reduced the effectiveness of the government's response to COVID-19 and severely impacted the performance of the essential public health functions of the Chinese health system. As the Chinese government announces the continuation of its "dynamic zero" policy, the public health system will be under tremendous pressure for some time. Therefore, the Chinese government should work to address the "ritualization" of public health emergency plans to accelerate the recovery of the public health system and to better respond to COVID-19.

First, Chinese laws and regulations lack legal provisions directly related to emergency plans, resulting in emergency plans not having general legally binding power in public health emergencies (23). The Chinese government should strengthen the legal support for emergency plans and attach importance to the status and role of public health emergency plans. Particular policies should be formulated to regulate the process and content of the plan development to increase the operability of the plan (24). Keeping public health emergency plans feasible will increase the government's emergency response capacity and help the public health system recover from the impact of COVID-19.

Second, in practice, governments at all levels should incorporate the training, rehearsal, maintenance, and updating of public health emergency plans into the assessment of community emergency managers and establish relevant rewards and penalties, and systems to improve the motivation of community emergency managers for emergency management (25). In daily life, particularly during early stages of health systems and socioeconomic recovery, when the memory of a public health emergency is still alive and potentially traumatic, local communities should vigorously carry out various forms of emergency publicity and popularization activities to attract community residents to participate in developing and rehearsing emergency plans. The improvement of emergency managers' and community residents' emergency response capabilities not only helps implement public health emergency plans but is also an essential support for the recovery and optimization of the public health system.

Finally, existing studies tend to focus on a single factor that affects the implementation of public health emergency plans, ignoring the interaction between multiple factors. The analytical framework constructed in this study includes internal and external factors, allowing researchers to analyze the implementation of public health emergency plans more comprehensively and providing a reference for researchers to analyze similar issues. In particular, the concepts of "ritualization" and "Li" adopted in this study provide explanatory pathways for the various non-institutionalized behaviors and the persistent problems of local governance that arise in the context of formalized systems.

4.4. Study strengths and limitations

This study has three main advantages in comparison to previous research. First, it adopts the concept of "ritualization" to vividly describe the state of public health emergency plans that have only a virtual symbolic meaning and do not have a policy practice function. Second, it constructed an analytical framework based on the Smith Policy-Implementation-Processing pattern, offering a more multidimensional and integrated perspective than those used by previous research. Both internal and external factors were analyzed to explain comprehensively how public health emergency plans shift toward "ritualization." Third, the study had a large sample size (1,485 survey respondents) and adopted a multi-method approach.

While we followed principles of random selection of respondents, the final sample had rather uneven proportions of men and women (64.85% and 35.15%, respectively). There appear to have been unaccounted for factors which influenced our selection of respondents during the research process. In addition, the research sites selected for this study were all urban communities due to the practicalities of access. With over 500 million people living in rural areas in China, there are significant differences between urban and rural communities. Future research needs to compare urban and rural

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communities in terms of patterns of ritualization of public health emergency plans.

5. Conclusions

This study constructed an analytical framework based on the Smith Policy-Implementation-Processing pattern and collected data from 1,485 residents in 13 prefectural-level cities in Jiangsu Province, China. The results indicated that the infeasibility of the plans, ineffective implementation by emergency management agencies, the obstructive behaviors of community residents, and the lack of an appropriate policy environment all contributed to the "ritualization" of public health emergency plans. Public health emergency plans play an important role in emergency response and in accelerating the recovery of public health systems. If public health emergency plans are far more locally adapted, feasible, and less "decorative," members of the public, who are still experiencing the impacts of the COVID-19 pandemic, will be more likely to trust they can return to their normal rhythms of life while staying healthy. They can also have greater confidence that the lessons of the past have been incorporated into plans for the future and that future public health emergencies will not destroy lives, livelihoods and wellbeing at the scale at which COVID-19 did.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The study was approved by the Ethics Committee of the School of Public Policy and Management of the China University of Mining and Technology (approved 6-2021). This study does not involve human or animal experiments.

Author contributions

RZ: conceptualization and methodology. RZ, CW, CL, and YX: investigation. RZ and YX: formal analysis. RZ, CW, and CL: writing—original draft. RZ and CW: writing—review and

editing. All authors have read and agreed to the published version of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1047142/full#supplementary-material

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The provision and utilization of essential health services in Afghanistan during COVID-19 pandemic

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Introduction: The COVID-19 pandemic has disrupted provision of essential health services and overwhelmed even robust health systems worldwide. The Afghanistan health system has suffered both from the pandemic, as well as from political upheaval and regime change.

Methods: We evaluated essential service delivery using data collected from a cross-sectional survey of health care facilities in Afghanistan based on administration of a World Health Organization standardized assessment of frontline service readiness. A multi-stage sampling scheme was used to identify a representative sample of 92 health facilities (68 clinics and 24 hospitals) providing essential health services in five provinces. Facility managers were asked to report on changes in health service delivery in late 2021 and early 2022 (corresponding to the end of a significant national COVID-19 surge in infections) compared to the same period one year earlier.

Results: Among health facilities evaluated; 29 were in urban and 63 were in rural settings. Most facilities reported an increase in the provision of outpatient care particularly in maternal and child health services as well as for tuberculosis, chronic respiratory diseases, mental health, and substance abuse; the number of in-patients also increased. In contrast, provision of services for malaria, neglected tropical diseases, and community outreach programs decreased. Nearly all facilities used strategies to maintain services, including targeting high-risk patients, promoting self-care, and redirecting patients to alternative health care sites. Nearly three fourth (70.6%) of facilities provided no training about COVID-19 to staff; only 65.2% referred COVID-19 patients to designated hospitals and 44.6% had safe transportation for these patients.

Discussion: Increased demand for services during this period was likely due to a backlog in need generated during the preceding COVID-19 surge and the political changes happened a few months earlier to this survey. Facilities used various methods to maintain services, although the decrease in provision of community outreach was concerning. Facilities appeared to be able to maintain essential health services, despite an increase in demand. However, awareness and training of COVID-19 protocols and appropriate and safe referrals need to be improved. In general, these series of surveys are informative

and helpful to identify any changes in provision of essential health services and can facilitate recovery of health systems during and after pandemics.

Introduction

The global spread of SARS-CoV-2 infections (COVID-19) was declared a public health emergency by the World Health Organization (WHO) in early 2020 (1). As of November 2022, more than 632 million infections and 6.6 million deaths have been reported globally (2), an underestimate of the true burden of disease due to limited access to testing and surveillance in many countries. The pandemic has challenged public health systems worldwide, revealing that even seemingly robust health systems can be rapidly overwhelmed and compromised (3–6). Health seeking behavior for routine care also declined during the COVID-19 pandemic (7–10). In the US, for example, the combination of increased workload and reduced number of health workers due to infection, fears about exposure, and burn-out, led to a severe strain on the capacity to maintain essential services (11). Mortality related to disruption in essential health service delivery during an epidemic can exceed the number of deaths directly attributed to the disease itself (12, 13). Although the impact of the COVID-19 pandemic has been well-characterized in the US and Europe, less is known about what occurred in Lower Income Countries (LICs), particularly in areas that also experienced political upheaval, such as Afghanistan.

The first case of COVID-19 in Afghanistan was identified in February 2020 in Herat Province, in the west of the country. By November 2022, more than 200,000 confirmed infections and nearly 8,000 deaths had been reported (14). Nearly half of all cases were detected in the five most populous provinces (Kabul, Herat, Kandahar, Balkh, and Nangarhar) (Figure 1). Afghanistan has experienced five surges of COVID-19 since early 2020 (Figure 2). At the start of pandemic, the Afghanistan Ministry of Public Health (MoPH) designated specific hospitals, at least one in each of the 34 provinces, to take care of COVID-19 patients, leaving other health facilities to continue to provide routine and essential care. People with clinical or laboratory-confirmed infection were to be referred to the COVID-19 hospitals. The National Disease Surveillance and Response (NDSR) report shows that there is an increase in trend of Pneumonia and Measles incidence percentage over the past 3 years in Afghanistan (15).

Policy decisions to mitigate health system bottlenecks during any pandemic, including COVID-19, should be informed by

accurate and real-time data collected through ongoing tracking and monitoring of health services. To obtain a rapid snapshot of changes and challenges in service delivery and utilization, the WHO designed national "pulse surveys" that could be implemented to help evaluate the continuity of essential health services and identify critical bottlenecks during the pandemic (16). Several of these surveys were implemented in Afghanistan, the results of which suggested that 65% of essential health services in early 2020, and 10% of these services in early 2021, had been disrupted (17). The periods during which the surveys were administered, coincided with the first three waves of COVID-19 in the country.

The pulse surveys were designed to be administered to key informants or senior program managers, often at the national level, with responses based on their own assessments; therefore, the surveys did not obtain information from individual health facilities themselves and data were subjective. Therefore, the WHO developed a suite of frontline service readiness surveys in 2021 to measure the extent to which facilities provided essential health services and COVID-19 case management during the pandemic; a component of the surveys also assessed community needs (18). These WHO surveys were implemented in 18 countries in sub-Saharan and north Africa, eastern Europe, and Latin America at various times during 2021–2022 (19–37). In this current paper, we present the results of the first round of this frontline service readiness survey administered in Afghanistan to a representative sample of non-COVID designated health facilities from five provinces. The timing of the survey corresponded to the end of third wave of COVID-19 in the country.

Materials and methods

Summary

We present the results of a survey administered to health facility mangers of 92 health facilities to evaluate self-reported changes in health services following the third COVID-19 surge in Afghanistan. This survey was developed by the WHO (18) and modified for local use. We used a multi-stage sampling scheme to identify a representative sample of health facilities, both hospitals and clinics in five provinces, not including facilities that were specifically designated to provide COVID-19
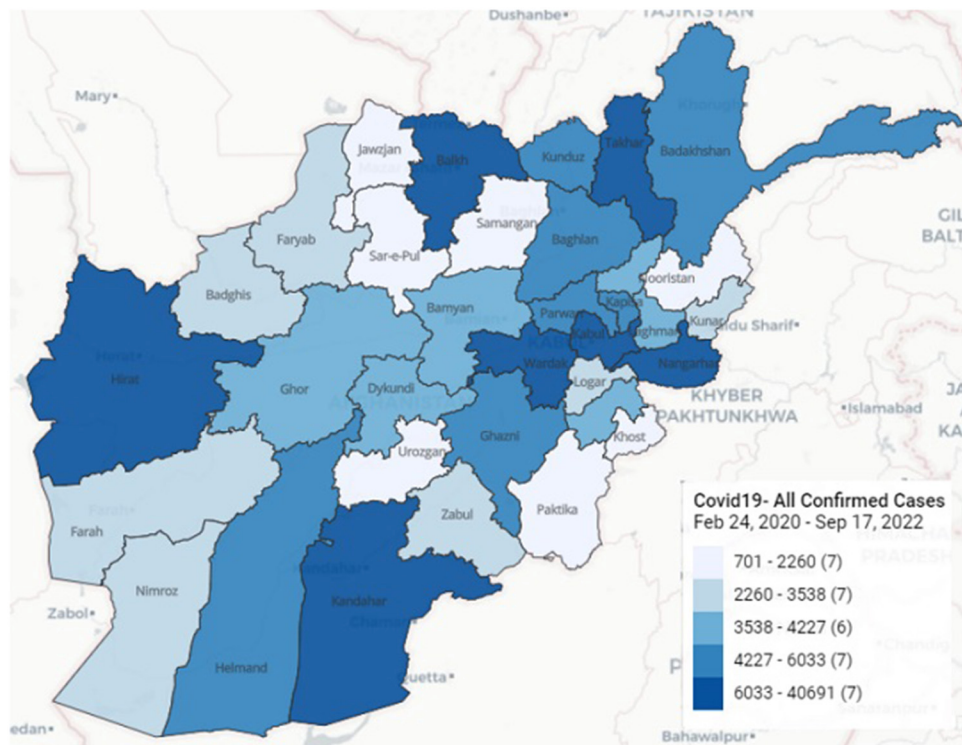
FIGURE 1
Geographical distribution of COVID-19 confirmed cases in Afghanistan (24 Feb 2020-17 Sep 2022) (48).
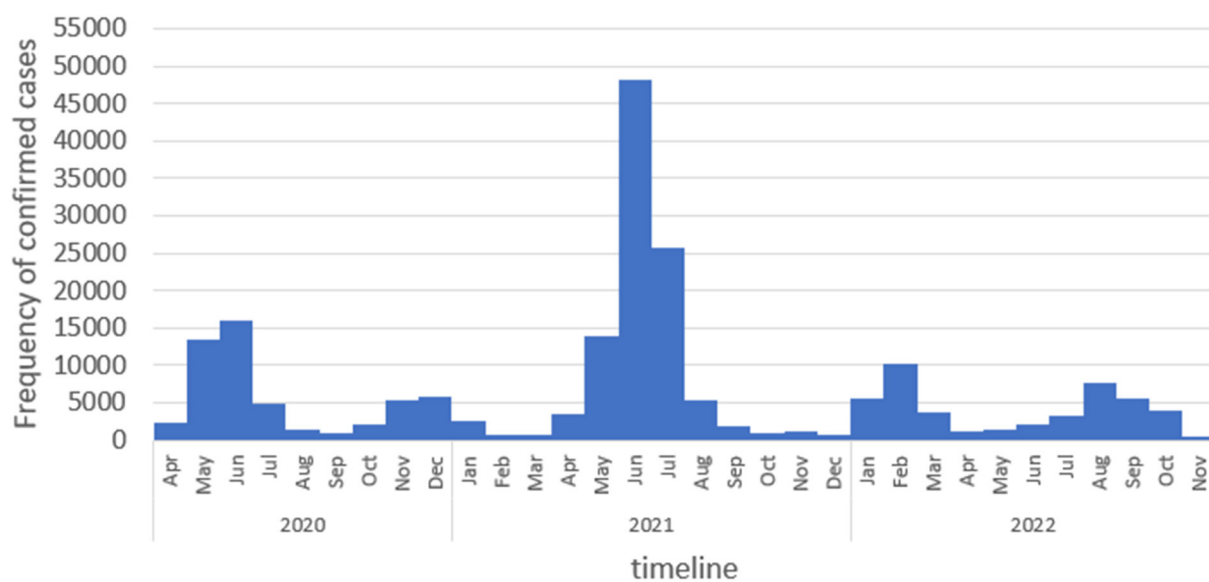
FIGURE 2
Frequency distribution of COVID-19 positive cases in Afghanistan. April 2020 to Nov 2022. Source: DHIS2, Afghanistan Ministry of Public Health.

care. Data collection was conducted in February 2022; facility managers were asked to report on changes in health service delivery from November 2021 through January 2022 compared to the same 3 months a year earlier.

Study population and sampling

We selected five of the seven regions in Afghanistan; within each of the five regions, we selected the most populous province. In 2019, 15.5% of the total country population was estimated to reside in these five provinces (38), which include 81 districts. We randomly selected 20 districts, in which 222 health facilities and 29 non-COVID hospitals were operating. We randomly selected 63 primary healthcare facilities and included all 29 non-COVID designated hospitals in the sample. Some clinics managers (*N* = 17) were not available for the interview, and were replaced by identifying another randomly selected site. All managers of selected hospitals were available.

Measurements

The standardized WHO questionnaire "Continuity of Essential Health Services: Facility Assessment Tool" (39) was used for this study. The questionnaire was content validated by the WHO country office and the Afghanistan MoPH. The survey was piloted among five managers of health facilities not included in the sampling frame and questions were adapted to the Afghan context prior to administration. The questionnaire was administered to facility managers by trained staff of the Afghanistan National Public Health Institute (ANPHI), by phone from 8 to 20 February 2022. Responses were entered electronically using the offline LimeSurvey application (40) and uploaded to a secure database. The questionnaire included 169 questions and took ∼80 min to complete. In this paper, we only report on a subset of the data collected, and do not include information collected from community leaders using a different component of the parent survey.

We evaluated whether the health care facility was managed by the government or by a non-public/non-governmental local organization (NGO), was situated in an urban or rural area, whether it provided only out-patient services or included in-patient care, the number of in-patient beds, and the number of health care and non-health care staff. Questions were asked about the following in the previous 3 months: the number of staff who became infected with SARS-CoV-2; whether new staff numbers or re-allocation of staff were required to accommodate patient load; and whether training about COVID-19 was provided. These trainings include infection prevention and control (IPC), proper use of personal protective equipment (PPE), triage protocols for COVID-19 case management, management of emergency conditions, and provision of remote health care.

Questions were asked about changes in last 3 months in service delivery and utilization of different types of outpatient services, emergency unit visits for non-COVID-19 related issues, provision of outreach services, and inpatient admissions. The survey also asked about changes made to control the spread of COVID-19, to maintain the essential service delivery and whether facilities could refer infected patients to COVID-19 designated treatment centers.

Statistical analyses

Data were entered into excel, cleaned, and then exported into and analyzed using Stata version 17. We calculated the frequency distribution of characteristics of facilities, and responses to other questions, stratified by urban and rural facility.

Ethical considerations

The study protocol was reviewed and approved by the ANPHI of the MoPH institutional review board (IRB Code No: A.0122.0389). Verbal informed consent was obtained from each facility representative who was interviewed.

Results

Of the 92 health facilities evaluated, 29 were in urban and 63 were in rural settings; 77.2% of them were managed by local NGOs (Table 1). The median (IQR) number of beds in facilities (*N* = 51) was 10 (6–49) in rural facilities and 40 (8–222) in urban facilities. More than half of all staff (64.7%) were clinical. Staffing of urban facilities (median 212.4 staff/facility) was much higher than for rural facilities (17.1 staff /facility). Overall, 70.6% of facilities received no COVID-19 related training in the past 3 months; 34.5% of urban compared to 7.9% of rural facilities received training in all five topics. Approximately a tenth of all staff (12.0%) were diagnosed with COVID-19 in past 3 months; 29.3% of facilities had to increase or re-direct staffing to accommodate changes in the volume of patients.

Eighty-eight health facilities reported providing outpatient services, of which 88.6% reported an increase in provision of outpatient services during Nov 2021-Jan 2022 (Table 2). Most reported increased delivery of family planning (73.0%), antenatal (79.0%), postnatal care (75.0%) and pediatric care (79.3%), and immunization (68.7%). For infectious and non-communicable diseases, facilities reported the highest increase in service delivery and utilization for tuberculosis (64.3%), chronic respiratory diseases (76.5%), mental health and substance abuse (69.3%). Only a small proportion of facilities reported a decrease in services, mostly for malaria (25.9%), neglected tropical diseases (24.6%), and intimate partner and sexual violence (30.7%). Among the 78 facilities that reported an increase in outpatient services, the main reason provided was addressing backlog from disruptions of services prior to the past 3 months (Data not shown). Among the eight facilities (9%) that reported a decrease in provision of outpatient care,

TABLE 1 Characteristics of health care facilities and changes during November 2021-January 2022, Afghanistan (N = 92).

Characteristic	All (N = 92)		Urban (N = 29)		Rural (N = 63)	
	N	(%)	N	(%)	N	(%)
Management						
Government	21	22.8	12	41.4	9	14.3
NGO	71	77.2	17	58.6	54	85.7
Service provided						
Only outpatient	40	44.0	4	13.8	36	58.0
Outpatient and inpatient	51	56.0	25	86.2	26	42.0
Inpatient beds/facility, median (IQR) (N = 51)[a]	10	(10–49)	40	(8–222)	10	(6–20)
Number of staff	N = 7,240		N = 6,161		N = 1,079	
Clinical	4,687	64.7	3,936	63.8	751	69.6
Non- clinical	2,553	35.3	2,225	36.2	328	30.4
Average number of staff / facilities	78.6		212.4		17.1	
COVID-19-related training topics provided, last 3 months[b]						
5 topics	15	16.3	10	34.5	5	7.9
3–4 topics	3	3.3	1	3.4	2	3.2
1–2 topics	9	9.8	5	17.2	4	6.3
No training	65	70.6	13	44.8	52	82.5
Referral of COVID-19 patients						
Aware of COVID-19-specific hospitals	60	65.2	23	79.3	37	58.7
Safe transportation for referral	41	44.6	21	72.4	20	31.7
Impact of COVID-19 on staff, last 3 months						
Staff diagnosed with COVID-19	868/7,240	12.0	800/6,161	13.0	97/1,079	9.0
Facilities requiring increased or change in staffing to accommodate patient volume or patient type related to COVID-19[c]	27	29.3	10	34.5	17	27.0

[a] 51 facilities had inpatient beds (excluding those used for delivery).

[b] Topics included: infection control, use of PPE, triage of COVID-19 patients, management of emergency conditions, remote health care.

[c] Changes related to patient/volume type because of COVID-19, including reassignment, increasing hours or overtime, new staff recruitment, use of volunteers, switch to different facility, layoff or unpaid leave.

the main reason for the change was disruption in ability to provide services including limited availability of medicines or consumables and limited availability of medical staff (data not shown).

We asked the health facilities' managers about the changes in visits from emergency unit for non-COVID-19 related issues. Overall, 47.3% of health facilities reported increase in service delivery and utilization. 55.3% reported an increase in emergency surgery, including emergency Cesarean-section (C-section), followed by a rise in urgent blood transfusion services (43.7%). However, 48.1% facilities reported a decrease in delivery and utilization of services for injuries (Table 2).

Almost one-third (32.5%) of the 55 health facilities providing community outreach, reported a decline in provision of outreach services including immunization (34.0%), malaria prevention campaigns (38.2%), neglected tropical diseases (32.6%), and community based mobile clinics (33.3%). Half of health facilities reported no changes in provision of malaria prevention campaigns, but 47.1% of health facilities reported on a rise in provision of home visits (Table 2).

Among the 51 health facilities that provided in-patient care, 68% reported in an increase in the number of admissions in the previous 3 months, compared to the same 3 months the previous year (Table 2).

TABLE 2 Number of facilities with self-reported changes in service delivery and utilization, November 2021-Janurary 2022, compared to a year previously, Afghanistan.

| Type of service | Change in service delivery | | | | | |
| | Increased | | Decreased | | No change | |
	N	%	N	%	N	%
Outpatient						
Any (N = 88)[a]	78	88.6	8	9.0	2	2.3
Non-specific symptoms[b] (N = 89)	77	86.5	5	5.6	7	7.8
Family planning/ante and prenatal care, pediatrics, immunization						
Family planning, contraception (N = 89)	65	73.0	10	11.2	14	15.7
Antenatal care (N = 89)	71	79.8	4	4.5	14	15.7
Postnatal care (N = 88)	66	75.0	6	6.8	16	18.2
Immunization (N = 83)	57	68.7	10	12.0	16	19.3
Pediatrics (N = 87)	69	79.3	5	5.7	13	15.0
Infectious disease						
HIV (N = 59)	21	35.6	8	13.6	30	50.8
Tuberculosis (N = 70)	45	64.3	10	14.3	15	21.4
Malaria (N = 81)	23	28.4	21	25.9	37	45.7
Neglected tropical diseases (N = 73)	27	37.0	18	24.6	28	38.4
Sexually transmitted infections (N = 73)	21	28.8	9	12.3	43	58.9
Non-communicable disease						
Chronic cardiovascular disease (N = 62)	25	40.3	9	14.5	28	45.2
Chronic respiratory disease (N = 81)	62	76.5	5	6.2	14	17.3
Diabetes (N = 64)	24	37.5	7	11.0	33	51.6
Cancer (N = 35)	11	31.4	4	11.4	20	57.1
Mental health, substance abuse (N = 75)	52	69.3	10	13.3	13	17.3
Intimate partner or sexual violence (N = 65)	18	27.7	20	30.7	27	41.5
Physical rehabilitation (N = 68)	24	35.3	15	22.0	29	42.6
Emergency unit visits						
Any (N = 55)	26	47.3	14	25.4	15	27.3
Injuries (N = 54)	17	31.5	26	48.1	11	20.4
Emergency surgery, including C- section (N = 38)	21	55.3	9	23.7	8	21.0
Non-communicable diseases[c] (N = 49)	15	30.6	13	26.5	21	42.9
Blood transfusion (N = 48)	21	43.7	3	6.3	24	50.0
Outreach services						
Immunization (N = 53)	25	47.1	18	34.0	10	18.9
Malaria prevention (N = 34)	4	11.8	13	38.2	17	50.0
Neglected tropical diseases[d] (N = 43)	15	34.9	14	32.6	14	32.5
Community-based mobile clinics (N = 33)	10	30.0	11	33.3	12	36.4
Home visits (N = 41)	18	43.9	10	24.4	13	31.7
Inpatient admissions (N = 50)	34	68.0	7	14.0	9	18.0

[a]The number in parentheses refers to the number of facilities that provided specific services.
[b]Fever, pain, fatigue, and cough, not ascribed to another cause.
[c]Myocardial infarction, arrhythmia, stroke, diabetic ketoacidosis, asthma, chronic obstructive pulmonary disease, and cancer.
[d]Includes mass drug administration.

We also asked the health facility managers about changes in service provision to control the SARS-CoV-2 transmission and strategies used to maintain the provision of essential health services in the period of study (Table 3); 33.0% reduced the scope of specific services and 28.2% reduced number of patients that could be seen. Most health facilities tried to maintain health service delivery using strategies like targeting high-risk patients (95.5%), promoting self-care (93.5%), redirecting patients to alternative healthcare facilities (87.0%), providing all care in a single visit for multiple morbidities (78.8%), and using home-based care (68.5%). The application of these strategies by health facilities was similar in urban and rural areas. Only 65.2% of health facilities reported that there was a referral system for COVID-19 patients, however, 44.6% of these facilities only had access to safe and isolated transportation to transfer the patient's following referral.

Discussion

In this cross-sectional study of a representative sample of hospitals and clinics from five provinces in Afghanistan, a large proportion of health care sites reported changes in the volume of patients and essential health service delivery over three-months in late 2021 and early 2022, corresponding with the tail-end of the last COVID-19 surge in 2021. Most facilities reported an increase in the provision of outpatient services, particularly in maternal and child health including immunization, family planning, and emergency C-sections. The main reason reported for increased demand was a backlog in request for services. During high levels of community transmission of SARS-CoV-2 immediately prior to the period surveyed, women may have refrained from seeking health care to reduce their exposure to infection. Because we do not have comparison data during the surge or at other time points, we can only rely on responses to the few questions that asked about overall causes of change in demand. Nevertheless, the increase in need for maternal and child health care may indicate a greater toll of the pandemic on delayed access to care among women and children, who are particularly vulnerable.

A time series analysis in 18 low- and middle-income countries including Afghanistan from 2018 to 2021 estimated an average 13.1% decline in outpatient volume and average decline of up to 5% in utilization of maternal and child services (41). These declines were associated with an estimated 3.6 and 1.5% increase in child and maternal mortality, respectively. Because Afghanistan does not have a death registry and data on mortality were further jeopardized by political chaos after the takeover by the Taliban, we do not know whether any of the service delivery changes identified here were associated with increased mortality.

More than half of facilities also reported increase in utilization and delivery of care and treatment of tuberculosis, chronic respiratory diseases, mental health, and substance abuse,

and about half reported an increase in emergency department visits. These changes may also have been as a result of previous delays in health seeking. In contrast, almost two-thirds of facilities reported either a decrease or no change in demand for treatment of injuries, which may be due to less political violence during this period.

In our study, nearly half of health facilities reported increasing reliance on home-based care, which can reduce exposure to COVID-19 and be helpful when transportation is restricted. Other countries have also taken a similar approach to reducing transmission by providing non-facility-based care (42–45). The decline in community outreach services including malaria prevention campaigns, neglected tropical diseases, and mobile clinics may have been another method of reducing transmission of SARS-CoV-2. Alternatively, the demand for treatment of malaria and neglected tropical diseases may have decreased due to lower incidence of these infections during cold weather months.

Facilities reported making other changes to service delivery: about one-third reduced the volume of patients and/or changed the type of services that they provided; a much smaller number either closed or discontinued some services. The reasons for these changes cannot be inferred from the questionnaire itself, however. The relatively small proportion who made these changes may have been because of a decline in reported SARS-CoV-2 infections during the months to which the survey referred; alternatively, facilities may not have wanted to make changes despite COVID-19 risk, in order to maintain services. Nearly all facilities used at least some strategies to maintain services, including targeting high-risk patients, promoting self-care, and redirecting patients to alternative healthcare facilities.

Despite the availability of COVID-19 specific hospitals in each province, not all facilities referred patients with clinical or laboratory-confirmed infection. It is not clear whether this is because they were unaware of the availability of designated care facilities or did not refer them for other reasons. Less than half of the facilities reported having safe transportation for COVID-19 patients, and most of these were located in urban settings.

Only one-fourth of facilities provided comprehensive training about COVID-19. With the onset of a pandemic and within a short timeframe, healthcare facilities must ensure that personnel are correctly trained and capable of implementing infection control procedures. In a study of 22 African countries, 42,058 frontline healthcare workers were trained during the first wave of COVID-19 pandemic. The evaluation documented significant short-term improvement but indicated that sustained changes required ongoing supportive supervision and monitoring (46). The results of our survey indicate that training around COVID-19 prevention needs to be improved.

The cause of the changes that we found in service delivery could be due to the pandemic but could also be a result of political upheaval after the collapse of the government in August

TABLE 3 Facilities that modified service delivery during the months November 2021-January 2022, Afghanistan (N = 92).

Service delivery modification		All (N = 92)		Urban (N = 29)		Rural (N = 63)	
		N	(%)	N	(%)	N	(%)
Strategies to control of COVID-19 spread	Closed	4	4.3	3	10.3	1	1.6
	Change in service hours	17	18.5	6	20.7	11	17.4
	Reduced scope of specific services	30	33.0	7	24.1	23	37.1
	Reduced number of patients seen	26	28.2	6	20.7	20	31.7
	Suspended provision of specific services	9	9.8	2	6.9	7	11.1
Strategies to maintain essential health service delivery	Redirected patients	80	87.0	24	82.7	56	88.9
	Targeted high-risk patients	86	95.5	28	100.0	58	93.5
	Provided single visit for multiple morbidities	72	78.8	22	75.8	50	79.2
	Promoted self-care	86	93.5	26	89.6	60	93.5
	Used home-based care	63	68.5	18	62.0	45	71.4
	Used tele-medicine	45	48.9	13	44.8	32	50.8
	Used tele-prescription	29	32.2	11	37.9	18	29.5

2021. Most international donors froze their financial support and may have been the reason for the closure of some of the facilities surveyed. Widespread vulnerability due to high levels of poverty, food insecurity, limited access to safe drinking water and sanitation, as well as natural disasters including earthquakes and droughts have all impacted the wellbeing of the population, coupled with nearly 40 years of chronic conflict (47).

Our study had several additional limitations. First, changes in service delivery were by self-report of managers and were not based on collection or review of actual facility - level data. Therefore, respondents may not have been able to recount what happened during the previous 3 months of the survey compared to the same months last year. Availability of facility-level data would have been limited in any case, due to the general lack of electronic health records. Second, many questions in the survey were non-specific, and did not assess whether changes were directly due to a backlog of need due to COVID-19, to the political situation, to reduce exposure of health care staff and the community to SARS-CoV-2, or were due to other reasons. Importantly, we cannot tell from the survey whether the changes in services did not ensure adequate delivery of care. Including a limited number of more open-ended questions or following up with focus group discussions to obtain more nuanced information would be very helpful to understand the implications of the findings. Third, we only present a sub-set of data from the survey and did not include information about COVID-19 related testing or services, or

funding issues. Fourth, although we included a representative sample of government and NGO-run facilities, we did not include private sector facilities; however, public health facilities are primarily responsible for essential health care services. We propose conducting the next round of assessments in more provinces of Afghanistan including public and private health facilities.

Finally, our study focused on facilities in the five most populous provinces; these facilities receive greater support than facilities in less sparsely populated areas. Less- resourced health care sites might experience greater or different disruptions in services.

These surveys can be helpful in monitoring fluctuations in service delivery over time, and if followed up with more detailed interviews, and can assist in determining methods to ensure delivery of essential health services. The use of a standardized questionnaire delivered in multiple settings would ideally allow comparisons across countries and WHO regions. The use of an offline electronic data collection was also useful, particularly in a country such as Afghanistan, without access to stable or high-speed internet.

These types of assessments could be used in similar outbreaks or pandemics in future. Information can be used to update the country response plans and development of policies and planning for emergency management within wider efforts to strengthen the country's health system. We propose the following actions: identifying and mapping existing resources and weaknesses to determine priority needs; strengthening competencies of public health professional and their role in

emergency management; developing health workforce capacity to engage the local population; adapting policies and planning with monitoring and accountability; determine the needs for long-term health system strengthening to maintain essential health and social services especially for non-communicable diseases, mental health and health emergency preparedness.

Our study showed increase in demand and utilization of many essential health services during the COVID-19 pandemic. After nearly 3 years of the COVID-19 pandemic, Afghanistan should focus more on maintaining essential health service delivery especially for the dual burden of communicable and non-communicable diseases. Control and case management of COVID-19 should be integrated into primary, secondary, and tertiary levels of health system.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found in the article/supplementary material.

Author contributions

NN, DH, DA, and AI designed the study. NN lead the data collection and analysis of the data. CL, SP, and NN wrote the manuscript. All authors reviewed the manuscript and contributed to its development and approved the final version.

Conflict of interest

SP was employed by Nezarat Consulting Ltd.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Early effects of COVID-19 on maternal and child health service disruption in Mozambique

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'

Introduction: After the World Health Organization declared COVID-19 a pandemic, more than 184 million cases and 4 million deaths had been recorded worldwide by July 2021. These are likely to be underestimates and do not distinguish between direct and indirect deaths resulting from disruptions in health care services. The purpose of our research was to assess the early impact of COVID-19 in 2020 and early 2021 on maternal and child healthcare service delivery at the district level in Mozambique using routine health information system data, and estimate associated excess maternal and child deaths.

Methods: Using data from Mozambique's routine health information system (SISMA, Sistema de Informação em Saúde para Monitoria e Avaliação), we conducted a time-series analysis to assess changes in nine selected indicators representing the continuum of maternal and child health care service provision in 159 districts in Mozambique. The dataset was extracted as counts of services provided from January 2017 to March 2021. Descriptive statistics were used for district comparisons, and district-specific time-series plots were produced. We used absolute differences or ratios for comparisons between observed data and modeled predictions as a measure of the magnitude of loss in service provision. Mortality estimates were performed using the Lives Saved Tool (LiST).

Results: All maternal and child health care service indicators that we assessed demonstrated service delivery disruptions (below 10% of the expected counts), with the number of new users of family planing and malaria treatment with Coartem (number of children under five treated) experiencing the largest disruptions. Immediate losses were observed in April 2020 for all indicators, with the exception of treatment of malaria with Coartem. The number of excess deaths estimated in 2020 due to loss of health service delivery were 11,337 (12.8%) children under five, 5,705 (11.3%) neonates, and 387 (7.6%) mothers.

Conclusion: Findings from our study support existing research showing the negative impact of COVID-19 on maternal and child health services utilization in

sub-Saharan Africa. This study offers subnational and granular estimates of service loss that can be useful for health system recovery planning. To our knowledge, it is the first study on the early impacts of COVID-19 on maternal and child health care service utilization conducted in an African Portuguese-speaking country.

1. Introduction

As of July 6, 2021, 15 months after the World Health Organization (WHO) declared the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) a global pandemic, there were more than 184 million cases, resulting in 4 million deaths worldwide (1). By December 31, 2020, 3 million deaths had been recorded worldwide, corresponding to 1.2 million excess deaths in 2020. However, these are likely to be underestimates (2). Moreover, it is challenging to distinguish between direct and indirect deaths as a result of potential service disruption due to the COVID-19 pandemic. Early forecasts from May 2020 estimated a 9.8–44.7% increase in under-five child deaths and an 8.3–38.6% increase in maternal deaths per month due to service disruption of several maternal and child interventions in 118 low-income and middle-income countries (3).

Mozambique reported its first case of COVID-19 on March 22, 2020, with 80,888 cases reported resulting in 912 deaths as of July 6, 2021 (4). Two major outbreak waves were observed between March 2020 and April 2021, and a third wave occurred between June and September 2021. The third wave was dominated by the delta variant, with many reported cases and a higher fatality rate; however, by that time the country had vaccinated health care workers and had begun to vaccinate other major risk groups (e.g., older adults over 60 years) and had increased capacity for diagnosis and management of severe COVID-19 cases.

Early in the epidemic Mozambique established a scientific committee to guide and counsel the government's COVID-19 response, mounted a surveillance system for SARS-CoV-2 infection, and enacted a 6-month state of emergency beginning April 1, 2020 that included a range of measures to limit the spread of infections including (a) actions for personal protection (e.g., promotion of hand washing and enforcement of face mask wearing), (b) social measures and prohibition of public gatherings (social distancing; closing schools, churches, beaches, and gyms; reducing the number of workers; and instituting curfews), (c) travel restrictions, (d) environmental measures (e.g., disinfection of surfaces frequently touched) (5, 6). These actions—combined with a general public fear of contracting SARS-CoV-2 and

misinformation about the source and treatment of COVID-19—potentially led to lower rates of health service utilization (3, 7).

Health information systems are core components of functional health systems as they ensure the production, analysis, dissemination and use of reliable and timely information on health service utilization, health determinants and health status (8, 9). Routine health information systems (RHIS) provide regular, repeated data that is multilevel (including data from primary care facilities to differentiated care) that can be used to establish utilization patterns and to detect deviations from these patterns that can be used to describe the magnitude and duration of disruptions to health service utilization. Such assessments are essential to plan for health service recovery, including monitoring the effects of corrective interventions (9).

The purpose of our research was to assess the early impact (2020 and early 2021) of COVID-19 on utilization of maternal and child health services at the district level in Mozambique based on routine health information system data. In addition, we aimed to estimate excess maternal and child mortality due to these losses.

2. Materials and methods

2.1. Study design

Using data from the country's routine health information system (SISMA, *Sistema de Informação em Saúde para Monitoria e Avaliação*), we conducted a time-series analysis to assess changes in selected indicators of maternal and child health care service provision in all districts of Mozambique in 2020 to March 2021, before widespread detection of the delta variant.

Routine health data are collected primarily *via* paper registers at health facilities and aggregated in monthly reports at the district level. These reports are then entered into SISMA. The dataset used for our analysis was extracted as counts of services provided from January 2017 to March 2021 for each of Mozambique's 159 districts. Since October 2019, there has been military conflict affecting vast areas of Cabo Delgado Province, leading to unprecedented population loss and displacement, as well as the destruction and closure of health facilities. We therefore decided to remove data from the Cabo Delgado Province from our analysis (Box 1).

2.2. Study setting and overview of Mozambique and its health system

Mozambique is in southeastern Africa (Figure 1), with a surface area of 801,590 km^2 and 2,700 km of coastal line. It is crossed from

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BOX 1 Cabo Delgado Province under military attack (10).

Since October 2017, the northern province of Cabo Delgado has been under armed nonstate group attacks. During 2020 there was an escalation of the attacks with brutal attacks toward civilians, setting fire to homes, shops, schools, and religious and government buildings, and forcing people to flee into the bush and neighboring villages and provinces. Between April 2020 and April 2021, the number of internally displaced people (IDP) increased from 172,000 to 732,000. Around 72% of the displaced live with host communities, while 28% are in IDP camps.

FIGURE 1
Map of Mozambique with administrative divisions (provinces). Maputo City (not in the illustration) is contained within Maputo Province. Source: Darbyshire et al. (11).
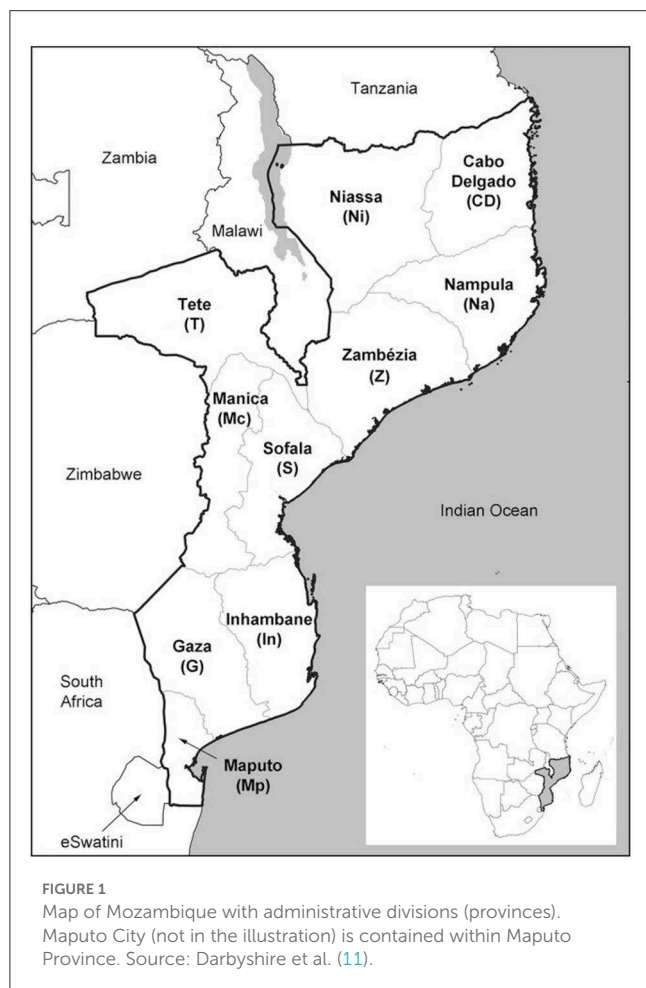
west to east by large rivers, isolating parts of the country during the rainy season (between October and March), a situation that is worsening with climate change. Administratively, the country is divided into 11 provinces. Apart from Maputo City and Maputo Province, each province is divided into ∼15 districts, with a total of 159 districts in the country. The 2017 National Census recorded 26,899,105 inhabitants, with a median age of 16.6 years, life expectancy at birth of 53.7 years, and an estimated 2.8% yearly population growth rate (12). Children under five and women of reproductive age (ages 15–49) corresponded to 34.6 and 23.8% of the population, respectively. Overall Mozambique has a low population density, with 34.1 inhabitants per km^2, except for Maputo City where the density is 3,107.1 inhabitants per km^2 (Table 1). In 2019 the infant mortality ratio (IMR) was estimated at 51.0 deaths per 1,000 live births—among the 20 highest globally even after an average annual decrease of 2.6% since 1990 (13). The

maternal mortality ratio was estimated at 289 deaths per 100,000 live births in 2017, the 3rd worst figure among the 16 nations in SADC (Southern African Development Community) region and one of the top 20 high in sub-Saharan Africa (14). Mozambique is a low-income country with a gross national income per capita in 2019 of US$504 (15). Mozambique ranks 181 out of 189 countries assessed in the Human Development Index (16).

The national health system provides nearly all health care services throughout the country, whereas private sector facilities are available primarily in Maputo City and a few provincial capitals. The national health system is divided into four levels of progressively more complex care. (1) The primary level (health centers or posts) provides primary care, including basic maternal and child health services in most facilities. (2) Secondary level facilities (rural, district, or general hospitals) are located at the district level, and serve as referral facilities for primary level facilities (note that some secondary level hospitals may include surgical services such as cesarean sections). (3) The tertiary level consists of hospitals located in provincial capitals, acting as referral facilities for the province. (4) The quaternary level (central hospitals) serve as regional (North, Center, or South) referral facilities (17).

2.3. Data sources and processing

Monthly data on health service provision at the district level were extracted from SISMA in April 2021 following a request from the National Directorate of Public Health (DNSP, Direcção Nacional de Saúde Pública) to assess the impact of COVID-19 on maternal and child health routine indicators. The population data (total women of reproductive age and children under five) were extracted from Government of Mozambique projections using the 2017 National Census (7).

A set of nine indicators were selected based on data availability, completeness, and whether the indicators could be used in the Lives Saved Tool (LiST) (18) for mortality estimation. The indicators included are: (1) number of women who attended first antenatal care visits; (2) number of institutional deliveries; (3) number of visits for measles vaccination; (4) number of visits for third dose of DPTH (diphteria, pertussis, tetanus toxoid combined with hepatitis B) vaccination; (5) number of postnatal care visits within 48 h after delivery; (6) number of postnatal care visits within three to seven days after delivery; (7) number of visits for treatment of malaria with Coartem for children under five; (8) number of first well-child visits; and (9) number of new family planning users. Data completeness was assessed as the proportion of district-months without missing information. Indicators missing fewer than 10% district-months were kept for analysis (Table 2) with two

TABLE 1 Mozambique demographic characteristics by province.

Province	Population	Women (%)*	Women of reproductive age (%)*	Children under 5 (%)*	Population density (inhabitants/km^2)	Crude birth rate	Number of districts
Cabo Delgado[†]	2,267,715	51.6	22.8	35.5	29.0	39.6	17
Gaza	1,388,039	54.8	24.7	28.1	18.4	31.6	14
Inhambane	1,454,804	54.3	24.5	26.4	21.1	28.8	14
Manica	1,851,931	52.1	23.5	36.0	29.6	44.0	12
Maputo City	1,080,277	51.7	29.0	20.8	3,107.1	24.5	1[‡]
Maputo Province	1,908,078	52.2	27.7	24.6	81.8	30.3	8
Nampula	5,483,382	51.5	22.8	38.6	69.9	38.2	23
Niassa	1,713,751	51.4	22.2	39.7	13.2	41.9	19
Sofala	2,196,845	51.7	23.9	33.5	32.3	40.7	13
Tete	2,551,826	51.2	22.9	35.6	25.3	38.0	15
Zambézia	5,002,457	52.1	23.1	38.6	48.4	43.3	23
Total	26,899,105	52.0	23.8	34.6	34.1	37.9	159

*Proportions over total population.
[†]Cabo Delgado was excluded from analysis due to insecurity and military conflict affecting the region.
[‡]Maputo City has seven municipal districts. Municipal districts are not equivalent to districts as in other provinces.

exceptions—treatment of malaria with Coartem and first well-child visit. These indicators were retained as measures of child health care utilization are required to estimate mortality using LiST. The team agreed that the data were sufficiently reliable to use for mortality estimation, and that while there would be greater uncertainty in LiST findings, they would still provide important guidance.

2.4. Statistical analysis

The outcome of our analysis were the service utilization counts for each indicator, aggregated at the district level. We conducted an exploratory analysis to assess data completeness, identify potential outliers, and determine the model parametrization type. Descriptive statistics (mean, standard deviation, coefficient of variation, median, first and third quartile, and proportion) were used for district comparisons, and district-specific time-series plots were produced to select the final model parametrization. Given higher unpredictability in trends in 2020 and 2021, we modeled linear trends using data prior to 2020. We then used the model predictions for each month in 2020 and the first quarter of 2021. We compared the observed counts with the expected (predicted) counts as absolute differences and ratios to provide a measure of the magnitude of loss in service provision for maternal and child health services as a result of COVID-19.

To model the data prior to 2020, we used a hierarchical negative binomial regression model with district- and province-level random effects for intercepts and district-level slopes. A negative binomial model was chosen to accommodate count outcome data with potentially greater variability than a common Poisson model. The hierarchical model addresses that districts are nested within provinces (i.e., at the highest level is the between-province variability); the multiple observations per district

(i.e., between districts variability); and month-to-month within-district variability. In addition, we account for annual seasonality variability. The model has the following parametrization:

$$log(count_{dt}) = (\beta_0 + b_0{}^*d + b_0{}^*p) + (\beta_1 + b_1{}^*d) \cdot t$$
$$+ \sum_{m=2}^{12} \delta_m \cdot I(Month_t = m) + 1 \cdot [log(Population_{dt})]$$

Where *count* is the count of service delivery from a district *d* at time *t*. The variable and subscript *t* variable *time* index time in months from January 2017 through December 2019. The parameters of interest are the β's and b's. The β_0 represents in log-scale the overall district average counts in January 2017, whereas the $b_0{}^*d$ and $b_0{}^*p$ are deviations of a particular district d and province p, respectively. The β_1 represents in log-scale the monthly average increase with $b_1{}^*d$ a particular district deviation. The summation with δ and I (Month$_t$ = m) are dummy indicator variables to capture monthly seasonal deviations from a January month. To account for the differences in district populations, district population is introduced as an offset (an independent variable in the model without a coefficient estimated) in the model. All regression models were estimated through the Bayesian framework using Stan programming language in the brms package [19] of R version 3.6.3 [20]. The software default priors (uninformative and diffuse priors) were found to be appropriate for this analysis after the number of iterations was increased to 20,000 (5,000 per chain), and a thinning interval of 5 and 1,000 observations in the burn-up period. From the posterior distribution, 10,000 realizations of the sets of parameters were obtained and used to estimate the absolute and relative loss of service delivery for each month in 2020 and the first quarter of 2021.

Mortality estimates were performed using the LiST [18], which is a mathematical model that uses community-level maternal

and child health service data as inputs to estimate maternal and child mortality. We used coverage estimates from the 2015 Immunization, Malaria and HIV/AIDS Indicator Survey (21) and the 2011 Demographic and Health Survey (22) as inputs for service coverage data. Changes in health service utilization were estimated using RHIS data aggregated at the district level, which is assumed to reflect the experience of district populations given the high utilization of maternal and child health services through the public sector, as well as infrequent population migration in Mozambique.

2.5. Ethical considerations

For this study we used district-level aggregated data, with approval from the Ministry of Health. We extracted data from the routine health information system (SISMA). Because routine data do not contain personal identifiers, ethical approval was deemed unnecessary. However, the National Directorate of Public Health approved the use of the data.

3. Results

3.1. Trends before 2020

From January 2017 through December 2019, with the exception of Cabo Delgado Province, 140 districts reported data. Table 2 describes the selected maternal and child health indicators prior to January 2020. On average, a typical district per month reported 854 new first antenatal care consults, 571 institutional deliveries, 507 postnatal visits within 48 h after delivery, 87 postnatal visits within 3–7 days after delivery, and 604 visits for a third dose of the combined diphtheria, pertussis, tetanus, and haemophilus influenza (DPTH3) vaccine. However, there is a large district-level variation with the coefficients of variation (CV) being

at least 75%, i.e., for each indicator the standard deviation is above three quarters of its mean, and reaching above 100% among the monthly counts of post-antenatal care visits, malaria treatment with Coartem and first well-child visits. Antenatal care visits, institutional deliveries, measles and DPTH3 doses, and postnatal care visits within 48 h of delivery saw a relative annual growth of about 5%, whereas the other indicators saw a smaller magnitude year descending trend. The number of family planning new users remained stable in the years before COVID-19.

Table 3 shows the regression coefficients for service provision counts per 1,000 inhabitants (except for the first well-child visits, which is in counts per 100,000 children) between January 2017 and December 2019, accounting for population size and seasonality. Except for postnatal care visits (within 3–7 days) and first well-child visits, all indicators had a relative growth of 2–7% per year, apart from treatment of malaria with Coartem for children under age five, which reached 35% increase per year. The standard deviation of the random effects illustrates heterogeneity between districts (district random intercept) and provinces (province random intercept) as well as the trajectory of the indicators over time (district random slope).

3.2. Service disruptions

Table 4 shows the observed and expected service counts in 2020 and for the first quarter of 2021. We estimated relative losses for all service provision indicators at the national level. Our findings show that all services experienced losses, but the services most affected were family planning (number of new users) and malaria treatment with Coartem (number of children under five treated), which showed relative losses of more than a quarter (29.87 and

TABLE 2 Selected maternal and child health indicators for analysis between January 2017 and December 2019 (district-month counts).

Indicator	Number of observations	Missing (%)	Minimum	Maximum	Mean	SD	CV	Relative annual growth (%)*
Antenatal care (first visit)	4,895	5 (0.1)	6	5,577	854	656	0.77	4.5
Institutional delivery	4,899	1 (0.0)	5	3,336	571	429	0.75	5.4
Measles vaccination	4,895	5 (0.1)	3	7,563	604	488	0.81	4.8
DPTH3 vaccination	4,895	5 (0.1)	4	8,549	604	479	0.79	6.1
Postnatal care visit (within 48 h)	4,897	3 (0.1)	5	2,248	507	375	0.74	8.2
Postnatal care visit (within 3–7 days)	4,545	355 (7.8)	1	1,138	87	107	1.23	−3.3
Treatment of malaria with Coartem (children under 5)†	1,476	204 (13.8)	0	9,270	1,322	1,347	1.02	−1.6
First well-child visit†	1,502	178 (11.9.6)	0	7,436	1,286	1,790	1.39	−4.6
Family planning (new users)¶	3,219	1 (0.0)	19	10,350	1,503	1,449	0.96	0.7

SD, standard deviation; CV, coefficient of variation (the ratio of the SD to the mean); DPTH3, third dose of diphtheria, pertussis, tetanus, and haemophilus influenza vaccine.
*Estimated from a generalized linear model regression with family quasipoisson and log-link for descriptive purposes.
†No data available on SISMA before January 2019.
¶No data available on SISMA before January 2018.

TABLE 3 Mixed-effect negative binomial regression coefficients for selected indicators, January 2017 to December 2019.

Indicator	Intercept (per 1,000 inhabitants)	Time (year)	σ$_{district\_intercept}$*	σ$_{district\_slope}$*	σ$_{province\_intercept}$*
Antenatal care (first visit)	7.92 (6.56–9.60)	1.02 (1.01–1.03)	0.203 (0.178; 0.233)	0.045 (0.038; 0.053)	0.283 (0.165; 0.512)
Institutional delivery	5.42 (4.57–6.40)	1.03 (1.02–1.04)	0.245 (0.215; 0.280)	0.049 (0.042; 0.057)	0.244 (0.133; 0.435)
Measles vaccination	5.89 (5.09–6.81)	1.02 (1.00–1.03)	0.199 (0.172; 0.230)	0.053 (0.043; 0.064)	0.196 (0.104; 0.353)
DPTH3 vaccination	5.87 (5.04–6.82)	1.02 (1.01–1.03)	0.180 (0.157; 0.207)	0.036 (0.028; 0.045)	0.216 (0.121; 0.381)
Postnatal care visit (within 48 h)	4.64 (3.69–5.78)	1.05 (1.03–1.06)	0.299 (0.261; 0.342)	0.074 (0.064; 0.086)	0.334 (0.188; 0.587)
Postnatal care visit (within 3–7 days)	0.83 (0.69–0.99)	0.88 (0.83–0.94)	0.641 (0.556; 0.736)	0.312 (0.269; 0.363)	0.158 (0.007; 0.440)
Treatment of malaria with Coartem (children under 5)[†]	8.13 (2.83–25.37)	1.35 (1.21–1.49)	0.635 (0.539; 0.744)	0.277 (0.225; 0.335)	0.299 (0.069; 0.625)
First well-child visit[†]	18.82 (14.32–25.25)	0.89 (0.82–0.96)	0.545 (0.394; 0.689)	0.219 (0.152; 0.288)	1.656 (1.019; 2.775)
Family planning (new user)[¶]	14.87 (12.00–18.44)	1.04 (1.02–1.07)	0.369 (0.273; 0.468)	0.139 (0.096; 0.181)	0.398 (0.214; 0.715)

*Standard deviations of the random effects are on the log scale.

[†]Data available on SISMA since January 2019. First well-child visits are measured per 100,000 children under five.

[¶]Data available on SISMA since January 2018.

The intercept indicates the average rate (counts per 1,000 inhabitants) on January 2017. The time coefficient indicates the increasing factor per year (e.g., the antenatal care visits rate increases 1.02 times in a year). The sigmas are an indication of the source of variability for the intercept and slope.

29.62%, respectively) compared with what was expected. Other services sustained losses of <10% of what was expected in 2020, with substantial increases in losses during the first quarter of 2021.

The monthly ratio of observed counts to expected counts reveals immediate losses in April 2020 (Table 5) for nearly all indicators, with ratios below 0.90. Most of those indicators had sustained losses (ratios below 0.95) for more than 3 months, except for first antenatal care visits and first well-child visits. However, these patterns varied slightly by province (Supplementary Figures S1–S9). The provinces of Manica, Maputo City, Nampula, and Sofala experienced the most severe losses in the number of family planning new users.

3.3. Mortality impact

Using the LiST for 2020, the number of estimated excess deaths (and relative increase) is 11,337 (12.8%) children under five, 5,705 (11.3%) neonates, and 387 (7.6%) mothers (Table 6), compared to a scenario without COVID-19.

4. Discussion

To assess the early impacts of COVID-19 on maternal and child health service provision and maternal and child mortality in Mozambique, we analyzed data from the country's routine health information system between January 2020 and March 2021 and compared it with data from before the pandemic. We focused on the early stages of the pandemic when a COVID-19 vaccine was not yet available, there was limited and centralized laboratory capability to diagnose COVID-19, there was little to no clinical experience with a respiratory distress disease outbreak, and before the delta variant emerged as the dominant strain. Moreover, during

this period, the government of Mozambique instituted a state of emergency between April and August 2020, then changed to a state of public calamity in September 2020. These restrictions included police-reinforced measures to reduce movement and access to public spaces and services (5). From April 2020 through March 2021 we found evidence of substantial service provision loss in selected indicators across the maternal child health care continuum in Mozambique. These losses are estimated to have contributed to a substantial increase in maternal, neonatal, and child mortality in 2020. Our findings complement findings from a report published in April 2022 indicating an overall negative impact on health services utilization as a result of COVID-19 from March through December 2020 in Mozambique (6). In addition, our study adds to the literature on maternal and child health service utilization losses due to COVID-19 in other sub-Saharan African countries (23, 24), and will contribute to planning for Mozambique's health system recovery. To our knowledge, this is the first study on the early impacts of COVID-19 on maternal and child healthcare service utilization and mortality conducted in one of the six African Portuguese-speaking countries.

The overall magnitude of losses in our selected indicators of maternal child health service provision are similar to what was reported for other sub-Saharan countries (24, 25), except for new users of family planning and the number of children treated with Coartem, which in our analysis reached almost 30% of service count loss. The provision of these two services includes an enormous contribution of the community health workers (CHW) in rural areas. The restrictions due to emergency or public calamity state halted CHW activities, which likely contributed to the observed service disruption. It is notable that despite experiencing losses below 10% of expected service counts, other services had accelerated losses in the first quarter of 2021. These losses represent a major blow to the efforts toward universal health coverage; however, the losses could potentially be worse still if there had not been a well-designed and implemented multi-sectorial response

TABLE 4 Mozambique observed and expected service losses by indicator, 2020 and first quarter of 2021.

Indicator	2020				First Quarter 2021				Overall			
	Observed	Expected	Difference	Percentage loss (%)*	Observed	Expected	Difference	Difference (%)*	Observed	Expected	Difference	Percentage loss (%)*
Antenatal care (first visit)	1,752,157	1,787,674	−35,517	−1.99	446,890	475,221	−28,331	−5.96	2,199,047	2,262,894	−63,847	−2.82
Institutional delivery	1,169,966	1,223,790	−53,823	−4.40	298,712	312,064	−13,351	−4.28	1,468,679	1,535,853	−67,174	−4.37
Measles vaccination	1,164,151	1,254,650	−90,498	−7.21	268,441	301,688	−33,248	−11.02	1,432,592	1,556,338	−123,746	−7.95
DPTH3 vaccination	1,164,712	1,274,312	−109,599	−8.60	224,389	309,538	−85,149	−27.51	1,389,102	1,583,850	−194,748	−12.30
Postnatal care visit (within 48 h)	1,053,793	1,149,645	−95,852	−8.34	266,587	294,773	−28,186	−9.56	1,320,381	1,444,418	−124,037	−8.59
Postnatal care visit (within 3–7 days)	159,760	160,383	−623	−0.39	38,513	43,899	−5,387	−12.27	198,273	204,283	−6,010	−2.94
Treatment of malaria with Coartem (children under 5)	2,815,039	3,685,427	−870,389	−23.62	645,443	1,231,383	−585,940	−47.58	3,460,482	4,916,811	−1,456,329	−29.62
First well-child visit	2,145,752	2,334,514	−188,763	−8.09	–	559,308	–	–	–	2,893,823	–	–
Family planning (new user)	2,229,723	3,240,669	−1,010,946	−31.20	533,932	700,080	−166,148	−23.73	2,763,655	3,940,749	−1,177,094	−29.87

The observed counts in the table are slightly different from the raw data, because here we computed first the average (per indicator) then multiplied by 159 (total number of districts) to account for districts with missing information.

The expected counts are estimates from the model for each parameter.

*The percentage loss is computed as $100 \times$ (observed – expected)/expected.

TABLE 5 National-level relative reduction in service counts by indicator and month, 2020 and first quarter of 2021.

Indicator	2020												2021		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Antenatal care (first visit)	0.96 (0.88–1.04)	0.99 (0.91–1.08)	1.03 (0.95–1.13)	0.87 (0.79–0.95)	0.99 (0.90–1.09)	0.95 (0.86–1.04)	1.00 (0.90–1.10)	1.08 (0.97–1.19)	0.98 (0.88–1.08)	1.08 (0.96–1.20)	1.01 (0.90–1.13)	0.90 (0.80–1.01)	1.07 (0.95–1.20)	0.96 (0.85–1.09)	1.01 (0.89–1.14)
Institutional delivery	0.95 (0.73–1.22)	1.04 (0.79–1.34)	1.02 (0.77–1.34)	0.78 (0.58–1.03)	0.66 (0.49–0.90)	0.82 (0.59–1.11)	0.91 (0.66–1.25)	0.98 (0.70–1.37)	1.07 (0.75–1.50)	1.11 (0.77–1.58)	1.07 (0.73–1.54)	1.05 (0.71–1.54)			
Measles vaccination	0.99 (0.90–1.09)	1.01 (0.91–1.11)	1.02 (0.92–1.13)	0.84 (0.75–0.93)	0.92 (0.82–1.02)	0.85 (0.76–0.95)	0.94 (0.83–1.05)	0.96 (0.85–1.08)	0.88 (0.77–0.99)	0.96 (0.84–1.08)	0.87 (0.77–1.00)	0.88 (0.77–1.00)	0.92 (0.80–1.05)	0.81 (0.70–0.93)	0.83 (0.72–0.96)
DPTH3 vaccination	0.97 (0.86–1.09)	1.04 (0.92–1.17)	1.08 (0.95–1.22)	0.82 (0.72–0.93)	0.90 (0.79–1.03)	0.87 (0.76–1.00)	0.91 (0.79–1.05)	1.00 (0.86–1.15)	0.89 (0.76–1.03)	0.94 (0.81–1.10)	0.86 (0.73–1.01)	0.96 (0.81–1.13)	1.03 (0.87–1.21)	0.93 (0.78–1.11)	0.97 (0.81–1.15)
Postnatal care (48 h)	0.92 (0.73–1.14)	0.99 (0.78–1.24)	0.99 (0.77–1.26)	0.80 (0.62–1.02)	0.72 (0.55–0.92)	0.72 (0.55–0.94)	0.76 (0.57–0.99)	0.83 (0.62–1.10)	0.71 (0.53–0.94)	0.75 (0.55–1.01)	0.49 (0.36–0.67)	0.76 (0.55–1.04)	0.93 (0.66–1.28)	0.89 (0.63–1.24)	0.85 (0.60–1.20)
Postnatal care (within 3–7 days)	0.99 (0.92–1.05)	0.99 (0.92–1.06)	1.00 (0.93–1.08)	0.92 (0.85–0.99)	0.97 (0.90–1.05)	0.94 (0.87–1.02)	0.95 (0.87–1.04)	0.94 (0.86–1.03)	0.95 (0.87–1.05)	0.96 (0.87–1.06)	0.96 (0.87–1.05)	0.95 (0.86–1.05)	1.04 (0.94–1.16)	1.01 (0.91–1.12)	1.01 (0.91–1.13)
Treatment of malaria with Coartem (children under 5)	1.01 (0.72–1.39)	0.97 (0.68–1.34)	1.02 (0.70–1.46)	0.89 (0.60–1.29)	0.78 (0.52–1.17)	0.76 (0.49–1.15)	0.73 (0.47–1.12)	0.67 (0.42–1.04)	0.62 (0.38–0.99)	0.84 (0.51–1.36)	0.82 (0.49–1.35)	0.63 (0.37–1.07)	0.70 (0.37–1.33)	0.69 (0.38–1.25)	0.79 (0.44–1.38)
First well-child visit	1.04 (0.62–1.71)	1.01 (0.58–1.74)	1.48 (0.80–2.76)	0.84 (0.47–1.48)	1.11 (0.60–2.06)	0.94 (0.49–1.83)	1.27 (0.64–2.55)	1.30 (0.65–2.62)	1.41 (0.67–2.96)	1.10 (0.54–2.22)	2.17 (1.02–4.53)	0.76 (0.35–1.65)			
Family planning (new user)	0.92 (0.73–1.14)	0.99 (0.78–1.24)	0.99 (0.77–1.26)	0.80 (0.62–1.02)	0.72 (0.55–0.92)	0.72 (0.55–0.94)	0.76 (0.57–0.99)	0.83 (0.62–1.10)	0.71 (0.53–0.94)	0.75 (0.55–1.01)	0.49 (0.36–0.67)	0.76 (0.55–1.04)	0.85 (0.60–1.20)	0.89 (0.63–1.24)	0.93 (0.66–1.28)

TABLE 6 Mozambique's relative reduction in service counts, by indicator and month for 2020 and first quarter of 2021.

	Total expected deaths in 2020 with no disruptions (counterfactual)	Total estimated deaths in 2020 with observed disruptions	Excess deaths in 2020 due to service disruptions	Relative increase in mortality due to service disruptions
Child deaths (0–59 months of age)	88,853	100,190	11,337	12.8%
Neonatal deaths (newborns < 1 month of age)	50,311	56,016	5,705	11.3%
Maternal deaths	5,084	5,471	387	7.6%

to prevent COVID-19 transmission (5). Still, it could be argued, as well, that some of the measures may have contributed to the losses (26).

We can group the losses in our analysis in three patterns of service loss over the months of 2020 and first quarter of 2021 (Table 5). The first includes indicators that experienced 1 month of loss (below 95% of the expected) or did not change over the course of the year relative to the expected. This is the case with first antenatal care visit counts, which in April 2020 were 13% below the expected. The second pattern includes those outcomes reduced to below 95% of what was expected for between 2 and 4 months. This group includes institutional deliveries and first well-child visits. The third group encompasses indicators that sustained more than 4 months with observed counts below 95% of what was expected. This group included immunization indicators (measles and DPTH3), post-natal visits, malaria treatment with Coartem, and family planning visits. Nevertheless, at the sub-national (province) level, there were substantial variations with Maputo City and Maputo Province showing loss of service provision (or utilization) of malaria treatment with coartem for more than 4 months, a completely different pattern to that of the other provinces. Many factors could concur with this observation. First, on the one hand, in recent years, Maputo Province and Maputo City reached a higher community prevalence of knowledge for malaria prevention and treatment that may contribute to lower malaria incidence compared to previous years. On the other hand, these two provinces were the ones with the highest reinforcement of COVID-19 prevention measures that could have contributed to deterred service utilization.

The first and second pattern of loss indicators, including first antenatal care, institutional deliveries and first well-child visits, were targeted by the National Directorate of Public Health in reaction to earlier service count drops after April 2020. The third group of indicators include services that are sensitive to health system changes like service discontinuation to provide COVID-19 treatment or health facility closure, insufficient personal protective equipment available for health care providers, and interruptions in the supply of medical equipment and health products, which likely contributed to their prolonged decrease. Notably, family planning services were the most affected likely due their reliance on community health workers.

Although our estimates of mortality due to service provision loss (an increase of under-5 child mortality by 11% and maternal

mortality by 8%) are small relative to other estimates for Mozambique (3, 27), this increased mortality is concerning as it rolls back the hard-fought gains Mozambique has achieved in reducing maternal and child mortality.

Our data analysis is based on selected indicators from the Ministry of Health's RHIS combined with population size estimates at the district level. Due to high levels of missingness (above 40% of the expected observations), a small number of indicators were included in our analysis. This study supports the need for further investments in RHISs as an essential health system building block that supports health system resilience by providing timely monitoring and feedback to health system authorities, and thus are a core element of health service recovery planning (9).

During the COVID-19 pandemic new health information tools were introduced to support the response to the evolving health provision needs (28). However, these changes were largely vertically designed and implemented, and did not integrate into the routine health information system (29). Efforts to transform these vertical systems into broader RHIS improvements should be prioritized in the efforts to restore routine health services. Lessons from this experiment can help identify future opportunities, such as a digital transition of RHIS that may improve responsiveness of the health system in real-time.

4.1. Strengths and limitations

We consider the use of RHIS data at the national level over time to be a strength of this study and to provide a model for similar analyses using the RHIS for policy evaluation (30). We used RHIS data which was readily available for 24 months before the COVID-19 pandemic and for the first 15 months of COVID-19. This allowed us to estimate the expected counts for each indicator if COVID-19 didn't happen, an essential step to compare with during COVID-19 service provision counts. Although we could not include Cabo Delgado province, our data is representative of Mozambique.

Of the 11 Mozambican provinces, we could not include Cabo Delgado province because of the military insurgency affecting large areas of the province with public service unavailability, massive population migration, including health providers, and

destruction of health facilities and infrastructure. This situation led to an inability to record data into RHIS and to properly assess, monitor and plan the health service provision in Cabo Delgado. This province has a damage beyond service disruption due COVID-19. For Cabo Delgado there is first need to restore peace and then a reconstruction of facilities and restoration of the health system. While the war continues efforts to restore the relief from the humanitarian crisis should be prioritized.

Our estimates are based on the assumption that the magnitude of relative reduction in health facility service utilization represents changes experienced at the district level. While RHIS data do not include services provided through the private sector, and there could be unmeasured changes in population size due to migration patterns, we are confident that our district-level estimates are sound given the lack of observed population migration (particularly under COVID-19 restrictions) and the lack of utilization of private health facilities outside of Maputo City. Second, we cannot provide uncertainty estimates from this model.

We chose a limited number of indicators along the maternal and child health care continuum based on data completeness and history of data collection. Therefore, this dataset might not fully capture service delivery disruptions [for example, malnutrition indicators may have worsened, as was documented during the early pandemic in Eastern and South Africa (31)]. In addition, our analysis was based on routine data from health facilities, which may not capture service utilization at the community level.

5. Conclusions

This study provides evidence of the negative impacts of COVID-19 on selected maternal child health service provision in Mozambique during 2020 and the first quarter of 2021. In addition, it estimates the number of children and mothers who died from such service losses. In doing so, it is another example of how RHIS can be used to quickly assess and inform a health system for better action.

These findings have important implications both within Mozambique and for the larger global health community. Plans and guidance for health system recovery can rely on data generated through routine health information system which calls for efforts to be directed to prevent parallel data collection systems. Furthermore, future epidemic responses should consider the essential role that community health workers provide in the health sector (such as in the delivery of family planning and malaria treatment). At the global level, our findings contribute to documentation of service disruptions related to a significant pandemic, and provides a model of how routine health information system data can be combined with modeling tools to provide robust, granular estimates of service disruption and associated mortality.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: The data belongs to the Ministry of Helth of Mozambique. Data can be obtained upon request. Requests to access these datasets should be directed to QF, ferq09@gmail.com.

Author contributions

OA, QF, KS, and BW conceptualized the research question, the study design, and the analytic strategy. QF, SC, and IM procured and secured the data. OA and TR performed the analysis with substantial inputs from BW and KS. OA developed the first draft with inputs from KS, TR, and BW. All authors provided substantial input, reviewed, and approved the final version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1075691/full#supplementary-material

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A novel approach to utilizing the essential public health functions in Ireland's health system recovery and reform

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'

The COVID-19 pandemic presented a challenge to health systems and exposed weaknesses in public health capacities globally. As Ireland looks to recovery, strengthening public health capacities to support health systems resilience has been identified as a priority. The Essential Public Health Functions (EPHFs) provide an integrated approach to health systems strengthening with allied sectors and their operationalization supports health systems and multi-sectoral engagement to meet population needs and anticipate evolving demands. The Health Systems Resilience team (World Health Organization, HQ) in collaboration with the Department of Health (Ireland) developed a novel approach to the assessment of the EPHFs in Ireland. The approach involved a strategic and focused review of the delivery and consideration of EPHFs in relation to policy and planning, infrastructure, service delivery, coordination and integration, monitoring and evaluation and learning. Informed by a literature review and key document search, key stakeholder mapping and key informant interviews, lessons learned from experience with COVID-19 nationally and internationally, strengths as well as potential areas of improvement to optimize delivery of EPHFs were identified. Mapping of the EPHFs in Ireland revealed that there is evidence of delivery of all 12 EPHFs to varying degrees; however a number of challenges were identified, as well as numerous strengths and opportunities. Recommendations to optimize the delivery of EPHFs in Ireland include to integrate and coordinate EPHFs, increase the visibility of the public health agenda, leverage existing mechanisms, recognize and develop the workforce, and address issues with the Health Information System. There is a public health reform process currently underway in Ireland, with some of these recommendations already being addressed. The findings of this process can help further inform and support the reform process. Given the current focus on strengthening public health capacities globally, the findings in Ireland have applicability and relevance in other WHO regions and member states for health systems recovery and building back better, fairer and more resilient health systems.

1. Introduction

The COVID-19 pandemic presented an unprecedented challenge to health systems globally and has highlighted the importance of building health system resilience. A resilient health system can effectively prevent, prepare for, respond to, and adapt to public health challenges while maintaining routine health system functions (1). Despite numerous warnings from public health officials, infectious disease experts and previous international commissions and reviews, the world was not prepared to respond to the COVID-19 pandemic (2). This, in addition to numerous other public health emergencies (PHE) such as the SARS epidemic in 2003, the H1N1 influenza pandemic in 2009, the Ebola outbreak in West Africa in 2014–2016, Zika, MERS, and other threats have demonstrated insufficiencies in actions to build health systems resilience globally. The World Health Organization (WHO) has recognized the essential public health functions (EPHFs) as a key strategy to build health system resilience and has called on countries to strengthen EPHFs and health systems foundations (3, 4).

The EPHFs are a fundamental set of collective actions under the primary responsibility of the state, which help to ensure effective public health actions, including the protection, maintenance and promotion of population health (4). They can be regarded as the capabilities that health authorities, in collaboration with other relevant sectors should build and strengthen within health and allied systems, and they are key to ensuring a holistic approach to public health from policy and planning to the provision of services (4, 5). Many countries, WHO regions and partners have developed EPHF frameworks that reflect their priorities and contexts. Although differences exist in these frameworks, there are significant commonalities such as a focus on health promotion, prevention, protection, and actions on the wider determinants of health and equity. The WHO recently developed a consolidated set of EPHFs and has proposed this as a reference list of activities for countries to ensure effective public health action for acute threats, evolving challenges and chronic stressors including the COVID-19 pandemic (4). The EPHFs advocate for proportionate investment in public health in relation to costly secondary and tertiary care and provide an integrated approach to health system strengthening.

When assessed in terms of average case rates, deaths and excess mortality, Ireland performed relatively well in response to the COVID-19 pandemic compared to many European countries (6). However, the pandemic response that was required to achieve this has had a substantial impact on essential health service delivery, including pausing of screening programmes during wave 1, reduced GP attendance, and disruption to elective care (7). Additionally, the direct effects of COVID-19, including long COVID-19, and the indirect consequences such as functional and cognitive decline, loneliness, low mood, anxiety, alcohol dependence, and weight gain are likely to have an impact on the health system into the future (7). Ireland currently has a relatively young population compared to the rest of Europe, however the demographic profile in Ireland is changing, placing substantial and sustained pressure on health services. Unlike most European countries, the size of the population in Ireland is increasing. The preliminary results from the most recent census (2022) demonstrated that the population has grown by 7.6% since the

last census (2016) to 5.1 million (8). This population growth is projected to continue for at least the next two decades, with increases in the older age groups projected to continue quickly and steeply (9). Older age cohorts are the highest users of the majority of health care services and increases in these age cohorts will have a significant impact on demands for health services in the future and their integrated delivery (9). Prior to the pandemic, Ireland's health system was already under strain due to longstanding weaknesses, with long waiting times to access health services and diagnostics (10, 11), and the changing demographics of the Irish population are likely to exacerbate problems if steps are not taken to bolster preventative health and health protection capacities and build health system resilience.

The Department of Health (DoH) provides governance of health and social care services. The Health Service Executive (HSE) is responsible for delivery of services and implementation of initiatives set out in the annual National Service Plan (NSP). In 2019, governance structures were strengthened with regular high-level meetings between both organizations and introduction into law of the HSE Governance Act (2019) which formally established a new HSE board accountable to the minister and led to appointment of a Chief Executive Officer (CEO) accountable to the board (12). There is broad consensus that the current health system in Ireland is overly hospital-centric, with community-based services that are fragmented with a lack of integration of care within and across different services (9). Reactive care takes precedence over proactive and preventative care and the system in its current form is not meeting the needs of patients. Therefore, the health system is undergoing a period of transformation and reform with the implementation of a 10-year cross party and cross governmental plan for transformation of the Irish health system published in 2017, "Sláintecare" (13). Sláintecare seeks to deliver universal access to high quality health services based on the reorientation of the system toward integrated primary health and community care. Although implementation has been modest to date and complicated by the COVID-19 pandemic, reform is ongoing and presents an opportunity to embed public health and a population-based approach to healthcare into a reformed system.

Responsibility for Public Health has historically been situated within the Health and Wellbeing division of the HSE, although its functions are scattered throughout the HSE. A statutory public health function in the role of "Medical Officer of Health" (MOH) is established in Ireland under the 1947 and 1953 Health Acts, and the Infectious Disease regulations 1981 (and subsequent amendments). A new model for the delivery of public health was developed in 2019 following the recommendations of an independent review, which recommended the development of a 'hub and spoke' model of service delivery, encompassing all domains of public health practice that enables strong public health leadership supported by multidisciplinary teams (14). Recruitment into this new model is currently underway.

The Health Systems Resilience team (World Health Organization, HQ) in collaboration with the Department of Health (Ireland) developed a novel approach to the assessment of the EPHFs in Ireland. The purpose of this assessment was to present an overview of the current delivery of the EPHFs to inform national policy for building health systems resilience as the country recovers from the COVID-19 pandemic.

TABLE 1   Fundamental list of essential public health functions.

1. Monitoring and evaluating the population's health status, health service utilization and surveillance of risk factors and threats to health
2. Public health emergency management
3. Assuring effective public health governance, regulation, and legislation
4. Supporting efficient and effective health systems and multisectoral planning, financing, and management for population health
5. Protecting populations against health threats, including environment and occupational hazards, communicable disease threats, food safety, chemical and radiation hazards
6. Promoting prevention and early detection of diseases, including noncommunicable and communicable diseases
7. Promoting health and well-being and actions to address the wider determinants of health and inequity
8. Ensuring community engagement, participation, and social mobilization for health and well-being
9. Ensuring adequate quantity and quality of public health workforce
10. Assuring quality of and access to health services
11. Advancing public health research
12. Ensuring equitable access to and rational use of essential medicines and other health technologies

2. Methods

In order to align with the timeline of a governmental reform process within Ireland, a rapid approach to the assessment of EPHF delivery was developed. The consolidated list of 12 EPHFs proposed as a reference for countries by WHO was reviewed by the joint team with agreement on definition, components and scope of each EPHF (Table 1) (4). A document search including academic literature, gray literature and government policy documents was then conducted to inform the current delivery and consideration for EPHFs as assessed across four key pillars; policy and planning, inputs and infrastructure, service delivery and coordination and integration. Two cross cutting areas; monitoring and evaluation and learning systems were also examined (Supplementary material). Documents were assessed using a key questions matrix developed by the joint working team (Supplementary material). Findings were then crosschecked and triangulated using key informant interviews, with interviewees identified through stakeholder mapping of EPHF delivery (Supplementary material).

3. Results

3.1. Mapping of the delivery of EPHFs in Ireland

The agreed list of 12 fundamental EPHFs (Table 1) formed the basis of the mapping process. A visual representation of mapping of individual EPHFs against key technical areas is provided in Figure 1. A number of the main findings are listed below.

- There is evidence of delivery of all 12 EPHFs to varying degrees; however, there is limited evidence of a coordinated approach, with some EPHFs being delivered directly through the health system and others in partnership with public bodies, non-governmental organizations, academia and other sectors.
- There is limited evidence of an overarching strategy, policy or governance structure to coordinate the planning and delivery of EPHFs across the system.
- Delivery of the EPHFs is siloed with respect to strategy, planning, financing, implementation and monitoring and evaluation mechanisms, and there appears to be limited consideration given to health system strengthening or identifying opportunities for synergies. This can contribute to duplication, gaps and inefficiencies.
- There are examples of a more coordinated approach such as Healthy Ireland structures that seek to integrate prevention and health promotion.There is no overarching governance structure for the delivery of EPHFs, and governance structures vary from national structures, national to regional structures, or regional only structures. A number of vertical programmes report into the Office of the Chief Clinical Officer on the Executive Leadership board of the Health Service Executive (HSE), the agency responsible for the delivery of health and social care services in Ireland, while others report through the office of strategic planning in the HSE. Legislation is in place to support many of the threats defined in EPHF5 (health protection) and EPHF10 (quality and access). However, legislation to support the delivery of all EPHFs is limited and what is in place applies to control of infectious diseases and is not specific to emergency response, which led to the need for a substantive amount of drafting of primary legislation in response to COVID-19.
- There are strong emergency focused inter-sectoral mechanisms and mechanisms that support inter-sectoral and international collaboration and information sharing, however at an operational level there is no lead agency mandated and resourced to lead emergency preparedness and response. The DOH is the lead government agency responsible for pandemic planning and health security structures, and the HSE is responsible for operational delivery of the health system's pandemic response.
- The Health Protection Surveillance Center (HPSC) within the HSE serves as the International Health Regulations focal point; however, it does not have the capacity to be the lead agency in preparedness and response within the HSE. There is evidence of a mismatch between the scope of public health activities outlined within national strategies and policies, and what is supported by planning, with a focus on health protection in terms of resourcing and infrastructure. The National Service Plan, which sets out the types and volume of health and social services to be provided on an annual basis, outlines resources for health protection (EPHF5) only.
- Although a significant amount of data informs health systems planning, operational limitations exist in the health information systems and infrastructure. Health information infrastructure is fragmented, with multiple data collection points and data repositories, with a lack of clarity around data access and sharing, and limited integration and linkage

FIGURE 1
Visual representation of mapping of individual EPHFs against key technical areas.
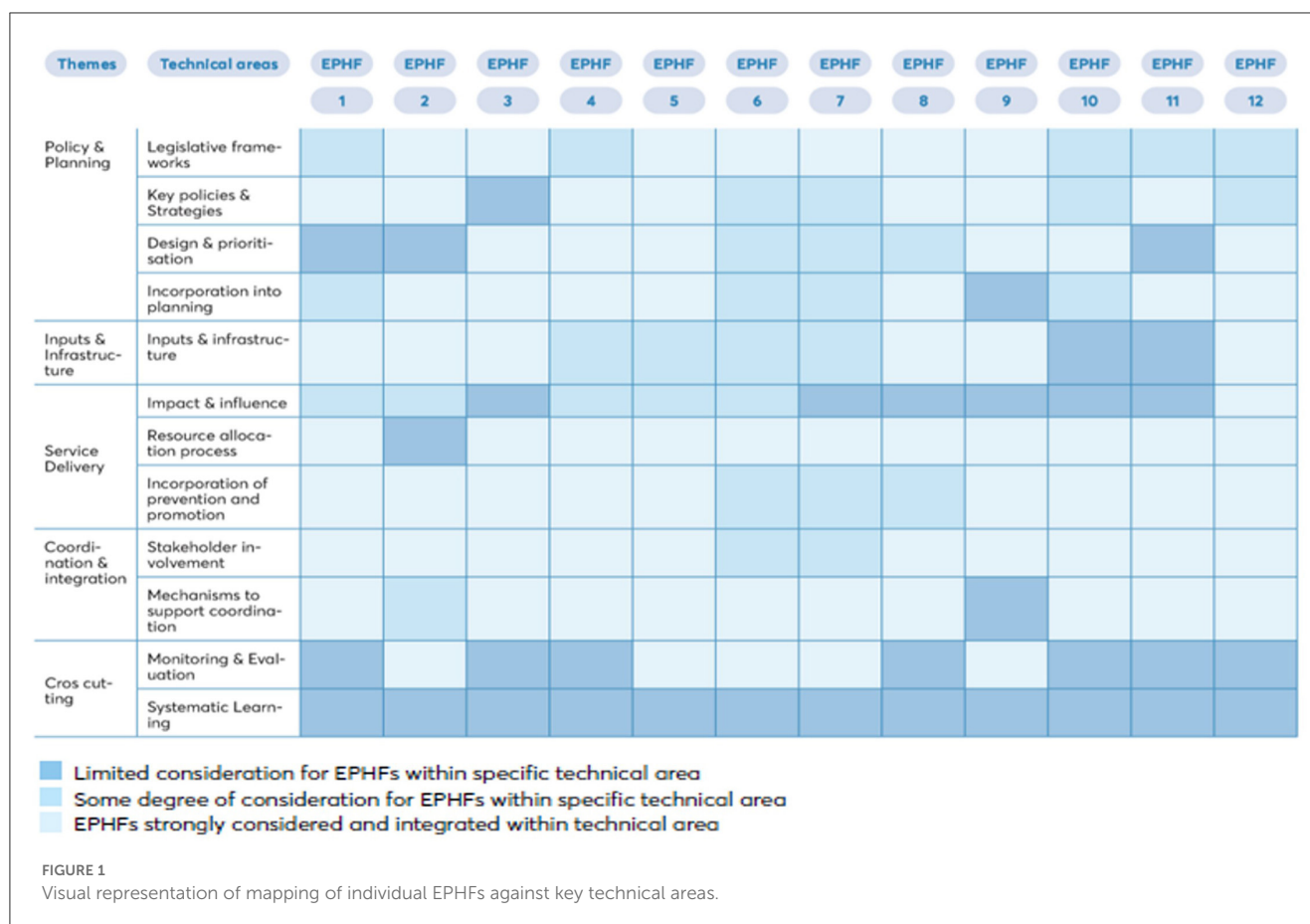
between systems. A dearth of modeling capacity in the HPSC existed prior to the COVID-19 pandemic.

3.2. Strengths and opportunities identified

Despite these challenges, the Irish health system performs relatively well across many health and health systems indicators, including in the context of the COVID-19 pandemic. However, Ireland is now entering a challenging time in the recovery period, and is facing increasing pressures on health systems with demographic changes and a backlog of demand stemming from the pandemic. Although this leaves the health system vulnerable to ongoing and future public health emergencies, there were a number of strengths identified that can be leveraged to build health systems resilience:

1. There is considerable capacity to deliver EPHFs within the system;
2. There is a high level of public health expertise within the system;
3. The Irish health workforce is resourceful and agile;
4. There is substantial evidence generation and synthesis capacity within the system;
5. There is a recognition of the need for a whole of society, whole of government approach to health;

6. Data informed planning is evident at a high level within the heath sector, despite infrastructural and capacity issues identified.

3.3. Potential areas for improvement

This review aimed to identify actions that could address gaps and optimize delivery of EPHFs in Ireland. Several opportunities were identified that could support optimal delivery of the EPHFs. These include:

1. **Integrate and coordinate EPHFs to reduce fragmentation and promote efficiency and effectiveness. This can be achieved by:**

   - Utilizing EPHFs to define the scope of public health.
   - Developing a national public health strategy, provide appropriate financing mechanisms and ensure existing capacity is leveraged.
   - Developing Key Performance Indicators for EPHFs and health system resilience, relevant to population health outcomes at national and subnational levels.

2. **Increase the visibility and profile of the public health agenda in the Irish setting. This can be achieved by:**

- Identifying the appropriate strategic placement and resourcing of a coordinating structure for public health.
- Reviewing the governance structures for the delivery of the EPHFs.
- Reviewing institutional arrangements for the delivery of public health at all levels.

3. **Sustain and leverage existing mechanisms in support of a whole-of-government and whole-of-society approach to health, including emergency preparedness and response. This can be achieved by:**

- Defining the new baseline for national systems, taking account of the additional resources and structures within the current, COVID-19 focused baseline.
- Identifying the structures and coordinating platforms to be sustained and leveraged to support an integrated whole-of-government approach to health.
- Sustaining and harnessing the existing mechanisms promoting whole-of-society participation in health.

4. **Define, recognize and develop the public health workforce to ensure that it is capable of adapting to ongoing and evolving public health challenges. This can be achieved by:**

- Defining the skill set and competencies of the public health workforce required to effectively deliver the EPHFs.
- Profiling and mapping the wider public health workforce and develop appropriate mechanisms to enable surge capacity during public health emergencies.
- Developing national and regional strategies for addressing priority gaps in workforce.

5. **Address critical Health Information System issues to ensure appropriate and timely data is available to effectively respond to all public health challenges. This can be achieved by:**

- Reviewing the ICT strategy to ensure recognized ICT issues with respect to infrastructure, security and digitalization are addressed and resourced.
- Ensuring integration and interoperability of data and systems across and between health and allied sectors.
- Ensuring sustainable modeling capacity, evidence synthesis and public health intelligence are in place.
- Ensuring the Health Information Bill recognizes the need for public health intelligence as distinct from health system performance data.

4. Discussion

The approach taken in this collaboration identified lessons learned internationally from the COVID-19 pandemic and their relevance to the Irish context, mapped the current delivery of the EPHFs in the Health System in Ireland, presented strengths and opportunities that can be leveraged to enhance the effectiveness of recovery efforts and build health systems resilience and identified actions to address gaps and optimize the delivery of public health in Ireland at a national and subnational level.

While the pandemic is ongoing and it remains too early to draw definite lessons from the pandemic response, lessons identified at this stage can inform the context for strengthening public health capacity in Ireland. This collaborative review has identified numerous strengths and opportunities within the Irish health system and presented recommendations for optimizing delivery of the EPHFs in Ireland, grounded within the national context as well as informed by experience with COVID-19. The capacity to deliver the EPHFs is readily identifiable within the Irish health system. Some integration is apparent, although mainly *ad-hoc* and informal, and this increased during the COVID-19 pandemic. This presents an opportunity to harness existing capacity and maximize synergies across EPHFs and align with current and evolving population health needs. Optimization of delivery of the EPHFs can help to ensure comprehensive and integrated delivery of public health services in Ireland following the COVID-19 pandemic, in response to the health needs of the population with a specific focus on vulnerable groups (e.g., elderly and migrants), and in anticipation of evolving disease profiles (e.g., multimorbidity). The findings of the review are being utilized to support high level advocacy for the strategic shift toward public health required to build and ensure health system resilience against future threats through the EPHFs.

Operationalizing the EPHFs in Ireland can help ensure public health challenges are met affordably and sustainably. As COVID-19 and past and ongoing public health stressors have demonstrated, the cost of inaction, and an overreliance on reactive secondary and tertiary healthcare, is too high. There is an urgent need for adequate and proportionate attention and investments in building preventative, health protective and health promotive capacities utilizing EPHFs for high level planning and advocacy within and beyond the health sector. Implementation of multi-sectoral approaches and health in all policies are also needed given the likelihood of future health systems shocks and stressors, be it from infectious disease outbreaks, climate related events, antimicrobial resistance or rising rates of non-communicable diseases and mental health conditions.

There are a number of limitations to this review. The timeline for analysis was short, in order to align with the ongoing public health reform process in Ireland and leverage political interest and support, limiting the options in terms of approach and granularity of findings. The timeframe informed the study design, and the review is not as in depth as previous assessments of EPHF. However, the review provided concrete and actionable policy options to optimize delivery of EPHFs in the Irish setting. The constantly evolving structures in response to the COVID-19 pandemic and the ongoing health sector reforms created a challenge in understanding the up-to-date delivery of EPHFs in Ireland. The majority of documents reflected delivery of EPHFs prior to the COVID-19 pandemic with some related to the pandemic response and other reflecting changing priorities during the pandemic. Some recent changes in EPHFs may not have been captured during this process. Key informant interviews addressed this challenge to some extent.

5. Conclusion

Building resilience into a reformed health system will be key in ensuring Ireland's ability to respond to future threats such as pandemics. Operationalization of the EPHFs can help ensure the health system is prepared to meet the next challenge affordably and sustainably. The findings of the review have been utilized to support high level advocacy for the shift toward public health required to build and ensure health system resilience against future threats. Work is currently underway to utilize the EPHFs to define the operational scope of public health in Ireland and to identify the scope and functions of a new national public health institute and will help inform ongoing implementation of public health reform. Given the current focus on strengthening public health capacities globally, the findings in Ireland have applicability and relevance to policy audiences and key decision makers within Ireland as well as more broadly to other WHO regions and member states for health systems recovery and building back better, fairer and more resilient health systems.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

TM: analysis and interpretation of results and draft manuscript preparation. LH: analysis and interpretation of results. GM, SM, and YZ: data collection and analysis and interpretation of results. SS: analysis and interpretation of results and study conception and design. ZJ and TH: study conception and design. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1074356/full#supplementary-material

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Lessons from inter-disciplinary collaboration to mitigate SARS-CoV-2 transmission in schools, Ireland, 2020/2021, to inform health systems and multisectoral recovery

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Introduction: School closures associated with the COVID-19 pandemic resulted in the loss of educational and social supports for up to 1,000,000 students in Ireland and disproportionately affected students from lower socio-economic backgrounds. For the 2020/2021 school year, multisectoral and interdisciplinary "Schools Teams" were established within Public Health departments to maintain in-person education by minimizing transmission of SARS-CoV-2 in schools. This study aimed to describe this model and explore the experiences of Schools Team members in the East of Ireland to identify factors that influenced effective working that can be sustained in the context of health systems and multisectoral recovery.

Methods: Schools Teams were comprised of multidisciplinary staff from regional Public Health departments and redeployed staff from the Education sector. Governance rested with Public Health departments. All staff operated to nationally agreed protocols following training. The experiences of the East Schools Team members were explored through an online survey and semi-structured interviews.

Results: The survey response rate was 53/70 (75.7%). Participants reported clear channels of communication within the team (44, 83.0%), feeling comfortable in their role following training (43, 82.7%) and a positive team culture (51, 96.2%) as key facilitators of effective inter-disciplinary working. Insufficient administrative support and mixed messaging to schools were identified as barriers to efficient team collaboration.

Discussion: The Schools Team model illustrates the potential for multisectoral partnerships to effectively address complex public health priorities and

contribute toward health system resilience to health threats. By recognizing and leveraging the ability of allied sectors such as the education sector, to contribute to public health goals, countries can move toward the kind of whole-of-government approach to health recognized as key to health system resilience. The strong links between the education and public health sectors developed through this collaboration could be extended and strengthened to more effectively pursue public health priorities in school settings. More broadly, mechanisms to support multisectoral working should be developed, expanding beyond reactive interventions to proactively address key health priorities and build resilience across health systems and communities. Such collaborations would promote healthier populations by promoting and encouraging a public health perspective among other sectors and embedding "health in all policies".

1. Introduction

Coronavirus disease 2019 (COVID-19), the disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was declared a pandemic by the World Health Organization (WHO) on 11 March 2020 (1).[1] Since then, countries worldwide have introduced a range of public health measures throughout the pandemic to control transmission of SARS-CoV-2.

School closures are one such measure, which have occurred in over 200 countries and territories globally to date, impacting millions of students (2).[2] These closures were often enacted in the early phase of the pandemic when the role of schools in SARS-CoV-2 transmission was uncertain (3). However, multiple studies have since demonstrated that schools are not drivers of SARS-CoV-2 transmission (4, 5). Instead, the incidence of COVID-19 in schools has largely followed that of the local community (6–9).

School closures drastically and rapidly altered the learning context for children worldwide since their introduction in 2020 resulting in the loss of educational and psycho-social supports (10). Despite many settings switching to online learning, school closures have deepened inequalities in education, with a disproportionate impact on children from lower socio-economic backgrounds who are less likely to have access to the prerequisites of effective online learning, e.g., computers, internet access and quiet learning environments. Leading health organizations have recommended that school closures should be used as a last resort to control COVID-19 transmission due to the adverse effects of these measures on children's physical and mental health (11, 12).[3]

In Ireland, pandemic related school closures were first introduced on 12 March 2020 as part of a range of public health restrictions. Schools did not re-open for the remainder of that school year to June 2020 (13).[4] By September 2020, increasing COVID-19 case numbers prompted the re-introduction of many public health control measures, including the closure of many retail shops, restaurants, bars, gyms and limiting public transport to 25% capacity (14).[4] However, unlike during the previous wave of infection, schools were not closed.

To support schools to remain open and develop a more resilient response to COVID-19 in educational settings (i.e., primary, secondary and special schools), dedicated multisectoral and interdisciplinary "Schools Teams" were established within each of the eight regional Public Health departments.

The COVID-19 pandemic has caused widespread disruption to health systems and placed increased demands on finite health system resources. However, there is a paucity of literature describing the potential of multisectoral and interdisciplinary collaboration to successfully address complex public health priorities. Therefore, there is a need to increase the evidence base for such interventions and promote awareness of this model among public health practitioners, health system managers and policy makers.

The aims of this study were as follows:

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[1]   https://www.who.int/news/item/29-06-2020-covidtimeline

[2]   https://data.unicef.org/resources/one-year-of-covid-19-and-school-closures/

[3]   https://www.ecdc.europa.eu/en/publications-data/children-and-school-settings-covid-19-transmission#no-link

[4]   https://web.archive.org/web/20200919034854/https://www.gov.ie/en/publication/2dc71-level-5/

1. To explore the experiences of Schools Teams members in the East of Ireland to identify factors that influenced effective inter-disciplinary working.
2. To discuss how the lessons learnt from the Schools Team model can inform future multisectoral collaborations to address complex public health priorities.

2. Methods

2.1. Schools team structure

Schools Teams were comprised of staff from departments of Public Health and staff redeployed primarily from the government Departments of Education and of Children, Equality, Disability, Integration and Youth. The Schools Team framework was developed at a national level and supported at government ministerial level. Clinical and data governance structures were agreed between stakeholders. Regular communication occurred between national Public Health and Education sector leadership to ensure understanding and confidence in the agreed processes between all stakeholders.

Schools Teams operated according to nationally agreed protocols to respond to cases and outbreaks of COVID-19 in educational settings. Once a COVID-19 case was identified in a student or school staff member, the case was referred to the Schools Team, who contacted the educational setting and performed a public health risk assessment. The objectives of the risk assessment included:

- To determine if a case attended school while infectious, i.e., within 48 h of symptom onset or 24 h of the test date if asymptomatic.
- To consider whether a case was likely infected in the community or part of a school outbreak.
- To determine the close contacts of the case, provide them with appropriate public health advice and refer them for testing *via* a dedicated pathway.
- To support schools in the practical implementation of infection prevention and control guidelines.

2.2. Study design

A mixed methods investigation was designed to identify the specific barriers and facilitators to effective team working among Schools Team members in the East region of Ireland. This team was chosen as it was the largest individual Schools Team (70 members) and covered 32% of the Irish school aged population. The experiences of team members were explored through an online questionnaire. Subsequently, interviews with randomly selected individuals were conducted to gain a deeper understanding of specific topics identified from questionnaire responses.

2.2.1. Questionnaire design

Draft questions were formulated in consultation with a core group of experienced Schools Team members and three pilot interviews were conducted to assess the questionnaire for content and face validity.

The questionnaire contained both open and closed-ended questions. Closed-ended questions were assessed by asking respondents if they agreed with a given statement using a five-point Likert scale. A "not applicable" (NA) option was also included as a potential response for each categorical question. A copy of the questionnaire is available in Supplementary material 1.

All Public Health and Education Schools Team members were contacted by e-mail and provided with information about the study and a link to complete the questionnaire. Online questionnaires were administered using the Jotform survey platform (15).[5] All survey data were collected between 22 December 2021 and 10 February 2022.

2.2.2. Interview design

Complex topics which required more in-depth understanding were identified from questionnaire responses and explored through individual semi-structured interviews. An interview guide was developed to ensure that core themes were covered in all interviews while still allowing flexibility to explore particular issues in line with participants' experiences.

Four team members (two each randomly selected from both the Public Health and Education sectors) were invited to participate in the interview process. All interviews were conducted over video call by a lead public health nurse with extensive experience in communications. The average interview duration was 42 min (range 30–53 min). Interviews were recorded and transcribed using the auto-transcribe feature of Microsoft Teams for Windows (version 1.5.00.9163). Each transcript was manually reviewed by the lead author for accuracy.

2.3. Study population

All staff who worked on the East Schools Team during the 2020/2021 academic year were invited to participate in the online questionnaire, regardless of their duration of service.

2.4. Data analysis

Descriptive statistics were generated using R statistical software and data visualization was carried out using the package ggplot2 (16, 17). Thematic analysis was performed on open-ended responses (18). These responses were reviewed

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5   https://www.jotform.com/

FIGURE 1
Respondent characteristics of East Schools Team survey, Ireland, 2020/2021 academic year.
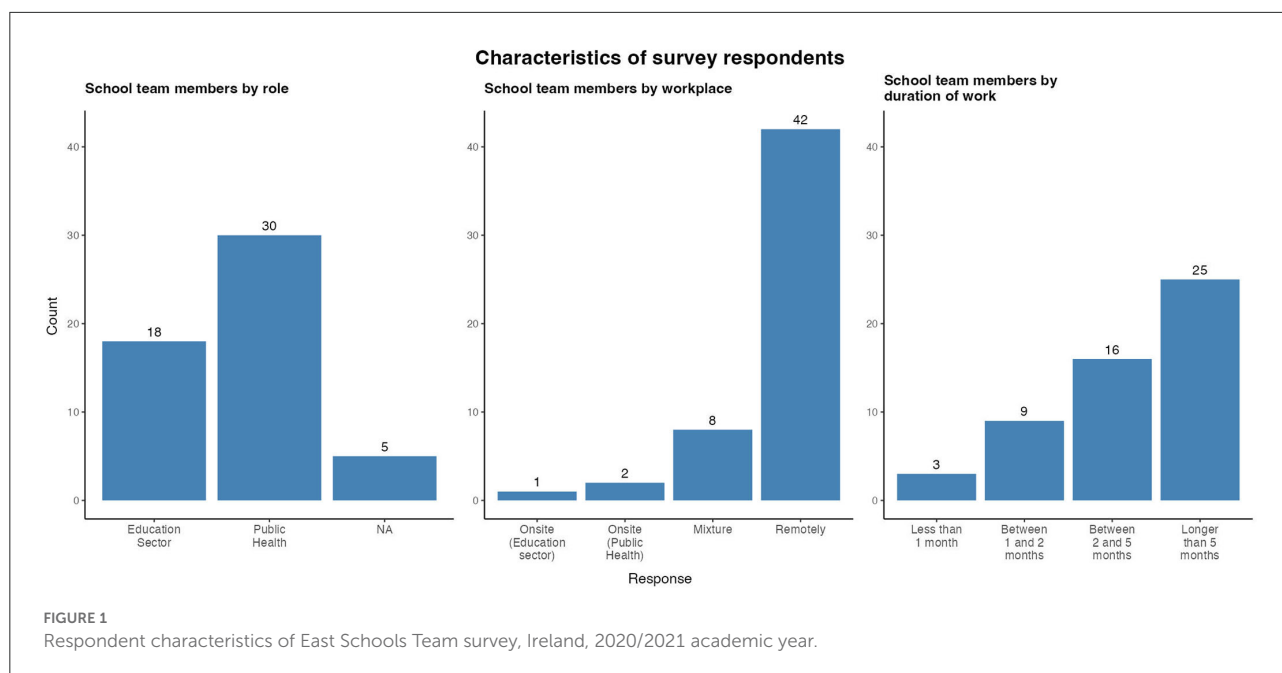
to identify the individual topics raised by each participant. Initial codes were generated for each topic and similar codes were grouped together to identify emerging themes relevant to the study question. This process was repeated several times as more responses became available. The data were examined by the lead author to identify patterns in the distribution of themes among participants and potential relationships between different themes. Data were analyzed using Nvivo – Mac (version 1.6.2) (19).[6]

2.5. Ethics

Ethical approval was not required as this work was a retrospective service evaluation of a public health response conducted under Infectious Diseases Regulations (1981) (20).[7] All collected data was anonymous and work conducted in line with ethical and data protection principles.

3. Results

3.1. Survey respondent characteristics

All 70 East region Schools Team members were invited to complete the online questionnaire. In total, 53 questionnaires were returned, resulting in a response rate of 75.7%.

Public Health staff comprised a higher proportion of respondents (30, 56.7%) compared to Education sector staff (18, 34.0%). No affiliation was declared by 5 (9.4%) participants (Figure 1). The majority of respondents (42, 79.2%) worked completely remotely and almost half (25, 47.2%) of the respondents had worked with the Schools Team for longer than 5 months.

3.2. Data analysis

Following analysis, data from open and closed ended survey questions and semi-structured interviews were grouped into three broad themes: communication, team organization and team culture. Findings concerning each of the broad themes are presented below.

3.3. Communication

Clarity of communication emerged from questionnaire responses as one of the key facilitators of effective team working (Figure 2). The majority of team members (44, 83.0%) agreed or strongly agreed that communications within the Schools Team were clear. Team members reported that the methods of communication used (phone calls, regular e-mail updates, daily virtual team meetings) efficiently disseminated information throughout the team. Several respondents also stated that daily meetings were a source of "moral support" as well as clinical guidance. The switch from telephone conference calls to video calls was identified as improving the clarity of communication

FIGURE 2
Survey results of evaluation of internal communication within East Schools Team, Ireland, 2020/2021 academic year.

FIGURE 3
Survey results of evaluation of external communication to and from East Schools Team, Ireland, 2020/2021 academic year.
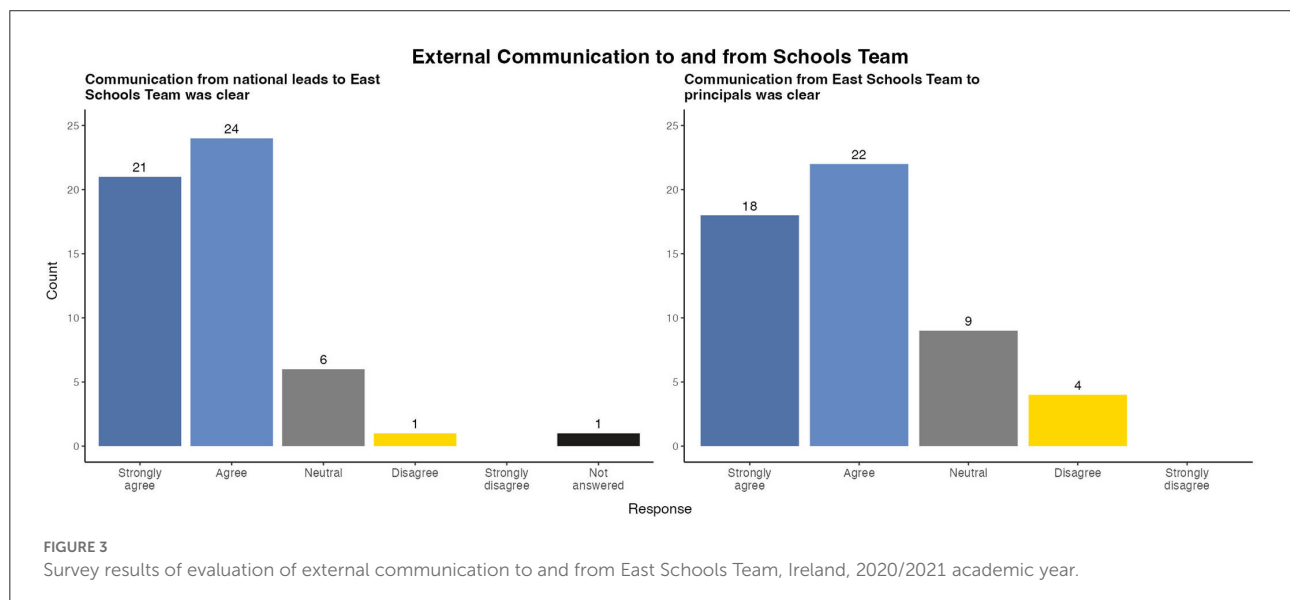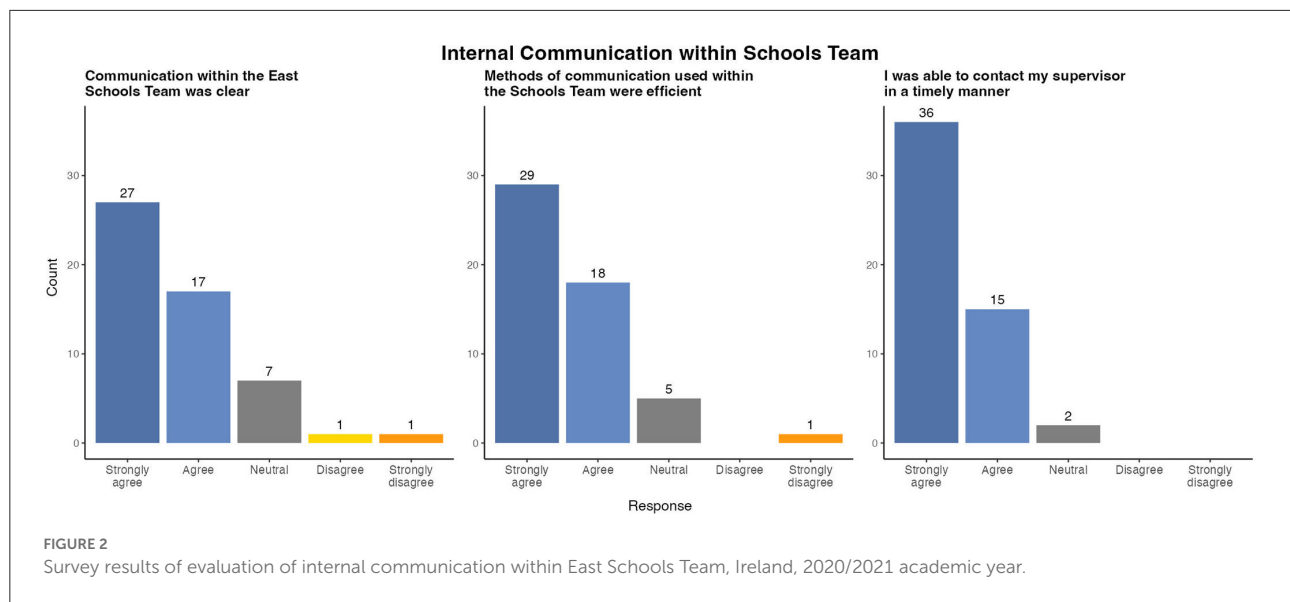
between colleagues when working remotely. Almost all (51, 96.2%) team members agreed or strongly agreed that they had timely access to senior support as required.

> "The effective communication across multidisciplinary teams, for me, was the most impressive part of working on the team."
>
> "Excellent system for keeping in regular contact with the team, despite a lot of the work occurring remotely."

Respondents were broadly satisfied that updates from the national schools leads were clearly disseminated to the East Schools Team (Figure 3). Many respondents credited the multisectoral composition of the team with improving the

effectiveness of communication with school principals. Several Education sector staff reported that their knowledge of the school environment and existing rapport with principals allowed them to provide more relevant guidance.

> "The communication was understood and translated by the Department of Education staff in a way to principals that made sense."

However, 9 (16.9%) participants felt neutral and 4 (7.5%) disagreed with the statement that messaging from the Schools team to principals was clear. This finding was explored in individual interviews which identified media reports and rumors of potential changes in COVID-19 guidance as barriers to communication with principals.

> *"Communications [with principals] were often confusing as there appeared to be conflicting advice coming from different quarters. A lot of time was spent clarifying queries which emanated from disinformation that principals had encountered in various quarters."*

Delays in receiving positive case notifications or duplicate notifications were also highlighted as barriers to effective communication with principals. Several respondents attributed these issues to insufficient administration staff.

> *"Unfortunately, sometimes there was mass duplication in the system and principals became frustrated when they received multiple calls from the Schools Team."*

3.4. Team organization

Clear and concise standard operating protocols were regularly identified by participants as facilitating effective team working. Team members reported that written protocols helped to define their roles and responsibilities and provided clarity on who to contact if they required support. Respondents stated that standardized protocols ensured a consistent approach across all settings and helped to empower them when communicating advice to principals. However, some respondents stated that the high frequency of protocol updates was challenging to implement, especially when principals had become familiar with a previous protocol iteration. The majority agreed that all updates were disseminated to the Schools Team in a timely manner (Figure 4). These findings were echoed in open ended questionnaire responses.

> *"Well written protocols, clear from an operational perspective."*
> *"The visual algorithms were extremely useful for new recruits to the Schools Team."*
> *"Updated iterations communicated to all team members in a timely manner; demonstrations undertaken when there were any major updates."*

Team members reported that standardized protocols facilitated efficient working and increased the number of case notifications which they could process per day. Despite these efficiencies, some respondents found managing the high expectations of schools to be challenging, for example receiving phone calls from schools outside of normal working hours.

Formal training in standard operating protocols, team organization and methods of communication within the Schools Team was identified as a concern by some respondents. In total, 14 (26.4%) respondents disagreed or strongly disagreed that they received adequate training prior to commencing work with the East Schools Team. Many of these respondents joined the

team later in the academic year and reported receiving helpful "on the job" training instead which involved shadowing existing team members. While new team members found this training useful, it led to an increased work load for the experienced team members conducting training.

> *"The opportunity to shadow colleagues was very helpful and important."*
> *"I think we got a lot of training at the very beginning, but once new team members arrived, they got a lot less and we had to take on their training."*

However, following the completion of training the majority of team members felt comfortable with their role and responsibilities in the Schools Team.

3.5. Team culture

A positive team culture was highlighted by both Public Health and Education sector staff as one of the strongest facilitators of effective working (Figure 5). The majority (41, 77.4%) of respondents strongly agreed that there was a culture of support, openness and respect within the Schools Team and this was reflected in open ended responses.

> *"It was a lovely culture, was lovely and supportive, you know, everybody got along. It was a great team vibe."*
> *"It was a very, very enjoyable working environment."*

Despite working largely remotely, a number of respondents referenced the positive working relationships which developed between staff from various disciplines over the academic year.

> *"I suppose the thing that stood out for me really was the relationship that built up between the Department of Education people and Public Health."*
> *"For me, the thing that worked the best was the really positive good collaborative relationships."*

Team members stated that the collaborative team atmosphere was especially helpful when dealing with complex cases.

> *"I felt we weren't doing this in isolation or you weren't just stuck in your room or your office, but that there was a community there around you and supporting you."*

When asked about the effectiveness of the Schools Team, 39 (73.6%) respondents strongly agreed that they felt they had successfully mitigated SARS-CoV-2 transmission in schools. Several respondents linked this sense of achievement as contributing to a positive team environment.

FIGURE 4
Survey results of evaluation of team protocols and training within East Schools Team, Ireland, 2020/2021 academic year.

FIGURE 5
Survey results of evaluation of team culture within East Schools Team, Ireland, 2020/2021 academic year.
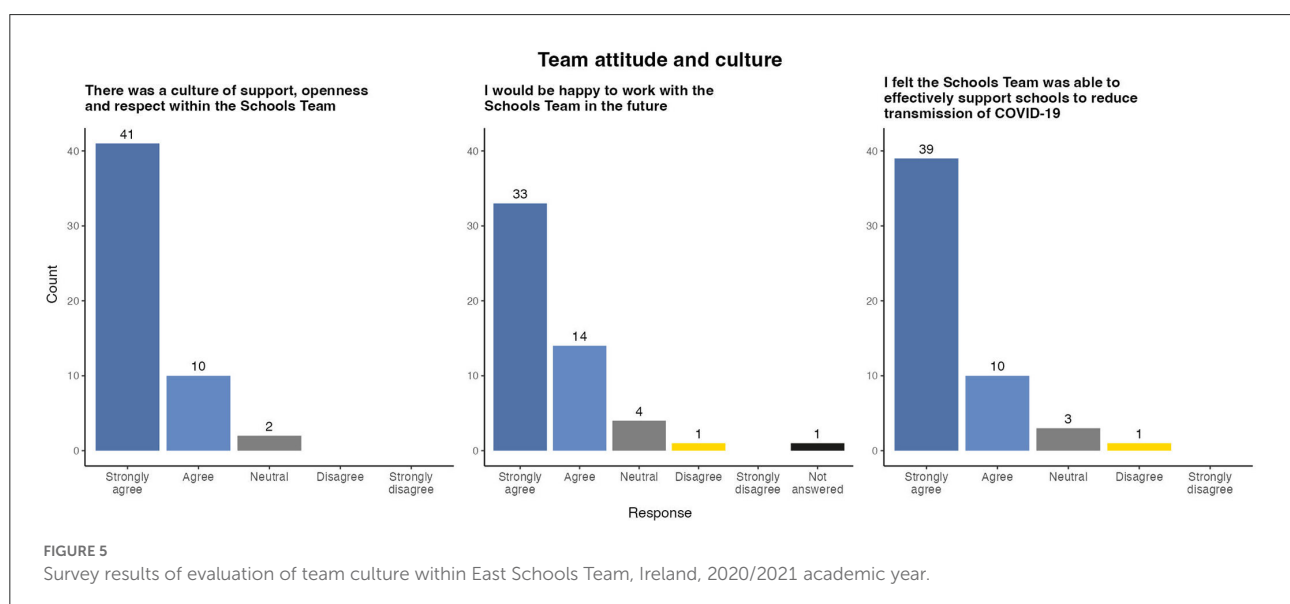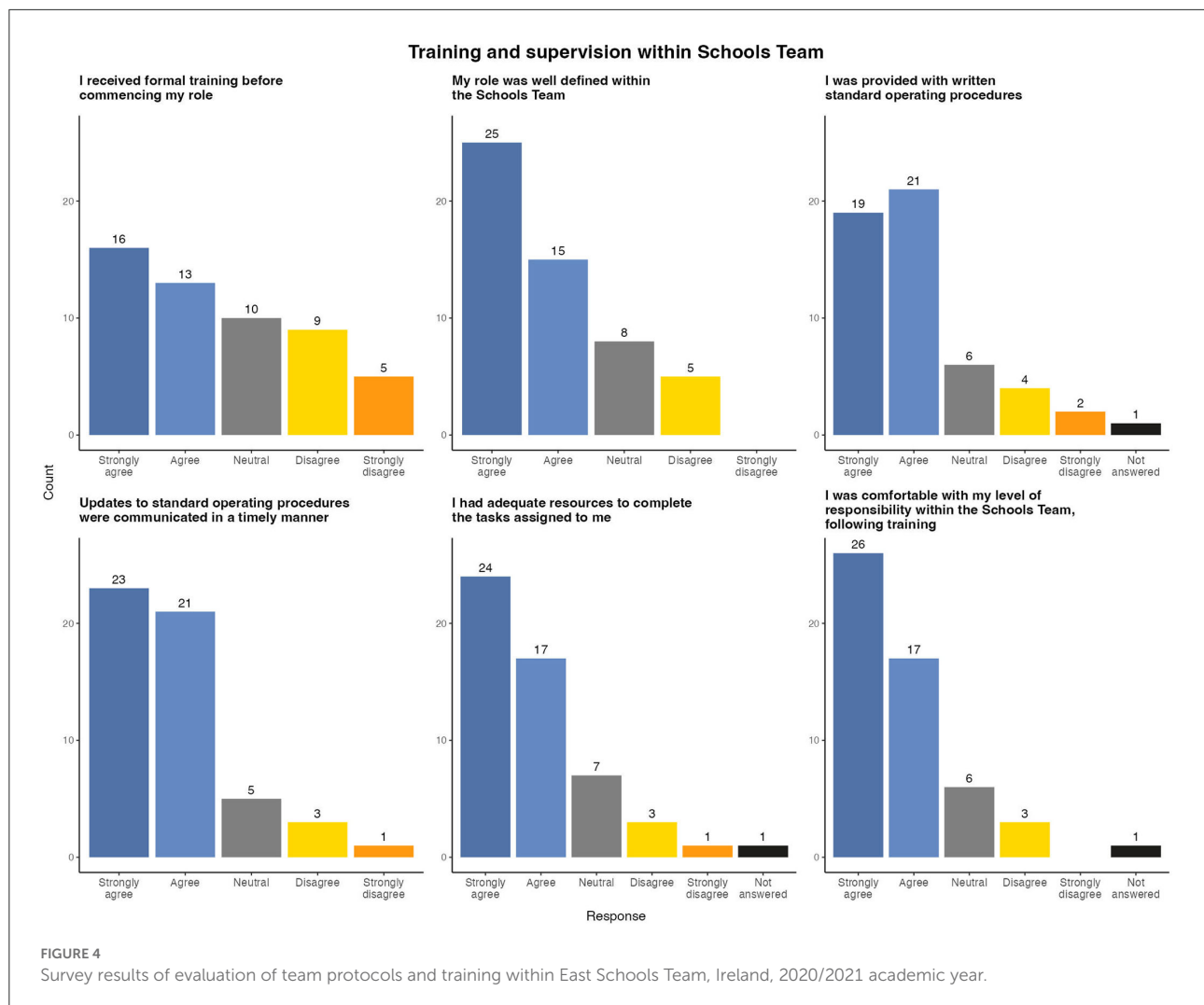
"There was a sense that we were contributing to the 'cause' and I think we all saw that as something very positive."

As a result of their positive experience, the vast majority of respondents stated that they would be happy to work with the East Schools Team again in the future.

4. Discussion

4.1. Consideration of key findings

These findings provide a clear insight into the human and organizational factors which promoted effective multisectoral and interdisciplinary work within the East Schools Team.

Open channels of communication were a key facilitator of early team integration, despite the majority of team members working remotely. Regular team meetings allowed the majority of issues to be addressed proactively, and accessible senior support allowed for timely discussion of urgent issues. Standardized protocols improved workflow efficiency by enabling team members to work with as much autonomy as possible, while accessing senior support as needed. When combined with training, this increased autonomy empowered all individuals (clinical and non-clinical) to maximize their contribution to the Schools Team and reduced barriers between staff from different sectors.

The multisectoral model enhanced the effectiveness of the Schools Team by leveraging the strengths of each sector. Public Health staff ensured that team protocols reflected the national guidance and optimal health protection approach to SARS-CoV-2 mitigation while Education sector staff utilized their knowledge of the practical challenges faced by principals to effectively implement guidance at local school level. A positive team culture also played a key role in fostering a proactive and unified team atmosphere. Team members benefited from formal and informal peer support and reassurance when dealing with challenging cases and a busy workload. The sense of contributing to the important national public health effort to keep schools open galvanized team members during challenging situations and promoted a positive work ethic. This was reflected in individuals' willingness to adapt their work practices significantly (e.g., longer days, weekends) compared to their previous posts.

This survey also identified factors which acted as barriers to effective multisectoral working. Conflicting media messaging and rumors of potential changes to COVID-19 guidance caused frustration among Schools Team members when communicating with school principals. Standardized protocols were updated regularly to reflect changes in national guidance. However, the frequency of these updates was identified as a source of frustration among principals and required regular re-training sessions for Schools Team staff. The formation of

the Schools Team occurred during waves two and three of the COVID-19 pandemic in Ireland, and the associated additional workload for the Public Health department was a challenge. Consequently, the level of administrative support available to the Schools Team was reduced at times resulting in late or duplicate COVID-19 case notifications, which caused frustration among team members and confusion among principals. Despite these challenges, the majority of team members stated that they were willing to work with the Schools Team again in the future, reflecting the successful integration of various disciplines into a single effective team.

4.2. Strengths and limitations

The high response rate (53/70, 75.7%) and number of respondents to the online questionnaires ($n = 53$) add to the validity of the findings and were above average for similar mixed methods investigations ([21], [22]).

However, in common with similar survey based evaluations, this dataset was susceptible to a number of sources of potential bias. No information was collected about the characteristics of non-responders and it was not known if this group differed systematically from those who did respond. However, the high response rate may have mitigated the risk of responder bias.

Semi-structured interviews were conducted over video call and were thus more susceptible to social desirability bias compared to written questionnaires, despite assurances given to interviewees that no identifiable information would be retained. The small number of semi-structured interviews ($n = 4$) limits the generalizability of the insights gained from this process.

While this evaluation was conducted specifically on the Schools Team in the East of Ireland, the formation of Schools Teams was a national public health initiative, with similar teams established in the other Public Health departments in Ireland. It is, therefore, possible that the barriers and facilitators to effective multisectoral team working identified by this study may not be generalizable to the experiences of Schools Teams working in other regional Public Health departments.

The assessment of the effectiveness of the Schools Team to mitigate SARS-CoV-2 transmission was analyzed in terms of the subjective experiences of schools team members only. No quantitative data to this effect was collected in this study.

4.3. The schools team model as an enabler for health system resilience

The COVID-19 pandemic has highlighted the importance of ensuring that health systems can "prepare for, manage and learn" from severe shocks ([23]). The multisectoral Schools Team model provides a framework for how the expertise and capacity of allied sectors may be recognized and leveraged to increase

health system resilience in the face of unforeseen shocks. The Schools Team exhibited several characteristics associated with health system resilience, as outlined below, which may be used when designing future similar initiatives (23, 24).

The flexibility demonstrated by all stakeholders during the initial establishment of the Schools Team, at both national and regional level, ensured the most efficient use of resources available to the health system. This whole of government approach allowed the Public Health and Education sectors to adapt to an acute shock without sacrificing the provision of core services. Effective governance allowed national co-ordination of roles and responsibilities between various stakeholders. Such leadership ensured consistent best practice operating protocols were implemented by all Schools Teams nationwide and avoided the fragmented approach associated with less resilient and inefficient organizations (25).

Effective communication between Schools Team personnel at the national and regional levels was promoted by regular reporting of COVID case numbers and timely dissemination of updates to operating protocols. This efficient information flow was a key facilitator of informed decision making among Schools Team leadership and ensured that the overall team objectives were communicated across all stakeholders. The resulting culture of open communication encouraged staff to share new ideas to improve the effectiveness and relevance of team protocols and is recognized as a vital factor in organizational resilience (26, 27).

This study also demonstrated that a congenial work culture not only facilitated effective collaboration, but meant that Education sector staff were willing to work with Public Health, if required, in the future. This indicates the strength of the working relationships formed between Education and Public Health during the pandemic response. These relationships need to be maintained and nurtured in the post-pandemic recovery phase to ensure that the connections are not lost and that future collaboration between the sectors will be possible to address new health threats that may emerge. Similarly, as public health practitioners endeavor to address the challenges posed by complex population health problems in the post-pandemic phase, such as the climate crisis, obesity, and the growing burden of mental health disorders worldwide, a holistic approach beyond Public Health alone will be required.

4.4. Application of the Schools Team model to other public health priorities

Despite the advantages of multisectoral partnerships and their potential to benefit population health, this model remains uncommon within public health practice. This deficit may be due to either a lack of evidence to demonstrate the benefits of collaborative working, lack of mechanisms to

support similar initiatives, lack of multisectoral accountability for health issues or lack of awareness among public health practitioners and senior health managers. An absence of similar teams in other international jurisdictions precluded comparison of the Schools Team model against existing benchmarks and highlighted the need to improve the evidence base of multisectoral and interdisciplinary working by ensuring service evaluations are integrated into future initiatives. The potential for the application of the multisectoral Schools Team model to other complex public health priorities are considerable.

The strong links established between the public health and education sectors to develop the Schools Team model should be extended and strengthened to more effectively pursue specific public health priorities in school settings. Two such priorities we suggest are school-based vaccination uptake and health promotion initiatives. Pandemic related disruption of school based vaccination programmes have contributed to the ongoing public health threats posed by vaccine preventable diseases, e.g. measles, polio. Lessons learned from the Schools Team initiative are particularly relevant in the application of multisectoral partnerships to optimize vaccine uptake in schools, and inform further collaborative working between public health and education sector professionals to ensure consistent vaccine-related communication and delivery in school settings. Such initiatives would also provide a vital resource to address vaccine mis-information which may be targeted at parents and schools.

The lessons highlighted by this study also extend to non-infectious disease public health priorities in school settings. The creation of environments supportive of health and the development of personal skills are cornerstone components of the Ottawa Charter for Health Promotion and schools represent a key setting where these components can be delivered (28). Effective collaboration between Education and Public Health sector professionals should support development and enhancement of health promotion initiatives to make the healthy choice (e.g., diet, exercise, active transport) the easy choice for students and staff alike.

The Schools Team model could also guide the formation of linkages between Public Health and non-Education sectors to proactively address public health priorities outside of the school setting. Given the growing complexity of modern infectious disease threats, initiatives could include the development of a formal collaborations with government and non-governmental organizations, to enhance efforts to mitigate disease transmission in congregate settings such as accommodation centers for refugees. The ongoing war in Ukraine and resulting mass population displacement has highlighted the need for a such a coordinated approach between Public Health and other relevant sectors in this regard (e.g., justice and social protection departments). Collaboration

with agricultural sector colleagues could also be promoted to support the One Health approach in balancing the health of people, animals and the environment, and protect the population against increasingly complex health threats across these domains.

5. Conclusion

The increasing scale of public health concerns underscores the need to better understand and promote factors which contribute to health system resilience. The Schools Team model illustrates the potential of multisectoral partnerships to effectively address complex public health priorities. However, increased awareness of this model is needed among public health practitioners and policy makers if this potential is to be realized.

The factors which contributed to the success of this initiative provide vital learning to enhance the ability of health systems to maintain core services in the face of unforeseen acute shocks. More broadly, mechanisms to support multisectoral working should be developed, monitored and evaluated expanding beyond reactive interventions to proactively address key health priorities which foster recovery and build resilience across health systems and communities. Such collaborations would promote healthier populations by promoting and encouraging a public health perspective among other sectors and embedding "health in all policies".

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

Acknowledgments

Conflict of interest

CK was employed by PricewaterhouseCoopers, while undertaking a Management Consulting Fellowship with the Royal College of Physicians of Ireland and PricewaterhouseCoopers (July 2022 to July 2023).

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1072566/full#supplementary-material

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Check for updates

Risk communication and community engagement as an emerging pillar of health emergency management in Iran: Achievements and the way forward

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This article is part of the Research Topic Health Systems Recovery in the Context of COVID-19 and Protracted Conflict.

Risk communication and community engagement (RCCE) is an essential component of emergency preparedness and response. In Iran, RCCE is a relatively new area of public health. During the COVID-19 pandemic in Iran, the national task force relied on conventional methods, which is to utilize existing primary health care (PHC) structure to implement RCCE activities around the country. The PHC network and the community health volunteers embedded in it enabled the country to bridge the health system and communities from the very beginning of the COVID-19 pandemic. The RCCE strategy to respond to COVID-19 was adapted over time with the development of a national program, commonly known as the "Shahid Qassem Soleimani" project. This project consisted of six steps including case detection, laboratory testing through the establishment of sampling centers, scale up of clinical care to vulnerable groups, contact tracing, home care for vulnerable population, and COVID-19 vaccination roll out. Nearly 3 years into the pandemic, the importance of designing RCCE for all types of emergencies, allocating a dedicated team to RCCE, coordinating with different stakeholders, improving the capacity of RCCE focal points, practicing more efficient social listening, and using social insight for better planning were identified as some lessons learned. Further, Iran's RCCE experience during the COVID-19 pandemic underscores the importance of continuing to invest in the health system, particularly PHC.

KEYWORDS

risk communication, community engagement, COVID-19, health hazards, infodemics

Introduction

Coronavirus disease 2019 (COVID-19) outbreak took the world by surprise, as SARS-CoV-2 virus rapidly spread from Wuhan, China to 114 countries giving rise to more than 118,000 confirmed cases and 4,291 deaths by the time the outbreak was declared a pandemic by the World Health Organization on 11 March 2020 (1). Soon thereafter, countries around the world started closing their borders, and public health officials urged people to wear masks, social distance, and practice hand hygiene (2). As people were urged to stay home amidst increasing uncertainty of the pandemic's trajectory, the pandemic heightened their anxiety.

The COVID-19 situation in the Islamic Republic of Iran was no exception. The first case in the country was a 68-year-old man, who was admitted to a hospital on 12 February 2020 in Qom, a holy city that welcomes thousands of tourists every year. He tested positive for COVID-19 on 19 February 2020, along with six additional confirmed cases from the same city. All seven confirmed cases lost their lives as of 23 February 2020 (3). The virus rapidly spread to neighboring areas, such as Tehran, Markazi, Isfahan, and Semnan provinces (4).

Between 19 February to 16 March 2020, Iran had the highest number of confirmed cases after China and Italy and was the hardest hit country in the WHO's Eastern Mediterranean region, with 14,991 cases and 853 deaths (4). A national task force for the COVID-19 response was formed under the President's office, and the Ministry of Health and Medical Education (MoHME) took the technical lead in the task force. As of January 2023, this task force continues to have the highest authority in the management of COVID-19. It serves as a coordination forum and advises on intersectoral collaboration and coordination, policy making, and monitoring and evaluation of outbreak control strategies, including surveillance, epidemiological investigation, contact tracing, points of entry, laboratory detection, infection prevention and control, case management, and vaccination. The task force also put in place a range of nonpharmaceutical public health and social measures (PHSM) to contain the virus spread around the country, such as closure of public places including schools and universities, travel ban, reduced working hours, COVID-19 hotlines, online screening platforms, and awareness raising campaigns (Figure 1) (5). Risk communication and community engagement (RCCE) emerged as an essential component of these aspects of the COVID-19 response.

According to the World Health Organization, risk communication is "the real-time exchange of information, advice and opinions between experts or officials and people who face a threat (hazard) to their survival, health or economic or social wellbeing" (6). Further, community engagement refers to "a process of developing and motivating relationships that enable stakeholders to work together to address health-related issues and promote wellbeing to achieve positive health impact and outcomes" (7). In its ideal form, RCCE is a proactive, two-way and iterative interaction between public health professionals and affected populations concerning a health-related hazard, with an intent to build trust to maximize appropriate prevention and control behaviors and actions in a health emergency. RCCE empowers individuals from the affected populations to make informed decisions, not only to protect themselves from the hazard but also to contribute to improving the health of others in their communities. At the same time, it enables public health professionals to establish effective means to protect the health of the population.

The use of RCCE as a guiding tool in emergency response is relatively new although elements of RCCE, particularly one-way risk communication to communities, have existed for decades. The field has evolved from risk communication, which is one-way provision of health information to communities, to risk communication and community engagement, which involves two-way communication to encourage participation by people in affected communities to co-create and disseminate knowledge and information. RCCE has direct benefits in mitigating health-related risks in disasters (8, 9), as it can play a role in managing mis- and dis-information and infodemics (10, 11), and in maximizing local capacities to shape an emergency response (12, 13). In Iran, the health workforce has increasingly recognized the significance of community engagement and resilience in disaster and emergency preparedness (14). RCCE in the early phase of the COVID-19 outbreak relied on conventional methods that have existed in the country since 1985, the year when the foundations of primary health care (PHC) in Iran were laid. As the pandemic evolved, the health authorities began to acknowledge the importance of listening to communities to enable RCCE activities and also significantly expanded the range, reach, and intensity of two-way communication.

Recognizing the continued importance of RCCE in future emergency preparedness and response, we reflect on the COVID-19 response in the country, in particular, to describe conventional RCCE methods that were employed in the initial public health response, ways in which the RCCE strategies adapted over the course of the outbreak, and a future direction based on the lessons learned.

Risk communication and community engagement approaches at the onset of COVID-19 outbreak

Pre-existing structure of primary health care and community health volunteering in Iran

PHC in Iran has a robust network, consisting of four main types of primary health facilities:

1) Health houses serve rural areas with their locations depending on the geography of the catchment area. They are staffed by "Behvarz", who have received a two-year certified training, and deliver health services to approximately 700 people;
2) Rural comprehensive health centers cover five health houses or approximately 7,500 people;
3) Health posts in urban areas provide care to 2,500 people, which are supported by family health care providers known as "Moragheban-e-salamat", who enter the workforce with bachelor's level health-related education; and
4) Urban comprehensive health centers which oversee the day-to-day operation of three health posts provide healthcare to roughly 30,000 population.

Within this PHC structure, there are community health volunteers who are directly and regularly trained and supervised by the four types of health facilities. These volunteers are known as "Rabetan-e-salamat" and "Safiran-e-salamat", and they both provide health education and personalized follow up for medical or health related issues. The former is assigned to a neighborhood, which is the catchment area, whereas the latter serves in an "ambassador" role to obtain knowledge from the health facilities and transfers it back to her own extended family (15).

Leveraging the pre-existing capacity of PHC and community health volunteers during early stages of the pandemic

PHC serves as the first point of contact of all individuals who are seeking healthcare, and thus provides a structural foundation of effectively responding to health emergencies (16). In this system,
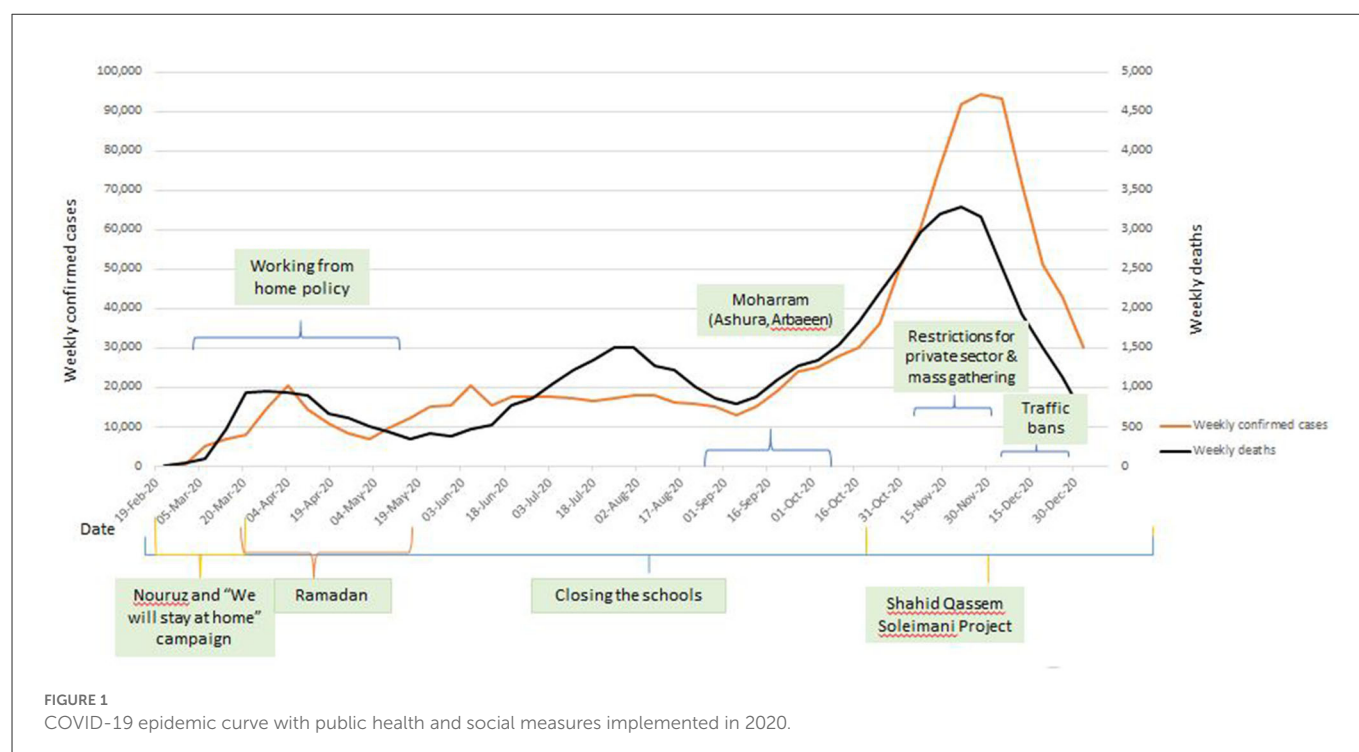
FIGURE 1
COVID-19 epidemic curve with public health and social measures implemented in 2020.

TABLE 1 Six steps of the national COVID-19 response project.

1- Screening and case detection of the catchment population through phone interview by community health volunteers, hotline, and self-reporting platforms
2- National mobilization of laboratory screening through the establishment of sampling centers in selected COVID-19 health facilities
3- National mobilization to scale up clinical care to those who could not receive necessary health care services
4- Conduct contact tracing, home care for vulnerable population, and neighborhood care through the support of the Iranian Red Crescent Society and local voluntary organizations
5- National mobilization for COVID-19 vaccination roll out
6- Encourage maximum community engagement in response to COVID-19 for vaccination, public health and social measures, and collaboration coordination of all governmental and non-governmental organizations, institutes, and offices using new technologies

community health workers (CHWs) are provided with sufficient training on how to interface with members of their community to transfer knowledge from health authorities and listen to concerns raised by communities. Concerns or questions are then brought back to the health authorities to be addressed or responded to, and the feedback loop continues. In parallel, the community members spread the knowledge gained to their peer groups.

Given PHC's routine scope of work that includes health education, public health awareness raising campaigns, health promotion, community and stakeholder engagement, one of the most recognized community engagement activities in response to COVID-19 was leveraging the capacity of existing community health volunteers in PHC. They were actively involved in communication with suspected, probable, and confirmed cases, providing them with health information regarding when and how to visit their physicians

and how to prevent transmission to others. In addition, the volunteers played a role in contact tracing by obtaining information regarding contacts from the cases and monitoring the health condition of the identified contacts. Since the onset of COVID-19, Behvarz and Moragheban-e-salamat have received additional courses on COVID-19 to improve their knowledge and practical skills.

Both types of community health volunteers (Rabetan-e-salamat and Safiran-e-salamat) supported other members of the community to participate in co-creating the information and message transfer to all target groups. For example, the Ministry of Health continuously provided up-to-date COVID-19 information to CHWs, who repackaged it in a culturally appropriate manner for their target audiences. Likewise, the information was made accessible to those with special needs or disabilities. For example, Behvarz disseminated COVID-19 related messages orally to those who were illiterate or blind. The volunteer system in the country was able to reach a wide range of populations, which also included people living with addiction, pregnant women, people living in remote areas, and refugees.

Adapting the risk communication and community engagement structure to respond to COVID-19

The national COVID-19 task force developed a program for the prevention and control of COVID-19, commonly known as the "Shahid Qassem Soleimani" project, named after a late military official, based on national priorities. Six priorities were implemented in a stepwise approach, with each step building on preceding step(s) (Table 1) while RCCE strategies and activities were adapted to suit the objectives of each step or priority.

In the first step, the screening of individuals was conducted for active case finding purposes. The community health volunteers called by telephone suspected and probable cases and associated contacts in their catchment area to monitor symptoms that would meet the COVID-19 case definition (17). Those who had symptoms were promptly referred for testing and/or clinical care. The community health volunteers also gathered data of suspected cases and entered the data either into a dedicated online surveillance database of the MoHME or delivered the data to Moragheban-e-salamat to be compiled into the integrated health platform.

The second step was aimed at expanding sampling and testing of suspected cases to break the chain of transmission. The community health volunteers, along with other governmental and non-governmental organizations, conducted rapid assessment of self-reported suspected cases, people over 60 years old, individuals with underlying medical conditions, and other high-risk groups (e.g., pregnant women) for this purpose. Additionally, the volunteers were trained to assess high-risk contacts during their visits to houses and recommend laboratory testing as required, thereby contributing to contact tracing efforts in the community.

The third step was dedicated to ensuring provision of routine care to those with chronic conditions who were refused care due to COVID-19 related concerns. Those who were deemed to be at high risk yet were not receiving their routine medical care were identified and abstracted from an integrated health platform of the MoHME. They were subsequently called by CHWs and volunteers, not only screening them for COVID-19 but also inviting them to come to PHCs to receive their regular health services. Through this step, 95% of the at-risk population received telephone calls from community health volunteers (MoHME data).

The fourth step was devised to manage and control the COVID-19 pandemic with public participation and coordination between two departments of the MoHME, namely Education and Health Promotion and Public Relations, specifically in the areas of contact tracing, home care for vulnerable population, and neighborhood care. In this step, RCCE efforts were scaled up with the establishment of four sub-teams:

a) The surveillance-care team was responsible for active tracing of patients, following up *via* phone calls, performing the rapid test, and providing home care;
b) The monitoring team was responsible for supervision and monitoring the quality of implementation of health instructions in public places. Members of this team were recruited from Iranian voluntary organizations;
c) The support team was responsible for supporting the families of patients and people who were in home isolation or quarantine, as well as people who experienced economic losses due to the mandatory health protocols; and
d) The risk communication and community engagement team was responsible for educating patients and families, public education, and managing infodemics and rumors. Training topics included media literacy, quarantine, hygiene guidelines, and, in the fifth step, persuasive communication to maximize vaccination uptake. Persuading governmental and non-governmental organizations to provide health and educational services in a PHC context was also performed by this team.

The RCCE methods in the fourth step carried over to the fifth step, making RCCE critical in the nationwide vaccination roll out. In this step the RCCE task force ramped up RCCE efforts by utilizing the influential power of religious leaders, athletes, artists, and experts as a key strategy in awareness raising campaigns to minimize vaccine hesitancy. To further entice people to get vaccinated, a travel ban was introduced for those who have not been fully vaccinated. As of November 2022, 82% of the population received their first dose of a COVID-19 vaccine, and 69% are fully vaccinated (MoHME data).

In addition to RCCE activities that were implemented under the six priorities of the "Shahid Qassem Soleimani" project, both official and unofficial efforts were made to enhance public health response. As with any health emergency response, a spokesperson was appointed at the national level, and additional spokespersons were designated in each of 64 universities of medical sciences in the country. Many campaigns were organized virtually as well as in person with the spokesperson delivering messages that had been generated and agreed by the COVID-19 task force. Such campaigns raised awareness about COVID-19, offered advice on how to prevent and treat it, and stressed the importance of adhering to PHSMs. Moreover, a new national committee was formed to recommend a variety of other RCCE activities which were endorsed by the MoHME, Ministry of Education, Ministry of Culture and Islamic Guidance, and Ministry of Higher Education, among others. A notable example is social listening, which is intended to "track, analyze and synthesize community inputs both digitally and offline" (10). To enable it, existing hotlines of MoHME and social welfare organization were repurposed for COVID-19 response so that resources could be dedicated 24 hours, seven days a week to respond to questions, concerns and critical opinions of the public as well as to provide free counseling on psychosocial issues. More informally, public health response relied on Iran's charity network to secure and distribute masks, hand sanitizers, food, and other necessities to vulnerable communities (18).

Lessons learnt and persistent challenges to RCCE during the response to COVID-19

While Iran's health system structure proved to be advantageous, COVID-19 certainly tested RCCE in this structure, as RCCE in Iran is not designed for all types of emergencies. Moreover, a dedicated unit or team specifically for RCCE did not exist in the government structure at the beginning of the pandemic. Consequently, there was limited coordination among different stakeholders which resulted in numerous duplications or incongruent activities (19). However, COVID-19 propelled the country to strengthen its RCCE structure. For example, the Education and Health Promotion Department of MoHME developed the RCCE national plan, in consultation with relevant stakeholders in various parts of the government, non-governmental organizations, and the media, to ensure multisectoral coordination and collaboration. Further, provincial universities have been involved in the implementation of RCCE activities to reach broad catchment areas and a variety of target groups.

At the beginning of the pandemic, RCCE focal points of the MoHME and in provinces did not have sufficient training and capacity to effectively and efficiently deliver RCCE interventions.

For example, although media monitoring had been in place, it was not sufficiently organized to encourage community participation and community resilience. Moreover, while 73% of Iranian people followed COVID-19 news *via* social media as well as national mass media (20), there were insufficient mechanisms to capture community insight and track misinformation and dis-information. In addition, these insights were not monitored for outbreak response purposes, resulting in missed opportunities to generate and disseminate appropriate responses to concerned communities.

Another notable lesson learned is the need for operational research in the area of RCCE during outbreaks and other health emergencies. While many studies, such as knowledge attitude and practice surveys, were conducted both nationally and at the provincial level, there was insufficient emphasis on knowledge translation. Thus, study results were not applied in real time to inform the RCCE response and translate into policy. Using evidence and insights from communities to adjust strategies during an emergency response would reduce the duration of the emergency as well as morbidity and mortality of the affected population (21, 22). Similarly, studies aimed at understanding the feedback loop between health professionals and affected populations would provide insight on information flow, mediating factors, and actions taken, which would in turn strengthen two-way communication required for optimizing a health emergency response. The same could be said for the co-creation of information in community settings, which was anecdotally reported but not systematically documented. Studies to understand the capacity of communities and factors that drive community engagement would inform preparedness and response to public health emergencies in the future.

Discussion

Owing to Iran's primary health care network and the community health volunteers embedded in it, the country has had a structure to connect the health system and communities from the very beginning of the COVID-19 pandemic, allowing the implementation of RCCE activities in a systematic manner. The pandemic reinforced RCCE as a critical component in health emergency preparedness and response, and now, 3 years since COVID-19 emerged, RCCE is included in all phases of emergency management (i.e., mitigation, preparedness, response, and recovery) in the country.

Due to its geographical location, Iran faces a number of potential hazards, including natural hazards (e.g., earthquakes), migration of Afghan refugees, and annual cross-border movement of people for mass gathering events, all of which carry a risk of outbreaks. Building on the experiences from COVID-19, Iran has already begun preparing for future health emergencies. Of note, the MoHME in partnership with Tabriz University of Medical Science conducted a workshop to develop a national preparedness and response plan for influenza and other respiratory viruses in July 2022, which will be followed by a simulation exercise. The MoHME also took the lead in hosting a "G5" meeting in September 2022, inviting the neighboring countries of Afghanistan, Iraq, and Pakistan, with the support of the World Health Organization, to strengthen cross-border collaboration to mitigate risks during health emergencies. To prepare for and respond to potential cross-border transmission of high threat pathogens during the pilgrimage of Arbaeen, which is the world's largest annual mass gathering, RCCE was activated to protect at least five million Iranians from health-related hazards, such as heat stroke, food-borne diseases, and traffic accidents, and even stampede and terrorist attacks.

To build on these achievements so that Iran's RCCE can flourish in the future, it is essential to strengthen multi-sectoral coordination, capacity of spokespersons, healthcare providers, community volunteers, and others who are working in RCCE, social listening techniques, community-led initiatives to engage community members, monitoring and evaluation, and reporting. Moreover, recognizing that the effectiveness of RCCE interventions is dependent on public trust and vice versa (23), there is a need to leverage the power of individuals in the community who people trust and those active in social media and to maintain a continuous dialogue between the governmental entities, humanitarian organizations, other actors in disaster management, and the public (24). Finally, improving the level of health literacy would complement RCCE, as it is associated with trust building (25, 26) and can ultimately affect patient outcomes due to health disparities (27).

In summary, Iran's RCCE experience during the COVID-19 pandemic underscores the importance of investing in the health system, particularly primary health care. Considering cultural factors of community engagement, the capacity of voluntary organization and community members are a significant asset in responding to a major health hazard. With unique challenges, such as the economic sanctions including foreign trade, financial services, and technologies, strengthening the capacity in all aspects of RCCE is essential for sustainability purposes, especially considering that certain tools, such as social listening platforms and fact checking services, are available internationally but not in Iran, hindering Iran's ability to fully implement RCCE. Promoting a fair and equitable response to COVID-19 has been extensively highlighted in this pandemic (28), and this guiding principle is perhaps the most important as the country continues to manage the COVID-19 pandemic while addressing health system recovery and resilience and preparing for future health emergencies.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

MK, MS, and SMHB contributed to the main ideas in collaboration with EG, PP, and SJH. MK wrote the first draft of the manuscript. MS as the senior author, critically reviewed, substantially revised, and polished the entire manuscript. All authors contributed to the manuscript review and revision and approved the final version.

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"Beyond just the four walls of the clinic": The roles of health systems caring for refugee, immigrant and migrant communities in the United States

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'

Introduction: Refugee, immigrant and migrant (hereafter referred to as "immigrant") communities have been inequitably affected by the COVID-19 pandemic. There is little data to help us understand the perspectives of health systems on their role, in collaboration with public health and community-based organizations, in addressing inequities for immigrant populations. This study will address that knowledge gap.

Methods: This qualitative study used semi-structured video interviews of 20 leaders and providers from health systems who cared for immigrant communities during the pandemic. Interviewees were from across the US with interviews conducted between November 2020–March 2021. Data was analyzed using thematic analysis methods.

Results: Twenty individuals representing health systems participated with 14 (70%) community health centers, three (15%) county hospitals and three (15%) academic systems represented. The majority [16 health systems (80%)] cared specifically for immigrant communities while 14 (70%) partnered with refugee communities, and two (10%) partnered with migrant farm workers. We identified six themes (with subthemes) that represent roles health systems performed with clinical and public health implications. Two foundational themes were the roles health systems had *building and maintaining trust* and *establishing intentionality* in working with communities. On the patient-facing side, health systems played a role in *developing communication strategies* and *reducing barriers to care and support*. On the organizational side, health systems collaborated with public health and community-based organizations, in *optimizing pre-existing systems* and *adapting roles* to evolving needs throughout the pandemic.

Conclusion: Health systems should focus on building trusting relationships, acting intentionally, and partnering with community-based organizations and public health to handle COVID-19 and future pandemics in effective and impactful ways that center disparately affected communities. These findings have implications to mitigate disparities in current and future infectious disease outbreaks for immigrant communities who remain an essential and growing population in the US.

1. Introduction

The COVID-19 pandemic has disproportionately affected the health of refugee, immigrant, and migrant communities in the United States (1) (hereafter, "immigrant" communities[1]). Although national-level statistics are sparse, immigrant communities have lower COVID-19 testing prevalence, higher COVID-19 positivity (2), more severe COVID-19 (3, 4) infection and mortality rates twice as high as non-immigrant communities (5, 6). The reasons for these disparities fall into three main categories: community context, health system access, and community experience with government agencies (including public health).

At the community level, multigenerational and higher density housing is a source of collective strength for immigrant communities. However, being near family and social support can increase risk of COVID-19 exposure (7). Moreover, immigrants are often "essential" workers and therefore were excluded from "stay home, stay safe" early in the pandemic (8–10). At the level of health system access, systemic racism and xenophobia prevent equitable access to quality healthcare (11). Immigrants are more likely to be uninsured than their peers (8, 12), and uninsured people are more likely to be hospitalized with COVID-19 infection, adjusting for age, race, ethnicity, and comorbidities (13). At the level of experience with government agencies, fear of legal repercussions from immigration policy is associated with increased risk of COVID-19 infection and decreased healthcare utilization (14, 15). Immigrants also face barriers to inclusion in public health programs, including case investigation and contact tracing (CICT) (16, 17), prompting calls for improved language access within CICT programs and rapid dispersal of culturally and linguistically appropriate public health messaging (14, 18).

Clinicians are often trusted health information messengers (19). When clinicians and health systems gain the trust of immigrant communities, access to healthcare improves (20). Therefore, health systems are critical stakeholders in the public health response to COVID-19 to ensure that programs are effective and inclusive of immigrant communities (21). There is little data, however, describing how health systems serving immigrant communities have navigated the public health response

to the COVID-19 pandemic (22). We aim to address this gap in the literature.

2. Methods

2.1. Study design

We used a qualitative interview study design with data collected for a qualitative needs assessment at the National Resource Center for Refugees, Immigrants and Migrants (Supplementary material). The project was deemed non-human subjects research by the University of Minnesota and exempt by the University of Washington. This exemption status was granted given participants were members of health systems and considered non-vulnerable participants.

2.2. Study population

To capture the scope and variation of health system involvement in the public health response, we recruited participants through stratified purposive sampling (23) across specialities, resources, and geography [including all United States Department of Health and Human Services (HHS) regions]. We recruited participants through emails and webforms in existing networks of health care providers, including the Society of Refugee Healthcare Providers, Migrant Clinicians Network, American Academy of Pediatrics Council on Immigrant Child and Family Health, International Rescue Committee, and the Community Leadership Board of NRC-RIM. We sampled health system settings including: academic centers, small rural hospitals, and community health centers. We focused on health systems with established programs serving immigrant communities and anticipated thematic saturation at 20 interviews. Eligible interviewees were individuals from health systems who directly interacted with immigrant communities during the COVID-19 pandemic (e.g., physicians, nurses, administrative staff).

2.3. Data collection

We conducted Zoom interviews which lasted up to 60 minutes between 11/11/20 and 3/25/21, using a semi-structured interview

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1   While we will use the term "immigrant" communities, we understand that these communities are each unique with different and rich histories and lived experiences and are not a monolith.

TABLE 1 Characteristics of participating organizations (*N* = 20).

	Health system providers/leaders (%)
Total number of interviewees	20
Location, by HHS region	
1 or 2 (Boston or New York)	3 (15%)
3 or 4 (Philadelphia or Atlanta)	5 (25%)
5 or 6 (Chicago or Dallas)	3 (15%)
7 or 8 (Kansas City or Denver)	2 (10%)
9 or 10 (San Francisco or Seattle)	7 (35%)
Organizational level*	
Local (City/County)	20 (20%)
State	0
Regional	0
Organizational type	
Community Health Center (could be county, Federally Qualified Health Center [*FQHC*], etc: HRSA definition)	14 (70%)
County hospital	3 (15%)
Academic health system	3 (15%)
Immigrant-specific organization**	4 (20%)
Populations served*	
Refugees	14 (70%)
Migrant workers	2 (10%)
Other immigrants	16 (80%)
Interviewee profession	
Clinical (physician, nurse practioner, nurse)	16 (80%)
Administrator (director, chief medical officer, manager)	12 (60%)
Interviewee identifies as a member of an immigrant community	
Yes	6 (30%)
No	14 (70%)
Interview completed after first COVID vaccine EUA****	10 (50%)

*Organization level was categorized as local (e.g., city or county) even if part of a state-wide, regional, or national group when the operational unit that participated in the interview was focused on a local area. For example, an interview focusing on an FQHC's city-wide programming would be categorized as "local" even if the FQHC was part of a state-wide FQHC network.

**We categorized organizations as "refugee, immigrant, migrant-specific" if the organization as a whole or the operational unit within the organization that participated in the interview (e.g., a state refugee health program within a Department of Public Health) focuses specifically on RIM communities.

***Many organizations work with more than one population.

****December 11, 2020.

The underline denotes Health and Human Services (HHS) regions, Health Resources and Services Administration.

guide. The interviews were audio-recorded and professionally transcribed. Interviewees received no compensation. We collected interviewee demographic information including years in practice, education and healthcare setting *via* REDCap electronic data capture tools to ensure we included the right organizational representatives (24, 25).

TABLE 2 Countries of origin of populations served.

Countries of origin of populations served	
Afghanistan	India
Algeria	Iraq
Bangladesh	Mexico
Bhutan	Morocco
Bosnia	Myanmar
Burma	Nepal
Cambodia	Nigeria
China	Philippines
Congo	Rohingya
Dominican Republic	Russia
Ecuador	Somalia
El Salvador	South Sudan
Eritrea	Syria
Ethiopia	Ukraine
Guatemala	Vietnam
Honduras	

Communities not identified by country of origin: Asylees, Migrant farm workers, and Hmong.

2.4. Data analysis

We developed a preliminary codebook deductively from the interview guide and added inductive codes based on concepts identified in the data. All interviews were coded in Dedoose (26). We held weekly meetings to discuss codebook definitions, emerging codes, and specific excerpts. Finally, we reviewed coded data to identify themes and created a conceptual map of their interrelations based on the thematic analysis methods of Braun and Clarke (27).

3. Results

We completed 20 interviews across all HHS regions (Table 1) representing communities from over 30 countries (Table 2). There were interviewees from 14 community health centers (70%), three county hospitals (15%), and three academic health systems (15%). Fourteen of the health systems worked specifically with refugees (70%), two with migrant farmworkers (10%), and 16 with other immigrants (80%). Ten (50%) interviews preceded the Pfizer vaccine emergency use authorization (28). Each interviewee spoke from their own perspective, while also representing their health system and its collective efforts.

We identified six themes with subthemes: two foundational themes (Table 3) and four operational themes that straddle the inward (organizational/administrative) and outward (patient-facing) roles of health systems (Table 4). The themes are displayed in a conceptual map in Figure 1.

The foundational themes (theme 1 and 2) are identified as they represented a common thread observed in the operational themes and represented the manner in which the operational themes (themes 3–6) were conducted. The foundational themes represent

TABLE 3 Foundational themes.

Establishing intentionality to promote equity	
Recognizing health disparities and anticipating immigrant-specific needs	"This pandemic has highlighted disparities and magnified them." HS10
	"There's no question that there's a history of oppression from the period of being a refugee, being resettled and then having to navigate through the social systems in this country and living at the poverty level for a minimum of a decade before you and your children are able to navigate out of it." HS18
	"For example, yesterday there was a young woman …And she was like, Well, if I test positive, I can't go to work. If I can't go to work, I can't make money and I can't afford housing for my child." HS02
Acting intentionally to provide equitable care	"Being very intentional… really meeting people where they gather." HS22
	"In many places, you see people go online and be able to schedule; our communities can't do that… because of the digital divide. So, our staff are basically calling, and we also set up a helpline that they can call, in different languages." HS22
	"[We] were able to convince all the clinical partners and the county that if a patient showed up at the [health system name] testing center, that they would just get tested without any questions asked … we're one of the only counties in the country that has dramatically oversampled, overtested, our nonwhite population relative to white population." HS04
	"And we work closely with them, as well, to ensure that there's overinvestment in the limited English proficiency populations for the COVID frontline care team so that they're always placed in the high-risk category, meaning they get the special attention from the outset, and so, in that way, it also works closely with the contact tracing teams." HS04
Building and maintaining trust	
Evaluating immigrant patients' attitudes toward the health system	"[Our] patient population is a population that has a very valid history of not always feeling comfortable with the medical profession." HS17
	"Patients get tons of terrible bills that don't make any sense, and they're often shafted because they don't speak English… so people are just really hesitant about the healthcare system." HS16
	"Because a lot of [RIM patients] have a little bit of uncertainty around their immigration status… giving out a lot of information feels pretty uncomfortable." HS12
	"So many people either don't necessarily give us their correct name and information because of fear of discovery." HS02
Enhancing patient trust	"The belief that you can all of a sudden show up and say, 'We're here to help you. Let's give you tests,' doesn't work. And people are still trying to do that, even though it has not worked for a long time." HS16
	"One is before any pandemic to have partnerships in place so that they can be rapidly operationalized for these sorts of crises, and that means years of building trust and sharing of power is probably the biggest thing." HS04
	"But I think harnessing relationships that people trust—like it seems that most refugees have pretty good relationships with their resettlement organizations and other community organizations. So, I think there is a good opportunity for those, um, those organizations to really—to really support refugees." HS02
	"I took it [the vaccine], our CEO took it, and did a video, and [said] 'Hey, if we turn into zombies tomorrow, we'll let you know,' but we did it in front of everyone, and I think that's what kind of generated this trust." HS21

Two foundational themes and subthemes with illustrative quotes from health system providers/leaders.

"how" processes occurred while the operational themes represent "what" processes occurred. We will introduce the foundational themes first to ground the basic approach used to guide actions taken by health system.

In what follows, themes are given in numbered section headings and subthemes are given in italics.

3.1. Theme #1: Establishing intentionality to promote equity

Health systems quickly *recognized health disparities specific to immigrant communities* and responded by *acting intentionally to provide equitable care.*

Early on, interviewees discerned that the pandemic "highlighted disparities and magnified them." One interviewee acknowledged the "oppression from the period of being a refugee, being resettled and then [navigating] social systems... living at the

poverty level for a minimum of a decade." Interviewees noted the disproportionate impact on immigrant communities, including increased COVID-19 exposure risk and more severe disease. They also recognized the challenges communities faced with higher prevalence of comorbidities and lower access to healthcare. Finally, interviewees acknowledged the potential hardships of following public health protocols. One interviewee mentioned a patient who declined COVID testing explaining, "If I test positive, I can't go to work… I can't make money and I can't afford housing for my child."

Interviewees worked to address health disparities, especially through health system responses centering immigrant communities. One interviewee described tailoring access and "being very intentional… really meeting people where they gather," while another mentioned strategies to bridge the digital divide. Interviewees also reported how their health systems addressed disparities in testing prevalence. One interviewee said they "convince[d] all the clinical partners and the county that if a

TABLE 4 Outward and inward facing themes.

Optimizing process	
Developing new processes through information sharing and merging established systems	"We do public testing. The [redacted city name] Housing Authority is somebody that we've partnered with, and we went to all of their different high-density housing locations like the towers we have here and did different, Saturday morning testing." HS17
	"Oftentimes there was a lag of five to seven days before the county health department had the information, so what I did is, any time we got a positive, I immediately contacted the county health department… That really helped a lot, because it took away six or seven days that were being missed because of the way the departments communicate with each other." HS16
Repurposing spaces/facilities	"We've actually had good success in doing school-based testing events, because I think schools are kind of like community health centers. They tend to be trusted spaces for families…". HS14
	"We're using it in a different way. They've actually been doing smaller groups … that's where they all come together, we provide food, they get organized, and it's kind of the distribution point. So, we've used it a lot, just not in the way that we envisioned." HS05

Adapting people and roles	
Repurposing of roles	"The only way we were really involved was by providing interpreters that they could use to help with the contact tracing, to try to see if people would be willing to give more information from someone who spoke their language. I mean, even though they used the language line, maybe they would recognize they knew this person from within the community." HS07
Capitalizing on relationships	"But one of the things we've found in our plan for us to be really effective, we felt like we needed to be partnering with somebody who's really already there doing the work." HS05
	"And we think that leveraging existing community-engaged research partnerships is one way to really adapt quickly to pandemics, not just this one, but in the future...." HS04
	"...these sorts of more grassroots that don't necessarily have much infrastructure but they have really deep social networks." HS04
	"So, it's been pretty easy to be collaborative because he can say what we can do, he can say what public health can do, and then we have just worked together … A lot of the double roles most of us play, it's a lot less bureaucracy to move and partner. It's a little bit more fluid, I would say. I think that was the biggest thing. Just having him in both camps really helped us be more versatile." HS12
Supports to staff	"But they just were carrying so much of this. And so, I think they're toward halfway through, and I was just checking in, and they were saying this was totally the space they needed: not just to be there providing the support but needing support themselves so that they could keep continuing." HS22

Communicating with purpose	
Focusing on the message and the messenger	"I think that we have our work cut out for us in terms of … getting people to understand what COVID is, why it's dangerous, and why a vaccine is really important." HS02
	"...just so that there was a single place for people to at least get some information that was consistent." HS15
	"Find a spokesperson—who's the spokesperson in the community that people know, and trust, and believe, and have them help get the message across." HS07
	"When we have our refugees that are resettled, for instance, they typically get a community liaison through [resettlement agency name] as well, so we have a contact there. They use the WhatsApp to help communicate with their families, and then they also already have a rapport with the families as their community partner, so they'll reach out to them." HS17
Listening to the community	"Communication leaders across nine different languages not only help co-create the messages, but also curate concerns that they're hearing within the refugee communities relative to COVID prevention, testing, and socioeconomic fallout, and bring that back to the group on a daily basis… so that messages can be updated and generated according to what we're hearing on the ground in real time, and also to influence policymakers as to the concerns that are out there from refugee and immigrant communities." HS04
	"Our center was one of the first to develop and utilize the saliva-based test, so we wanted to do that as a less invasive test offering, because in the beginning we heard from the community leaders that there was a lot of misinformation around the swab, both the invasiveness of the swab, as well as the concern that the swab was actually infecting people and was carrying virus." HS18

Reducing barriers	
Reducing barriers to patient care	"So, we stayed open through the whole pandemic. We thought that was really important and valuable. And part of the reason is we specifically located our clinic in a location that's walkable for the vast majority of the population because so many people in our community lack transportation." HS15
	"Where we really pride ourselves is we are the communities that we serve, in many cases, so we have staff who are bilingual, bicultural… so the services that we provide are… not through phone connection; it is understanding and very deeply rooted in the cultures that our patients are from." HS22
	"So, the end of April, we actually had our first what we call community testing day, where we just advertised, we said it's open to the community, anyone, and the idea was barrier-free: you don't need an order, you don't need to be our patient, you don't need insurance." HS07
	"That's another initiative we have going on, is having a line that actually is specifically for people to get an interpreter and get their phone call triaged within the system." HS09

(Continued)

TABLE 4 (Continued)

Reducing barriers	
	"We've had multiple mask handouts now … to literally hand out masks and place them on every door in an apartment complex." HS15
Reducing barriers to emergency assistance	"We have what's called the Refugee Drop-In Center, and they were reaching out to some people to see, like, 'Do you need help applying for unemployment? Do you need help applying for some of those other benefits t hat are available?" HS07
	"Through CARES Act funding through the county, we were basically able to meet any need; it's just a matter of connecting people to that, even things that are very indirectly related to COVID." HS04
	"One of the things we found out very shortly after the pandemic when people were raiding the stores, is they live on lentils, and they have a special type of rice they like, and those were… you couldn't find them, because people were buying all of the dry goods and storing up, and they couldn't find them, and the prices were going up 400 percent. Because of the hospital having its connections through our nutrition services, and so forth, we found resources to be able to provide every family." HS05
Reducing barriers for workers and tenants	"And she was afraid to say all these things because she didn't want to get in trouble with her employer and lose her job forever." HS22
	"I think that's a major issue that pertains to health equity, because if we're talking about patients who are undocumented and don't have a lot of power in the workplace, they need to be supported in this way; whereas people like you or me could potentially work from home and it's a non-issue." HS14
	"So very, very quickly, and this is something that I think all of us on the COVID team here are so proud of, we made good relationships with those employers from the very get-go, so we were able to go into their employment settings where our patients were most vulnerable and provide them with masks, with sanitization support, with temperature screening equipment, all of those different kinds of things as part of our community liaisons outreach toward them." HS17
	"We had some employers that, unfortunately, didn't respond as willingly at the beginning, at the onset of COVID. We were able to use some community influence there with our chamber of commerce, with some of our community liaisons and reach out to those places." HS17

The outward and inward-facing themes (and subthemes) with illustrative quotes from health system providers/leaders.

FIGURE 1
Thematic map demonstrating health system roles on the inward-facing (right of gray line) and outward-facing (left of gray line) aspects of healthcare delivery during the COVID-19 pandemic, enveloped by trust and intentionality. CBO, community-based organization; PH, public health; HS, health systems.
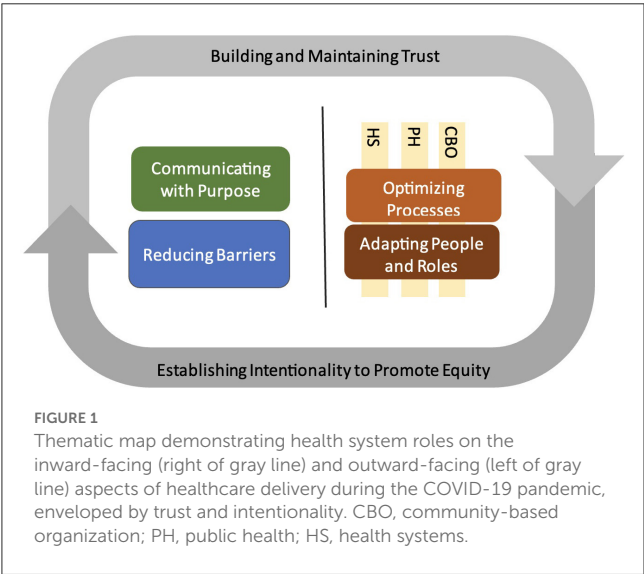
patient showed up at the… testing center, that they would just get tested without any questions asked." Some interviewees described how meeting with multiple regional stakeholders allowed them to shift resources to areas of need.

Interviewees described how they addressed disparities in follow-up with COVID-positive patients. One health system took the unusual step of modifying monitoring protocols to ensure that "limited English proficiency populations… were always placed in the high-risk category, meaning they get the special attention from the outset [by the care team]."

In sum, when interviewees considered how they had interacted with both communities and health systems, they emphasized the importance of maintaining an awareness of disparities and intentionally addressing these disparities through both inward (organizational/administrative) and outward (patient-facing) actions.

3.2. Theme #2: Building and maintaining trust

Interviewees *evaluated immigrant patients' attitude toward health systems* and worked to *enhance patient trust*.

Interviewees assessed immigrant patients' attitudes toward health systems and entities perceived to be associated with health systems before taking steps to building trust. Loss of trust is not just historic, as one interviewee explained: patients today "get tons of terrible bills that don't make any sense, and they're often shafted because they don't speak English." Interviewees understood that certain aspects of the public health response were challenging "because a lot of [immigrant patient communities] have a little bit of uncertainty around their immigration status… giving out a lot of information feels pretty uncomfortable." Interviewees mentioned reasons for distrust, including "fear of discovery" and legal repercussions like deportation.

Interviewees worked to cultivate the conditions for patient trust using three main strategies: investment over time, harnessing trusted relationships, and transparency. Interviewees recognized that building trust takes time: "The belief that you can all of a sudden show up and say, 'We're here to help you. Let's give you tests,' doesn't work." One interviewee stressed that a key to trust-building is having "partnerships in place

[that] can be rapidly operationalized for these sorts of crises, and that means years of building trust and sharing power." Interviewees noted they could support refugees by working with established, trusted entities. "Harnessing relationships that people trust" was key in building trust between health systems and communities. Interviewees acknowledged the fast-changing landscape of COVID-19 misinformation and addressed the need for transparency to build trust. One interviewee discussed vaccination saying, "I took it, our CEO took it, and did a video, and [said] hey, if we turn into zombies tomorrow, we'll let you know… and I think that's what kind of generated this trust."

As interviewees took steps to understand and ameliorate sources of distrust in health systems, they were able to center their communities in their health system's operational response.

3.3. Theme #3: Communicating with purpose

Interviewees played a role in *delivering the public messages used to communicate to communities* in ways and through mediums that were linguistically, culturally, and situationally appropriate while also *listening to the community*.

Interviewees discussed the importance of crafting a succinct, consistent message when information about COVID-19 was rapidly changing and misinformation was widespread. Interviewees tried to match communication strategies to each community's language(s), literacy levels, cultural values, trusted leaders, preferred media, and technology use (e.g., communicating through a resettlement agency that used WhatsApp). They emphasized the messenger: "find a spokesperson… in the community that people know, and trust, and believe."

Interviewees adopted a bidirectional approach to communication by informing immigrant communities about COVID-19 while gathering their questions and concerns. One interviewee described switching to less invasive saliva-based testing because "we heard from the community leaders that there was a lot of misinformation around … the invasiveness of the swab, as well as the concern that the swab was actually infecting people."

3.4. Theme #4: Reducing barriers

Interviewees recognized their role in encouraging public health measures for communities by reducing *barriers to patient care, barriers to receiving emergency assistance,* and *barriers at work.*

Interviewees reduced barriers to direct patient care related to language, technology, scheduling, transportation, and documentation. One strategy was simply keeping clinics open and communicating with patients. Another strategy was ensuring that patients could navigate services in a language they understood: "Where we really pride ourselves is, we are the communities that we serve, so we have staff who are bilingual, bicultural… the services that we provide are… very deeply rooted in the cultures that our patients are from." Interviewees also worked to make health measures practical for patients by providing them with supplies like masks and pulse oximeters.

To improve opportunities for testing, health systems offered options that were physically accessible: drive-up, pop-up, or mobile testing near patients' homes. Interviewees reported allowing walk-up testing and scheduling by phone for patients unable to schedule online. Finally, many health systems offered testing without requiring insurance or extensive personal information.

Interviewees reduced barriers to emergency assistance and socioeconomic support by informing immigrant patients about resources, helping them navigate resources, and in some cases by providing direct assistance. Interviewees told immigrant patients about available unemployment and rental assistance and helped them apply. Many interviewees mentioned supplying families with food, striving to make it culturally appropriate whenever possible.

Interviewees recognized that immigrant workers and tenants faced inequitably harsh financial consequences in the event of illness because they often lacked employment/tenant protections. One interviewee said, "patients who are undocumented and don't have a lot of power in the workplace, they need to be supported in this way; whereas, people like you or me could potentially work from home." Interviewees spoke with patients about work safety concerns, as well as the challenge of navigating public health measures while protecting employment and financial security. One interviewee recalled a patient diagnosed with COVID who "didn't want to get in trouble with her employer and lose her job forever." Interviewees built relationships through direct communication with employers and landlords *via* letters, phone calls, and in-person visits. One interviewee shared how they provided employers with masks, sanitation support, and thermometers. When employers were unwilling to communicate, the health systems sought out third parties (e.g., boards of health, chambers of commerce, and offices of elected officials) to prompt employer compliance with public health measures.

3.5. Theme #5: Optimizing process

Interviewees reported the pandemic created a need to develop new processes by *collaborating and merging established systems with public health and community-based organizations* and by *repurposing spaces*.

Interviewees provided examples of new processes, including a process to implement testing in high-density housing by sharing information with a municipal Housing Authority and Department of Health, and a process to expedite lag times between positive testing and public health CICT through data sharing. Interviewees also discussed combining established systems to provide new services. One example was supporting a community center's testing day by lending health system interpreters to facilitate communication. Collaborating with community partners was also effective: "our community partner organizations let their communities know about [testing] and helped them register, and they were present at the testing site to talk to people."

The use of physical spaces and facilities was another area where interviewees reported adjusting to better accommodate the needs of immigrant communities. As the country went into lockdown, many public locations were empty, including schools. Schools and

school-based health centers, often ideally located near immigrant communities and known as "trusted places for families," became equipped for testing and other services.

3.6. Theme #6: Adapting people and roles

Interviewees reported mobilizing and expanding human resources by collaborating with public health and community-based organizations to *repurpose roles*, *capitalize on relationships*, and *support staff*.

As the pandemic created a need for new roles, health systems were able to fill gaps by repurposing skilled staff. One interviewee praised a system's resource navigator whose role expanded to finding immigrant-specific resources during the pandemic. Another health system's interpreters conducted contact tracing with public health. In a smaller jurisdiction, one interviewee emphasized the flexibility their health system had because staff also held roles in the public health department: "a lot of double roles most of us play, it's a lot less bureaucracy to move and partner."

A key to quickly addressing immigrant communities' needs was capitalizing on pre-existing relationships with community-based organizations and other stakeholders. One interviewee developed a relationship with members of the city government: "probably once a month, [we] talk about what's going on, whether it's jobs or neighborhood conditions or health issues." These relationships ensured information sharing was reciprocal and included diverse perspectives to facilitate fast, effective, and equitable healthcare delivery.

Interviewees lamented the toll the pandemic took on health systems, particularly for employees from immigrant communities. One interviewee expressed concern for struggling staff who "were carrying so much." As a result, this health system provided extra mental health support and piloted a curriculum for staff support groups. These groups were critical as the staff was "providing the support [to patients] but needing support themselves."

4. Discussion

As the COVID-19 pandemic surged, health systems caring for immigrant communities found themselves responding on two fronts: controlling a new disease and addressing recurrent disparities. Our analysis found health systems addressing both fronts in their outward patient-facing roles as well as their inward-facing, administrative roles. These findings have implications for the remainder of and recovery from this pandemic, future infectious disease outbreaks (i.e., MPX or Monkeypox) and other disaster preparedness efforts as immigrant communities remain an essential and growing population in the US (see action items in Table 5). As it pertains to the COVID-19 pandemic, health systems must repair damage done to their relationships with disproportionately affected immigrant communities. Operational lessons from this pandemic can inform recovery measures that promote resilience in the relationships fostered between health systems and the communities they serve.

We found two key themes that underpinned all other themes: intentionality and trust. Health systems are better positioned to plan and execute successful interventions and recovery measures when they understand the diverse situational context and disparities specific to immigrant communities (29–32). By understanding context, health systems can manage their many roles: creating messaging that is linguistically appropriate, recognizing patients' vulnerabilities in the workplace and actively engaging with employers, and identifying areas in the community that are familiar and accessible for testing. Health systems recognized this contextual heterogeneity and adjusted their approaches to the needs and perspectives of their communities.

Just as health systems cannot plan their interventions without cultivating an awareness of burgeoning disparities for immigrant communities, they cannot successfully implement outreach strategies without trust (33–35). For some immigrant communities, concerns involving legal status and the fear of deportation (in the context of the public charge rule) sapped trust in the health system, resulting in fewer immigrants accessing healthcare benefits (10, 36, 37). Partnering with community advocates whose background and connections bring "home" to mind is a proven strategy for building trust throughout the pandemic, and trust supports resilience as partners develop stable relationships that can weather challenges through time (38–41). Our findings support that it takes time and deliberate effort to build trusting relationships with communities and to develop partnerships with community leaders and organizations, particularly before crises (33, 34). Community engagement and trust were vital to the success of the health system interviewees and are critical in preparing for future public health emergencies. While our study was US-focused, similar findings have been shared in studies with immigrant communities globally (42, 43).

We further appreciate the overarching importance of trust and intentionality when we consider healthcare delivery during a crisis. Responding adequately during the pandemic required collaboration between health systems, public health and community organizations/advocates across all processes and interventions. Collaboration fostered sharing data, resources, relationships, and expertise to address needs in critical moments. Health systems were able to use pre-existing processes and resources in combination and to a degree of efficiency that effectively transformed them into new approaches. This was evident through: sharing the benefits of pre-existing trusting relationships, data sharing on COVID-19 cases for geospatial mapping, and sharing established language resources to improve CICT. The benefits of collaboration across sectors to improve public health are well-documented (44, 45), particularly in past crises (46, 47). The cross-sector alignment theory of change developed by the Robert Wood Johnson Foundation emphasizes alignment of public health, health systems and social services, and recognizes the importance of community engagement, without specifying the timing and extent of this engagement (48). Our findings suggest primary, constructive, and enduring collaborations with community-based organizations improved outreach and fostered trust.

This study has limitations worth noting. First, the recruitment method involved self-selection bias and as such, our analysis highlights positive deviance rather than dysfunction. The networks we recruited from and individuals who agreed to our interview represented health systems that identified as caring for immigrant

TABLE 5 Bringing it home.

Theme	Action items
Building and maintaining trust	**Invest in relationships over time** • Partner in activities and events with communities and community organizations over time • Participate in yearly community health-promoting fairs/activities
	Invest in relationships with those trusted by the community • Develop relationships with local businesses, community leaders, religious leaders, trusted advocacy groups, resettlement organizations, etc.
	Model transparency • Record and share on social media videos of trusted individuals receiving vaccines, testing, masking, etc.
Establishing intentionality to promote equity	**Providing community-specific support** • Set up helpline specifically for communities who prefer a language other than English
	Design intervention for inequity in health outcomes • Designate immigrant communities as High Risk to facilitate close monitoring, contact tracing, and follow-up • Invest in funding for sufficient testing in immigrant communities
Communicating with purpose	**Use available media and promote a single, reliable message across all media** • Develop a website, WhatsApp group, newsletter, online informational meetings, etc.
	Communicate through trusted sources • Partner with resettlement groups who have frequent touch points with community to communicate information • Partner with religious leaders (priests, imams, rabbis) to communicate information
	Involve communities in message development • Co-create messages with leaders from different communities to ensure consistent messaging across different languages and provide space for communities to participate in messaging
Reducing barriers	**Reducing barriers for patients with their employers** • To simplify process for providers, develop a formalized process with letter templates for communicating between the health system and employers re: public health recommendations, isolation requirements after test-positivity, quarantine requirements after exposure, etc. • Develop relationships with major employers: assist in developing appropriate screening protocols, provide materials for public health precautions (thermometers, masks, hand sanitizer), provide on-site testing or vaccination
	Reducing barriers to accessing patient care • Routinely evaluate possible barriers to care in the patient population: transportation, insurance, language, work schedules, etc. • Keep local, walkable clinics open during hours that patients are likely to go, and/or take services to patients' communities • Provide translation and interpretation and offer alternatives that don't require literacy or digital literacy • Promote services that do not require information regarding insurance status, immigration status, etc.
	Reducing barriers to emergency assistance • Provide information to patients about emergency food, rental, and other assistance • Develop processes to help patients navigate applications for unemployment and emergency assistance • Work through hospital nutrition services to find wholesale culturally-appropriate foods for community members
Optimizing process	**Sharing information to develop new processes** • Maintain open lines of communication between health systems and public health to make CICT more efficient and to allow support for patients to start earlier
	Combining systems to develop new processes • Partner with public health and community-based organizations to capitalize on each other's strengths and expertise • Use a clinic's established language database and interpretation services to provide interpretation at public health mass-testing/vaccination events • Use a community organization's preferred mode of communication to distribute informational packets/resources
	Repurposing spaces/facilities • Routinely assess how spaces and facilities are being used, and adjust facility use to fit current or anticipated needs
Adapting people and roles	**Flexible/repurposing of roles** • Routinely assess how employees and volunteers are being distributed across tasks, and adjust roles to fit current or anticipated needs
	Capitalizing on relationships • Partner with public health and community-based organizations to capitalize on each other's networks and connections
	Supports to staff • Allot time and resources to provide support for staff (apply for funds for mental health resources for staff, provide time and space for support groups, etc.)

Bringing it home: examples of health system interventions by theme.

communities; as such, these health systems are among the minority who likely had insight into, investment in, and resources for supporting the varying needs of their communities. This element of selection bias reduces the generalizability of this study. Second,

our purposive sampling method limits representation. However, we recruited individuals from a range of health systems that cared for various immigrant communities to capture a diversity in responses. Third, we present the perspectives of health systems

without the perspectives of public health and communities within the same jurisdiction, which limits our ability to draw definitive conclusions on the efficacy of collaboration. Nevertheless, this study's strength is the rich descriptions collected from 20 individuals within health systems who interacted with numerous immigrant communities. Future work should center voices from community members to better assess health system efficacy and represent actualized outcomes.

Immigrant communities have been disproportionately harmed by COVID-19. Our findings show that health systems addressed the magnified disparities affecting immigrants by sustaining and reimagining roles to align with the public health response. By focusing on building trust, ensuring intentionality in processes and interventions, and optimizing avenues for collaboration with public health and community partners, health systems can save lives in future public health emergencies.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

SA and DA had full access to all of the data in the study, take responsibility for the integrity of the data, the accuracy of the data analysis, and involved in drafting the manuscript. ED-H, KYun, and EM were responsible for the study concept, design, and involved in obtaining funding for this project. ED-H, KYun, SA, SH, SK, EM, KYu, CT, DA, WF, KS, and YG were all involved in the acquisition and analysis and interpretation of data. SA, DA, TC, SS, KYun, and ED-H were involved in the critical revision of the manuscript for the important intellectual content. SK provided administrative and technical and material support. ED-H and KYun were involved in study supervision. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

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Evaluation of a medical education policy with compulsory rural service in China

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Background: Since 2010, China has implemented a national programme to train general practitioners for rural areas. The programme enrolled medical students with a rural background who signed a contract for 6 years' compulsory rural service after graduation. China is transitioning its national COVID-19 strategies in view of the features of coronavirus Omicron variant, the vaccination coverage, and the need for socioeconomic development. Strengthening primary health care, especially the health workforce in rural areas, should be an important consideration during the policy transition. This study aims to evaluate the implementation process of enrolling medical students in the programme, their willingness to work in the rural settings and their actual job choice after graduation.

Methods: The study chose four medical universities in central and western China. A total of 2,041 medical graduates who have signed a contract for compulsory rural service and 1,576 medical graduates enrolled "as usual" (no compulsory rural service) were recruited in five campaigns−every June from 2015 to 2019. A survey was conducted 1 week before their graduation ceremony.

Results: The top three reasons for choosing this programme were: a recommendation of a family member or teacher, a guaranteed job after graduation and the waiver of the tuition fee. 23.0−29.7% of the study participants were not familiar with the policy details. 39.1% of the medical students signed a contract with a county other than that of their hometown. Medical graduates on the compulsory rural service programme had very low willingness (1.9%) to work in rural areas but 86.1% of them actually worked at township health centers. In contrast, the willingness to work at township health centers was 0.2% for the comparison group (medical graduates without the contract), and their actual job choice at township health centers was 0%.

Conclusions: Although the well-trained medical graduates on the compulsory rural service programme have low willingness to work in the township health centers, 86.1% of them choose to do so following their contract. This programme will strengthen the primary health workforce to deal with the increasing disease burden as China is transitioning its national COVID-19 strategies.

KEYWORDS

evaluation, China, policy, compulsory rural service, medical education

Introduction

Shortage of Human Resources for Health (HRH) in rural areas has long been a worldwide issue (1–3). In China, although the economy has experienced a rapid growth over the past three decades, the disparity of HRH between rural and urban areas has been enlarging (4). The need for well-trained doctors in rural areas is still an urgent challenge. Interventions to attract and retain rural health workers include medical education (e.g., enrolling students from rural areas), compulsory regulation, financial incentives, personal and professional support (5). Yet evaluations of the policy process and its effectiveness are very limited (6).

In 2010, along with the overall health system reform, China started a national medical education programme to train physicians for township health centers (THC) in central and western provinces. THC is the main type of PHC facilities in rural China. Although varying greatly in size, it usually has a team of 10–20 physicians working with other health workers to provide essential medical and public health services to a population of 20–50 thousand. Each year since 2010, 5,000 medical students with a rural background are enrolled into a 5-year free medical education programme and also granted a modest living allowance. They need to sign a contract with the medical university and local health authority, committing to work at THC for 6 years after graduation. Breaking the contract means repayment of the tuition fee plus a fine and constraints in medical practice within the province.

The COVID-19 pandemic starting in 2020 has posed additional challenges to the shortage of quality health professionals in rural PHC setting in China. During the COVID-19 pandemic, most PHC workers including the well-trained GP were intensively engaged in combating the pandemic, and therefore dedicated less efforts in maintaining the routine care to patients and communities (7). China is transitioning its national COVID-19 strategies and policies in consideration of the features of the Omicron variant, the vaccination coverage, and the need for economic development. There will be a surge in COVID-19 cases and pressures on health systems to meet the population's health needs. In this transitioning, rural primary health care will meet increasing challenges and pressures. Rural health systems in China are vulnerable for lack of well-trained general practitioners. Therefore, there is a pressing need to strengthen primary health workforce in rural area. Although the medical education programme with compulsory rural service in China was designed and implemented before the COVID-19 pandemic, it should be able to strengthen the rural workforce to support recovery from COVID-19.

The programme of training medical graduates committed to compulsory rural service has been implemented for 12 years. This study aimed to evaluate the programme implementation, including medical students' reasons for enrolling in the programme and their awareness of the details of the contract they have signed. The study also evaluated the programme effectiveness, in terms of the place of work of the newly qualified GPs and their current willingness to work in that place.

Abbreviations: THC, Township Health Centre; HRH, Human Resources for Health; FGD, Focus Group Discussions; KII, Key informant interviews; GP, General practitioner.

Methods

Study sites and participants

The study chose medical graduates from four medical universities in central and western provinces of China, Qinghai, University (QU), Jiujiang University (JU), Gannan Medical College (GMC), and Guangxi Medical University (GMU).

In each university, two groups of medical graduates were selected to participate in the study: one group of medical graduates who had signed a contract for compulsory rural service (hereafter referred to as intervention group), the other group of medical students enrolled "as usual" (without signing a contract for compulsory rural service, hereafter referred to as comparison group). They were recruited into the study in the summers from 2015 to 2019, 1 week before their graduation ceremony.

Questionnaire

After providing informed consent, the graduates who agreed to participate in the study completed a questionnaire. Key literatures (5, 8) on interventions to attract and retain health professionals for rural areas were reviewed in order to develop the study design and questionnaire. We also consulted 14 experts including policy makers, medical education specialists, and researchers on human resources for health to provide advice on the questionnaire development. We did a pilot study with 50 participants in Qinghai University to further improve the questionnaire. We used the same questionnaire in all years to enable direct comparison of the findings.

The survey contents included questions about the graduates' demographic information, the reason for choosing the medical education programme with compulsory rural service (1 question), their knowledge about the programme (4 questions), and their willingness to work at THC after graduation (1 question). The majority of the questions were closed multiple choice questions. The questionnaires were administered in a classroom, where research team members were available to answer questions, if participants needed clarifications, and also checked all questionnaires for completeness when they were handed back in.

Sampling

In all the four universities, the medical students who had signed a contract for compulsory rural service were enrolled into separate classes from other medical students. We included all medical graduates committed to compulsory rural service from the four universities and identified one class of medical students enrolled in the same year from the same university as a comparison group. The classes of the comparison group were consistently smaller in size than those of the intervention group. In total, 2041 students with compulsory contract and 1,576 students without compulsory contract were included in the study.

In addition to the questionnaire, we also conducted Focus Group Discussions (FGD) with medical students to explore their perception of the programme. Key informant interviews (KII) with teachers and programme managers were conducted to investigate the process of student admission, education, and deployment after graduation.

Senior researchers from the research team conducted the FGDs as facilitator with postgraduate students as the observer and note takers. No other participants (e.g., university teachers or managers) were present during the FGDs. In each year, we conducted at least one focus group with a compulsory contract, KIIs with at least one teacher and one programme manager in each university (38 FGDs and 61 KIIs in total). All FGDs and KIIs were conducted in a meeting room or a classroom, and tape recorded after obtaining informed consents from the participants. Each FGD o KII lasted for 40 min to 1 h.

Data analysis

The survey data were double entered into computer using Epidata 3.1. Descriptive analysis was applied to explore the characteristics of the medical students with compulsory rural service, including the reason for choosing the programme, their knowledge about the programme, the status of their contract, and their willingness to work at township health centers after graduation. Comparisons were made between the two groups with and without compulsory contract in terms of their willingness to work in THCs and their actual job choices after graduation.

Qualitative data were analyzed using the framework approach with the help of MaxQDA 10.0 (9). A thematic framework was developed based on the interview topic guides and emerging issues form the FGDs and KIIs. High level themes included reasons for choosing the medical education programme, student admission process, students' study motivation during the education process, deployment process after graduation, and perceptions about the programme.

Results

Among the medical students with compulsory contract, 67.6% grew up in a rural setting while they were 0–15 years old. This was higher than the percentage for the comparison group (61.5%). The proportion of rural medical students varied from 56.6% in Jiujiang University to 79.1% in Gannan Medical University. Medical students with contracts were mostly from poorer families, having lower household annual income than the comparison group (Table 1).

The top reason for choosing the programme was a recommendation from their family member or a teacher (28.7%). The second and third reasons were guaranteed job after graduation (22.1%) and free tuition (19.2%). Some variations could be found among the four universities. For example, more students in Qinghai University (which is located in one of the poorest provinces in China) chose the programme because it can guarantee a job after graduation (Table 2).

23.0% of medical graduates with a compulsory service contract did not have detailed information about the medical education programme, implying they were uncertain how the policy would work in practice. Large variations were found among the four universities. Students from Guangxi Medical University had better knowledge about the programme, while in Qinghai University, more than half of the students did not know details about their contract with the local health bureau and the university (Table 3).

The medical education programme encouraged participants to sign a contract with their hometown so that they are more likely to

fulfill it and go back to their hometowns to work after graduation. However, 60.9% student did so, the other 39.1% students signed a contract with a county other than that of their hometown. Almost all (97.6%) students in Guangxi have signed a contract with their hometown, while in Qinghai only 24.9% of students did so (Table 4).

Qualitative data revealed that the reason for the variation was the use of different criteria and processes for student admission across the four universities. In Qinghai, students with better performance in the college entrance examination were allowed to choose their favorite county to sign a contract with. They usually chose rural counties close to an urban city with better socioeconomic development. Those with lower examination performance had to sign a contract with a less developed county. This arrangement resulted in a high proportion of students not signing a contract with their hometown. The process was quite different in Guangxi, where the enrolled medical students can only sign a contract with their hometown. The other two universities (Jiujiang and Gannan) applied similar admission policy as in Guangxi, but when there were not enough eligible candidates in a county, they could recruit applicants from neighboring counties.

Only 1.9% of medical graduates in the intervention group reported willingness to work at THC, yet 86.1% actually worked at THC. In contrast, the willingness to work at THC was 0.2% for the comparison group, and the actual job choice at THC was 0 (Table 4).

Discussion

This study analyzed the implementation process and initial effectiveness of a medical education programme with compulsory rural service in China. It found that the programme recruited students from poor rural families. The students' knowledge about the programme was quite limited. Some students did not sign contracts with their hometown because of different student admission procedures. Although the students had very low willingness to work at THC, the majority of them followed their contract to work at THC after graduation.

The medical education programme with compulsory rural service in China has been designed based on international experiences. First, medical students are recruited from rural backgrounds so that they are more likely to return to the countryside after graduation (10–12). A systematic review by Grobler et al. (8) showed that "rural origin is the single factor most strongly associated with rural practice." Second, courses about rural health and internships in rural health facilities are built into the curriculum of this special medical education programme in order for medical graduates to appropriate knowledge and ability to work in rural areas. All the four medical universities made considerable efforts in developing the rural courses. Including courses about rural health and internships in rural health facilities have been proved to be effective interventions (5, 13, 14). Finally, financial incentives and compulsory regulations are combined to attract and retain rural health workers. Free medical education plus living allowances are the financial incentives, while 6 years' rural service after graduation is the compulsory regulation. A similar programme in Japan had positive results in staffing rural health service (15–17).

However, our study found some significant barriers in the implementation process. First, the students had limited knowledge about the programme. The two main reasons for choosing the programme were the free tuition and guaranteed job position after

TABLE 1 Demographic information of the study participants.

	QU	GMU	JU	GMC	Total
Female medical graduates (*n*, %)					
Intervention group	374 (56.2)	231 (48.3)	84 (38.2)	284 (42.1)	973 (47.7)
Comparison group	294 (61.9)	255 (56.2)	105 (40.4)	153 (40.1)	807 (51.4)
Participants with rural background (*n*, %)					
Intervention group	435 (65.5)	378 (79.1)	124 (56.6)	437 (65.1)	1,374 (67.6)
Comparison group	284 (59.8)	300 (66.2)	149 (57.8)	231 (60.5)	964 (61.5)
Household annual income (Yuan)					
Intervention group	35,904	30,800	47,540	40,622	37,450
Comparison group	48,572	40,857	55,396	54,306	48,810

1. There were 7, 17, and 234 missing data points in responses to the three questions on gender, rural background and household income; 2. The "total" column is the sum total or average of participants from the four universities.

TABLE 2 Top reason for choosing the medical education programme (*n*, %).

	QU	GMU	JU	GMC	Total
Guaranteed job after graduation	245 (37.0)	36 (7.5)	44 (20.2)	124 (18.3)	449 (22.1)
Low score in college entrance exam	20 (3.0)	121 (25.3)	50 (22.9)	167 (24.7)	358 (17.6)
Free tuition	94 (14.2)	164 (34.3)	31 (14.2)	101 (14.9)	390 (19.2)
Family member or teacher recommendation	231 (34.8)	111 (23.2)	51 (23.4)	192 (28.4)	585 (28.7)
Permanent job position	32 (4.8)	4 (0.8)	15 (6.9)	25 (3.7)	76 (3.7)
Work location close to home	5 (0.8)	12 (2.5)	9 (4.1)	14 (2.1)	40 (2.0)
Reasonable income	11 (1.7)	3 (0.6)	1 (0.5)	5 (0.7)	20 (1.0)
Can get the work experiences from grass-roots service	5 (0.8)	6 (1.3)	6 (2.8)	7 (1.0)	24 (1.2)

1. Participants were asked to provide up to three reasons for choosing the programme in order of priority. This table shows the results for the first reason. 2. There were 7 missing data points for this question; 3. Low score in college entrance exam means they would have no chances to be admitted to medical school under normal conditions.

TABLE 3 Percentage of the students who did not know the policy details (*n*, %).

Policy details	QU	GMU	JU	GMC	Total
No tuition fee, living allowance	165 (24.8)	57 (11.9)	60 (27.4)	187 (27.6)	469 (23.0)
Contract with local health bureau and university	352 (53.1)	55 (11.6)	30 (13.9)	107 (15.9)	544 (26.8)
6-year service at THC	299 (45.0)	37 (7.8)	66 (30.4)	202 (29.9)	604 (29.7)
Repay and fine if breaking contract	279 (42.0)	53 (11.1)	38 (17.4)	108 (16.0)	478 (23.5)

There were 1, 11, 7 and 7 missing data points in the four questions respectively.

TABLE 4 Percentage of the graduates' willingness to work and actual work at THC.

	QU	GMU	JU	GMC	Total
Proportion of signed contracts with hometown	158 (24.9)	446 (97.6)	118 (57.6)	460 (71.3)	1,182 (60.9)
Willing to work at THC					
Intervention group	10 (1.5)	18 (3.8)	2 (0.9)	8 (1.2)	38 (1.9)
Comparison group	2 (0.4)	0	0	1 (0.3)	3 (0.2)
Actual work at THC					
Intervention group	619 (92.9)	386 (80.8)	175 (79.5)	578 (85.4)	1,758 (86.1)
Comparison group	0	0	0	0	0

There were 100 missing data points for the hometown contract question, and 41 missing data points for the willingness question.

graduation, but some students did not have proper knowledge about their commitment to rural service. This indicates the policy needs to be further disseminated to the target candidates. Only with full understanding of the advantages and disadvantages of the policy, the programme will identify and recruit suitable candidates who have high willingness to work at THC. Second, due to different admission processes, some students, especially those in Qinghai University, did not sign a contract with their hometown county. Local recruitment and local deployment have been well-documented as an effective measure to attract and retain rural health workers (18–20). Local education authorities need to improve the student admission process by applying the principle of "local recruitment and local deployment."

The study also found medical students had a very low willingness to work at THCs. This is understandable since rural health workers in China have a very low income level and limited career development opportunities, compared to their counterparts in urban areas (4). However, the survey showed that most of the students adhered to their contract to work at THCs. This is most likely driven by the compulsory measures. If the students break the contract, they should return the tuition fee, and the local health authority will also prohibit their medical practice in the region. The low willingness to work at THC is a serious concern for the sustainability of the programme. One of the key constraints is the selection and recruitment process. Candidates are not well-informed of the implementation of the programme. They choose the programme because of the guaranteed job, and free medical education, without even exactly understanding the conditions of the contract, i.e., 6 years' rural service. Only by the end of the 5-year medical education when the survey was conducted, they begin to understand the constraints they are facing. The selection and recruitment process should disseminate far more effectively the policy design and implementation details, to select and recruit the potential candidates who have enthusiasm to serve the rural population, or who may have higher willingness to fulfill the contract to work in rural areas.

In addition, financial and non-financial incentives should be developed to improve the medical graduates' willingness to work for rural primary health care. Salary increase, rural allowances, and performance-based awards are possible options to increase the attractiveness of rural job positions and to increase medical graduates' willingness to serve the rural population. Career development opportunities including in-service training, promotion of professional titles and management positions, and short-term work opportunities in higher level hospitals are potential non-financial incentives to increase their willingness. There is no single intervention that can work as magic bullet to address the shortage of health professionals in rural areas. By combining multiple measures, including selection of appropriate medical student candidates, free medical education, compulsory rural service contract, financial and non-financial incentives, it is possible to attract more medical graduates to work in the rural areas.

Cheng et al. (7) showed that during the COVID-19 pandemic, medical graduates from this special medical education programme were intensively involved in the pandemic response, including health promotion and education, community epidemic prevention and management, and nucleic acid testing and screening, among others. Although they faced challenges including lack of protective equipment and worries about themselves and their family being infected, more than half of them reported an increase in daily clinical workload, implying their important role in maintaining routine care during the pandemic. During the current COVI-19 strategy transition, China has encouraged more PHC facilities to provide medical services to the increasing number of patients infected with COVID-19 (21). The GPs trained in this programme will play an important role in the post-COVID recovery of the health system.

While these findings may illustrate the importance of this medical education programme with compulsory rural service in supporting the health system recovery from COVID-19, there are two important limitations of the programme to be further improved. First, the low willingness to work at THCs may predict high attrition rate after they complete the 6 years' contract as analyzed previously. This will reduce the potential of this medical education programme in supporting responses to future public health emergencies like COVID-19. Second, the curricula for this special education programme were designed far before the COVID-19 pandemic, with a focus on medical science and less on public health issues. Considerable efforts should be made to improve the curricula design to achieve goals of responding to disruptive public health events and increasing health system resilience.

The study collected data for 5 cohorts of medical graduates, forming the biggest cohort to investigate the implementation process and effectiveness of the medical education programme in China. The study has a few limitations. First, data for this paper was mainly from the baseline survey of the cohort study. The actual job choice of the medical graduates after they complete the contract at THCs cannot be measured at this stage. Second, the questionnaire used for the study was developed by the research team without rigorous analysis of its validity and reliability.

The preliminary evaluation of China's medical education programme with compulsory rural service shows positive results and potential in supporting health system resilience and recovery from COVD-19. The cohort will be further followed to investigate the long-term effects of the medical education programme in attracting and retaining health workers for rural China.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of Peking University Health Sciences Center. The patients/participants provided their written informed consent to participate in this study.

Author contributions

XL and DH contributed to the original conception and design of the study, interpretation of the data, and final revision of the manuscript. BZ contributed to data collection and analysis. MH,

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The role of the university in recovering from COVID-19 and preparing for future crises— perspectives and experiences from Sunway University, Malaysia

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'.

Universities, as engines of knowledge creation and dissemination and as incubators of disciplined yet original thinking, have a key role to play in tackling the most complex challenges that societies and our planet face, from infectious diseases to the climate emergency. This commentary presents the perspectives from Sunway University, a young private university in Malaysia that made a strong commitment to the sustainable development goals (SDGs) prior to the pandemic, and its experiences in promoting research, innovation, and learning as part of COVID-19 recovery and in preparation for future crises such as the climate emergency. Some of the university's initiatives include embracing the planetary health approach, reviving essential public health functions, exploring pandemic resilience, addressing 'infodemics' and promoting science diplomacy. The example of Sunway University provides some insights on the opportunities and challenges that academic institutions face as they seek to reorient the paradigm of education, research, and service away from disciplinary siloes and towards a more integrated, preventive, accessible and translational approach.

1. Introduction

The COVID-19 pandemic exposed the many gaps and challenges in the global health system, from the inability to halt the transmission of the virus and the failure to ensure access to life-saving vaccines for everyone, especially for people in low- and middle-income countries. Pre-pandemic efforts to strengthen health systems were not sufficient to achieve universal health coverage (UHC), which is an important ingredient for health system resilience in the face of shocks and stresses such as a pandemic (1). Meanwhile, lack of prioritization and weak investments in health security across countries limited their ability to adequately prepare for and

respond to the outbreak. In all these global health failures, it is the most vulnerable, the poorest, and the marginalized who have faced the greatest disadvantage, and the resulting gap between the 'haves' and 'have nots' continues to grow as a result.

To worsen the situation, a lack of focus on tackling the upstream drivers of infectious disease emergence increases the likelihood of another pandemic happening within this century. Due to the slow pace of worldwide action to reduce greenhouse gas emissions, the climate emergency is already negatively impacting human health, including triggering more zoonotic spillovers thus increasing pandemic risk (2). Other planetary crises such as biodiversity loss and plastic pollution are jeopardizing human health, especially but not exclusively in poor and marginalized populations. What complicates this scenario is the emergence of mis/disinformation epidemics that negatively influence human behavior and decision-making and impede timely and urgent action.

These are the current and emerging challenges that academia, as the engine of knowledge creation and dissemination, must urgently respond to and prepare for, respectively. During this pandemic, universities have shown their adaptiveness, as demonstrated by the rapid and widespread adoption of digital technologies for teaching (3), their responsiveness to the crisis, from modeling the spread of the disease, recommendations on behavioral and social measures, and accelerated discovery and development of pandemic tools such as vaccines (4), to the provision of technical advice to governments. These achievements must be sustained and accelerated by universities as they embark on the road to post-COVID-19 recovery and prepare for future crises.

Sunway University, established in 2011, is one of Malaysia's leading private universities. It is a strictly not-for-profit institution and dedicated to quality education, supporting enterprise, and undertaking research focused on key global problems. The University is relatively young by global standards but already ranked within the top 2 percent of universities in the world (QS World University Rankings and The Times Higher World University Ranking). It is ranked 122nd in the QS Asia University Rankings 2023, as well as being ranked within the top 150 universities in the world under 50 years old.

This commentary presents perspectives from the university, which had already forged a strong commitment to the SDGs prior to the pandemic, and its experiences in promoting research, innovation, and learning as part of COVID-19 recovery and in preparation for future crises such as the climate emergency. The examples from Sunway University provide some insights on the opportunities and challenges that academic institutions face as they seek to reorient the paradigm of education, research, and service away from disciplinary siloes and towards a more integrated, preventive, accessible and translational approach.

2. The planetary health approach

Humanity's continued susceptibility to infectious disease pandemics, as well as the advent of worsening ecological crises such as the climate emergency, requires a new approach that acknowledges the interconnectedness of these global problems and their underlying root causes. These challenges reveal that the health of people and the planet are inextricably intertwined; people's health cannot be fully protected from pandemics and climate impacts if the health of the planet is ignored. In response, one approach that has emerged in

recent years is planetary health, which is a scientific field, global movement, and problem-solving approach focused on understanding and addressing the growing human health impacts of anthropogenic global environmental change (5). Central to this approach is the recognition that many of the health harms that humanity is facing today are a result of human activities. Hence, at the heart of solving planetary health damage is stopping it at the source—be it rapid deforestation that disturbs pathogen-carrying wildlife or greenhouse gas emissions from humanity's profligate use of fossil fuels.

As a biodiversity hotspot, Southeast Asia is a strategic location to advance the planetary health approach and ensure that it is integral to crisis prevention at local, regional, and global levels. In mid-2021, Sunway University established the Sunway Center for Planetary Health, aiming to pioneer the application of the planetary health approach to pressing health threats in the region (6). For its inaugural phase, the Center chose to tackle four priority themes that are highly relevant to the region: preventing the next pandemic; tackling the climate emergency; creating healthy cities; and achieving sustainable food systems. In order to address these themes, the Center also focuses on three cross-cutting enablers—governance, communications and education. The ultimate goal of planetary health is to usher the "Great Transition" of the social and economic systems that currently drive planetary health problems (7), which means that these three enablers of transformational change must not be ignored.

During its first year, the Center has closely engaged with the Malaysian government and other local, regional and international partners to help embed planetary health in policymaking and advocacy, including in supporting crafting the country's 12th Malaysia Plan and National Planetary Health Action Plan, and piloting the Doughnut Economy model (8) in Ipoh city (Malaysia's 4th largest city). The approach taken by Ipoh City Council emphasizes use of a regenerative economics approach to development and incorporates recognition that human health and wellbeing can and must thrive without transgressing planetary boundaries. This pilot project, the first of its kind in Asia, was launched in 2022 to support achievement of the sustainable development goals and demonstrate that living within the safe limits defined by the planetary boundaries is possible in urban environments in Asia. The Center has also deepened the discourse around reorienting the humanitarian sector towards a more anticipatory planetary health approach, and is using its advocacy and communications capacity to promote planetary health across society in Malaysia and the region.

In order to prepare the next generation, who will be on the frontlines of planetary health challenges, the Center developed a core course entitled "Community Service for Planetary Health," which will expose all students at Sunway University to planetary health regardless of discipline. The Center has collaborated with various organizations to organize youth townhalls, bootcamps, and hackathons, which cultivate leadership and entrepreneurship for planetary health among young people.

The Sunway Center for Planetary Health is a new but active member of the Planetary Health Alliance (9) and will host the Alliance's annual meeting in 2024 in Asia, a region not only at risk of climate and other disasters but also the epicenter of many disease outbreaks, while also serving as the global economic powerhouse of the future. The focus of the meeting will be to connect academic discourse with public participation in the planetary health movement, with the theme "From Evidence to Action: Confronting Reality."

3. Essential public health functions

The COVID-19 pandemic has revealed weaknesses in social and health systems stemming from weak public health capacities in most countries. In this context, "essential public health functions" (EPHFs) are being revitalized to support an integrated approach to ensuring more sustainable and resilient health systems. In particular, World Health Organization (WHO) resolution WHA69.1 calls for strengthening essential public health functions as a basis for improving public health practice and building resilient health systems capable of meeting Universal Health Coverage (UHC) goals (10). The set of 12 EPHFs being promoted by WHO are seen as minimum requirements for countries to ensure public health and are generally regarded as a fundamental and indispensable set of collective actions under the responsibility of the state which are needed to meet public health goals, including the attainment and maintenance of the highest level of population health possible within given resources (11).

Many, if not all, postgraduate/master's degree programs, including the most prestigious ones in the world, are based on traditional public health thinking and approaches. An extensive review of over 30 well known Master's in Public Health (MPH) and Master's of Global Health programs in North America, Europe and Asia-Pacific showed that none of their curricula had modules specifically dedicated to EPHFs (12). There is a clear need to establish a programme that addresses principles, theory and practice that is based on essential public health functions. The COVID-19 pandemic demonstrated that this is the public health training programme that the countries need moving forward. In response, Sunway University is developing an innovative Master's in Public Health programme geared towards establishing competencies in support of EPHFs.

The programme will contribute to developing a workforce that can deliver the full range of EPHFs, including emergency preparedness and response, and be competent in other critical areas such as planetary health, global health and health diplomacy. It is also clear that the next generation of public health leaders needs to be equipped with practical skills necessary for navigating crises such as leadership, communications, and entrepreneurship. Thus, the planned MPH programme will draw expertise from the different schools and departments of Sunway University, including business, psychology, and communications, as well as from professionals and experts from around the world who will bring practical insights to the classroom.

This unique programme, working with international public health institutions, WHO collaborating centers, the WHO Academy and health care innovation hubs for internships, trainings and fellowships, will provide students with additional international exposure. It will produce graduates who are not only equipped with principles and theory, but with the tools and experience to operate immediately in public health practice nationally and internationally. Furthermore, the new MPH should also contribute to the Malaysian Government's plans to future-proof healthcare, which gives more prominence to public health as means to achieve UHC and SDG 3 (Good Health and Well-being).

4. Resilience to future pandemics

The COVID-19 pandemic was not only a wake-up call but also an opportunity to define how humanity responds to future pandemics and the climate emergency. Thus, it is important for academic institutions to harvest the lessons from the pandemic and begin incorporating them into existing structures and systems. Sunway University is collaborating with the Universiti Kebangsaan Malaysia (UKM) to establish the Pandemic Resilience Institute. This public-private partnership harnesses the unique strengths of both institutions for mutual and greater good. By investing in the promotion of cross-institutional and multi-sector transdisciplinary collaboration, we hope to improve our biomedical understanding of disease pathogenesis and clinical outcomes as well as develop pragmatic interventions to enhance the socio-economic resilience of local communities to the random and chronic disruptions caused by pandemics.

Although significant gaps in available local health and socio-economic data have always impeded the provision of equitable, accessible, well-connected and coordinated care across all aspects of an individual's health and social needs, the pandemic exacerbated this challenge. A key area of investment, which this collaboration focuses on, is the development of long-term studies that capture and monitor data on risk factors and health outcomes as well as the effect of specific health promotion interventions. This initiative will be approached through robust university-industry-public-environment interactions often referred to as the quadruple helix model in knowledge economy (13); especially through health promotion activities for the public through collaboration with various non-governmental organizations, particularly those working in the areas of health, climate and youth, policy recommendations and formulations with key governmental policy stakeholders and agencies, and demand-driven solution creation for key industries.

5. 'Infodemics' and science diplomacy

Finally, as alluded to earlier, clear and effective communication is a vital ingredient in crisis response, whether information is targeted to policymakers, international partners, or the general public. Unfortunately, mis/disinformation, especially but not exclusively delivered *via* social media, derailed progress in expanding vaccine coverage and eroded trust between leaders and citizens (14). In response to this challenge, Sunway University contributed to a study on 'Addressing inaccurate and misleading information about biological threats through scientific collaboration and communication' (15). While the study focused primarily on a scientific network in Southeast Asia, its report and recommendations are also relevant to scientists in other parts of the world.

Another level of communication that is critical for crisis prevention and response is international diplomacy. Sunway University has close links with universities across the Association of Southeast Asian Nations (ASEAN) and has served as a hub to the ASEAN Young Scientists Network and the International Network for Government Science Advice (INGSA)-Asia, both of which have been useful platforms for knowledge dissemination between countries and between scientists and policymakers within countries. Through the ASEAN Young Scientists Network, Sunway University has played a particularly critical role in supporting establishment of three important initiatives: 1) ASEAN Science Leadership Programme (ASEAN-SLP) that promotes inclusive leadership training and practice; 2) ASEAN Emerging Research Conference (ASEAN-ERC) that encourages the diversity of various domains of knowledge and

research to converge through the lens of the ASEAN perspective; and 3) ASEAN Responsible Conduct of Research (ASEAN-RCR) that promotes mainstreaming of research integrity in the SE Asia research and development ecosystem. Through INGSA-Asia, various pilot initiatives have been established to build science advice capacity and promote the use of scientific evidence in informing policy at all levels of government in the region. For example, the INGSA Asia Grassroots Science Advice Promotions Awards have provided opportunities for individuals and stakeholders in the region to be involved in knowledge promotion activities across various themes ranging from open science, agrobusiness, water management, climate change and disasters, and women in science. Currently, INGSA Asia is working with the US National Academies of Science, Engineering and Medicine on a project to develop a guide on the prevention and mitigation of zoonotic spillovers in the live animal supply chain in the region (16).

Notwithstanding this progress, some important challenges that institutions such as Sunway University must confront when it comes to international collaboration are to ensure: (1) their sustainability beyond pilot projects; (2) academic outputs are accessible and useable by various consumers of knowledge such as policymakers and the general public; and (3) tangible impacts are measured beyond surrogate markers of academic achievement.

6. Conclusion

The end of COVID-19 may already be within sight. However, the harsh lessons that this pandemic has forced upon us cannot be simply forgotten and the gains that were made as a result must be sustained. Academic institutions such as Sunway University have a vital role to play in ushering in the recovery process and enhancing societal preparedness for future crises—through learning, research, advocacy, and innovation. Universities can start by creating an enabling environment for transdisciplinary collaboration, as public and planetary health challenges such as pandemics and the climate emergency cannot be successfully addressed through disciplinary siloes but rather through deepened collaboration between disciplines and with other economic and social sectors. Moreover, these health threats are rapidly evolving, and urgent action is needed now given the ever-increasing proximity of what we used to refer to as "tomorrow's problems." Therefore, universities must embrace a renewed emphasis on rapid transmission and translation of knowledge to the world of policy and practice, in order to solve problems and make real-world change.

Author contributions

ER conceived the paper. ER and RQ created the draft. JM, OL-H, AV, and SP provided inputs and reviewed the draft. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Section II: Cross-country experiences and learning

The four papers in this section present the COVID-19 experiences and learning of countries within a region or group. In some cases, these are regional to global entities, such as the Commonwealth or WHO regions. In other cases, new networks have emerged from the recognition of shared challenges (e.g. challenges of children's surgical services in Bangladesh and Zimbabwe).

The use of innovative approaches to strengthen health system resilience during the COVID-19 pandemic: case studies from selected Commonwealth countries

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'.

The COVID-19 pandemic has exposed the vulnerabilities and limitations of many health systems and underscored the need for strengthening health system resilience to make and sustain progress toward Universal Health Coverage (UHC), global health security and healthier populations in tandem. In response to the COVID-19 pandemic, Commonwealth countries have been practicing a combination of innovative integrated approaches and actions to build health systems resilience. This includes utilizing digital tools, improvements in all-hazard emergency risk management, developing multisectoral partnerships, strengthening surveillance and community engagement. These interventions have been instrumental in strengthening national COVID-19 responses and can contribute to the evidence-base for increasing country investment into health systems resilience, particularly as we look toward COVID-19 recovery. This paper gives perspectives of five Commonwealth countries and their overall responses to the pandemic, highlighting practical firsthand experiences in the field. The countries included in this paper are Guyana, Malawi, Rwanda, Sri Lanka, and Tanzania. Given the diversity within the Commonwealth both in terms of geographical location and state of development, this publication can serve as a useful reference for countries as they prepare their health systems to better absorb the shocks that may emerge in future emergencies.

Introduction

The impact of the COVID-19 pandemic has been widely felt around the world – and Commonwealth countries have not been spared (1, 2). The Commonwealth, which is a voluntary association of 56 independent countries spread across Africa, Asia, the Americas, Europe and the Pacific, has experienced major economic and health crises as a result of the COVID-19 pandemic, with over 107 M cases out of a total of 760 M globally (3).

From an economic standpoint, Commonwealth countries collectively lost as much as US$475 billion worth of exports in 2020, including $100 billion in intra-Commonwealth trade. Intra-Commonwealth exports rebounded in 2021 and are estimated to have reached $768 billion, the highest recorded in value terms (4). Likewise, the pandemic has left even the most well-equipped health systems in the Commonwealth vulnerable and has stalled progress toward wider global and national health priorities, including Universal Health Coverage and the Sustainable Development Goals (SDGs). In 2023, the Commonwealth remains far short of reaching the SDG target of 3.8 to achieve UHC (5). Commonwealth leaders sought to address this at the last Commonwealth Heads of Government Meeting in 2022, and "recognized the importance of strong, resilient, and inclusive health systems … for countries to better prepare, prevent, detect, respond and recover from health emergencies" (6).

The COVID-19 pandemic has demonstrated that health system resilience – defined as the health system's ability to prepare for, resist, manage, adapt, recover, and learn from a hazard and its effects – is key in maintaining and strengthening health system functionality (7). Countries around the globe are confronting the challenge of how to recover from the legacies of the pandemic, which provides an opportunity to learn from countries grappling with common challenges and asking similar questions about what a resilient health system should look like. Some of these examples include leveraging health information for immediate and robust actions, whole-of-society approaches and a recognition of the interconnectedness of health systems and public health emergency management.

We present here perspectives from five Commonwealth countries: Guyana, Malawi, Rwanda, Sri Lanka and Tanzania. While there is no one size fits all approach, the lessons derived in this publication can aid in understanding how resilient health systems can be developed and operationalized in different contexts.

Method

In recognition of the need to understand what worked and what did not work during the COVID-19 pandemic, the Health Section in the Commonwealth Secretariat contacted officials within Commonwealth countries to propose a compendium of case studies on lessons learnt from the pandemic. Representatives from the five Ministries of Health participating in this publication include Ministers of Health, Permanent Secretaries, Chief Medical Officers, National Focal Points for COVID-19, Epidemiologists, and other key decision makers in national COVID-19 response plans. The participation of senior Ministry of Health representatives was key given their unique position to comment on the development, implementation and evaluation of national COVID-19 responses. Country officials were

requested to submit relevant examples of lessons learnt from the COVID-19 pandemic, under three broad themes: digital health, pandemic management and maintaining essential health services. These case studies were then developed and integrated by the Commonwealth Secretariat in collaboration with Ministries of Health.

Supplementary information was sourced through national documents and reports, literature reviews of peer reviewed publications, data sourced from World Health Organization and other international health agencies, and government webpages. For each country, data from March 2020 to September 2022 were collected.

Country responses for effective COVID-19 pandemic management

Guyana case study: Strengthening COVID-19 governance through establishing a national COVID-19 taskforce

Guyana's National COVID-19 Taskforce, which is the focus of this case study, has been instrumental in mounting an integrated response strategy since the first case of COVID-19 was identified on 11 March 2020. Between March 11, 2020, and September 1, 2022, Guyana had 87,835.57 of cumulative confirmed COVID-19 cases per million people and 1,570.26 confirmed deaths per million people (3). In the early stages of the COVID-19 pandemic, the coping capacity of Guyana's healthcare system was limited in responding to health emergencies. While in the history of Guyana, no such epidemic or health event of this magnitude has occurred, there have been smaller outbreaks or suspected outbreaks in different locations of the country, which usually garnered a response mainly from the Ministry of Health. As a single entity, the Ministry of Health's capacity for responding to the COVID-19 outbreak was severely limited and therefore identifying effective approaches to coordinate the mitigation of cases while retaining public confidence was key.

The country established the National COVID-19 Task Force and 10 subordinate committees for each of the administrative regions of Guyana, to oversee the coordination and implementation of the COVID-19 pandemic response strategy (8). The Taskforce used an integrated approach focused on strong leadership and state and non-state partnership which corresponds with successful interventions outlined in existing literature. The National COVID-19 Task Force was led by the Prime Minister and had the participation of ministers, directors and leaders representing health, disciplined services, civil defense, tourism, finance, trade, commerce, points of entry, immigration, law enforcement, private sector commissions, religious leaders, indigenous leaders, non-governmental agencies, etc. As a result, the Taskforce became the largest assembly of state and non-state representatives working together and sharing resources to achieve a shared goal. Ten Regional COVID-19 Task Force committees had a similar composition and conducted activities at the level of their respective administrative regions. This multisectoral approach ensured that all support, in every aspect, was directed to COVID-19 response.

The accumulated resources dispensed by the state and non-state partnership were utilized to address many issues, including to procure and implement a free COVID-19 vaccination program for all persons within Guyana, implement subsidies on food items and basic hygiene

products and provide free primary, secondary and tertiary healthcare services to its population.

One of the most logistically challenging measures was the implementation of the National COVID-19 Vaccination Program, which included transporting and storing vaccines in line with cold-chain requirements to distant and peripheral regions of Guyana and sensitizing the public and responding to vaccine hesitancy. However, due to the support and use of resources from state agencies, the private sector and non-state leaders through the Taskforce, Guyana was able to operate almost 150 fixed and mobile vaccination sites daily in all 10 administrative regions, with vaccination teams working on weekends and holidays and visiting hard-to reach communities and ensuring service provision to all eligible persons free of cost regardless of citizenship.

The success of this program is reflected in Guyana's COVID-19 vaccination coverage, with the first national dose coverage in the adult population reaching 87.6 percent and the second dose covering 68.2 percent (3). The Government also took measures to ensure that the rights and privileges of both citizens and migrants were not infringed upon. Migrants originating from neighboring Venezuela were afforded special considerations to safeguard their health and safety, as their circumstances rendered them among the most vulnerable. This was considered an important part of the mitigation strategy as there were approximately 33,000 Venezuelan migrants in Guyana.

Another key priority for the National COVID-19 Taskforce was to ensure that essential health services at the primary, secondary and tertiary level were maintained. Efforts included the Ministry of Health's creation of a Package of Essential Health Care Services for Primary Health Care in March 2022, with 215 different health interventions to be offered at every health institution in the country (9). The Task Force made use of support from other state agencies and healthcare professionals to provide primary healthcare services to all citizens within their catchment area including specialized clinics for maternal and child health, pediatric clinics, and NCD clinics. Emergency and surgical interventions continued based on the level of urgency while non-essential services were either postponed or conducted through home visits.

Through the implementation of the National COVID-19 Taskforce, which remained operational until the end of 2022, Guyana was able to pool together sufficient human, material, financial, logistical, and other resources to mitigate the impact of the pandemic. Beyond COVID-19, this institutional mechanism will be key to address future preparedness and response in health shocks and emergencies.

Malawi case study: Adopting resiliency approaches for national preparedness and response

The COVID-19 pandemic response in Malawi was aided by its Ministry of Health's existing frameworks for health emergency preparedness and response, which will be the focus of this case study. By the time the first three cases were detected on April 2, 2022, and through the COVID-19 peaks, with a cumulative number of recorded cases and deaths per million at 4,306.57 and 139.09, respectively, between then and September 1, 2022, Malawi was better positioned to mitigate the spread and impact of the pandemic (3).

In 2019, Malawi conducted the first Joint External Evaluation (JEE) of International Health Regulation (IHR) core capacities (10). During this evaluation, the country's capacity for public health emergency preparedness and response was highlighted for improvement. Based on these findings, the major challenges affecting pandemic management in Malawi were: (1) inadequate Incident Management System (IMS) capacity, including human and infrastructure challenges at national and district levels for planning, emergency detection, coordination and responses; (2) lack of fully functional emergency operations centers (EOCs) and an operational hotline for handling a disease of unknown origin; and (3) a national multi-hazard contingency plan which does not address emergency preparedness for IHR-relevant hazards, including those that have the potential to cause Public Health Emergencies of International Concern (PHEIC). Before the pandemic, Malawi adopted a One Health approach for the country's epidemic preparedness and response, listed in the Health Sector Strategic Plan II 2017–2022 (HSSP II) as one mechanism to address the gaps identified by JEE. An online instant message (IM) forum was created to gather all one health related stakeholders together, and a "One Health Surveillance Platform (OHSP)" was established in 2019. The OHSP was developed using the open-source district health information system 2 (DHIS2) technology and aligned with the open health information exchange (OpenHIE) framework to accommodate country "One Health" surveillance needs from human, animal and environmental domains. The IM and OHSP platforms were applied to enhance outbreak and emergency detection, and coordination for preparedness. All interventions were established before the COVID-19 pandemic to better prepare for potential future health shocks and emergencies. To support these interventions, the Ministry of Health initiated the development of a National Action Plan for Health Security (NAPHS) in collaboration with the Department of Disaster Management Affairs. The priority focus of these interventions was to increase Malawi's health system resiliency when confronted by a potential epidemic or pandemic in the future, which provided useful when the IM/OHSP picked up the alert for the start of the COVID-19 outbreak. Following the formal declaration of a PHEIC by the World Health Organization in March 2020, the government put in place a state of disaster in the country and installed several preventive measures to mitigate its severity.

After Malawi registered its first cases, the Ministry of Health activated its national-level COVID-19 Emergency Operations Centre (EOC) the following day to ensure UHC efforts were not disrupted by COVID-19 and to coordinate and execute all COVID-19 response activities, including but not limited to surveillance, contact tracing, border health, clinical care and treatment, risk communication and community engagement. The EOC set up several initiatives, including launching a dedicated 24/7 hotline to receive public incidents, as well as various digital tools such as RapidPro, a community toolkit for health education and public communication, and EOC internal dashboards to manage the pandemic effectively (11). Regarding the EOC hotline and call center operations, the Ministry of Health harmonized the health-related hotlines by combining the Chipatala cha pa Foni (CCPF), a ministry-owned telehealth service, and the rapidly established COVID-19 EOC hotline into one call number (929). The calls were centrally monitored and responded by the EOC call center operators (12, 13). Between the establishment of the center in early 2020 to its closure in July 2022, the call center received 2,929,984 calls, including self-suspect reporting, COVID-19-related

information checking, vaccination and digital certificate inquiries, and adverse event after immunization reporting.

The response strategies exemplified in this case study demonstrate some key indicators for successful pandemic response, including steering the response through effective, timely and comprehensive systems, and utilizing a range of channels to engage and include the country population in mitigating the spread of COVID-19. Of particular focus is Malawi's Emergency Operations Center (EOC), which served as the data-driven core of the government's pandemic response to coordinate pandemic responses across the country, and which leveraged routine and novel data sources to address the rapidly evolving pandemic. Malawi's efforts to adequately prepare for health emergencies can provide insights into the linkages between pandemic preparedness and response.

Rwanda case study: Leveraging existing digital health technologies to strengthen national COVID-19 testing and vaccinations

Below we highlight the interventions made by Rwanda to utilize digital solutions to mitigate the spread of COVID-19. Rwanda has made significant progress in recent years toward its goal of becoming a middle-income country by 2035 and a high-income country by 2050. Rwanda's development is supported by strong government investment in the country's digital transformation, digital government systems and digital connectivity to increase affordability and access. The Rwanda Health Management Information System (HMIS) was established in 1998 with the goal to improve the quality of routinely collected health data from community health workers and the system has been upgraded to a web-based system known as the District Health Information System Version 2 (DHIS2) (14).

While Rwanda had taken steps to be better prepared for health emergencies, like many countries, it faced challenges in responding to the COVID-19 pandemic, including limited capability to receive national COVID-19 statistics data, delays in laboratory results and lack of digital solutions to facilitate cross border travelers. When the first case was detected on March 14, 2020, the operational response to the COVID-19 pandemic required the rapid adaptation and leveraging of the existing HMIS to collect, transmit and analyze key health data in real-time to increase understanding of the epidemiological situation and support in designing appropriate control measures (3). Rwanda, as one of the more advanced countries in promoting information technology in the region, maintained focus on applying technologies for the surveillance and control of the COVID-19 pandemic (15). The establishment of the national command post also played a key role in coordinating COVID-19 surveillance and the digital solutions (16). The command post facilitated rapid deployment of digital solutions utilizing the existence of the national strategy and pre-existing infrastructure.

The digital solutions developed by Rwanda during the COVID-19 pandemic emphasize patient access, enabling individuals to directly receive or track their own test results. It also minimizes the strain on the health sector to communicate results and to issue COVID-19 test result certificates where needed through the integration of laboratory and health management information systems across the cascade of COVID-19 diagnosis. The use of mobile data collection tools for community-based surveillance generated valuable insights to inform timely responses to outbreaks. Tracing and monitoring of cases and contacts using digital tools reduced the burden on the health system and allowed the country to focus its limited capacity on delivering services to the most at-risk individuals.

The system reports real-time data. For instance, the system has been able to report COVID-19 cases since the first case was detected. Between March 14, 2020, and September 1, 2022, the cumulative number of confirmed COVID-19 cases and deaths per million people is reported as 9,612.02 and 106.41, respectively, (3). The system to monitor COVID-19 was able to handle multiple concurrent users up to 9,000 in vaccination and more than 3,200 in a Covid-19 testing environment. With the existing digital tools, COVID-19 cases in the community have been monitored and provided with communication to report on their status.

Through leveraging existing HMIS technology, Rwanda gained increased capability to provide the required rapid response to the pandemic in areas of surveillance and contact tracing, case management, and in maintaining access to high-quality essential services. The collaboration between multiple arms of government and the private sector facilitated the deployment of these digital solutions through enabling the health sector to leverage existing data systems. These digital solutions led to a greater degree of health system resiliency, particularly through increased testing capacity and clinical management.

Sri Lanka case study: Interventions to maintain essential health services during the COVID-19 pandemic

Given Sri Lanka's position as one of the first countries globally to commit to working toward Universal Health Coverage, it is helpful to understand how it modified healthcare delivery to ensure pre-existing health services were adequately maintained (5). The first case of the virus in Sri Lanka was confirmed on 27 January 2020. Sri Lanka opted for a containment strategy like that in Singapore (17). In view of global disease trends and patterns, the health authorities focused on strengthening the hospital emergency preparedness and response plans of all health-care institutions. The emerging needs of these institutions were addressed by the government using a three-tier approach: (1) declaration of designated COVID-19 treatment facilities, (2) declaration of isolation hospitals and (3) identification of centers with ICU/HDU facilities in the country (18). While many countries had challenges on planning for essential health services, Sri Lanka ensured that special measures were in place for continued services for routine care while managing COVID-19. National guidelines were developed for the management of noncommunicable diseases (NCDs) and other routine clinics at hospitals and care arrangements for vulnerable groups. The government also worked under a whole of society approach through which the non-health sectors cooperated and were involved in supporting infrastructure facilities, mobility and providing their vehicles and equipment for the distribution of essentials and medicines (19). The state military and police extended support in contact tracing, quarantine measures and vaccine drives, reflecting the commitment to a Whole of Government and Whole of Society approach to COVID-19 in Sri Lanka (20).

In response to the COVID-19 lockdown measures, the country instituted modified means of healthcare delivery to ensure continuity of health services. During the planning phase, the Ministry of Health developed and disseminated guidelines using electronic media, for the smooth continuation of essential services related to maternal and child health (MCH) services in both the curative and preventive sector (21). Small scale alternative clinics targeting several clusters were established so that both parents and children could walk to nearby outreach center for vaccination. The Family Health Bureau, which operates under the Ministry of Health, released specific guidelines to ensure uninterrupted field maternal and child health-care services for lockdown areas and quarantined families (18).

Throughout the pandemic, the epidemiological information was shared continuously, and the weekly epidemiological situation by WHO was of immense importance and thereby evidence-based policy decisions were possible to be made. For instance, between March 2020 and September 1, 2022, the cumulative number of confirmed COVID-19 cases per million people was recorded as 30,692.21 and confirmed cumulative deaths per million people was 764.88 (3). This surveillance information has been used to devise surveillance strategies with the rapid spread of infection seen during the third wave and the availability of the rapid antigen tests and for updating the testing strategy for workplaces in May 2021 (22).

The three-tiered approach used by Sri Lanka to strengthen the hospital emergency preparedness and response plans health-care institutions generated fruitful results. As of 2022, the mortality rate for COVID-19 in Sri Lanka is at 0.48 percent which is considerably lower than the global rate of 2.14 percent (23). The adaption of service delivery and the provision of alternative patient care pathways and interventions was a means of managing the treatment of COVID patients and maintaining essential non-COVID care. These effective approaches are recommended for smooth continuation of healthcare services and can inform health systems looking to build greater resilience in post-COVID recovery.

Tanzania case study: The use of digital tools in enhancing disease surveillance measures

Tanzania's national efforts to integrate digital products into its COVID-19 response is the focus of this case study, through its application in COVID-19 surveillance. The first COVID-19 case in Tanzania was reported on March 16, 2020. By September 1, 2022, the cumulative number of confirmed COVID-19 cases and deaths per million people was 594.69 and 12.90, respectively, (3). The COVID-19 pandemic prompted an unprecedented response from all levels of government in the country, which subsequently led to the country opting to use a mitigation strategy which focused on reducing transmission rates. This type of control strategy has also been used by other countries like the United States (24) and Italy (25). In the early stage of the pandemic, Tanzania used its existing electronic integrated disease surveillance and response system (eIDSR) to enact this strategy, which enabled initial cases that were presented at health facilities to be easily captured (26). As cases increased, the IDSR system needed to adapt to the fast-changing crisis to effectively

capture cases in the community, as well as in health facilities. For those entering Tanzania at a formal point of entry, a web-based application known as Pima – meaning "measures" – was developed to enable reporting and screening. To facilitate health declarations, bookings, and rapid antigen test payments for travelers upon arrival, the government developed a travelers digital surveillance system known as Afyamsafiri meaning "Health Traveller." These systems were both linked to the eIDSR system. In addition, linkages between point of entry screening and health service delivery systems were enhanced using a standard operating procedure which was developed to facilitate referral system. At health facilities, digital applications for COVID-19 were developed in partnership with University of Dar es Salaam to improve case base reporting at health facilities and facilitate contact tracing (27).

These digital health tools have been anchored within the District Health Management System 2 software (DHSI2) with several new indicators added to facilitate planning for surge capacity (28). These indicators included the number of individuals vaccinated against COVID-19, the number of ICU beds occupied, number of oxygen equipment and the number of health care workers infected. The platform has also been incorporated within HIV/AIDS clinics and care treatment systems to facilitate the monitoring of COVID-19 vaccinations.

This COVID-19 digital ecosystem which was integrated into the existing national surveillance has become an essential element of building resilience as it has facilitated better data-driven planning and decision-making. An interactive dashboard within the application has generated case-list reports and has enabled the country in planning for case management, contact tracing, coordination and operations, diagnostic tools, event-based surveillance, health facility and provider administration, laboratory systems, points of entry, risk communication and community engagement, routine surveillance, supply chain (29). The use of innovative digital technology in strengthening monitoring, surveillance and early warning systems can therefore be identified as a key consideration in pandemic recovery plans.

Summary of country interventions

This publication highlights five country experiences and identifies interventions that have proved critical in responding to the COVID-19 pandemic and increasing national health system resilience. The following section attempts to synthesize some of the key learnings and interventions from these case studies.

Governance and multisectoral approach

In the context of Guyana, Malawi, and Rwanda, the early centralized governance structure and coordination mechanisms stood out as key strategic interventions during the early COVID-19 response. Although the organization of such mechanisms varied from country to country, case studies demonstrated the need for actors from across government and in multiple sectors to be focused on one unified response plan. Indeed, the COVID-19 pandemic has offered decision-makers an opportunity to work

collectively in crisis for effective planning and coordination. There are many testimonies documenting that to have an effective response, concerted multisectoral efforts involving public, private, and civil society actors within and beyond the health sector is required (30). For coordinated action to be sustainable, there is a need to have supporting structures like formalized institutional arrangements and policies which stipulate clear processes for working together. Other countries beyond the scope of this paper have demonstrated how this can be done (31). Given the interconnected nature of societal health, this level of engagement, if sustained, will be crucial to address other global health crises including the climate crisis.

Health information system: Linking data sources and systems to identify unmet needs for essential health care

Health Management Information System (HMIS) is considered as one of the main building blocks of health systems by the World Health Organization (WHO). Health systems strengthening and efforts toward health security need to be integrated to promote sustainability, efficiency, and effectiveness at both national and subnational level. Strong HIS allow for a coordinated response in times of public health crisis and thus implicitly bear a large potential for overall economic and social benefits (32). WHO recommends having "expanded (dual) dashboard of service coverage and delivery indicators and the use of key tracer indicators on utilization patterns and mortality on both COVID-19 and non-COVID-19 conditions to manage a dual-track health system" (33). Tanzania and Rwanda case studies have shown that investment in HMIS assisted in ensuring health system resiliency. Their experiences have left a key message that integrated data reporting systems if well-built can support fine-tuning of containment measures during a pandemic as well as in recovery phases.

Digital health: A tool for ensuring continuity of essential health services

Digital technologies have been instrumental in improving county responses to infectious-disease threats as well as in strengthening primary healthcare. All five countries embraced digital health tools to tackle a range of issues, include border surveillance, contact tracing, laboratory results and the provision of virtual patient care. In this publication, Malawi's One Health approach to its digital tools aided the country to have a resilient information system during its COVID-19 response. Tanzania strengthened its digital health system by leveraging existing platforms and integrating COVID-19 into routine HIV/AIDS Care and Treatment Clinics. Similar examples were evident in Sri Lanka's case study. While it is widely recognized that technologies like the Internet of Things (IoT), big data, artificial intelligence, block chain will have an impact on public health strategies, scaling up digital health will require significant institutional support to build country capabilities (34).

Maintaining essential health services during the COVID-19 pandemic

The impact of the COVID-19 pandemic on essential health services has been demonstrated widely (35). All five countries adopted strategies to ensure essential health services were maintained and any previous progress on both communicable and noncommunicable diseases was not lost. This included the adoption of special measures for the continuation of routine care in Sri Lanka, leveraging existing digital technology to provide rapid and later incorporated vaccination in their National Response Plans in Rwanda and Tanzania, and creating a multi-sectoral response to the COVID-19 pandemic in Guyana and Malawi, bringing together actors including the private sector to maintain essential health services. Similar examples have been documented in cross-country comparisons on planning services, managing cases, and maintaining essential health services (36, 37).

Study limitations

This paper could be strengthened through a more comprehensive review of country interventions across the Commonwealth before and during the COVID-19 pandemic. While several thematic similarities emerged across the five participating countries, the inclusion of more countries in this review would increase its rigor and understanding of the Commonwealth's broader response to the COVID-19 pandemic. It would also be helpful to understand how these responses compare to interventions made during previous health shocks or emergencies, to provide a form of comparison. A stronger quantitative approach could also strengthen the discussions in the paper, to assess the outcome of the documented interventions more effectively.

Conclusion

The paper has offered perspectives on country experiences in responding effectively to the COVID-19 pandemic and includes interventions that aimed to maintain essential health services, build health system resilience, and strengthen country preparedness. As countries continue to recover from the impact of the COVID-19 pandemic, these case studies present us with an opportunity to gain experience on what has worked, and what has not. The experiences of country representatives from Guyana, Malawi, Rwanda, Sri Lanka, and Tanzania, who have served as co-authors for this paper, have provided a unique observation on the impact of the discussed interventions in responding to the pandemic and in increasing health system resilience within the country.

It is hoped that these case studies, while limited in scope and size, can contribute to the broader literature to understand what is needed to strengthen health system resilience to future shocks in the spirit of building back better. The case studies call for strong leadership and governance to prioritize and invest in well-resourced health systems, including through strengthening surveillance systems, facilitating multisectoral approaches to health, implementing innovative tools

such as digital technologies and incorporating strong primary health care.

The COVID-19 pandemic has made a clear case for greater investment into health and looking forward, policymakers should explore how interventions such as those discussed in this paper can support in the building of strong and resilient health systems for recovery from the pandemic and to face future health threats.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

JM, EG, and LR were responsible for the concept, structure and finalization of this publication. All other authors ultimately contributed sufficiently and meaningfully to the drafting and editing of the final version for submission.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Role of hospitals in recovery from COVID-19: Reflections from hospital managers and frontliners in the Eastern Mediterranean Region on strengthening hospital resilience

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Background: COVID-19 highlighted the critical role that hospitals play throughout the prolonged response and continuous recovery stages of the pandemic. Yet, there is limited evidence related to hospitals in the recovery stage, particularly capturing the perspectives of hospital managers and frontliners in resource-restrained and humanitarian settings.

Objective: This paper aims to capture the perspectives of hospital managers and frontliners across the Eastern Mediterranean Region on (1) the role of hospitals in recovering from COVID-19, (2) Hospitals' expectations from public health institutions to enable recovery from COVID-19, (3) the Evaluation of hospital resilience before and through COVID-19, and (4) lessons to strengthen hospital resilience throughout the COVID-19 recovery.

Methods: A multi-methods approach, triangulating a scoping review with qualitative findings from 64 semi-structured key-informant interviews and survey responses ($n = 252$), was used to gain a deeper context-specific understanding. Purposeful sampling with maximum diversity supported by snowballing was used and continued until reaching data saturation. Thematic analysis was conducted using MAXQDA and simple descriptive analysis using Microsoft Excel.

Findings: In recovering from COVID-19, hospital managers noted hospitals' role in health education, risk reduction, and services continuity and expected human resource management, financial and material resource mobilization, better leadership and coordination, and technical support through the provision of updated clinical evidence-based information from their public health institutions. Qualitative findings also indicated that hospital managers attributed considerable changes in hospitals' resilience capacities to the pandemic and suggested that strengthening hospitals' resilience required resilient staff, sustainable finance, and adaptive leadership and management.

Conclusion: Hospitals are the backbone of health systems and a main point of contact for communities during emergencies; strengthening their resilience throughout the various stages of recovery is critical. Hospitals cannot be resilient in silos but rather require an integrated-whole-of-society-approach, inclusive of communities and other health systems actors.

KEYWORDS

hospital, resilience, recovery, health emergency and disaster risk management, COVID-19

1. Background

Hospitals are the backbone of health systems and a main point of contact for communities during emergencies; it is, therefore, imperative to ensure their continued functionality, safety, and resilience (1). "Hospital resilience" can be conceptualized by its six interdependent components (1) space, (2) stuff, (3) staff, (4) systems, (5) strategies, and (6) services), four resilience capacities (absorptive, adaptive, transformative, and learning), resulting in the primary outcome where resilient hospitals fulfill their most essential functionality then recover to its original state or a new adaptive state in a timely and efficient manner (2). In many conflict-affected or fragile health systems, where shocks are chronic and prolonged, resilience is day-to-day, with daily opportunities to adapt and transform in response to complex challenges and various simultaneous types of hazards (3). In this light, hospital resilience comprises both everyday resilience strengthened during routine operations as well as event-based emergency preparedness and response which require surge capacity (1). Hospital (and health systems) resilience occurs through each of the disaster risk management (DRM) cycle or stages of prevention, preparedness, response, and recovery (PPRR) (1). In many public health emergencies, the stages of response and "early recovery" are often overlapping with numerous interventions needed to rapidly stabilize and address the immediate needs of the population during a crisis (4). Scholars note the importance of hospitals' functionality (particularly emergency units) during the first 3 days highlighting the "72-hour golden window" to optimize survivorship following emergencies (5, 6). On the other hand, the pandemic has intertwined the response and recovery stages over 3 years as hospitals continued responding to COVID-19 while recovering to resume the provision of their services (7). Furthermore, hospitals are frontlines during public health emergencies, ensuring their immediate recovery and functionality is therefore central to both health systems and community resilience (8, 9). Despite the critical role hospitals play in DRM, across the literature, there is limited evidence related to hospital's resilience particularly in the recovery stage (2).

According to the United Nations Office for Disaster Risk Reduction, recovery is defined as: "The restoring or improving livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and "build back better," to avoid or reduce future disaster risk" (4). The recovery stage encompasses early recovery, leading to short-, medium-, and long-term rehabilitation, and finally reconstruction, which eventually closes the PPRR cycle back to prevention and preparedness. Moreover, the "build back better" (BBB) is a core principle of recovery and offers the opportunity to build back more resilient hospitals, health systems, communities, and societies more broadly. A study from the natural-disaster-prone Caribbean region described an efficient approach post-disaster "resilient recovery highlighting three dimensions to the BBB approach: (1) building back *stronger* (reconstructed infrastructure can resist more intense events), (2) building back *faster* (income, assets, consumptions, and services are restored as early as possible), and (3) building back more *inclusively* (reaching the poorest, most exposed, and most vulnerable) (10). Another interpretation of the BBB approach brought together six dimensions of communities (people, place, planet, peace, prosperity, and participation), centering

governance and equity, and highlighting the impacts of healthy cities on the health and wellbeing of communities, which ultimately result in urban, sustainable, economic, human and social development (11). Furthermore, in understanding the role of hospitals in recovery and resilience, it is important to consider the multi-sectoral nature of recovery and the interdependence and interlinkages between hospitals, health systems, and community resilience (12). Resilient hospitals contribute to building stronger and more resilient health systems, and healthy communities, and ultimately impact sustainable development (7). Beyond fulfilling their primary function in service delivery, hospitals also play a critical role in essential public health functions (EPHF) such as disaster risk reduction and also contribute to social, economic, and community development, and environmental sustainability (2).

The Eastern Mediterranean Region (EMR) reports the highest number of humanitarian emergencies exacerbating pressures on health systems which often face multiple types of hazards simultaneously. The EMR is a highly diverse Region, with 6 high-income countries (Group 1), 4 upper-middle income, 7 lower-middle income (Group 2), and 5 low-income (Group 3) (Box 1) (13). In the EMR, there are ∼740,000 hospital beds, with 80% in the public sector (1). At the beginning of the pandemic, hospitals in the Region were challenged, in learning and responding to a new virus with many countries also facing humanitarian emergencies; as the years progressed, these challenges were constantly evolving (14). In the first months of the COVID-19 response (and early recovery), health workers, hospital managers, and policymakers faced fear and anxiety due to the high rates of infections, limited and conflicting evidence-based guidelines, and misinformation and stigmatization of the virus and hospitals (14). Hospitals suffered from financial losses due to disrupted health services and increased costs, along with shortages of health workers (specifically ICU specialists/staff), and disrupted supply chains exacerbating the global shortages of sufficient PPEs, testing kits, and supplies (1). These shortages and limited testing capacities resulted in delays in diagnosing and confirming suspected cases which contributed to designated hospitals being overwhelmed, inefficient use and wastage of resources, and in some cases preventable infections and deaths among patients and health workers (1). Across the Region, the highest reported challenges were the shortages of staff and Personal Protective Equipment (PPEs) (14). A regional study further highlighted the adaptability of EMR hospitals in addressing complex challenges to maintain operations, respond to emergencies, and protect patients and staff, while also continuously evolving to strengthen their readiness for subsequent surges and plan for recovery (7, 14). Throughout the pandemic, hospitals (and health systems) needed to be resilient, continuously learning, absorbing, adapting, and transforming to ensure the safe and continuous delivery of critical services during emergencies (2, 13, 15). Hospitals exhibited these four resilience capacities throughout the prolonged COVID-19 response and overlapping recovery stages.

Across the literature, evidence on hospital resilience remains nascent and generally concentrated in the Global North, with few studies from the EMR and fragile and conflict-affected settings (2). Literature across both hospital and health systems resilience offers divergent and inconsistent definitions and frameworks for conceptualization with limited evidence on its operationalization and evaluation through the stages of PPRR (2). Moreso, evidence on health systems and hospital resilience focuses on the preparedness and response stages, with limited evidence on recovery (2, 16,

17). While the role of hospitals in recovering from emergencies is generally assumed, it remains under-documented (2). Further to this, across the literature on hospital resilience, limited research qualitatively captures the reflections of hospital managers, policymakers, and frontline emergency response managers in resource-restrained and conflict-affected settings. Addressing these research gaps, this paper aims to capture the perspectives of hospital managers (HMs) across the EMR on:

(1) The role of hospitals in recovering from COVID-19,

(2) Hospitals' expectations from public health institutions to enable recovery from COVID-19,

(3) Evaluation of hospital resilience before and through COVID-19,

(4) Lessons to strengthen hospital resilience throughout the COVID-19 recovery.

2. Methods

Due to the dearth of literature in the early stages of the pandemic, particularly from the EMR, this multi-methods study triangulated findings from three sources: literature review, online survey, and in-depth semi-structured key informant interviews (KIIs), to comprehensively capture hospitals' diverse and complex experiences in combatting and recovering from COVID-19 from the Region. For the purposes of this paper, we consider the intertwined phase between response and early recovery as recovery.

This paper is a derivative of a large mixed-methods regional research, which occurred over two phases: firstly, at the onset of the COVID-19 pandemic in March 2020 related to hospitals' experiences (challenges, interventions, and lessons learned) in combatting COVID-19, and secondly, 2 years later, related to hospitals' subsequent resilience throughout the prolonged response and recovery phases. During the first phase of the research, qualitative data was gathered from participants regarding five areas:

(1) challenges, (2) interventions, (3) lessons learned in combatting COVID-19, (4) the role of hospitals in the recovery, and (5) hospitals' expectations from their public health enabling their response and recovery. During the second stage, participants were asked about (1) their conceptualization, (2) interventions for operationalizing, and (3) strategies for evaluating their hospital's resilience, along with (4) the lessons learned in strengthening hospital resilience throughout the pandemic. This qualitative paper synthesizes the findings from parts 4 and 5 of stage 1 and part 4 of stage 2, using qualitative content analysis, to address the prominent research gap on recovery and resilience, particularly from the EMR. The findings of the other stages, including the literature review, can be found in following references (2, 7, 14).

Regarding the first objective, a broad question was intentionally asked regarding the role of hospitals in recovery, and responses were tiered as they related to spheres of influence (role on the hospital itself, community, health system, society, globally or the planet). Regarding the second objective, for the purposes of this research, public health institutions were divided into national and international. Hospitals were asked about their expectations from (1) the Ministries of Health (MOH) as the leading health systems coordinator at the national level and (2) the World Health Organization (WHO), as the United Nations' leading organization on global health. Regarding the third objective, we qualitatively evaluated hospital managers' perceptions and experiences of their hospitals' resilience before and after COVID-19, using Likert-scale questions in an online survey triangulated with open-ended questions across key informants and survey modalities. Ten statements related to hospitals' responses across the DRM cycle captured the hospital's capacities to absorb, adapt, transform, and learn, in accordance with the definition of hospital resilience presented in the background. Of these ten statements, eight were either directly or indirectly related to the recovery stage including early recovery (which starts during the response stage) and learning (which occurs through the prevention and preparedness stages). Finally, for the fourth objective,

BOX 1 Challenges faced by hospitals in the EMR by country-groups, according to WorldBank 2022 income-classification (from 2019 survey, unpublished by WHO/EMRO).
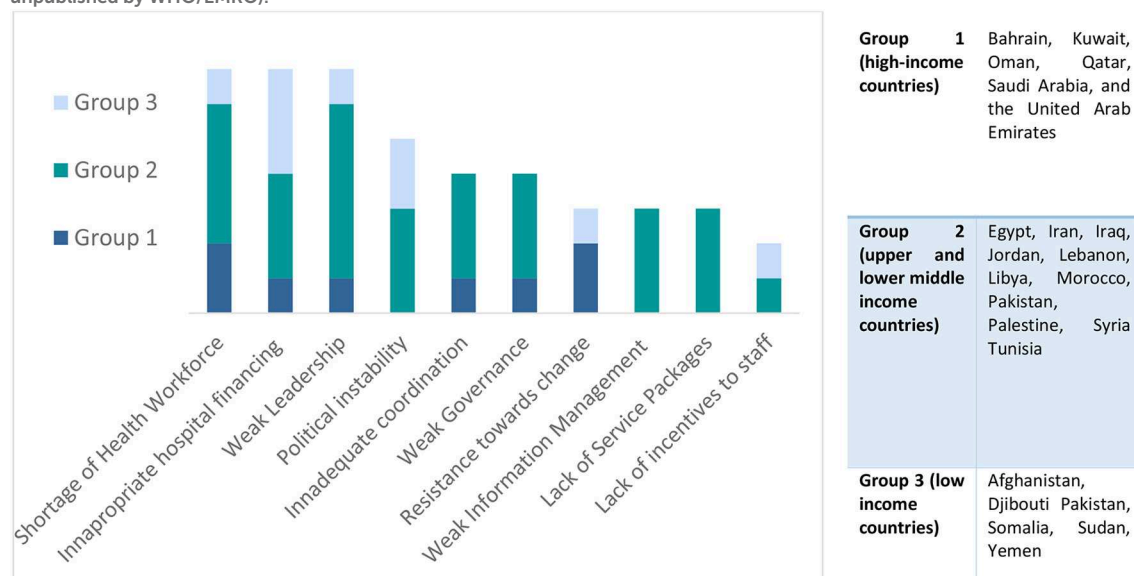
we asked hospital managers regarding their top 1–3 tips or lessons to their peers on strengthening hospital resilience. Most of their responses were related to hospital resilience components offering a complementary perspective to the survey which predominantly captured capacities.

2.1. Study design and data collection

To complement the limited findings from the literature review and gain a deeper understanding of the context-specific and diverse challenges and experiences faced by hospitals in the EMR, this study utilized a qualitative methodology, based on data from KIIs and open-ended survey questions. For both modalities, responses were collected anonymously and voluntarily during both stages of data collection. KIIs provided their informed verbal and written consent after receiving all relevant information about the project, a detailed consent form, and a copy of the interview topic guide. Survey respondents read an introduction to study objectives and an overview of ethical considerations before accessing the questions; all responses were collected anonymously and voluntarily. This study received ethical approval from the Regional Ethical Review Committee of the World Health Organization's Eastern Mediterranean Regional Office, which permits research to be conducted in the 22 countries of the Region.

Semi-structured in-depth key informant interviews were conducted during the two phases of the research: firstly, between Jul–Oct 2020 and secondly between Nov 2021–Feb 2022. For each stage, a topic guide for semi-structured interviews was created and an online questionnaire using GoogleForms was developed, piloted, and disseminated widely through WHO country offices to key national stakeholders, their staff, and professional networks *via* email and social media platforms such as WhatsApp. All study tools were reviewed by a small team of multi-disciplinary global and regional experts in the fields of health systems, hospital management, emergency response, and disaster management. The study tools were piloted and modified accordingly.

In all stages, purposeful sampling with maximum diversity was used to recruit interviewees ensuring maximum variation. WHO country offices recruited participants and 18/22 EMR countries provided nominations: 46 interviews were conducted in the first stage and 18 in the second until data saturation was reached (Annex 1 in Supplementary material). The selection was based on the participant's role as policymakers, hospital managers, and/or members of senior management teams in hospitals treating COVID-19 across the 22 countries of the EMR. Participation was voluntary and, in most cases, KIs agreed to be interviewed only in a few cases, where the high workload and pressure of the pandemic responses, did they nominate other relevant stakeholders in their place. To optimize the diversity, comparability, and transferability of findings, no restrictions were placed on the type or size of the facility, participants represented 18/22 EMR countries, ranging from low, middle, and high-income countries, including countries in conflict settings and emergencies, and included various health cadres in management positions along with health professionals from various specializes.

KIIs were conducted online (using Zoom) for 50–90 mins by 2 members of the research team. Almost all interviews were conducted in English, with few conducted in Arabic, Persian, or French. In line with Lincoln and Guba's "naturalistic" criteria for qualitative research

Trustworthiness, the four dimensions of credibility, dependability, transferability, and confirmability were considered to ameliorate the internal and external validity of findings (18). Active listening and probes along with prolonged engagement and immersion with the data were used to increase credibility and dependability. Following the repetition of themes during KIIs, the research team conducted a few additional interviews to confirm data saturation and reached a consensus. To improve confirmability and dependability, a record of analytical activities was kept. The interviews were audio-recorded and kept in secure files to be deleted within 2 years of project finalization. To improve credibility, the initial findings were shared with participants for discussion and feedback, the results were also presented in several regional webinars with key informants and technical experts, each with over 100 participants. The feedback was positive and did not significantly change the results.

Regarding the online surveys, upon revision and piloting, links were shared through two modalities: firstly, all key informants interviewed received a link to the survey (some of which confirmed to have responded while others shared within their networks), and secondly, through WHO country offices who disseminated the link to relevant stakeholders, including but not limited to Hospital managers, clinical directors, management teams, senior front-line health professionals, who were invited to participate and share the link within their respective networks. Surveys in both stages asked a few questions regarding participant demographics and hospital characteristics. The first survey was disseminated between July and October 2020 and was guided by the 10 domains of the WHO/EMRO hospital's COVID-19 readiness checklist. This survey included open-ended questions regarding hospitals' experiences, challenges, lessons learned, and the roles and expectations of hospitals, governments, and WHO in enabling recovery from COVID-19 which provided rich qualitative data for further analysis and triangulation. The second survey was disseminated between February and April 2022 and focused on evaluating hospital resilience by using Likert-scale questions, related to resilience to various types of hazards, responses and recovery from the last non-COVID emergency or disaster, changes to resilience capacities before and during COVID-19, and a checklist of available measurement tools, assessments, or evaluation strategies across six components for hospital resilience. This survey included open-ended questions on challenges/barriers (internal and external to the health facility) and practical tips/lessons learned through COVID-19 recovery on strengthening hospital resilience. To optimize responsivity, follow-up messages were sent regularly to remind participants to respond and widely share the survey.

2.2. Data analysis

Thematic (content) analysis was used following the six steps of the Braun and Clark approach (18, 19). Firstly, the research team transcribed the KIIs using electronic software and familiarized themselves with the data by reviewing, cross-referencing against the notes taken by the interviewers, and identifying initial codes. In non-English KIIs, a translation was made by the research team, and main notes were shared in English for summary, discussion, and consensus. Secondly, open coding was used and the research team systematically generated initial codes using an inductive approach. The MaxQDA

TABLE 1 Themes and sub-themes by study objective.

Study objective	Themes	Sub-themes
1. The role of hospitals in recovering from COVID-19	**1.1. Education**	1) External/Community-facing: Rebuilding public trust, health promotion, and communication with the community, raising awareness, managing fear and misinformation, 2) Internal/Hospital-facing: Building capacities of frontliners
	1.2. Risk reduction	1) Infection prevention and control including managing visitors 2) Strengthening surveillance and information systems 3) Environmental impacts
	1.3. Services continuity	1) Utilizing telemedicine 2) Business/services continuity planning
2. Hospitals' expectations of public health institutions to enable recovery from COVID-19	**2.1. Hospitals' expectations of MOH**	1) Human resource management 2) Financial and logistical support 3) Leadership and management
	2.2. Hospitals' expectations of WHO	1) Source of evidence-based information 2) Coordination 3) Resources mobilization
3. Evaluation of hospital resilience before and through COVID-19	**3.1. Resilience to various types of hazards**	Per WHO hazards categorization: Natural, Biological, Technological, Societal, and Environmental
	3.2. Resilience capacities across DRM stages	1) Resilience to the last non-COVID emergency or disaster 2) Changes in hospital resilience before COVID-19 and now
4. Lessons to strengthen hospital resilience throughout the COVID-19 recovery	**4.1. Resilient staff**	1) Availability and mobility, 2) Competencies and in-service training, and 3) Physical, mental, and financial safety
	4.2. Sustainable finance	1) Back-up funding for emergencies, 2) Financial literacy of hospital managers to ensure informed decision-making, and 3) Diversity income sources
	4.3. Adaptive leadership and management	1) Learning and adapting strategies and systems, 2) Hospital-level preparedness and response programs, and 3) Empowering frontline stakeholders (including the community) to ensure swift decision-making

software was used to organize and analyse all the qualitative data. Thirdly, two coders discussed the completeness of the data and reached a consensus regarding data saturation when no new concepts emerged. Fourthly, the coded segments were sorted to identify the main themes and sub-themes for the main research questions stated in the study objectives. Initial themes were organized and merged accordingly. Fifthly, the word-cloud functions of the software were used to generate the names of abstract themes and confirm the most cited ones. Finally, qualitative findings were synthesized, triangulated with survey results and literature review, and shared with experts for further validation (20).

As for the surveys, after data cleaning, a total of 139 survey responses were included from 14/22 EMR countries from the first survey, and 113 from 13/22 countries were included in the second. A descriptive analysis was also conducted using Microsoft Excel (Annex 2 in Supplementary material).

3. Results

For each of the four study objectives, qualitative findings captured the following themes and sub-themes detailed in the following section and summarized in Table 1.

3.1. Role of hospitals in recovering from COVID-19

Following the first wave of COVID-19, hospital managers, and frontline workers reflected those hospitals have a major role to play not only in the initial response to the pandemic, but also in the recovery, transition to "normalcy," and preparation for forthcoming surges. The most common themes included: (1) **education** (including health promotion and communication to raise awareness in the community and strengthening capacities of frontline staff), (2) **risk reduction** (including infection **prevention** and control), and (3) **service continuity** (Table 1). These themes were reflected as the top three interventions across survey respondents (Figure 1) and further confirmed by Figure 2 whereby the most frequently mentioned concepts and words are largest in font, including: "educational," "awareness," "preventive," "services," "continuous" and "care."

3.1.1. Education

Education was the most prominent theme across the qualitative findings (Figure 2). During emergencies, hospitals have an external-facing obligation toward educating their patients and communities, working together with other actors and partners within a whole-of-society approach, but also have an internal-facing obligation to train

Role of Hospitals in the EMR in recovery and in preparation for second-wave: Overall and by country-groupings (13 countries, open-ended questions of survey, n=139)

FIGURE 1
Survey responses ranking role of hospitals, in the EMR, in recovering from COVID-19; by country group and overall.

FIGURE 2
Word cloud of qualitative responses on role of hospitals in recovery from COVID-19.

and capacitate their staff (Table 1). The role of hospitals to educate their health workers will be addressed under Section Resilient staff.

The vast majority of survey respondents noted that hospitals must play a role in the recovery phase by being a strong force for health promotion (education) and raising awareness about preventive and public health measures to the general public particularly during emergencies (Figures 1, 2). Hospitals have an essential role to play

not only in service delivery but more significantly in rebuilding the public's trust in the health system through health promotion and health education. Emphasis was placed on providing "reliable information" and "not spreading false rumors to intimidate society." Healthcare providers and frontline workers advised using "social media," "brochures" and technology to spread awareness and educate the public on social distancing, isolation of suspected and confirmed

cases, and handwashing as the most important IPC strategies for everyday life and return to work. Hospital managers reflected on the impact of mobilizing and collaborating with the community not only in rebuilding trust but also in resuming hospital operations:

> *"As part of our communication efforts: (1) our staff educated patients and their families to avoid visiting the hospital unnecessarily, (2) we arranged awareness sessions in our colleges and education institutions to empower the youth regarding vaccination and personal protective equipment, and (3) we mobilized our community to help the hospital" (KI 1).*

Raising awareness in the community to actively contribute to the reduction of infections was a key role of hospitals in the recovery. According to respondents, this directly resulted in minimizing public health and economic threats enabling society to return to normal after the pandemic.

3.1.2. Risk reduction

Participants highlighted the essential role that hospitals and health facilities play in fulfilling the health system's public health functions, whether in health promotion and education; risk reduction and IPC; or surveillance.

One issue that was raised extensively among key informants and survey respondents alike was the management of visitors which posed a threat to cross-infections (Table 2). Notably, hospital managers learned and adapted to ensure safety and high-quality both patients and staff, many mentioning the shift in infections from nosocomial during the first wave to community-based during the subsequent waves. They also stressed the importance of reducing the risk of cross-infections between COVID-19 and non-COVID patients to ensure the continuity of essential health services and limit disruptions to operations (Table 2).

Additionally, some respondents suggested that hospitals should be involved in "widespread surveillance; with ongoing data collection," should utilize "robust screening and triage practices," and should ensure "early detection and reducing spread of disease." On the other hand, few respondents noted the hospital's role in reducing risks more broadly related to environmental sustainability, suggesting the need for "more rational utilization of resources, such as consumables, personal protective equipment [PPE], and basic medical supplies" and "minimizing wastage at hospital level."

3.1.3. Services continuity

About a quarter of participants described the role of the hospital as primarily to "treat the illness," and provide "quality care and clinical management of COVID-19 cases." Nevertheless, hospital managers across the Region highlighted the use of telemedicine to reduce the burdens on the hospitals and the need for service (and business) continuity planning including efficient coordination and management of limited human, financial, and material resources for surges (Table 1).

A sub-analysis among different types of frontline workers revealed a general agreement between professional groups regarding the importance of health promotion/education and increasing awareness in the community (including health workers) to ensure safety in service provision. Physicians emphasized the need to work collaboratively with the community, considering them as a partner in the pandemic response. Nurses and administrators highlighted the need for a culture change, both within hospitals and the community, regarding the perceptions and practices of IPC. Health workers expressed different priorities when it came to planning for services continuity in the recovery (Table 2). Nurses and administrators alike emphasized the need for staff mental health and psychosocial support. On the other hand, physicians highlighted the need for business continuity plans to ensure that future emergencies or surges don't disrupt the provision of care.

Across the EMR, the role of hospitals in the recovery stage can be summarized through the three overarching themes mentioned above. While all three themes were commonly mentioned across countries of all-income groups (Figure 1); their operationalization varied depending on resources. For instance, the second theme regarding infection prevention and control (IPC) and reducing risks is interpreted differently between high and low-income countries. In most high-income countries (Grp 1), respondents indicated that the role of hospitals in the recovery is to "follow the rules," "develop guidelines according to national strategy," "contribute to training," "promote social distancing," and reduce the load on hospitals through "use of telemedicine." On the other hand, in lower-income countries (Grp 2 and 3), preventing infections and reducing risk looked like "enhancing hospital surveillance and information systems," "rebuilding the trust of the community in the health system," "protecting health workers" and "promote a hygienic environment." The latter reflects the need for overall health system strengthening and stabilization, particularly in countries facing ongoing humanitarian crises. Notably, across both the highest and lowest income country groups equally, respondents reflected the need to "promote evidence-based practices (EBP)"; however, the implementation of these EBP is directly related to hospital culture which is influenced by numerous factors. Managers reflected on the challenges of the nuances in hospital culture, the interplay of society and community, and the perceptions of health workers (as community members) as factors that must be considered to uphold IPC, combat stigma, and resume health services. Furthermore, stakeholders from the Region, across countries of all-income groups, highlighted the need for creating a safe and supportive working environment and reducing occupational risks and deaths, especially in the early months of the pandemic.

3.2. Hospitals' expectations of public health institutions to enable recovery from COVID-19

For this study, we asked hospital managers their expectations of their ministries of health (Section 3.2.1: Hospitals' expectations of MOH) and of the WHO (Section 3.2.2: Hospitals' expectations of WHO) in enabling recovery from COVID-19; the sub-themes were generally similar, particularly in the Region's resource-retrained settings (Table 1).

3.2.1. Hospitals' expectations of MOH

Qualitative findings revealed that the four major requests from their respective national MOH were related to **(1) human resource**

TABLE 2   Priority themes among different types of health professionals regarding the role of hospitals in recovery from COVID-19.

Management: Head of Deparment/Directors/Policymakers	Nurses	Physicians
"Regular and more education for the public on social media and television regarding the transmission of infection and safety precautions. This will reduce fears and myths and at the same time increase awareness in the public to continue taking all safety precautions"	*"We have to pass this hard time by having awareness of infection control and act as role models in preventing infection"*	*"Hospitals should collaborate with the community to win the battle"*
"It is easy to return to the pre-pandemic business mode with an emphasis on infection control"	*"The hospital administration is trying very hard to reduce and limit the spread of the disease. The issue remains a 'cultural issue' in individuals and the community"*	*"Balancing resumption of services with the safety of patients and staff"*
"Hospitals should be and remain a safe place for patients. We must work to provide services for both COVID patients and other patients smoothly and safely as possible"		*"Constant awareness of hospital visitors. Spreading educational brochures among cadres and visitors"*
		"Disseminating awareness videos among the community through various means of communication"
"Supporting doctors and creating medical and psychological assistance teams"	*"Psychological health education is the most important factor"*	*"Establish a business continuity plan that allows the department to run its emergency plans during COVID-19"*

management (HRM), particularly remuneration, training, increased staffing, and psychological support, (2) financial and logistical support, (3) leadership and management (including communication and clinical support) (Table 1). Table 3 highlights the main sub-themes (including sub-sub-themes and examples), raised by respondents regarding the expectations of MOHs in supporting hospitals directly responding to COVID-19 which are further reflected in Figure 3 through the prominent words "financial," "incentives," "equipment," "supplies," "PPE," "training" and "communication."

In the early phase of COVID-19 response and recovery, qualitative findings identified that hospitals expected better human resource management particularly regarding financial and logistical support (whether through fixed contracts, more secure remuneration, improved incentives, or provision of sufficient PPEs, supplies, and equipment), as well as training. Respondents raised that more holistic incentive packages may encourage staff to work with COVID-19 despite significant fears of occupational infections and significant illness, they may also encourage clinicians from other disciplines or remote locations to volunteer their help when the healthcare system is overburdened. Additionally, high-quality clinical care requires adequate staff numbers as well as a reliable supply chain for PPE, diagnostic services, oxygen, medical equipment, and medication-survey respondents felt that the MOH has an important role to play in providing and ensuring the ongoing availability of these materials (Figure 3; Table 3). Moreso, survey results indicated that among the most frequently cited hospital requests to MOH were around the themes of logistical, financial, and managerial support, including providing adequate medical supplies, equipment, and PPEs (around 22%), securing adequate qualified critical care staff and specialists (15%), and increasing financial support (about 12%).

When exploring a sub-analysis by types of health professionals, all hospital staff in clinical and managerial roles including heads of clinical departments including nursing, senior management teams, physicians, nurses, and IPC specialists, found logistical support and the provision of supplies, equipment, and PPE chief among expectations of MOH. Clinical staff, namely doctors and nurses, identified financial support in the form of incentives as the main request from their governments. Regarding HRM and the distribution of the health workforce, hospital directors, members of senior management teams, and nurses expected MOHs to secure

sufficient and adequately trained numbers of specialists across designated hospitals responding to COVID-19. Hospital managers complained that the shortages of specialists posed a major threat to the response, especially in resource-restrained countries in the Region where workforce shortages and maldistributions are common. Both clinical staff (physicians and nurses) and members of the senior management team highlighted the need for increased staff mental health training, psychosocial support, recognition, and efforts to raise health worker profiles and morale; these were considered top expectations of MOH in the early months of the pandemic.

Generally, hospitals in the EMR's high-income countries are more likely to anticipate ministerial support in promoting telemedicine, raising awareness in the community, and enforcing measures related to social distancing, compulsory mask use, screening, and testing. On the other hand, hospitals in the Region's LMICs expected governmental support expected stronger leadership, smoother coordination of actors (including the private sector), efficient HR management, increased training, as well as financial and logistical support, whether through fixed contracts, more secure remuneration, improved incentives, or provision of sufficient PPEs, supplies, and equipment. Notably, in most Group 3 countries, hospitals are more likely to request a wide range of technical, financial, managerial, and logistical support from ministries and government, WHO, and other international organizations. This was attributed by respondents to the fact that their hospitals were facing COVID-19 as well as other humanitarian emergencies, within fragile health systems further strained by the public health and financial pressures exacerbated by the pandemic and ongoing conflicts.

In addition to the primary obligation of MOH to disseminate clinical guidelines to hospitals and update them according to international standards, respondents expected ministries to improve their **leadership and coordination** (Table 3). Hospitals expected clear communication and early involvement of multiple stakeholders to ensure a unified response. Another issue raised in the first phase of our study was the burden on hospitals to provide different sets of data and information in different modalities/platforms to various directorates in their MOHs; hospital managers expected to have a more integrated approach toward information management at the central level. One of the top issues expected of the government was proactive preparedness and more comprehensive contingency planning related to all aspects of the health system, including early

TABLE 3 Most frequent themes regarding how the MOH could support hospitals responding and recovering from COVID-19, in order of frequency.

Sub-theme	Sub-sub-theme	Examples
Human resources management (HRM)	Incentives	"Providing incentives for workers," "Implement incentives system for staff," "Give money to staff," "Pay incentives for staff on time, and regularly," "Give graduated students scholarships and grants for qualification," "With material incentives for worker," and "Providing incentives/ hazard pay"
	Training	"Training of cadres," "Train health workers," "Helping in queuing training," "Regular training of staff," "Training on IPC," "Trained personal are essential and worth investing in, having infrastructure for capacity building," and "Qualify all staff for an anticipated emergency even those who are in primary health care and psychiatric hospital"
	Staff number specialization	"Supporting the hospital with human resources," "Recruitment of extra staff," "Provide the number of employees," "More staff recruitment to avoid overburden," "Reduce the work load of staffs," "High staff," and "Putting the right employee in the right job arrangement of paramedical staff"
	Psychological support	"Support the staff, listen to their concerns/allow the staff to verbalize their feelings because it's really difficult for them to handle this situation because of fear of contracting COVID-19," "Frequently test and vaccination of staff," "stress management," "Be sure for the physical and mental wellbeing of staff," "Counseling, emotional support," "Allowing employees to take leave to rest because it is one of their rights," and "To provide more psychological support, Support how, "Moral support"
Financial and logistical support	Support and incentives	"Financial aid, financial support," "Providing satisfying financial support" "Financial compensation for the staff," "Support is in financial resources," "Provide the budget for the financial health facility completely," "Motivating medical personnel financially enough to motivate them to work," and "Supporting health workers and strengthening them financially and psychologically"
	PPE	"Full PPE support," "Prepare PPE," "Providing quality PPE," "By providing enough PPE for healthcare workers," "To provide enough PPE kit to all staffs," and "Provide for the needs of the hospitals, especially for PPE"
	Other equipment	"Good equipment," "Hospitals affording material aid and equipment," "Allocate hospitals in each specialty area for a respiratory infection that is equipped with equipment," "Providing all medical equipment and supplies, and medicines," "Providing devices and equipment that we lack in isolation centers, such as ventilators," and "To provide the essential material, supplies, and equipment"
	Supply chain management	"Efficiency in supply chain Management," "Organization of adequate medical supplies," "Providing supplies, devices, and medicines and ensuring their continuous flow," "Fast supply chain," "The regular provision of medical and non-medical supplies," "Keep supply chain maintained," "Maintain the supply of essential items," and "Clear communication pathway-unified supply chain"
Leadership and management	Communication	"Good communication," "Stop mixed messages," "Communication of government leaders with HCW and encouragement through field visits," "Involvement of the stakeholders," "Clear with employers," "Be transparent," "MOH regularly meets with frontline leaders from hospitals," and "Mass Communication"
	Strategies	"Commitment," "Holistic administration of the pandemic," "Effective communication system," "Effective utilization of the resources central bed management," "New management based organization on, performance and accountability, "Analysis of each hospital individually according to their need and respond to them," "Professional rather political approach," "Coordination and cooperation between the technical and administrative teams in crisis management," "Situation analysis and review of outcomes," "Data collection and transparent communication to HCW and the public," "Encouraging, supporting, and conducting research, particularly in using off-label medications," and "Sharing of resources"
	Bed capacity	"Allocate hospitals in each special area for respiratory infection," "Central bed management," "Arrange more beds for COVID-19 pts," "Sufficient specialized ward with adequate medical items," "Create new secondary care hospital so care continues their regular services"
	Guidelines	"Case definitions," "Management protocols," "Centralized guidelines, institution rather than individualized protocols," "Update the local policy and share it with the end users," "Support by updating recommendations and strategies relevant to the various target populations of COVID," and "Enforced regulations and SOPs"
	Diagnostic capacity	"Activate the work of laboratories by securing and controlling materials and kits necessary for laboratory work," "Government to provide adequate diagnosis and treatment facilities," "PCR testing," "Continue tests even from outside of the hospital," and "Early detection"
	Medical treatment	"Try to find proper vaccines," "Providing effective treatment," and "Free treatment"
	Research	"By calculating the no of recoveries," "Data collection and transparent communication to HCW and public," and "Encouraging, supporting and conducting research, particularly in using off label medications"

FIGURE 3
Word cloud of qualitative responses on hospitals expectations from MOH in enabling recovery from COVID-19.

procurement of supplies and equipment such as PPEs, medicines, and testing kits. This was especially highlighted across hospitals in resource-restrained and conflict-affected settings. Further to this, hospitals expected greater coordination in the form of referral pathways, and distribution of ICU beds, ventilators, medicines, medical supplies, and equipment.

3.2.2. Hospitals' expectations of WHO

Regarding the role of WHO in supporting hospitals' responses to COVID-19 in the early months of response and recovery, hospital managers expected several key interventions (Table 4) including but not limited to providing technical support and guidelines, raising awareness and keeping the public, implementers, and frontliners updated on latest evidence-based practices, building capacity (including technical and managerial capacities), coordinating between health actors and ensuring financial and logistical support through adequate resource mobilization, especially in resource-restrained and humanitarian settings, and finally in research and development (particularly related to vaccine development and distribution). These interventions can be synthesized into three main sub-themes: **(1) WHO as a reliable source of evidence-based information, (2) WHO as a politically-neutral actor in coordination, and (3) WHO as a support in resource mobilization.**

In most high-income countries, hospitals highlighted the essential role of WHO in providing technical and informational support, in addition to this, hospitals in lower-and-middle-income countries, especially those in humanitarian settings, also rely on WHO for resource mobilization through financial and material

support. Across all countries, the role of WHO was highlighted in building the managerial capacities of hospital directors.

3.2.2.1. WHO as a reliable source of evidence-based information

Among survey respondents, the most significant theme regarding the role of WHO in supporting hospitals responding to and recovering from COVID-19 was providing "evidence-based information" (Table 4; Figure 4). Based on participants' responses, this encompasses: (1) "technical guidelines," (2) "capacity building and training," (3) "technical support to recover and continue essential health services," and (4) "innovation for rapid and safe vaccination."

Firstly, hospital managers throughout the Region relied on WHO to provide technical guidance, not only related to the nature of the virus, its epidemiology, infectivity, and transmission but the implications on hospital management and clinical practice. The onset of a new and evolving virus brought heightened anxiety due to the limited evidence and widespread misinformation. Hospitals in the EMR expected WHO to continuously provide and update reliable evidence-based guidelines and recommendations, guide clinical management, implement IPC protocols, ensure hospital operations run efficiently and safely, and increase preparedness and resilience for surges, especially in the early stages of COVID-19 response and recovery. Hospital managers and health workers considered WHO a trusted entity to verify and disseminate reliable and updated evidence regarding IPC, emergency and surge preparedness and response, and clinical management (including identification, diagnosis, and treatment) of COVID-19. One hospital manager mentioned:

TABLE 4 Most frequent sub-themes related to how the WHO could support hospitals responding and recovering from COVID-19, in order of frequency.

Sub-theme	Sub-sub-theme	Examples
Source of evidence-based information	Technical guidelines and training	"Prepare guidelines conduct training"
		"Guidelines, safety at work place and home, public awareness"
		"Sharing appropriate treatment protocols and guidelines training"
		"Staff how to handle pandemic (disaster plan)"
		"Regular guidelines"
		"By providing proper guidelines in advance!"
		"Provide us with EB guidelines, success stories from other countries"
		"Disseminate information in real-time, the establishment of Protocols and guidelines"
		"Guidance and counseling"
		"Guide lines for health care workers safety"
		"Continuous training and qualification for health staff and continuous medical guidance"
		"By supporting new hospital strategy conceptualization of new models—training—expertise"
	Evidence and research	"WHO should be independently evaluating the data on certain treatments/ interventions—not influenced by social media, countries or public or politics"
		"Provide us with EB guidelines"
		"Scientific update"
		"Revised protocols"
		"Real identification of the elements that work scientifically and practically and communicating with them with the COVID epidemic"
	Essential services	"Aid to continue providing basic services during the emergency period in order to limit the number of direct or indirect death and"
		"Ensure the continuation of providing the necessary services to the citizens until they obtain the necessary support from medicines, equipment, and consumables essential for work"
	Innovation	"New invention of preventive measures"
		"Updates to vaccine and treatment"
Coordination	Direction and accountability	"Universal policy for All hospitals under the ministry of health in combatting COVID-19"
		"Ensuring the Ministry's commitment to implementing rehabilitation projects for health institutions and supporting health institutions far from the center"
		"Direct supervision and evaluation"
		"Cooperation, equality and justice"
		"Good coordination"
		"Set clear policies, oblige the Ministry of Health to establish quality and infection control department"
		"By visiting some of the hospitals randomly and acting realistically"
		"Classifying countries according to severity"
		"To listen"
		"Vigilance and support," "Prioritize and guide the allocation and targeting of resources to achieve the goals"
Resource mobilization	PPE, medical	"Hospitals affording material aid and equipment"
		"Personnel and protective equipment"
		"Providing devices and equipment that we lack in isolation centers"
		"Ventilators"
		"Medical equipment support"
		"Oxygen insurance and protective equipment"
	Finances	"Support financially"
		"Assistance with the operational budget, such as patients' meals and other supplies"
		"Provide scholarships and grants for staff"
		"Try to stimulate the staff through incentive support"

FIGURE 4
Word cloud of qualitative responses on hospitals expectations from WHO in enabling recovery from COVID-19.

"[WHO] is the most important job all over the world, just to understand this new disease and update the critical protocols. For instance, I expect WHO to have a clear understanding of the duration of infectivity; if we should decrease isolation from 10 days to 9, it has a huge impact on the hospitals" (KI 2L).

Secondly, hospitals expected capacity-building support from WHO, as confirmed by the two largest words (most frequent themes) of "training" and "guidelines" (Figure 4). In the first quarter following the announcement of COVID-19 as a Public Health Emergency of International Concern (PHEIC) (July 2020), training, health workforce strengthening, and the use of telemedicine (including its use for education) have been identified among the top three requests across two-thirds of the Region. Hospital managers in resource-restrained and humanitarian settings, where critical shortages of health workers and specialists are chronic health systems stressors, confirmed the need for continuous education and in-service training and re-training to ensure that frontliners (including students, volunteers, and health workers from various specialties) have adequate competencies to provide critical and emergency care safely.

Thirdly, hospital managers expected WHO's technical expertise to support countries in maintaining and monitoring essential health services and transitioning health systems back to normalcy and recovery. In the early months of response, one hospital manager mentioned:

"Nobody's talking about the recovery phase yet because everybody's talking about the second wave. A second wave is a concern, but people are not only dying from COVID, but they will start dying from us not providing health care. We need to know how to recover safely" (KI 3).

Hospital managers across the EMR relied on WHO to build capacities in emergency and disaster preparedness, leadership, supply chain management (especially in FCS), risk communication and health promotion, HRM, mental health and psychosocial support for front-liners, clinical management (including triage, screening, diagnosing, strengthening laboratory capacities, providing critical care, managing COVID-19 co-morbidities, treatment in isolation wards, etc...), maintenance and expansion of essential health services, use telemedicine, and improvements to hospitals' quality, safety, and IPC measures. In the face of critical staff shortages, high workload, and burnout, hospitals in resource-restrained and humanitarian settings promptly identified the need to build the capacities of clinicians on stress management and greater emphasis on mental health in crises and psychosocial support:

"Beyond training staff in isolation centers and clinical areas, there is no focus on psychosocial support from WHO or any other organizations" (KI 4).

Fourthly, hospital managers expressed that WHO had a timely responsibility to support ongoing research, evidence generation, knowledge sharing, and dissemination, as well as documenting and

evaluating innovative interventions in triage, treatment, and vaccine development. Though there are vast inequalities in access to COVID-19 vaccines globally, hospital managers attributed the development and distribution of vaccines as a critical enabler to early recovery from COVID-19. One hospital manager mentioned:

> *"At the onset of the pandemic, there were no vaccination protocols yet. I secured them somewhere to be able to sleep at night and carry on their daily activities so that they won't be obliged to leave the hospital and expose their parents or their families to the transmission of COVID. The vaccines allowed us to resume almost-normal operations" (KI 5).*

3.2.2.2. WHO as a politically-neutral coordinator

Across the Region, especially in emergency and humanitarian settings, KIs highlighted the role of WHO as an objective actor and trustworthy source of reliable internationally sound standards and guidelines. In conflict-zones, where parallel governments may exist between opposing parties, hospital managers stressed the importance of WHO ability to remain apolitical and provide evidence to frontliners to deliver high-quality care:

> *"The WHO is a reliable source of information and remains an honest broker. In our country, if guidelines are coming ministry of health of [x] region, they will not be followed, but they will agree if they are coming from WHO but not from the opposition" (KI 6).*

3.2.2.3. WHO as support in resource mobilization

In the early months of response and recovery, the top request from WHO was related to financial and material resource mobilization and timely procurement of essential supplies (namely PPEs). While some high-income countries, were utilized procurement channels through WHO; this was especially true in the Region's LMICs, particularly those health systems facing the double burdens of war/humanitarian conflicts and this pandemic. In many of these Region's emergency countries, WHO was responsible for the initial provision of PPEs, testing kits, medicines, supplies, and equipment. Hospital managers from at least 10 emergency countries also mentioned relying on the WHO to pay the salaries of frontliners in designated COVID-19 hospitals.

3.3. Evaluating hospital resilience before and through COVID-19

KIs qualitatively evaluated two dimensions of hospital resilience; firstly, hospital resilience to various types of hazards (according to WHO categorization), and secondly, through evaluating the hospital's resilience four capacities through DRM stages.

3.3.1. Hospital resilience to various types of hazards

Survey respondents were asked about the last non-COVID hazard facing their hospitals and then asked to evaluate their hospitals' resilience to the various types of hazards on a 5-point Likert scale from least resilient (1) to highly resilient (5). Apart from COVID-19, the most commonly reported type of hazards were natural (27.9%)

and societal hazards (24.3%), followed by technological (21.6%), biological (7.2%), and environmental (1.8%) (Figure 5).

Generally, hospital managers across the EMR neutrally evaluated their hospital's resilience to various types of hazards. All types of hazards, with the highest reported score was 3/5 (yellow) across all five categories of hazards (Natural, Biological, Technological, Societal, and Environmental) (Figure 6). Overall, findings revealed that the highest reported scores were across societal followed by biological hazards, indicating a medium or average level of hospital resilience to these types of hazards. With the exception of environmental hazards, findings reflect a skew toward "less resilient" with the second most frequent response in all graphs being 2/5 (Figure 6). Conversely, responses for environmental hazards indicate a positive skew toward "higher resilient" with the second highest response as 4/5. Across all hazard-categories, the lowest reported score was 5 (highly resilient—purple in Figure 6) indicating that most respondents did not perceive that their hospitals were highly resilient to any hazard. These scores further reflect the need to build on existing structures and efforts and improve hospital resilience to all types of hazards across the EMR.

3.3.2. Hospital resilience through resilience capacities across DRM stages

With regards to hospitals' resilience before COVID-19, 10 statements were presented to respondents regarding hospital's responses to a non-COVID emergency or disaster, whereby respondents selected along a 10-point Likert scale where 1 corresponded to highly disagree and 10 to highly agree (Figure 7).

Generally, hospital managers and frontliners responded positively as indicated by mode scores for all 10 questions, where seven questions reported modes of 8/10 and three reported modes of 9/10 (Figure 7). This positive skew across all questions is further reflected, in the high median scores of 8/10 in eight of ten questions, a mean ranging from 6.9 to 7.5, and a small range where 50% of responses (between the first and third quartiles) were scored between 5 or 6 and 9 (Figure 7). Moreover, in seven of ten questions, more than 40% of respondents selected one of the three topmost scores (8, 9, or 10/10), with the other two questions just barely below 38 and 39% respectively. On the other hand, when exploring the three lowermost scores [Bottom 3 (%)], all but one question found that 10% or less of respondents selected these.

Notably, the question with the highest scores was related to *timely recovery (Q6)* with 60% of respondents scoring in the three topmost categories, resulting in a mean of 7.51. On the other hand, the question with the greatest variation in responses was related to *a system for continuous learning and evaluating preparedness, response, and recovery (Q9)*, where 12% of respondents selected the lowermost scores, and around 16% equally scored 5,7,8,9 and 10 (Figure 7). Similarly, a few graphs also reflected notable peaks around score 5 indicating neutral evaluations of *hospitals' ability to absorb the impact of disaster without loss of function* (Q2) and hospitals *having a mechanism for communicating new adaptations and lessons learned with all staff in a regular manner (Q10).* These areas reflect opportunities for improving hospital resilience.

To compare hospital resilience before COVID-19 and currently, an assumption was made to integrate and align the resilience capacities: absorb, adapt, transform, and learn, with the stages of DRM: prepare, respond, recover, and apply new lessons for prevention and risk mitigation. A question was posed over a
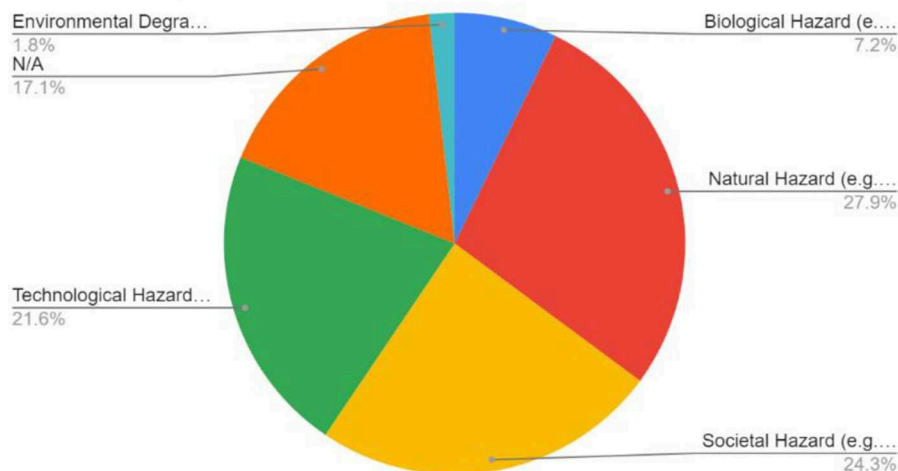
FIGURE 5
Last type of emergency or hazard faced by hospitals in the EMR excluding COVID-19.
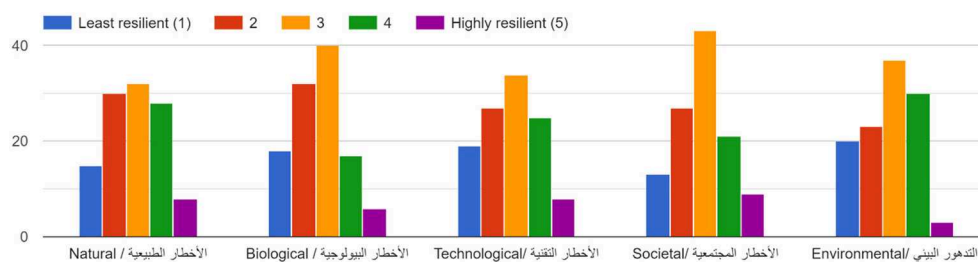
FIGURE 6
Five-point Likert-scale evaluation of hospital resilience by type of hazard.

four-point Likert scale ranging from No change (0) to Significant change (3). Generally, hospital managers positively evaluated the changes to their hospital's resilience capacities following the pandemic. Across all four capacities, hospital managers most frequently reported some change (2/3), with all four graphs positively skewed with significant change being the second most reported response across all capacities (Figure 8). Overall, hospital managers reported the most changes in their capacities to respond and adapt followed by their capacities to prepare and absorb shocks. Notably, although a total of four responses (4/113) were recorded indicating no change across all four capacities, two of these were related to the capacity to recover and transform. This capacity also recorded the highest score among minimal changes.

3.4. Lessons for strengthening hospital resilience through COVID-19 recovery

In response to asking hospital managers about their top lesson learned in strengthening their hospital resilience throughout

recovering from COVID-19, the most prominent theme was related to strengthening hospitals' soft resilience through strengthening the resilience of the various hospital components with a particular focus on (1) resilient staff, (2) sustainable finance, and (3) adaptive leadership and management (Table 1).

3.4.1. Resilient staff

The theme of health workforce resilience was among the most prominently mentioned across qualitative findings, and consistently with global and regional literature. The sub-themes include (1) availability and mobility, (2) competencies and in-service training, and (3) physical, mental, and financial safety (Table 1).

In the early response, hospital managers reassigned staff from other departments including specialists in primary care, emergency medicine, critical care, respiratory, cardiology, and internal medicine specialists to ICUs. In the face of critical shortages, KIs further reflected task-shifting volunteers, retirees, students, and residents to support in the COVID-19 response; this was especially necessary for the early stages when health workers were getting infected and
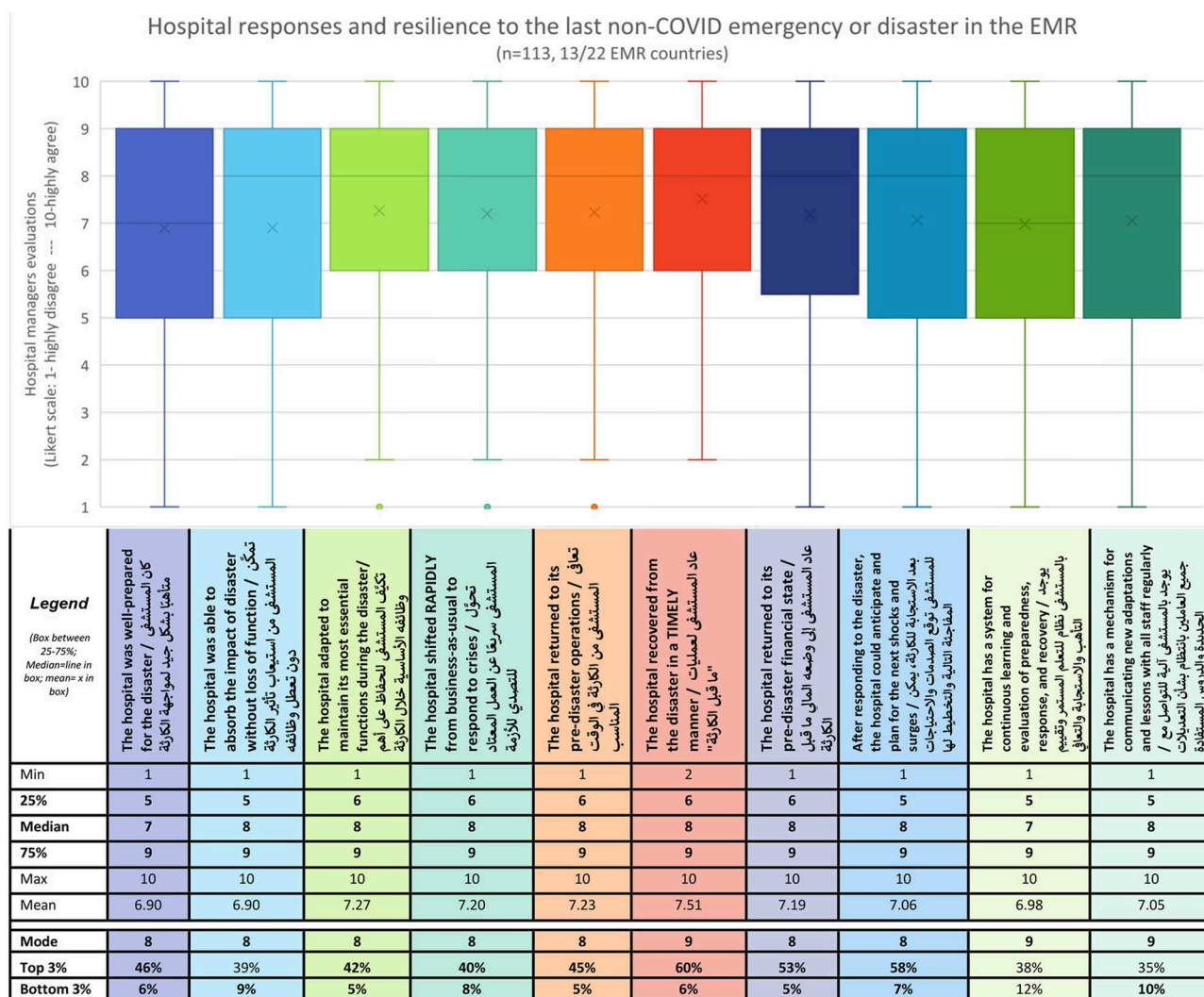
FIGURE 7
Ten-point Likert-scale evaluation of hospital resilience to the last non-COVID disaster or emergency.
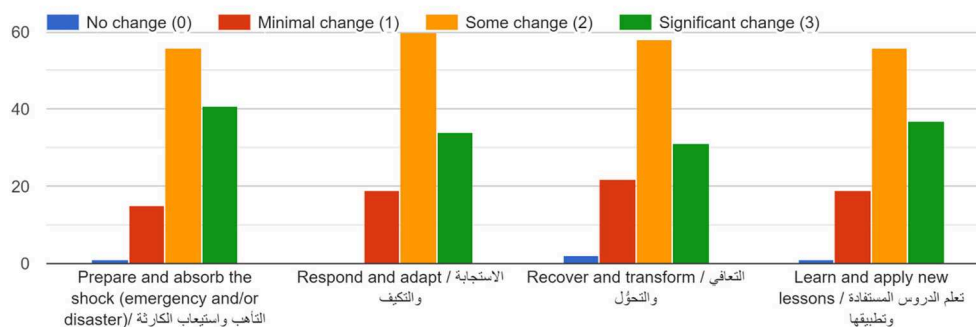
FIGURE 8
Evaluation of changes in hospital resilience before COVID-19 and in the current response.

needed to quarantine and recover over weeks. Relatedly, hospital managers noted the need for cross-training staff on all emergency and disaster response and management initiatives and activities to ensure adequate competencies:

> *"Our staff cannot just be highly specialized in one area, we need to ensure that they have at least the needed basic skills to be mobilized or redeployed where needed" (KI 7).*
>
> *"During the pandemic, what was very important is cross-train the staff, the skill-mix training. We can't train a nurse [from scratch] during a crisis. So, mobility of human resources between units is also essential" (KI 8).*

Moreso, hospital managers across the Region reflected on continuous training and learning as a key enabling factor to resilience. To improve the timely transfer of new information and knowledge, hospital managers noted utilizing e-learning, social media platforms such as WhatsApp, and intensive hands-on in-service training for frontliners. KIs further reflected on the importance of continuous improvement and creating a culture of learning at the facility-level as a core pillar to recovery and ultimately resilience.

Hospital managers further reflected on the various interventions used to protect and sustain "their most valuable resource" with particular emphasis on protecting health workers' wellbeing, especially during the prolonged and intertwined response and recovery phases of COVID-19:

> *"Our first priority was to keep our human resources safe from any harm, we distributed PPEs daily. We implemented the guidelines issued by the infection control department. We arranged training led by the infection control department and medical directorates via zoom for all staff: faculty, nursing, paramedics, and even staff working in non-clinical areas" (KI 1).*

Across the EMR, hospital managers from Afghanistan, Iran, Lebanon, Pakistan, Palestine, Oman, and Saudi Arabia, mentioned the motivation of human resources as a key enabler of hospital resilience. One hospital manager mentioned:

> *"The personnel should be really satisfied to work in a hospital, not obliged to. The dedication of the staff to helping people or their loyalty to the hospital in which they are working. This is the cornerstone strength that this hospital had which allowed us to open and respond to COVID-19" (KI 5).*

Across the Region and throughout the last 3 years of COVID-19, hospital managers attributed their hospital's resilience to the courage, humanitarian spirit, commitment, and sacrifices made by health workers, especially in some LMICs where their remuneration was often delayed and inconsistent due to national financial and political crises. Despite the difficult financial crises, one of the major interventions highlighted by hospital managers in LMICs and FCS was securing their health workers' timely compensation:

> *"We did not furlough, we did not terminate, we did not fire people, but we reviewed compensation methodology to ensure that we are able to pay our employees what they deserve and motivate them during the crisis" (KI 8).*

3.4.2. Sustainable finance

In many of the Region's LMICs, one of the most critical issues raised related to hospitals' early recovery and ultimately resilience was finance and its implications on staffing, logistics, and supplies. Challenges were especially exacerbated in countries with political instability exacerbated financial crises and fragmented procurement which affected hospital operations as reflected by hospital managers from Afghanistan, Lebanon, Pakistan, Somalia, and Sudan. One key informant shared: *"Financing played a key role in adaptability. The restrictions of cash flow in the country following the crisis affected the continuity of services" (KI 9)* while another hospital manager reflected on the harsh economic crises over the phases of COVID-19 response: *"In the first wave, the dollar was 1,500 pounds, now every dollar is 25,000 pounds. In face of this big inflation and the high cost of the maintenance contracts for repairing the damages, we are facing an economic crisis not only a health one" (KI 5).*

KIs, especially those in resource-restrained contexts, recommended that every hospital manager should have back-up funding for emergencies which can be immediately mobilized during a crisis. One hospital manager stated: *"The administrator must always have a financial reserve in the budgeting dedicated and put aside for extraordinary pressure for extreme cases that a hospital might face" (KI 5).* KIs also stressed the need for hospital managers to be financially literate and have a pragmatic understanding of financial analyses of budgets along with a committed knowledgeable team to inform staffing and procurement of supplies:

> *"To improve hospital resilience, the manager must have internal finance and administrative systems, detailing the income, contributions from which departments and number and skill-mix of health workers" (KI 10).*

Further to this, hospital managers in LMICs and countries in emergencies also noted the need for financial autonomy with clear accountability mechanisms, diversifying hospital income sources, conducting internal audits to cut unnecessary expenditures, and doing medium-term and scenario planning based on various revenue streams. One hospital manager reflected:

> *"How does the institution make itself financially sustainable or financially resilient? The solution is multifold starting with a diversification of income sources, because if the institution is only dependent on income from the hospital, then it will take a very big time to recover" (KI 8).*

Despite the diversities in finance management systems across the Region, in many EMR countries in emergencies, hospital managers urged for an increase in hospital budgets allocated by the government as well as increased autonomy to expedite (financial, material, or human) resource mobilization.

3.4.3. Adaptive leadership and management

The theme of adaptive leadership and management was highlighted by hospital managers who reflected the importance of the "systems" components, particularly the continuous improvement of strategies and processes throughout the ongoing response and recovery cycles. The subthemes include: (1) learning and adapting strategies and systems, (2) hospital-level preparedness and response

programs, and (3) empowering frontline stakeholders (including the community) to ensure swift decision-making (Table 1).

Firstly, the constant adaptation in guidelines, communication of changing protocols, information, and knowledge sharing intra and inter-hospitals, and between hospitals and ministries of health, was among the most critical enablers to hospitals' resilience in the EMR. To improve hospital resilience, hospital managers reflected on the need to learn and adapt their strategies to improve service delivery. In the face of COVID-19, hospitals integrated telemedicine and embraced technology to improve their operations. One hospital manager from Lebanon further cited the hospital's use of artificial intelligence to identify available COVID-19 beds between the hospitals of the governorate while another hospital manager from Pakistan highlighted the use of zoom to provide ICU and IPC training to surrounding regional and provincial hospital staff. Nevertheless, hospital managers further reflected the need for an established system to enable this systematic or rapid adaptation of protocols and strategies: *"Take the good learnings from the pandemic and apply it on a day-to-day basis; that is going to be the way forward" (KI 4).*

Secondly, hospital managers reflected that while adaptation in crisis is necessary and predicted, there needs to be a system in place to enable learning, adaptation, and transformation, ultimately enabling resilience: "*When something happens, you don't have time for hospitals to adapt, there needs to be a process and a system in place as to how does one deal with the crisis and what is required to be done" (KI 8).* Further to this, KIs reflected on the importance of proactive preparedness based on risk assessment and risk prioritization, in line with national DRM efforts. Moreso, HMs highlighted the need for hospital-level multi-hazards emergency preparedness and response programs, plans, and strategies, which ideally include all hazard and risk-informed contingency plans, service and business continuity plans, and recovery plans with a build-back better approach. HMs also stressed the importance of establishing a multidisciplinary hospital incident command system with clear communication and assigned roles and responsibilities to act in unity and speed and enabler adaptive management:

> *"The [most important] part of disaster management is preparedness: You have time for risk assessment and to develop some emergency operation plans, you have time to improve your capacities, to develop early warning system, educate and train staff and use simulation exercises and drills, engage and communicate with the community, and finally learn from after action reviews and corrections. This will help you improve your resiliency" (KI 11).*

Thirdly, hospital managers across the EMR frequently mentioned "agile and adaptive management" and "swift decision-making" as enablers of hospital resilience. Within the hospital, senior managers worked to empower middle management to improve processes and strategies and shifted the decision-making autonomy closer to the implementation and impact. Across the Region, hospital managers identified a gap in training and the need to build the competencies of hospital managers in DRM. Furthermore, decentralizing decision-making power to ensure swift action was a principal lesson highlighted by hospital managers across high-income and resource-restrained countries:

> *"Resilience is transferred from top to bottom" (KI 10).*
> *"We had to move away from the traditional bureaucratic decision-making procedures; we were able to do so much during the pandemic, just because we were taking quick decisions" (KI 8).*
> *"During the crisis, if [staff] don't have that space of authority (autonomy to make decisions), then they are not likely to be resilient. Initially, all the decisions that came from leadership were cascaded down. Today, our front staff and our middle management are actually making decisions and improving whatever is needed to meet this demand without actually waiting for senior leadership" (KI 7).*

4. Discussion

This study sought to address a prominent research gap in hospital resilience, especially through the recovery stage. Based on the reflections of hospital managers and frontline workers from combatting COVID-19 in the EMR, this qualitative paper explored four main questions: (1) the role of hospitals in recovering from COVID-19, (2) Hospitals' expectations from their public health institutions to enable recovery from COVID-19, (3) Hospital managers' evaluation of their hospitals' resilience before and through COVID-19, and (4) their lessons to strengthen hospital resilience throughout the COVID-19 recovery.

Firstly, according to frontliners, the role of hospitals in recovering from the pandemic includes health education, risk reduction and prevention of infections, and service continuity. In the first quarter following the declaration of COVID-19 as a PHEIC, hospital managers and frontline workers in the EMR concluded that hospitals have a critical role in recovering from the pandemic, not only in the early recovery stage but throughout the prolonged response in returning operations to "normal." This proved to be true, 3 years later, as the world continues to combat COVID-19 and prepare for subsequent surges manifested by different variants. Frontliners aptly noted the hospital's role in fulfilling their primary functions in service delivery but also additional functions in health promotion, community engagement, and risk mitigation. This is consistent with global literature on hospitals during health emergencies where the primary objective of resilient hospitals is to "maintain their function, which occurs when they provide quality (safe, effective, patient-centered, timely, efficient, equitable) and continuous critical and essential services, amidst the crises, while leaving no one behind" (2, 21–24). Whereas historically public health functions have been associated with primary care; recent evidence on building resilient health systems to achieve UHC and health security highlights the contributions of all health systems actors (including hospitals) in fulfilling EPHF (13). This study confirmed that hospitals have a responsibility in fulfilling their essential public functions whether through health promotion and education, surveillance, risk reduction, or other activities which minimize the impacts of public health emergencies (25–27). Moreover, and consistently with the lessons from the global responses to Ebola and COVID-19, scholars concluded that the interplay between communities and hospitals particularly during emergencies is an essential part of the response and early recovery (28–30).

Secondly, across the EMR, hospital managers' expectations from national and global health institutions to enable their recovery from COVID-19 included: human resource management particularly regarding financial and logistical support, better leadership and coordination, and technical support through the provision of updated clinical evidence-based information. The qualitative findings of this study confirmed that hospitals cannot be resilient without the support of their community, health systems, and national and global public health institutions. Further confirming this interconnectedness, hospital resilience (and the role hospitals play in recovery) is vital to both community and health systems resilience (31, 32). Resilient hospitals integrated within a primary-care and whole-of-society approach, contribute and collaborate with different health and emergency response actors, including their community, MOH, and WHO, to fulfill their primary function of continuous delivery of essential services and secondary contributions in risk reduction, health promotion, and social and economic development (1, 2, 13, 31). Confirming the global literature, this study also found that the interconnections between hospitals and communities during health emergencies are essential to recovery as hospitals contribute majorly to the community's social, economic, and environmental development (33). Moreover, strengthening hospital resilience, particularly throughout the recovery phase, influences both policy and practice with implications across health, economic, social, and environmental domains. Furthermore, the lessons from the pandemic highlighted the need for more inclusive and community-oriented governance approaches (at both facility and national levels), including greater community engagement, gender-equal leadership, and fairer representation from marginalized communities to ensure that no one is left behind in BBB (34).

Thirdly, regarding evaluating hospital resilience before and during COVID-19: according to hospital managers and frontliners, despite a medium level of resilience to various types of hazards and generally high scores in response to non-COVID emergencies and disasters, the pandemic resulted in considerable changes in hospitals' resilience capacities. Hospital managers reflected that they learned to become better prepared to absorb various shocks but reflected lower levels of changes regarding their capacities to recover and transform. This is consistent with a systematic review of health systems resilience which found that the transformative capacity was the least researched or evaluated; indicating a significant gap in strategies to systematically evaluate the recovery stage (16). Despite these perceptions, scholars could argue that EMR hospitals' transformative and learning capacities increased as they adapted their systems and strategies in responding to and recovering from COVID-19. Further research is needed regarding institutionalizing learning across hospitals in the Region. Across the EMR, hospitals in resource-restrained and emergency-affected settings have exhibited an everyday resilience to a multitude of simultaneous hazards and chronic health systems shocks (e.g., societal, natural, and biological: civil unrest and instability, droughts or flooding, while managing COVID-19). In many of these settings, evaluating hospital resilience is nuanced by the different types of hazards; hospital managers reflected the challenges in the conceptualization of hospital resilience; as their hospitals may have been resilience to some types of hazards more than others, indicating a "partial" resilience which cannot be enumerated. Evaluating hospital resilience is complex given the multitude of qualitative and quantitative evaluation strategies and fragmented approaches presented in the empirical literature; this is

especially difficult to do without a baseline assessment (2, 9, 35–37). Moreso, systematic reviews found that measuring or evaluating hospital (and health systems) resilience remains a fragmented and new topic in the empirical literature; qualitative approaches were found to be more comprehensive as quantitative ones were limited by the lack of objectivity and validated indices (2, 15, 16, 38–40).

Fourthly, regarding strengthening hospital resilience throughout the recovery phase; hospital managers highlighted the components of hospital resilience namely resilient staff, sustainable finance, and adaptive leadership and management. Firstly, qualitative findings from this study echoed global literature confirming that the ability to surge staff and redistribute health workers according to hospital needs was critical to the hospital's response, recovery, and ultimately resilience (6, 14, 24, 27, 28, 41, 42). Given the prolonged response and recovery phases of COVID-19 over the last 3 years, scaling up mental health services and psychosocial support as well as providing training on stress, time, and crisis- management is essential to recovery (2, 15, 43, 44). The COVID-19 pandemic has shown the importance of strengthening health workforce resilience as burnout threatens the retention, motivation, and mental health of frontliners and first responders as the world enters its third year of the pandemic (45, 46). Recent studies have shown that one in five health workers is leaving the health sector due to the increasing pressures and limited support (47). This is critical to consider in the EMR as most LMICs and countries in emergencies already suffer from severe shortages of health workers, including critical care and other emergency-related specialists (48). The psychological aspects of health workforce resilience and interventions related to self-care remain understudied especially in the EMR where their implications are most needed especially with the high number of humanitarian crises. Secondly, the lack of financial resources and flexible financing arrangements were raised as key challenges which inhibited hospitals from timely recovery, particularly in LMICs and FCS where centralized budgeting and donor-dependency are common (3, 8, 14). It is also crucial to differentiate financial resilience between private and public sector hospitals and their implications on the rapidity of their response and recovery. In many contexts, particularly following natural disasters, investments must be made to rebuild hospitals *stronger*, ensuring their hard resilience to enable their soft resilience (2, 17, 37, 39, 49). Further to this, one of the most critical elements of recovery was related to rapidity; building back *faster* with the needed financial and material resources to resume operations (10). Notably, the hospital's chief expectations of MOH and WHO were financial and material resources, especially in resource-restrained settings. These parallels between findings for study objectives 2 and 4 (the expectations of hospitals to enable recovery and the main lessons which allowed hospitals to be resilient) point to the need for resilient and decentralized financing mechanisms to enable recovery, consistent with global and regional literature (1, 7, 15, 27, 50). Operational guidance on strengthening hospital and health systems resilience detail specific interventions for securing and improving finance, logistics, and supply chain management throughout the recovery stages (1, 4). Thirdly, consistent with regional and global research, this study confirmed that strong leadership and coordination and strengthening learning mechanisms are required for recovery and resilience from emergencies, both at the facility and national levels (34, 51, 52). A study on hospital responses to COVID-19 from the Region found that the most frequently cited lessons included: "prevention," "leadership," "coordination," "human

resource management," and "communication" (7). These lessons highlight the importance of strengthening hospitals' preparedness along with agile and adaptive leadership and management in health emergencies and DRM (36, 51, 53). Within the context of DRM, hospital managers and policymakers alike must proactively and innovatively plan, manage, and protect their human, financial, and material resources; these stakeholders would benefit from building learning organizations in recovering from COVID-19 and in preparation for future emergencies. Moreover, consistent with current evidence, strengthening the capacities of hospital managers in emergency response is critical to strengthening hospital resilience (51).

In the aftermath of COVID-19, the momentum for recovery and the impetus on BBB has highlighted the critical need to rebuild hospitals, health systems, and societies around the axes of **sustainability and equity**. On the one hand, environmental sustainability, rational use of resources, and minimizing wastage were minimally mentioned throughout the qualitative data, recent studies found that hospitals must play a significant role in mitigating their contributions to climate change. A recent WHO report found that medical waste from the COVID-19 response has strained already weak healthcare waste management systems as a third of healthcare facilities (two-thirds in the least developed countries) are not equipped to handle existing waste loads, not considering the additional waste load from the pandemic (54). As of the end of 2021, ∼87,000 tons of personal protective equipment (PPE) were procured and shipped, 140 million test kits, generating 2,600 tons of mainly plastic waste and 731,000 L of chemical waste, and over 8 billion doses of vaccine have been administered globally producing 144,000 tons of additional waste in the form of syringes, needles, and safety boxes (55). Moreover, this type of pollution results in magnanimous environmental threats and health risks for health workers and vulnerabilities for communities living near landfills and disposal sites. The pandemic exposed poorly managed trade-offs between resuming services to mitigate financial losses, overuse of resources toward infection, prevention and control (IPC) measures, and few environmentally sustainable practices, highlighting the urgent need for a healthy and green recovery. Further to this, recognizing the impacts that hospitals and health facilities have on health and the environment, the WHO developed the *Guidance for Climate Resilient and Environmentally Sustainable Health Care Facilities* which ensures that health facilities are built to be environmentally sustainable by implementing interventions that optimize the consumption of resources (e.g., water, energy, food), reduce emissions of greenhouse gases, and properly manage waste (including biological, chemical and radiological) and are sustained through ethical and environmentally sustainable procurement of goods and services (56). On the other hand, the pandemic also exposed and exacerbated health, social, and economic inequalities, especially in conflict-affected settings as many in the EMR; in response, the Commission on Social Determinants of Health recommended a "Build Back Fairer" approach to ensure and enhance health equity in the post-pandemic recovery (57). The theme and sub-theme of equity were also minimally mentioned across the findings of this study beyond the use of telemedicine to reach vulnerable groups. This indicates the need for political, social, and multi-sectoral initiatives to ensure that no one is left behind in recovering from COVID-19.

Strengthening hospital resilience throughout the recovery phase not only improves efficiency and effectiveness in emergency response but also ensures continuity in the provision of critical and essential health services during emergencies and guarantees sustainable development in the health system. In the early phases of response and recovery, a report published by WHO in Aug 2020, found that low and lower-middle-income countries reported the highest percentage of partial disruptions in 75% of services essential health services during the COVID-19 pandemic where the EMR was the most affected Region (58). Notably, in the EMR, emergency and critical care were the least disrupted service group; a significant achievement, where more than half of countries face humanitarian emergencies, attributed to the resilience of hospitals, especially in the recovery phase. Strengthening emergency care systems during routine times is critical to a hospital's resilience during emergencies and to various types of hazards. Some studies even evaluate hospital resilience using the functionality and performance of hospital emergency departments during and prior to the onset of disasters; further highlighting the importance of hospitals' resilience in the response and early recovery stages (5, 6). Moreso, regional research found that in the EMR, hospitals consume around 70% of public health expenditures and employ the vast majority of health workers nationally (59). Interventions to strengthen health systems' resilience for public health emergencies, therefore, require a specific focus on strengthening and transforming hospital sectors. Ultimately, ensuring the recovery of hospitals and strengthening their resilience increases financial gains and economic growth at the individual, familial, community, and national levels. A study from the USA found that the national hospital sector supports 16 million total jobs and around $3 trillion in an economic activity where each hospital job supports 2 additional jobs and each dollar spent by a hospital contributes to $2.3 in additional businesses (60).

Finally, in operationalizing hospital and health systems resilience, it is imperative to consider the role of hospitals within PHC-oriented models of care (13, 59). Hospital resilience is intricately integrated within strengthening both health systems and community resilience; which are able to absorb, adapt, transform, and learn in the face of various types of hazards and shocks and respond to community needs both in routine times and emergencies (2). Recent evidence has pointed to the importance of context-appropriate coordination mechanisms to actualize a multisectoral whole of society approach to strengthening hospital and health systems resilience; this requires integrating various stakeholders such as UN, development partners and donors (especially in humanitarian settings), public health institutions, academia, private sector, hospitals and primary care (1, 7, 13, 59, 61). Moreover, building resilient health systems requires investing in EPHF to achieve UHC and health security (13). A recent regional analysis from the African Region highlighted the role of national public health institutions in EPHF for both UHC and DRM with limited mention of hospitals (61). Further research is needed to delineate the roles and functions of hospitals in implementing PHC-oriented models of care, fulfilling EPHF, and protecting health security through DRM.

One of the major strengths of this study is that it is among the first to capture hospitals' experiences responding, recovering, and building resilience during COVID-19 at a regional level. As the Region with the highest number of emergencies, the perspectives

and lessons learned on recovery and resilience offer both context-specific insights along with practical approaches for hospitals in similar humanitarian and/or resource-restrained settings. This study addresses a gap in the regional and global evidence by exploring the roles that hospitals play in recovery and resilience, particularly from the perspective of frontliners and hospital managers. Additionally, this paper is among the first to capture the expectations hospital managers have of their ministries and WHO during public health emergencies, which provides invaluable lessons for national, regional, and global health and DRM policymakers and practitioners in anticipation of forthcoming public health emergencies. On the other hand, as this data was collected during the response to COVID-19, this study was limited by the high workload, pressures, and limited time of frontliners and hospital managers. The short study period also constrained the number, geographic distribution, and diversity of KIIs and survey respondents; whose individual experiences do not reflect all hospitals (size, public, private, peripheral, or central) of a country. The self-reporting bias presents a limitation to the survey tool whereby it is likely that respondents report a higher score than anticipated, reflecting a more positive evaluation of their hospital responses, recovery, and resilience. Nevertheless, the triangulation with other survey questions including open-ended ones, as well as with key informant interviews provided a more complete picture regarding hospital resilience capacities, lessons, and challenges in the EMR. Furthermore, the topic of hospital resilience, and the hospital's role in recovery, health systems for health security, and sustainable development, remain nascent and require further research, particularly from the Global South, humanitarian, and resource-restrained settings. Systematic reviews on both hospital and health system resilience highlight the limited evidence on this new subject along with the diversity and discrepancies between its conceptualization, operationalization, and evaluation (2, 16, 38). The exact impacts that hospitals play in ensuring health systems fulfill their essential public health functions remains understudied and requires further investigation (62). Additional research is also needed regarding scaling adaptive and agile hospital management along with the costs, specific interventions, and evaluations of hospital resilience (including hospital workforce, supply chain/logistics/financial resilience, etc. . .).

5. Conclusion

During emergencies, hospitals are among the community's first points of contact with health systems, it is, therefore, critical to ensure their functionality across the response and recovery stages of DRM. COVID-19 showed that hospitals played a critical role in service delivery and contributed to EPHF, health systems resilience, health security, and sustainable social, economic, and environmental development. Policymakers and hospital managers should be equipped with operational guides and tools to continuously improve hospital resilience in preparation for future outbreaks and

other public health emergencies. Strengthening hospital resilience requires investing in hospital workers and their wellbeing, innovative and flexible mechanisms for resource mobilization, especially in resource-restrained settings, and finally, agile, adaptive, and proactive leadership and coordination.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by WHO EMRO Regional Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

Author contributions

MK and HR: conceptualization, data collection, data analysis, and writing and editing. JA-B, AN, AA, and HK: revision of data collection tools, data collection, data analysis, and technical revision of manuscript. All authors read and revised the final version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1073809/full#supplementary-material

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Perspective: Lessons from COVID-19 of countries in the European region in light of findings from the health system response monitor

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Introduction: Decision-makers initially had limited data to inform their policy responses to the COVID-19 pandemic. The research community developed several online databases to track cases, deaths, and hospitalizations; however, a major deficiency was the lack of detailed information on how health systems were responding to the pandemic and how they would need to be transformed going forward.

Approach: In an effort to fill this information gap, in March 2020, the European Observatory on Health Systems and Policies, the WHO European Regional Office and the European Commission created the COVID-19 Health System Response Monitor (HSRM) to collect and organise up-to-date information on how health systems, mainly in the WHO European Region, were responding to the COVID-19 pandemic.

Findings: The HSRM analysis and broader Observatory work on COVID-19 shone light on a range of health system challenges and weaknesses and catalogued policy options countries put in place during the pandemic to address these. Countries prioritised policies on investing in public health, supporting the workforce, maintaining financial stability, and strengthening governance in their response to COVID-19.

Outlook: COVID-19 is likely to continue to impact health systems for the foreseeable future; the ability to cope with this pressure, and other shocks, depends on having good information on what other countries have done so that health systems develop adequate policy options. In support of this, the country information on the COVID-19 HSRM will remain available as a repository to inform decision makers on options for actions and possible measures against COVID-19 and other public health emergencies. Building on its previous work on health systems resilience, the European Observatory on Health Systems and Policies will sustain its focus on analysing key issues related

to the recovery from the pandemic and making health systems more resilient. This includes policy knowledge transfer between countries and systematic resilience testing, aiming at contributing to an improved understanding of health system response, recovery, and preparedness.

Contribution to the literature in non-technical language: The COVID-19 Health System Response Monitor (HSRM) was the first database in the WHO European Region to collect and organise up-to-date information on how health systems were responding to the COVID-19 pandemic. The HSRM provides a repository of policies which can be used to inform decision makers in health and other policy domains on options for action and possible measures against COVID-19 and other public health emergencies. This initiative proved particularly valuable, especially during the early phases of the pandemic, when there was limited information for countries to draw on as they formulated their own policy response to the pandemic. Our perspectives paper highlights some key challenges within health systems that the HSRM was able to identify during the pandemic and considers policy options countries put in place in response. Our research contributes to literature on emergency responses and recovery, health systems performance assessment, particularly health system resilience, and showcases the Observatory experience on how to design such a data collection tool, as well as how to leverage its findings to support cross-country learning.

Introduction

At the onset of the COVID-19 pandemic, decision-makers sought evidence to determine what, if anything, they could do to mitigate the pandemic's impact. The research and information community responded by quickly developing online databases to track cases, hospitalizations, and deaths, as well as to document a range of policies put in place by countries with respect to travel restrictions, fiscal measures, and lockdowns (1–4). Missing from these early initiatives, however, was information on what health systems were doing in response to the pandemic. This represented a crucial gap in knowledge.

Variations in health system responses may help to explain why some countries experienced relatively low hospitalisation and death rates even in the face of severe COVID-19 outbreaks, and why some countries largely avoided (at least some) COVID-19 waves. In addition, information on health system responses can contribute to wider understanding of why some countries have been better at maintaining the provision of essential health services and routine care, and how they avoided substantial service disruptions that resulted in increasing waiting times, which are already having substantial impact on health outcomes.

Rationale, coverage and evolution of the health system response monitor

To fill this information gap and gain an understanding of effective policies that countries rolled out to mitigate the impact of the COVID-19 pandemic, the COVID-19 Health System Response Monitor (HSRM)[1] was developed by the European Observatory on Health Systems and Policies, World Health Organisation Regional Office for Europe (WHO/Europe), and European Commission, to cover 50 countries' health systems and policy responses, primarily those in the WHO European Region (5). The HSRM was launched in March 2020 and remained operational and regularly updated well into 2022 (6). Although the focus was primarily on health system responses, the HSRM also captured wider public health initiatives on preventing transmission as well as relevant responses in other sectors, such as border controls, mobility and economy, amongst others (Table 1). It gathered evidence *via* publicly available information in English through a network of country experts from academia and WHO Country Offices. Observatory analysts worked with country experts to cheque and cross-reference, edit,

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1   https://eurohealthobservatory.who.int/monitors/hsrm/overview

TABLE 1   The HSRM topics and core information collected.

Topics	Core information
Preventing transmission	Key public health measures Measures in place to test and identify cases, trace contacts, and monitor the scale of the outbreak
Ensuring sufficient physical infrastructure and workforce capacity	Physical infrastructure Measures to address shortages Steps to maintain or enhance workforce capacity Workforce skill-mix and responsibilities Training and HR initiatives
Providing health services effectively	Planning and patient pathways for COVID-19 cases Maintaining essential services
Paying for services	How countries are paying for services Entitlements and coverage
Governance	Pandemic response plans Steering of the health system Emergency response mechanisms Regulation of health service provision to affected patients
Measures in other sectors	Borders Mobility (transport) Economy State aid Civil protection Cross-border collaboration

and update posts for their respective countries. The country pages were then used to write a total of 70 concise comparative snapshots addressing specific policy questions covering a subset of countries in the database and aiming to distil concrete policy options.[2] The content compiled in the HSRM platform was used extensively to inform a range of analytical outputs that compared COVID-19 responses across the monitored countries, including several Eurohealth editions (7, 8), a special issue in the journal Health Policy (9), a study on health system resilience (10), and a policy brief on backlogs and managing waiting lists during and beyond the COVID-19 pandemic (11).

Other regional and global monitoring initiatives such as the pulse survey on the continuity of essential health services during the COVID-19 pandemic (12) and the ACT-Accelerator Global COVID-19 Access Tracker (GCAT) (13) provided similarly critical insights into the impact of the COVID-19 pandemic on health services and shed light on the challenges health systems were facing. The key difference between the three tools concerns their scope; while the HSRM has been organising information on the policies that countries chose in responding to the COVID-19 outbreak, the pulse survey assessed the impact of the pandemic on essential health services. The GCAT has been tracking progress towards the global targets for access to COVID-19 vaccines, treatments, tests and personal protective equipment (PPE).

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2   https://eurohealthobservatory.who.int/monitors/hsrm/analyses

Findings from the HSRM on health policies put in place in response to the COVID-19 pandemic

The HSRM analysis and broader Observatory work on COVID-19 and on health system performance catalogued a range of policy measures taken in response to the pandemic and shone light on a number of long-standing challenges and weaknesses within health systems. These include, amongst others, issues related to the level of investment in public health, workforce capacity and flexibility, financial stability and equity, and governance constraints. In the following section, we highlight some of the key findings from these analyses in areas that countries prioritised in their response to COVID-19.

Investing in public health

COVID-19 has exposed public health challenges and weaknesses on an unprecedented scale. The inability in many countries to slow disease transmission through test, trace, isolate mechanisms or to address the sharp increase in mortality in nursing homes during the pandemic can be seen as a reflection of the long-standing low priority given to public health, and long-term care in many European countries (14). The lack of investment in public health can also be seen in the poor state of the preparedness plans European countries had in place prior to the pandemic. Some of these plans ultimately could not be followed because they were either outdated, inadequate in terms of their level of detail (e.g., Italy, Spain), or otherwise were not suitable to address COVID-19 (Greece) (15).

Countries took a range of measures to improve their test, trace, isolate capabilities. To expand testing capacity, some countries, such as Germany, were able to take advantage of their extensive existing laboratory capacity at the onset of the pandemic, benefitting from its strong diagnostics industry. Similarly, many other countries repurposed existing laboratories (e.g., Croatia, France, Lithuania, Norway), while some smaller countries, at least initially, sent samples abroad (Ireland and Finland) (14). In Denmark, the national testing strategy gradually changed from a restrictive approach that included providing testing only to people with severe symptoms, to a much broader strategy offering testing also for people with mild symptoms in March 2020, asymptomatic individuals in April and others in May of that year (16).
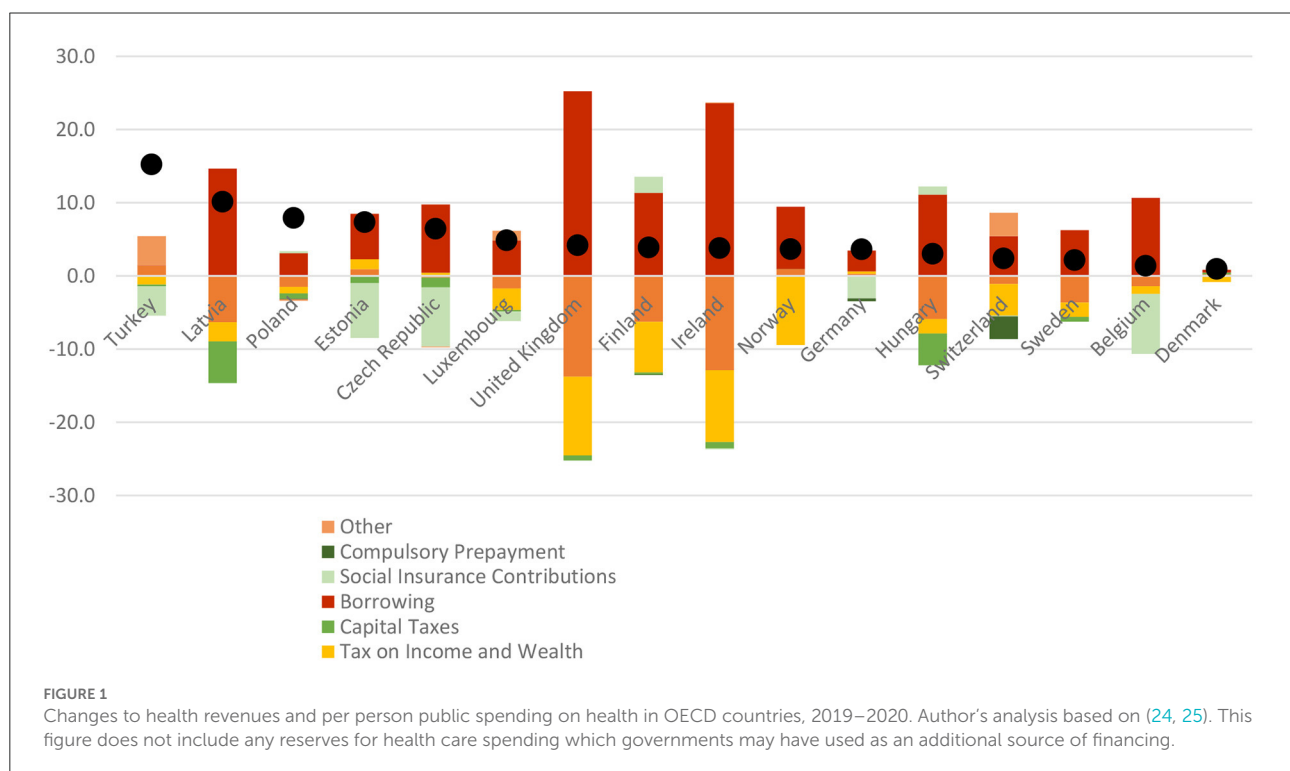
Similarly, contact tracing had to be scaled up during the COVID-19 crisis. This was accomplished in different ways, including by diverting existing health workers, including administrative staff and those recently retired, to contact tracing; setting up de-novo structures (e.g., Serbia); contracting with outsourcing corporations (e.g., UK); or using existing

capacity. In Germany, for example, the Federal Ministry of Health supported the local public health offices with €50 million to digitalize tracing operations and recruit additional tracers under an agreement between the federal and state governments. Similarly, in Austria the local health offices started performing contact tracing and monitor contacts in quarantine (14). Support for those who needed to isolate was nevertheless insufficient in many countries, resulting in some infected people continuing to engage in normal activities, particularly those on low-incomes or with precarious employment (14).

Supporting the workforce

Many European health systems faced health workforce shortages prior to the COVID-19 pandemic (17). The pandemic exacerbated these existing shortages in many countries and regions due to a rising workload related to care for COVID-19 patients, the need to maintain essential health and social care services and to adopt new procedures, regulations, and hygienic standards but also because many health care workers were affected by COVID-19 either in their families or themselves, as in the early stages of the pandemic medical staff often worked without adequate protection (18). To scale-up and maintain the existing workforce capacity most countries used a variety of strategies to mobilise additional health

workers. The most common approaches included: recruiting final year medical and nursing students, offering a transition from part-time to full-time work, modifying work schedules and cancelling leaves of absence, changing working patterns and bringing inactive or retired health professionals back to the workforce. In some countries the military and health professionals from the private sector helped to expand the available workforce capacity, and volunteers were recruited (e.g., Austria, Cyprus, Denmark, Estonia, Hungary, Montenegro) (19). Similarly, countries such as Italy, Romania and Spain re-deployed health workers to health facilities or regions with greater demand. Moreover, countries changed regulation to reskill and re-purpose health workers such as expanding the role of individual health professions and adapting or strengthening teamwork. England, Ireland and France, for instance, extended community pharmacists' scope-of-practise to renew certain prescriptions, while Germany shifted tasks from doctors to nurses to free up capacity (10, 18, 19). To protect health professionals from COVID-19 infections and mitigate further shortages, infection control policies and minimum standards of PPE use were defined and regular testing procedures were developed (20). Moreover, many countries such as France, Greece and Italy placed their health care workers high on the priority list for vaccine access or even mandated compulsory vaccinations for some or all health workers to promote uptake (21).

FIGURE 1
Changes to health revenues and per person public spending on health in OECD countries, 2019−2020. Author's analysis based on (24, 25). This figure does not include any reserves for health care spending which governments may have used as an additional source of financing.

Maintaining financial stability

The COVID-19 pandemic had major implications for economies and public finances, and in turn, for health system financial sustainability. Unemployment rose across Europe and wages declined, impacting the collection of social contributions and payroll taxes (22). Likewise, lockdowns and social distancing measures affected consumption behaviours and incomes, reducing taxes collected from these sources. As a result of these across-the-board effects on public revenues, to maintain health system financial sustainability, countries were required to borrow considerably and take on substantial public debt. This was made easier by temporary loosening of EU fiscal rules and extremely low borrowing costs, even in countries that had faced higher borrowing costs during the Great Recession (23).

To illustrate the extent of borrowing to finance health, Figure 1 shows changes in the mix of revenues used for health between 2019 and 2020 based on analysis of OECD data. Borrowing substituted for declines in social contributions and taxation most in the United Kingdom, Ireland, and Latvia, but even in countries with smaller shifts in the mix of health revenues, borrowing played an important role. Of note, in all OECD countries with data available, per person health spending by governments grew between 2019 and 2020.

Strengthening governance with a focus on trust

There are many ways to strengthen governance. Specifically, during the pandemic, attention to open data sources, crisis and risk management, quality regulatory mechanisms, public sector management and communication and policy coherence, coordination and evaluation are essential. Aside from these aspects, one of the key but often overlooked areas, for strengthening effective governance during the pandemic has been to solidify public trust in decision-making authorities (26), requiring close scrutiny. For COVID-19, the HSRM analysis found that an increase in trust in government and health officials, in countries like Denmark, Switzerland or Italy, led to a greater acceptance of government-mandated measures (e.g., regulations on testing, lockdowns, and vaccination) and less politization of the pandemic and its societal impacts (27, 28). In turn, these countries generally experienced better outcomes, including higher vaccination rates, and as a result, lower hospitalisation, and mortality rates (28).

Some positive changes in countries to increase trust could be observed through the HSRM contents. For example, providing open access to data and displaying how the data is used in response measures to COVID-19 was effective at improving transparency of decision-making, which was shown especially by Scandinavian countries Likewise, the dissemination of credible

and consistent scientific advice by key government actors was important in Germany where a well-known virologist was seen as a widely trusted source of information on COVID-19. Transparent and effective public communication was also crucial in response to disinformation (29). Examples of this can again be found in Germany and Switzerland. Finally, policy evaluation played an important role so that citizens could be reassured that policy decisions were based on available evidence and working towards delivering the desired outcomes (30); the Danish Strategy for managing COVID-19 is prominent example of this (31).

Brief outlook on the future role of HSRM for health system recovery and preparedness and the Observatory's work on resilience

COVID-19 is likely to continue to impact health systems for the foreseeable future; their ability to cope with increases in demands for services, and to prevent, prepare for and respond to other shocks, depends on having good information on what other countries have done so that health systems may develop judicious policies. In support of this, the country information on the COVID-19 HSRM will remain available as an archive of policy responses and there will also be a focus on ongoing analysis of key issues related to the recovery from the pandemic and improving health systems resilience.

Wider Observatory activities on health systems resilience

While COVID-19 has brought the topic of health systems resilience to the forefront of many organizations' analytical priorities, the Observatory's work on resilience started well before the pandemic, reaching back to the publication of the first edition of the State of Health in the EU (SoHEU) country profiles with the OECD and European Commission in 2017 (32). There, as well as in the subsequent second edition of the profiles (33), the analysis of resilience focused on the most pressing challenges specific to each country, as well as on more general pressures such as population ageing. The analysis for each country in the SoHEU series explored the long-term stability of health system resources, the ability to operate efficiently, and governance issues. Largely informed by the content compiled in the HSRM platform and its various analytical outputs in 2021, the third edition of the profiles looked at health systems resilience during the COVID-19 pandemic and focused mainly on countries' preparedness and management responses to the pandemic, presenting policy measures and strategies that were implemented within the health system to contain the pandemic

and respond to the health care needs of COVID-19 and other patients (34).

In addition, in early 2020, the Observatory policy brief "Strengthening health systems resilience: key concepts and strategies" sought to dispel some of the confusion around the concept of health systems resilience and to identify a list of key resilience strengthening strategies based on the lessons from previous shocks (35). In combination with the core HSRM material and its derivative outputs described above, this conceptual work continues to inform the Observatory's study of health systems resilience to COVID-19. More recent work refined the original, generic list of strategies into one pertaining specifically to the COVID-19 pandemic (10). By considering resilience through the lens of the core health system functions (governance, financing, resource generation and service delivery) the strategies endeavoured to unpack the complexity of responses and pinpoint entry points for improvements and reforms. Indeed, while the focus of this analysis was on policy responses during the crisis, the study also seeks to draw lessons going forward, appreciating the pandemic as an opportunity for health system strengthening.

Introducing the Observatory's work on systematic health system resilience testing

Looking ahead, systematic resilience testing should be considered as a useful tool to identify health system weaknesses before the next major health system shock. To this end, using the newly developed Health System Performance Assessment Framework for Universal Health Coverage (36) as a basis, the Observatory is developing a methodological approach to resilience testing that helps policy makes to identify health system weaknesses in light of specific health system shocks or challenges including recessions and cost-of-living crises, antimicrobial resistance (AMR), climate change, pandemics, and others. The project is funded by the European Commission and carried out jointly with the OECD. Beginning in 2023, the project aims to offer EU countries a systematic and harmonised approach that they can use to better understand the performance of their health systems in the face of health system shocks. Future work on health system resilience may also focus on health emergencies preparedness and other topics within health systems, such as the Primary Health Care Monitoring Framework and Indicators (PHCMFI) (37), International Health Regulations Monitoring and Evaluation Framework (IHR MEF) (38), and Health Emergency and Disaster Risk Management Framework (EDRM) (39).

The Observatory will continue to study health system resilience both retrospectively (i.e., how well have countries responded to COVID-19?), as well as prospectively (how can health systems better prepare for future shocks?) to contribute to an improved understanding of health system response, recovery, and preparedness in the European region (40).

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: https://eurohealthobservatory.who.int/monitors/hsrm/hsrm-countries.

Author contributions

FT and JC developed the concept and outline of the article. FT, EG, JW, CH-Q, MF, AS, MK, and JC drafted sections of the manuscript, with FT and JC finalising the article. All authors read and approved the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Building back better children's surgical services toward universal health coverage: Perspectives from Bangladesh and Zimbabwe

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Introduction: This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'. Children's surgical services are crucial, yet underappreciated, for children's health and must be sufficiently addressed to make and sustain progress toward universal health coverage (UHC). Despite their considerable burden and socioeconomic cost, surgical diseases have been relatively neglected in favor of communicable diseases living up to their inauspicious moniker: 'the neglected stepchild of global health'. This article aims to raise awareness around children's surgical diseases and offers perspectives from two prototypical LMICs on strengthening surgical services in the context of health systems recovery following the COVID-19 experience to make and sustain progress toward UHC.

Approach: We used a focused literature review supplemented by the perspectives of local experts and the 6-components framework for surgical systems planning to present two case studies of Bangladesh and Zimbabwe. The lived experiences of the authors are used to describe the impact of COVID-19 on respective surgical systems and offer perspectives on building back the health system and recovering essential health services for sustainability and resilience.

Findings: We found that limited high-level policy and planning instruments, an overburdened and under-resourced health and allied workforce, underdeveloped surgical infrastructure (from key utilities to essential medical products), lack of locally generated research, and the specter of prohibitively high out-of-pocket costs for children's surgery are common challenges in both countries that have been exacerbated by the COVID-19 pandemic.

Discussion: Continued chronic underinvestment and inattention to children's surgical diseases coupled with the devastating effect of the COVID-19 pandemic threaten progress toward key global health objectives. Urgent attention and investment in the context of health systems recovery is needed from policy to practice levels to improve infrastructure; attract, retain and train the surgical and allied health workforce; and improve service delivery access with equity considerations to meet the 2030 Lancet Commission goals, and make and sustain progress toward UHC and the SDGs.

Introduction

Universal health coverage (UHC) means that all people including children have access to quality health services without financial hardship (1). Surgery and surgical health services have been recognized as an essential part of UHC by the World Health Organization (WHO) and World Bank (2). Despite this, the importance of surgical care has been underappreciated for several decades due to a preferential focus on infectious diseases in the public health discourse. The burden of surgical disease in children is considerable—one third of childhood deaths in the world are attributable to surgical conditions—and with expected surge in child population in Africa, this figure can be expected to increase (3). It has been estimated that about 85% of children in low- and middle-income countries (LMICs) have surgically correctable conditions by the age of 15 years (4). However, two thirds of the world's children, mostly in LMICs, do not have access to surgical care (5). Every year over 77.2 million disability-adjusted life-years (DALYs) could be averted by basic, life-saving surgical care (6). Furthermore, through early prevention and corrective interventions, costly secondary and tertiary interventions at later stages in the life course can be averted for improved health and wellbeing, enhanced socio-economic prospects, and reduced healthcare costs. Bangladesh and Zimbabwe are two LMICs that have made impressive improvements in maternal and child health, however, there remains a large unmet need for surgical services with children in both countries facing similar challenges globally. This article examines the state of children's surgical conditions in both countries, outlines the gaps that still exist and describes the devastation wrought by the COVID-19 pandemic in this key area of global health that has been neglected for decades. The article offers perspectives from two LMICs on strengthening surgical services in the context of health systems recovery following the COVID-19 experience to make and sustain progress toward UHC. It draws heavily on The Lancet Commission on Global Surgery report—a landmark publication that outlined the scale of the previously underappreciated problem and laid out global aspirations for scaling up access to surgical care to underserved regions by 2030 (7). It is a roadmap for global surgical efforts that described core indicators for monitoring of universal access to safe, affordable surgical and anesthesia care.

Approach

We conducted focused literature reviews adapting an approach which has been utilized previously in considering global surgery in a health systems context (8). This involved searching PubMed and Google Scholar with review of the first five pages of sources for each of the 6 components in the framework for surgical systems planning to categorize the effects of COVID-19 on surgical systems in the target countries (Table 1) (7). The findings were supplemented by the perspectives of local experts to identify key vulnerabilities in surgical systems of each country (Bangladesh and Zimbabwe). Key vulnerabilities were identified, discussed and presented for each country. The countries represent two diverse LMIC regions (Sub-Saharan Africa and South-East Asia, respectively) and have evolving demographics reflecting the broader global south, i.e., growing young populations and likely increased prevalence of children's surgical conditions in the twenty-first century.

TABLE 1 The 6-component framework for surgical systems planning (7).

Component	Indicators
1. Infrastructure	• Proportion of the population with 2-h access to a first-level facility • WHO Hospital Assessment Tool (a structured appraisal of equipment, electricity, water and sundries) • Proportion of hospitals fulfilling the safe surgery criteria • Blood bank donation rate and distribution
2. Workforce	• Density and distribution of specialist surgical, anesthetic and obstetric (SAO) providers • Number of SAO graduates and retirees • Proportion of surgical workforce training programmes accredited • The presence of task sharing or nursing accredited programmes and number of providers • The presence of attraction and retention strategies • Density and distribution of nurses, and ancillary staff including operational managers, biomedical engineers, and radiology, pathology, and laboratory technicians
3. Service delivery	• Proportion of surgical facilities offering the Bellwether procedures • Number of surgical procedures done per year • Peri-operative morbidity and mortality • Availability of system-wide communication
4. Financing	• Surgical expenditure as a proportion of gross domestic product • Surgical expenditure as a proportion of total national healthcare budget • Out-of-pocket expenditures on surgery • Catastrophic and impoverishing expenditures on surgery
5. Information management	• The presence of data systems that promote monitoring and accountability related to surgical and anesthesia care • Proportion of hospital facilities with high-speed internet connections
6. Governance	• Governmental and non-governmental actors that influence SOA health delivery structures • The manner in which these key actors relate and engage with another to influence health delivery • Formulation of policies, regulations, and national budgets

Zimbabwe and Bangladesh were chosen because they are the home countries of the authors who have on-the-ground experience as well as understanding of sociocultural norms and the local health system. In the context of extremely scarce research on children's surgical care in both countries, an approach of using evidence augmented by the insights of experts and vice versa is a pragmatic solution in developing initial recommendations for policy, practice and future research.

Findings

Bangladesh

Bangladesh has around 64 million children that make up 38.64% of the population (9). Despite this, pediatric surgical services are distributed unequally. The majority of services are only available in urban areas, especially in the large tertiary hospitals (10). Otherwise, pediatric surgical services are provided for by general surgeons in

peripheral district hospitals. Bangladesh has made good progress toward UHC with its UHC index improving from 38 in 2010 to 49 out of 100 in 2020.

Infrastructure

Similar to many LMICs the country has a hierarchical health system with primary health up to specialist-level hospitals. Peripheral care at subdistrict level is provided at Upazila Health Complexes (UpHCs) (Figure 1). The healthcare infrastructure under the Directorate-General of Health Services (DGHS) includes six tiers: national, divisional, district, upazila (subdistrict), union, and ward facilities that map onto the traditional three-tier system of care as follows: the upazila, union, and ward offer primary care; the district tier offers secondary care; and the divisional and national tiers offer tertiary care (Figure 1) (11). In 2013 there were 436 Upazila Health Complexes, 53 district hospitals, nine general hospitals and 12 specialized hospitals. Only 44% of UpHCs had a functioning anesthetic machine while Oxygen and a functioning anesthesia machine were unavailable in 14% of district and general hospitals (11). There is a shortage of neonatal and pediatric surgical intensive care facilities, total parenteral nutritional support availability, and oxygen supply in peripheral health facilities (expert observations).

Workforce

A considerable number of minor surgical procedures are performed by village doctors, paramedics and unqualified persons in peripheral health institutions (12–14). Not much national level data on the total number of pediatric surgical providers is available. In 2015 Bangladesh had 161 pediatric surgeons (0.3 pediatric surgeons per 100,000 population under the age of 15 years) with a deficit of 375 needed (15). In 2022, there are ~205 pediatric surgeons in the country (0.43 pediatric surgeons per 100,000 population under the age of 15 years) working in 22 public and 10 non-government healthcare facilities (personal communication).

It has been observed that more junior cadres (resident doctors) played a key part in service provision during the pandemic echoing the importance of human resources as a building block of successful health systems (16). Pre-pandemic shortage of pediatric and neonatal anesthetists, pediatric surgical nursing staff and pediatric pathologists is also the norm (expert observation).

Service delivery

Elective surgeries were pre-emptively canceled indefinitely across many countries in an effort to free up surge capacity and manpower as well as to reduce the risk of nosocomial COVID-19 infection in patients (8). In a nationwide survey of pediatric surgeons 75% of respondents revealed that they had experienced a drastic decline in surgical volumes of up to 70% while another study demonstrated similarly drastic declines in admissions (59%), outpatient attendance (72%) and elective surgery (83%) (17). Surgical volumes are a key indicator for success in the Lancet Commission report and during the pandemic reflected altered decision making by surgeons as well as reduced access.

Financing

The health financing system in Bangladesh heavily relies on out-of-pocket expenditure. About 72.9% of the health expenditure comes out-of-pocket, which is highest in the South Asia Region (18). A study from Bangladesh found that out-of-pocket cost for Inguinal hernia surgery is minimal [USD 5.3] when done as outreach surgical service (19). Reducing the financial burden of surgical care remains a major priority for LMICs.

The cost per disability adjusted life-year for a variety of surgical conditions in both countries such as hernias, appendicitis and abscess surgery compares favorably with other well known public health interventions (20). Children's cancer care is also very cost effective, contradicting the common fallacy that this kind of care does not provide value for money (21).

Information management

There is a wide disparity in availability of information technology equipment between public and private facilities. According to the Bangladesh health facility survey 95% of private facilities and 82% of district and UpHCs have a functional land-line or mobile phone while only 3% of union-level facilities and CC's do (11). Similarly, only 22% of union-level facilities have a functioning computer with Internet access while 91% of district and UpHCs and 75% of private hospitals do have access (11).

Governance

There is no national surgical obstetric and anesthesia plan (NSOAP) in Bangladesh, which is a first step to prioritizing surgery at a governance level. The Global Initiative for Children's Surgery (GICS) published a seminal document "Optimal resources for Children's Surgical Care" contributed by both high-income country (HIC) and LMIC providers where guidelines for different Levels of Care, Supplies, Equipment, Infrastructure and Research can be found (22).

Zimbabwe

Zimbabwe, similar to Bangladesh as well as many developing countries, is characterized by a young, growing, mostly rural (67%) population (23). People in the more remote rural areas have relatively less access to health facilities than their urban counterparts and have to travel longer distances to access care. There is a significant burden of both infectious and noncommunicable diseases as expected for an industrializing country in epidemiologic transition (23). The pace of UHC has slowed in recent years with the country's UHC index having remained around 55 percent since 2015 despite initial success.

There is scanty data on the burden of surgical disease in the country; however existing data reveals that the burden of injury, childhood cancer and congenital malformations is considerable. Injury is a major cause of death in children and adolescents. It is the second highest cause of death among children 5–14 years of age in Harare and has risen steadily in the rankings in the past decade (24). Road traffic accidents (RTAs) are the most common cause of injury in the country and are steadily rising (25). Zimbabwe is among countries with the highest age-standardized DALY rates (26) with an incidence of childhood cancer of 120 per million in 2013. Malignancies are

FIGURE 1
Hierarchy of Bangladeshi healthcare facilities under the directorate general of health services (11).
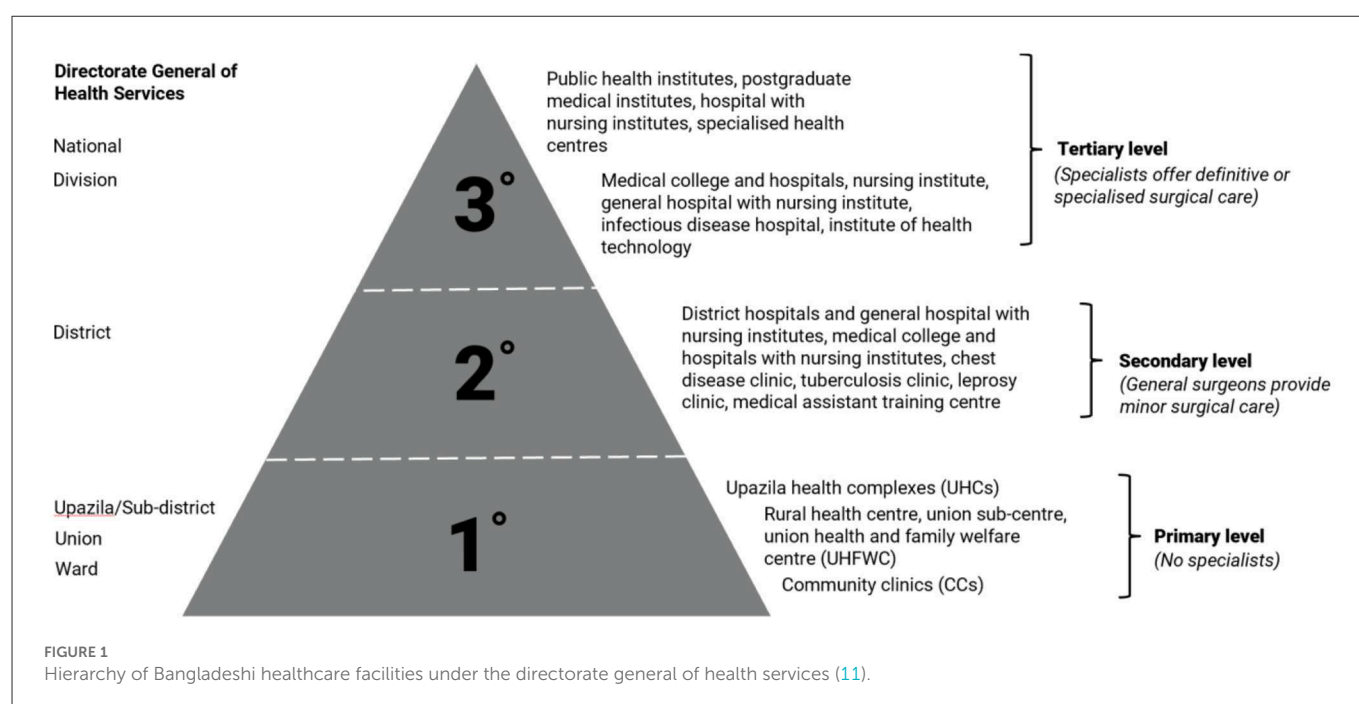
the 5th highest cause of death in Harare in the 5–14-year age group (26). In Zimbabwe, as in many African countries, late presentation and constrained access to cancer care services are common and predictably lead to worse outcomes (26).

Infrastructure

General infrastructure in Zimbabwe

Zimbabwe's health system has four hierarchical tiers of care that include primary, secondary, tertiary and quaternary levels as shown in Figure 2. Surgery for children of varying complexity is performed at all levels of this system ranging from basic procedures to complex, specialist surgery at the quaternary level. In 2015 there were 1,848 healthcare facilities in the country including 6 central hospitals, 8 provincial hospitals and 44 district hospitals (27).

Surgical infrastructure in Zimbabwe

Only 44% of all healthcare facilities in Zimbabwe offer basic surgical services that run the gamut from wound cleaning to incision and drainage and closed repair of a fracture. These are primarily offered at the higher tiers of care. Wide disparities exist in public vs private and urban compared to rural facilities. A much lower percentage of the country's hospitals have the capability to provide comprehensive surgical care. In a survey from 2018, 100% of hospitals had some form of oxygen and only 15% of both district and mission hospitals lacked a functioning anesthetic machine (28).

There are currently only two dedicated children's hospitals in the country, with child-only operating theaters. These are located in Harare and Bulawayo, two major cities. The concentration of children's services in one dedicated service facilitates synergies between specialities and increasingly specialized care, however, the separation of services has been cited as an impediment to timely care.

Workforce

Zimbabwe has faced a critical healthcare workforce shortage in recent years exacerbated by economic decline and brain drain. However, the expansion of the College of surgeons of east, central and southern Africa (COSECSA) training program has increased the surgical workforce in recent years (expert observation). Zimbabwe currently has 5 consultant pediatric surgeons; however, adult surgeons also perform surgery in children (expert observation). This is an increase from two in 2015 and shows that modest progress has been made. The pediatric surgical workforce density is still short of what it should be. The cadres who perform surgery for children in the country include consultant pediatric surgeons and adult surgeons, medical officers, and surgeons-in-training. The surgical workforce is being continually augmented by the training of non-specialist doctors in basic surgical care as part of the Zimbabwe essential surgical training initiative. As of 2018, 102 non-surgeons were trained under this program (unpublished data). During the pandemic healthcare worker industrial actions further constrained surgical care during the pandemic, in addition to COVID-specific factors (expert observation).

Service delivery

Service delivery for children's surgery experienced a precipitous drop during COVID-19 (29). In a recently published study, the weekly median surgical volume in Zimbabwe dropped from 37.5 to 13 procedures per week (29). The proportion of electives of total procedures dropped from 8.2 to 0% during the first 6 months of the pandemic (29). The low preCOVID-19 rate of elective procedures was notable because of the healthcare industrial actions that took place in the year and months preceding the pandemic. This will also have implications for the ability of the surgical system to rebound after the pandemic (30).

FIGURE 2
Hierarchy of Zimbabwean healthcare facilities under the Ministry of Health (27).
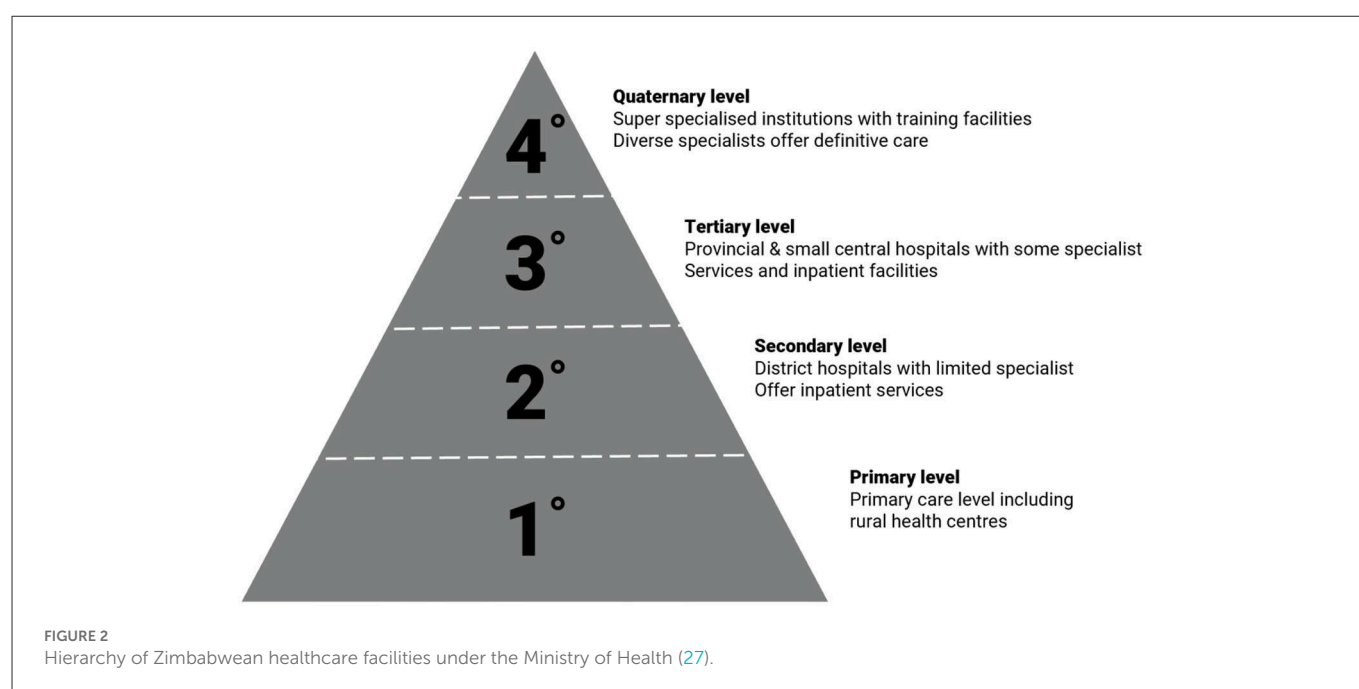
Financing

In Zimbabwe as in Bangladesh, asymmetries in protection by government subsidies, a high unemployment rate and high rates of poverty leave many households potentially vulnerable to catastrophic health expenditures (31). Out-of-pocket expenditure for healthcare in Zimbabwe is high, reaching 24% of health expenditures in 2015 (31). In 2018 total out-of-pocket expenditure (OOPE) for healthcare in Zimbabwe was estimated at 343.7 million USD, translating to 24.90 USD per capita per year (31). The per capita OOPE was around 10% of average personal 2018 monthly income but taking into account the significant wealth inequality, could amount to more than 100% of income for those people who attend public healthcare facilities (expert observation). Granular data for OOPE for surgical conditions in Zimbabwe does not currently exist but injury and neoplasms together account for 10.84% of total OOPE (31). Mechanisms of financial support to reduce out-of-pocket expenditure for healthcare that have been used in the country include vouchers for blood use in maternity care, donor-support for radiological investigations and medication in childhood cancer and waiving of user fees for under-5 children (expert observation).

Information management

Zimbabwe has a relatively robust health information system that collects routine health facility data from all levels of the health system to the Ministry of Health (32). However, there is no trauma registry nor is there a congenital diseases registry in the country that would contribute to high quality outcome and clinical data on these key pediatric surgical conditions. The country does have a long-standing cancer registry that includes pediatric tumors (33). Communication between rural and district surgeons and specialists in urban central regions increased during the pandemic as well as a surge in telemedicine utilization (expert observation). These changes were facilitated by updating of regulations for telemedicine during the pandemic (34) as well as a pragmatic response to changed

referral patterns during the pandemic (8). Published data on facility communication infrastructure or internet is not available.

Governance

Zimbabwe has recently completed and released its national surgical obstetric and anesthesia plan and is notably one of the few countries that have incorporated children in their NSOAS from inception (35, 36). This is a crucial first step to prioritizing surgery and bringing surgical disease to the fore in the country and demonstrates the government's commitment to the cause of global surgery. The development process was delayed by the COVID-19 pandemic which prevented teams from meeting and competed for policy and decision-making capacity (expert observation).

Discussion

A key step toward improving children's surgical services in the LMIC context is through institutionalized planning and policy instruments such as NSOAPs. Bangladesh does not currently have an NSOAP. A dedicated plan for surgical and obstetric care, that prioritizes children can put this neglected area on the radar of key decision makers at local, national and global levels. Furthermore, it can be utilized to bring the surgical community together in the country to advocate and leverage national ansd international funding, resources and in-kind support. Simply having a dedicated NSOAP, however, will not be enough to bring much needed attention to the children's surgery agenda. There will need to be specific considerations for common children's surgical conditions in line with national contexts in each NSOAP. Furthermore, the plans will need to be adequately funded with credible implementation plans in a reasonable time and provision made for monitoring and evaluation. Importantly, the NSOAP should not exist or be implemented in isolation and should link to multi-year national health policies and

plans, and their planning cycles, such as the national health sector strategic plan and essential package of health services.

Impacts on the SAO workforce were particularly influential in curtailing surgical care during the pandemic. This in addition to the pre-emptive cancellation of children's surgery was devastating to the 15-year campaign to expand access to surgery globally described by the Lancet Commission on Global Surgery report. Cancellations of elective surgery were common around the world but were not supported by evidence. The risk of infection in children remained low in Bangladesh (37) Cancellations in children in particular are controversial because children's beds did not provide useful surge capacity for COVID-19 in the target countries (29). And children have comparatively low perioperative mortality after COVID-19 infection (38). The excess mortality caused by untreated surgical disease may therefore still exceed the potential risk of COVID-19 related nosocomial infection or perioperative COVID-related death.

Governments should consider protection of SAO workers as the most important resource during and outside of pandemics (22). The promotion of their mental health and safety and retention is of utmost importance. The pandemic revealed preexisting vulnerabilities and stressed SAO workers to the limit. A more sustainable healthcare workforce will contribute to resilience for future pandemics. The Lancet Commission report made no specific mention of children's surgery, an important oversight. There is an urgent need to develop indicators for children's surgical care in addition to those for adults as well as bellwether procedures for children.

A common theme in both countries is the opportunity borne out of necessity for increased utilization of information and communication technologies (ICT) to facilitate links between central hospitals and distant facilities in districts and rural areas. Use of consultation prior to surgery, planning of surgery and decision-making for transfer and patient flow are just some of the applications of ICT that can mitigate the negative effects of the pandemic and improve efficiency and effectiveness in health systems.

The paucity of research and granular data (incomplete, non-interoperable, inaccessible and unpredictable) at subnational, community and rural levels is a barrier to the development and implementation of an evidence-based National Surgical, Obstetric and Anesthesia Plan with necessary considerations and resources for children's surgery in Bangladesh and other LMICs. For implementation of the NSOAP and scale up of children's surgical services, there is a need to conduct population needs assessment and cost assessment. It is critical to understand the service needs according to target population criteria such as children's age, sex, socioeconomic and education group, religion, geographical location (e.g., urban, rural, or tribal) and health sector (e.g., public, private, not-for-profit, informal).

There exist noteworthy limitations in the deliberations and conclusions drawn in this perspective piece including the risk of bias (e.g., citation bias) using non-systematic methods There is currently a dearth of literature in global pediatric surgery especially relating to the impacts of the COVID-19 pandemic in these countries and the effects varied widely across many LMICs. This manuscript is aimed at emphasizing those unique impacts in the context of Zimbabwe and Bangladesh and may have relevance for other LMIC country contexts as they progress with health systems recovery and making and sustaining progress toward UHC.

Conclusion

Bangladesh and Zimbabwe are examples of LMICs with a significant burden of pediatric surgical disease with major implications for broader individual and population health, psychosocial health and economic development. Current surgical services are unable to meet this demand with improvements needed in quality, access, equity, financial protection aligned with universal health coverage/sustainable development goals. The pandemic severely limited health system capacity for surgery and surgical systems resilience has been tested to the limit during this period. Urgent resuscitative attention and investment is needed from policy to practice levels to improve infrastructure, attract, retain and train the surgical and allied health workforce and improve service delivery access with equity considerations to meet the 2030 goals of the Lancet Commission report and make and sustain progress toward UHC.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

TC and DM contributed to conception, design of the study as well as literature review, and manuscript writing. KL and TB were involved in concept development, manuscript writing, and critical review. TTA, NT, and SM were involved in data acquisition and critical review. DM wrote the first draft of the manuscript. TTA, NT, SM, and TB wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Author disclaimer

The work undertaken in this paper was conducted by author, Saqif Mustafa, during his time affiliated with the University of Edinburgh. At the time of publication, the author, Saqif Mustafa,

is working for the World Health Organization. The perspectives expressed in this article are those of the authors and do not necessarily represent the decisions or the policies of the World Health Organization.

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Section III: Global perspectives

There are seven papers in this section. Some of them offer a multi-country or global perspective towards the COVID-19 response and the "building back better" of health systems. The core themes addressed are rapid information gathering, Primary Health Care and Universal Health Coverage as foundations for both health systems' resilience and health security, and multisectoral collaboration. The final two papers present a synthesis of two complex concepts underpinning the global agendas of universal health coverage, health security and healthier populations in an attempt to move towards the translation of these complex concepts into measurable actions: the essential public health functions and health systems resilience.

Assessing capacities and resilience of health services during the COVID-19 pandemic: Lessons learned from use of rapid key informant surveys

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict.'

Problem: Many countries lacked rapid and nimble data systems to track health service capacities to respond to COVID-19. They struggled to assess and monitor rapidly evolving service disruptions, health workforce capacities, health products availability, community needs and perspectives, and mitigation responses to maintain essential health services.

Method: Building on established methodologies, the World Health Organization developed a suite of methods and tools to support countries to rapidly fill data gaps and guide decision-making during COVID-19. The tools included: (1) a national "pulse" survey on service disruptions and bottlenecks; (2) a phone-based facility survey on frontline service capacities; and (3) a phone-based community survey on demand-side challenges and health needs.

Use: Three national pulse surveys revealed persisting service disruptions throughout 2020–2021 (97 countries responded to all three rounds). Results guided mitigation strategies and operational plans at country level, and informed investments and delivery of essential supplies at global level. Facility and community surveys in 22 countries found similar disruptions and limited frontline service capacities at a more granular level. Findings informed key actions to improve service delivery and responsiveness from local to national levels.

Lessons learned: The rapid key informant surveys provided a low-resource way to collect action-oriented health services data to inform response and recovery from local to global levels. The approach fostered country ownership, stronger data capacities, and integration into operational planning. The surveys are being evaluated to inform integration into country data systems to bolster routine health services monitoring and serve as health services alert functions for the future.

Introduction

The maintenance of essential health services during the corona virus disease of 2019 (COVID-19) pandemic has been critical, as disruptions to essential health services—including for health promotion, disease prevention, diagnosis, treatment, rehabilitation, and palliation—may lead to even greater adverse health outcomes than the pandemic itself, especially in vulnerable populations (1–7). However, throughout the pandemic, many countries have faced complex challenges that required accurate and timely data on facility capacities, service utilization, and community needs and preferences to inform the development of action plans and strategies to respond to COVID-19 while maintaining safe delivery of care.

Country health information systems generally comprise of many different data sources, including population-based surveys, civil registration and vital statistics systems, facility assessments, routine health information systems (RHIS), health workforce information systems, and financial information systems among others. Even before the pandemic, many countries faced pre-existing weaknesses in these systems, including around data access, availability, quality, timeliness and use. The World Health Organization's (WHO) 2021 Global report on health data systems and capacities showed that 65% of 133 countries had only moderate or lower capacities for availability of health services data (8). The COVID-19 pandemic placed even greater strains on country data systems globally.

Whilst there are well-established survey methodologies and routine data systems used by governments to monitor different aspects of service delivery (9–26), most were not designed to provide rapid and comprehensive evidence on dynamic aspects of service capacities and delivery needed to inform the immediate adaptation of service provision during the pandemic. They were also not devised to monitor the implementation of mitigation strategies, or track longer-term health service recovery over time.

To rapidly bolster and supplement country data systems and capacities, a suite of rapid methods and tools was developed to track and monitor health service readiness, resilience and responsiveness during the COVID-19 pandemic and for future health crises.

This work was led by WHO in collaboration with Member States, and with contributions from global partners of the Access to COVID-19 Tools Accelerator[1], including the United Nations Children's Fund,

the World Bank and Global Financing Facility, Gavi the Vaccine Alliance, and The Global Fund to Fight AIDS, Tuberculosis, and Malaria (27).

This paper provides an overview of the implemented methods and tools, introduces illustrative results of the types of findings that were generated and their use, and identifies early lessons learned. Further publications are forthcoming on additional in-depth analyses of country data, country experiences on data use, and implications for ensuring sustainable health services surveillance and monitoring systems for the future.

Methods

A suite of methods and tools was designed to complement existing country data systems and bolster capacities to monitor health service readiness, resilience and responsiveness, with an emphasis on supporting the continuity of essential health services during the COVID-19 pandemic. The tools were designed for implementation on a regular basis, in order to track trends in health service recovery and fluctuating service capacities over time. They contributed to a broader approach that aimed to strengthen country data capacities and platforms for tracking health services during the pandemic and into recovery.

The methods and tools were harmonized to supplement each other and support use of data at different levels of the health system. The suite included: (1) a national key informant "pulse" survey on continuity of essential health services that was administered to all countries; (2) rapid phone-based surveys in a sample of frontline health facilities on service capacities; and (3) rapid phone-based surveys in a sample of community representatives (most often, community providers) to provide demand-side understanding of the evolving health challenges and needs faced by communities.

The facility and community surveys were particularly designed to augment data from existing RHIS, national surveillance systems and other administrative sources. Many countries have well-established RHIS to provide regular information on service utilization and certain aspects of capacities. As noted previously, however, the use of RHIS data is often hampered by timeliness and quality issues—which were further exacerbated by the pandemic. Moreover, RHIS were not designed to capture qualitative details on the extent of disruptions, reasons for disruptions, usefulness of different mitigation strategies, or dynamic details of service capacities during a health crisis.

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1   The Access to COVID-19 Tools Accelerator (ACT-A) is a global partnership that was formed to end the pandemic as a global emergency. This work particularly contributed to the ACT-A Health Systems and Response Connector in the partnership.

National key informant survey on continuity of essential health services

WHO has conducted three rounds of the "pulse" survey on continuity of essential health services during the COVID-19 pandemic. In the absence of other globally comparable data, the survey provided rapid insights from national level country key informants into the extent of impact of the COVID-19 pandemic on health systems and essential health services, and priority needs in terms of resources and support against a quickly changing context (28–30).

The first survey was implemented during May-September 2020 (28), the second survey was implemented during January-March 2021 (29), and the third survey was implemented during November-December 2021 (30). The next pulse survey is planned for October-December 2022. The results in this paper are presented for 97 countries that completed at least one survey section for all three rounds of the pulse survey. This includes 36 countries in the African region, 21 countries in the Americas region, 17 countries in the Eastern Mediterranean region, 10 countries in the European region, eight countries in the Southeast Asia region, and five countries in the Western-pacific region[2].

Content

The pulse survey was designed in modular survey sections targeting different national level key informants in each country. It included a cross-cutting section covering governance aspects, disruptions to service delivery settings (including primary, community, emergency, critical, operative, rehabilitative, and palliative care), mitigation strategies, and main health system bottlenecks and needs.

It also included in-depth sections to track disruptions across tracer health service areas, including: sexual, reproductive, maternal, newborn, child and adolescent health; nutrition; care for older people; immunization; human immunodeficiency virus (HIV) and hepatitis; tuberculosis; malaria; neglected tropical diseases (NTD); non-communicable diseases, and mental, neurological and substance use disorders. The survey integrated and built on targeted WHO surveys that were disseminated early in the pandemic on specific tracer service disruptions (31–33).

Each survey asked key informants to consider the situation in countries during a specific period of time: 3 months prior to survey response for the first two surveys (28, 29), and 6 months prior to survey response for the third survey (30).

Implementation

The pulse survey was distributed to Ministries of Health in all countries. It was disseminated through WHO Regional Offices and WHO Country Offices using a secure web-based questionnaire in LimeSurvey software (34). The questionnaire was available in Arabic, Chinese, English, French, Portuguese, Russian and Spanish. Two or more reminders to complete they survey were sent were to all countries.

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2   WHO has six regions as described above. The list of countries by region can be found at: https://www.who.int/countries.

Respondents included health policy advisors, directors of health services, systems, or programmes, monitoring and evaluation focal points, public health officers and/or incident management team focal points within Ministries of Health and/or WHO Country Offices. The exact process for survey completion was flexible and varied by country, ranging from independent completion of sections by different key informants, to coordinated completion of sections based on collaborative key informant discussions. Completed country profiles were disseminated to countries through WHO regional offices.

Frontline health service capacity surveys (health facility and community surveys)

Since September 2020, WHO has supported a subset of countries that expressed country demand to implement rapid, high-frequency phone-based surveys to gain more granular insights into frontline health service capacity and delivery challenges faced at facility and community levels. The surveys aimed to enable more safe and real-time data collection, analysis and use throughout the rapidly evolving pandemic context.

They were designed for modular administration in hospitals, primary care facilities, and communities. Countries could tailor and implement different combinations of modules for either one-time or recurrent use based on context, priorities, resources, and need at different points of the pandemic (35).

This paper focuses on results from 22 countries that conducted at least one facility or community survey between December 2020 and March 2022. This includes 12 countries in the African region, five countries in the Americas region, three countries in the Eastern Mediterranean region, and two countries in the European region (see Annex 1 for details). Each country implemented 1–3 survey rounds.

Content

Health facility survey

The facility survey included two core modules to support countries to assess and track:

a. COVID-19 case management capacities, with an emphasis on availability of therapeutics, diagnostics, oxygen, personal protective equipment (PPE), vaccines, and vaccine readiness (36).
b. Continuity of essential health services, and facility and workforce capacities to maintain the safe provision of care (37).

Community survey

The community survey module focused on measuring community needs and perceptions, changes in care-seeking behaviors, and barriers to accessing care during the pandemic (38).

Further details on the three tools are presented in Annex 2.

Of note, while the above modules are the focus of this paper, the suite included additional facility checklists and inventory tools on hospital readiness (39, 40), biomedical equipment availability (41, 42), safe environment measures (43), and infection prevention and control (44). Countries could consider use of these modules for in-depth assessments as needed.

Methodology and implementation

The recommended methodology for the health facility and community surveys was phone-based interviews with facility managers and/or community representatives in a sample of facilities and communities. Responses were input into an online data collection instrument using a secure web-based questionnaire (34).

For the facility survey, the methodology recommended to randomly select 80–100 health facilities through a stratified sampling approach using a master facility list. For the community survey, it was recommended to select one community representative from the catchment areas of each primary care facility in the sample[3].

To track changes and trends throughout the rapidly changing COVID-19 context, the recommended frequency was to conduct a facility survey 2–4 times per year, with the supporting community survey implemented at intervals.

A package of implementation guidance and template materials was developed to enable rapid implementation and ultimate absorption into country data systems (45). It included standard data collection instruments using LimeSurvey (34), standard analysis codes in Stata (46) and R (47), automated outputs and visualizations in Excel (48), and template dashboards using ReactJS (49), and Kendo UI (50).

Key analyses

Analyses presented in this paper are based on data from the most recent survey round in each country, which ranging from January 2021 to March 2022. This includes data from 498 higher-level facilities (mainly hospitals) in 18 countries, 2,377 lower-level facilities (mainly primary care facilities) in 21 countries, and 1,277 community representatives (mainly community health workers) in 17 countries.

It covers descriptive analyses on changes in service volumes, reasons for disruptions, mitigation measures taken by facility management, community perspectives and needs, and availability of key health resources in hospitals and primary care settings. Definitions for availability of key health products differ by level of care as follows:

- Percentage of facilities with all tracer PPE items available for all staff Items include gloves and medical/surgical masks for primary care and gloves, medical/surgical masks and respirators (hospitals only).
- Percentage of facilities with available oxygen (primary care and hospitals).
- Percentage of facilities with a functioning invasive and/or non-invasive ventilator (hospitals only).
- Percentage of hospitals with onsite rapid diagnostic tests (RDT) and/or polymerase chain reaction (PCR) tests for COVID-19 diagnosis (hospitals only).
- Average availability of essential tracer diagnostics in facilities (average percentage of tracer items available) Items include tracer diagnostics to test for blood glucose, urine glucose, urine protein, pregnancy, HIV, tuberculosis, hemoglobin, and bloodtype as relevant (primary care only).

- Average availability of tracer therapeutics in facilities (average percentage of tracer items available) Items include tracer therapeutics to treat COVID-19 (hospitals only) and other essential health services (primary care only; see Annex 3 for complete list).

The overall average is calculated as the unweighted arithmetic mean of the countries with existing data.

As part of the broader approach, guidance was also provided on using routine data to monitor the effects of COVID-19 on essential health services (51). As such, efforts were made to use facility and community survey findings together with RHIS data to provide a more comprehensive picture of the supply-of and demand-for frontline health services. These findings are not presented in this paper, and will be published in forthcoming reports.

Results

Three rounds of the national level key informant pulse survey during 2020–2021 demonstrated the sustained impact of the pandemic on health systems and essential health services over time. Respectively, 87% (187 of 216), 63% (136 of 216), and 59% (132 of 223) of surveyed countries, territories and areas[4] responded to the first, second and third rounds of the pulse survey. The number of countries receiving the survey changed between rounds due to increased requests from WHO regions to include additional non-Member State territories and/or areas in the survey as well as requests from countries to submit multiple subnational responses when an aggregate national response was felt to be insufficient. In total 97 countries responded to at least one survey section in all three rounds. The time interval between the close of data collection and presentation of preliminary results to countries and partners was ~1 month.

The response rate varied by survey sections and by round [in round 3, response rate varied from 40 to 64% of countries where the area was relevant (i.e., malaria and NTDs survey sections were not asked in all countries)]. Additionally, responses of "Do not know" or "Not applicable" were not counted in the denominators. Response rate also varied by WHO regions. Overall, response rates in round 3 varied from 26% of countries in the Western Pacific region that responded to at least one survey section to 90% of countries in the Africa region that responded to at least one survey section. In round 2, response rates ranged from 43% in the European region to 95% in the Eastern Mediterranean region. In round 1 response rate ranged from 63% in the Americas region to 100% in both the Eastern Mediterranean and Southeast Asia regions.

Findings from the most recent survey revealed that as of December 2021, 92% of responding countries across all income levels and regions were still reporting persisting disruptions to services. Disruptions were reported in all service delivery settings, with primary care and community care among the most affected, showing that many people were still missing out on essential first-contact care. Significant disruptions were also noted for elective surgeries and emergency care, especially critical for people with urgent health needs (Figure 1A). Moreover, disruptions were reported across

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3 Given the country-tailored approach, the exact methodology and/or sampling approach may vary. Countries could choose to adapt the data collection modality (such as to in-person or online self-reporting), data collection platform, sampling approach, or frequency as relevant to country context, resources, priorities and need.

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4 From here on, the use of the term "countries" will refer to countries, territories and areas for the pulse survey results.
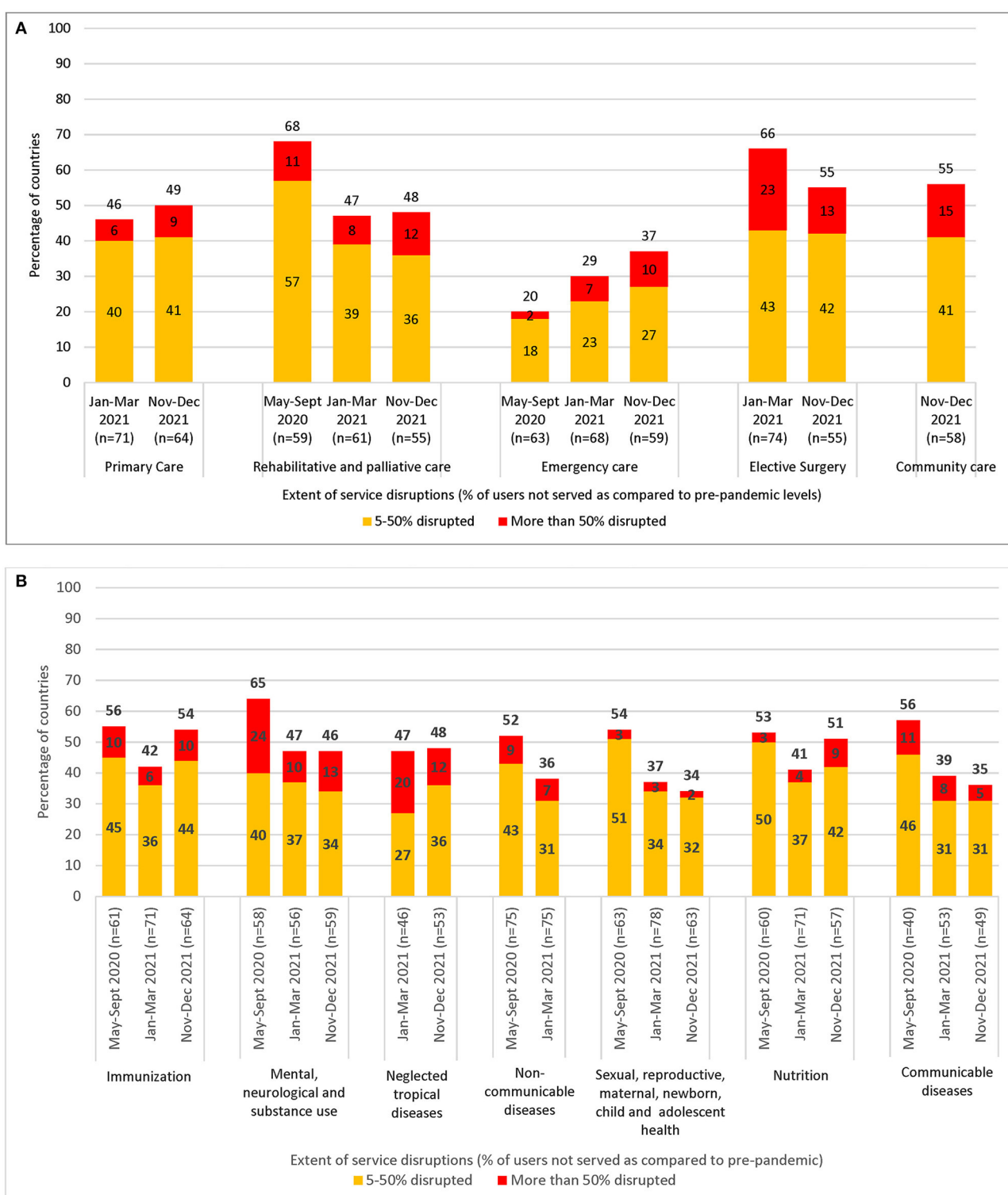
FIGURE 1
(A) Comparison of disruptions by service delivery setting in 97 countries responding to all three WHO pulse survey rounds: May–September 2020 (round 1), January–March 2021 (round 2), and November–December 2021 (round 3). Primary care services and elective surgeries were not included in me first May–September 2020 survey round. Community care services were not included in the first and second May–September 2020 and January–March 2021 survey rounds. As such, relevant service disruptions for these time periods are not presented. Each survey examined the situation in countries during a specific period of time. For rounds 1 and 2, the results refer to the period 3 months prior to survey and 6 months prior to survey response for round 3. **(B)** Comparison of disruptions by condition- or programme-specific tracer service area in 97 countries responding to all three WHO pulse survey rounds: May–September 2020 (round 1), January–March 2021 (round 2), and November–December 2021 (round 3). Neglected tropical diseases were not included in one first May–September 2020 survey round. Non-communicational diseases were not included in the second November–December 2021 survey round as a separate 2021 WHO NCD Country capacity survey was completed during a similar time period asking similar questions on disruptions. However, the methodology differed and consequently was not comparable for inclusion in terms of analysis trends. As such, relevant service disruptions for these time periods are not presented.
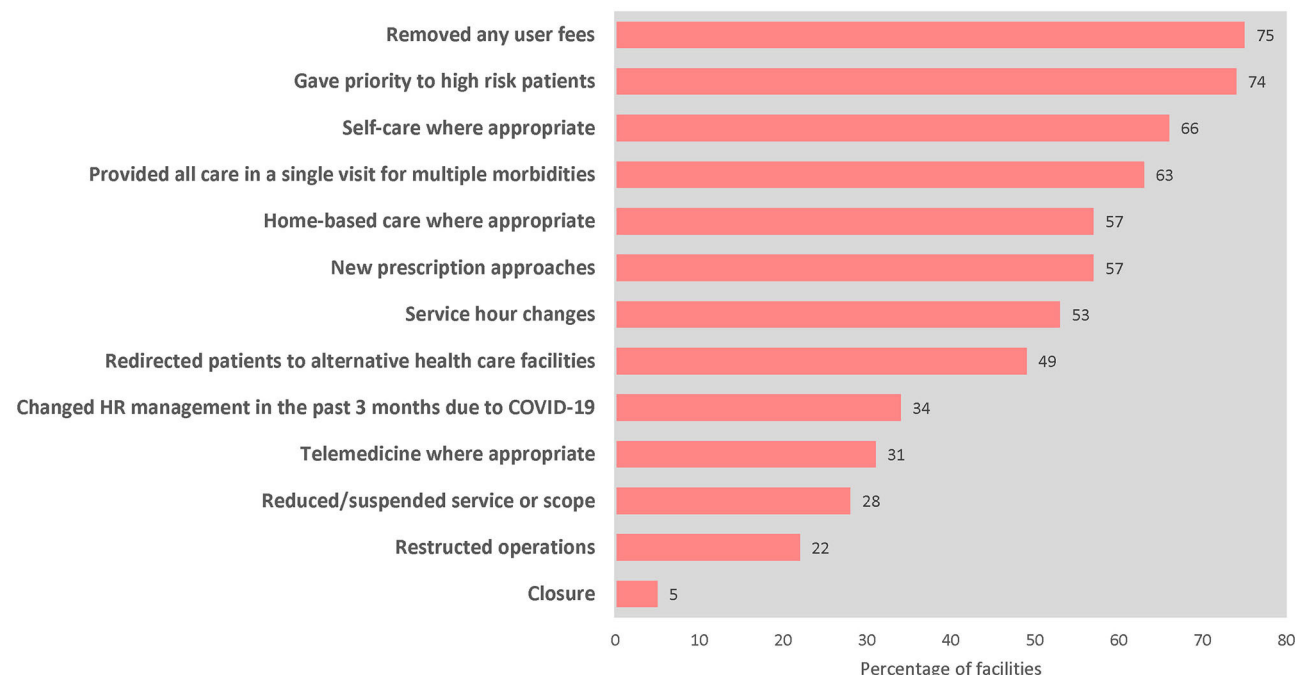
FIGURE 2
Percentage of primary care facilities ($n = 2,377$, 21 countries) that employed mitigation strategies to overcome service disruptions at the time of assessment (January 2021–March 2022).

all major condition- or programme-specific tracer health areas (Figure 1B) (30).

At the same time, 89 of 98[5] (91%) countries reported at least one major health system bottleneck in round 3 of the pulse survey to scaling up access to COVID-19 therapeutics (83% of countries), COVID-19 diagnostics and testing (78% of countries), COVID-19 vaccination (74% of countries), and PPE (65% of countries). The most frequently reported bottlenecks included health workforce challenges, shortages in supplies and equipment, and demand-side challenges (most notably for COVID-19 vaccination).

All countries ($n = 98$; see text footnote 5) reported using different strategies and innovations to overcome challenges, including improving access to essential medicines and health products, health workforce mitigation measures, service delivery modifications, and pursuing different community engagement and health financing strategies (Figure 2).

Comprehensive pulse survey findings are published on WHO's website (28–30)[6].

Health facility and community surveys on frontline health service capacities reflected similar challenges based on more granular level data. Facility managers and community representatives in 22[7] countries reported varying levels of disruptions across service

delivery settings, including to first-contact services. On average, almost 60% of primary care settings reported decreases in outpatient service volumes. Additionally, almost half of facilities reported scaled back outreach services. Disruptions were most often due to decreased demand, limited health system resources (e.g., health workers or essential health products), or intentional modifications to scale back services during COVID-19 outbreaks. Other facilities experienced disruptive surges in service volumes due to targeted campaigns and community communications to catch up on service backlogs.

Surveys with community representatives validated the notion that barriers to care had increased even further due to COVID-19 from the demand-side perspective. On average, over two-thirds of community representatives reported that the pandemic had moderately or severely affected people's access to care. Almost 90% also reported that people in their community had faced at least one unmet essential health need during the pandemic.

Facilities also reported shortages in health system resources needed to support the safe provision of care for both COVID-19 and other essential health services. Capacities for health worker protection were reported as problematic across all settings, with an average of only 49% of hospitals and 57% of primary care settings able to provide all tracer PPE items to all staff to protect them from infection (Table 1). Additionally, an average of 9% and 8% of clinical staff in hospitals and primary care, respectively, were affected by COVID-19 infection in the 3 months preceding the assessment. This is particularly concerning in the subset of 9 countries that are also on WHO's 2020 health workforce support and safeguard list, a list that identifies countries with health workforce availability of less than the global median of 48.6 per 10,000 population (52). In these settings, any additional

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5   Results for health systems bottlenecks and mitigation strategies are only presented for round 3. Ninety-eight countries responded to questions in these areas in round 3.

6   Response rates and findings may vary slightly compared to those included in the published global reports because some country responses were received after report publication.

7   One country, Zimbabwe, only conducted the community survey. Therefore, results at the health facility level are only presented for 21 countries.

TABLE 1 Availability of essential COVID-19 tools and other essential health products in hospitals (*n* = 498, 18 countries) and primary care facilities (*n* = 2,377, 21 countries) at the time of assessment, by country (January 2021–March 2022).

	Hospitals					Primary care			
	% of facilities with PPE for all staff	% of facilities with onsite RDT and/or PCR for COVID-19 diagnosis	Average availability of therapeutics to treat COVID-19	% of facilities with functioning invasive and/or non-invasive ventilators	% of facilities with available oxygen	% of facilities with PPE for all staff	Average availability of essential diagnostics[a]	Average availability of essential therapeutics[b]	% of facilities with available oxygen
Burundi	31	80	64	69	80	47	89	44	No data
Cameroon	18	62	63	55	75	40	75	65	No data
Chad	33	33	58	67	100	36	47	46	18
Congo	21	55	50	58	48	26	48	35	No data
Ghana	37	55	68	63	97	60	34	49	57
Kenya	21	53	59	96	99	12	60	55	14
Mali	36	0	74	100	100	57	80	55	29
Namibia	67	54	87	74	95	67	42	74	70
Senegal	36	100	63	93	93	60	95	71	51
Seychelles	No data	No data	No data	No data	No data	90	41	58	74
Zambia	56	96	68	64	100	47	72	58	32
Paraguay	95	95	87	100	100	25	No data	44	64
Peru	69	92	88	83	100	86	71	68	96
St. Lucia	No data	100	93	100	100	79	59	66	93
St. Vincent	100	100	80	100	100	71	44	62	93
Suriname	11	33	61	89	89	41	No data	No data	No data
Afghanistan	80	40	80	100	100	73	49	67	91
Libya	40	50	61	100	80	28	34	27	73
Yemen	87	87	59	100	91	68	65	51	80
Moldova	No data	No data	No data	No data	No data	99	65	75	78
Ukraine	No data	No data	No data	No data	No data	88	73	63	35
Average	**49**	**66**	**70**	**84**	**92**	**57**	**60**	**57**	**62**
91% or more	**80–90%**	**65–79%**	**50–64%**	**Less than 50%**	**No data**				

[a]Diagnostics for blood glucose, urine glucose, urine protein, pregnancy, HIV, TB, HBG, and bloodtype (as appropriate for facility type).
[b]See Annex 3 for therapeutics list.

restriction to health workforce availability, such as due to COVID-19 infection, could have detrimental effects on service delivery and outcomes.

Table 1 highlights shortages in other essential health product availability reported by hospitals in 18 countries and primary care settings in 21 countries. In terms of availability of health products for COVID-19 services, an average of 66% of hospitals reported availability of diagnostics for on-site COVID-19 testing. On average, hospitals only had about 70% of the tracer therapeutics for COVID-19 treatment available. In general, primary care settings showed even lower availability of essential health products. The average availability of tracer diagnostics and therapeutics for tracer essential health services in facilities was 60 and 57%, respectively. While a higher average of 92% of hospitals reported availability of oxygen, only 62% of lower-level facilities reported oxygen availability. These gaps bear implications not only in terms of COVID-19 case management, but also for the delivery of other routine and emergency essential health services.

All facilities adapted to these health system restraints and demand-side challenges by employing mitigation strategies (Figure 3). Reported mitigation strategies include the removal of user fees, adaptations to facility service hours, and innovative service delivery adaptations (such as promotion of telemedicine or home-based care) to improve access to care. Many facilities also adopted changes in human resources management to improve availability of health workers.

Discussion

In the wake of the pandemic, there has been a major recognition of the need to more intentionally leverage and design health system investments and interventions to make joint progress toward health security and universal health coverage based on a primary health care approach (53, 54). Central to this, is the use of evidence to strengthen health service readiness, resilience and responsiveness, with an emphasis on reducing barriers to care for the most vulnerable populations (55).

Disruptions are of particular concern in countries where service coverage was already limited before the pandemic, including fragile, conflict, and vulnerable settings. In this light, the methods presented in this paper contributed to country response during the COVID-19 pandemic, while building toward more resilient and sustainable data systems for future health crises.

Pulse survey country findings were used in various policy briefs (56), public health conferences (57), webinars, and country policy dialogues or roundtable discussions (often in triangulation with other country data from RHIS, surveillance systems, facility surveys, and household surveys). These mechanisms helped to synthesize and communicate findings to identify critical bottlenecks, trigger more in-depth assessments as needed, and ultimately inform the development of operational action plans to mitigate disruptions and address service backlogs. At the same time, the mechanisms contributed to the development of longer-term health service recovery and resilience building strategies for the future in many countries. In addition to country use, the pulse survey also filled important data gaps for monitoring global progress of multiple response-related plans, including WHO's COVID-19

Strategic Preparedness and Response Plan (58, 59), and the Global Humanitarian Response Plan for COVID-19 (60).

Findings from the facility and community surveys rapidly provided near-to-real-time data on what was happening at frontline health services in terms of the impact of COVID-19 on health care provision. Broadly, countries used the findings to inform decision-making and the development of action plans from national to facility levels for restoring services and strengthening facility capacities to respond to demands for both COVID-19 as well as other essential health services. When implemented regularly, the surveys allowed countries to alert changes in service capacities and track trends in recovery over time. Examples of key actions that countries have taken based on the survey findings include: prioritization of PPE access for all health staff in Kenya [(61), unpublished reports][8]; investments to improve equitable access to oxygen and ventilators in hospitals in Ghana [(62), unpublished reports][9]; the establishment of new COVID-19 testing and treatment centers in areas of need in Zambia (unpublished reports)[10]; and activities to empower community health workers to engage more regularly with community members to address demand-side challenges in Afghanistan (unpublished reports)[11].

Findings from the national, facility and community surveys were also integrated into the Global COVID-19 Access Tracker dashboard (63) and other global dashboards for tracking service disruptions (64). These dashboards have been used to inform country situation analyses and trigger partner investments for country support and targeted delivery of essential tools and supplies, most notably in the context of the Access to COVID-19 Tools Accelerator (27). Partners have also made use of certain of components of the tools to assess disruptions and guide investments for specific programme areas

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8   Unpublished reports include: Ministry of Health, Republic of Kenya. Readiness for COVID-19 Response and Continuity of Essential Health Services in Health Facilities and Communities February 2021; Ministry of Health, Republic of Kenya. Readiness for COVID-19 Response and Continuity of Essential Health Services in Health Facilities April 2021; Ministry of Health, Republic of Kenya. Trends in COVID-19 Response and Continuity of Essential Health Services in Health Facilities and Communities December 2021; Ministry of Health, Republic of Kenya. Readiness for COVID-19 Response and Continuity of Essential Health Services in Health Facilities and Communities—Experience from Kenya readiness assessments in the context of the COVID-19 pandemic May–June 2022 (presentation).

9   Unpublished reports include: Ministry of Health, Republic of Ghana. Health service readiness for COVID-19 response and continuity of essential health services in health facilities. Results from the first Ghana readiness survey, June 2021; Ghana Health Services. Innovations, Developments, Challenges, and Lessons learned for monitoring frontline health services utilization and readiness during COVID-19 in Ghana (presentation).

10   Unpublished reports include: Zambian Ministry of Health. Zambia Assessment on Service Readiness and Capacities in the context of COVID-19, June 2021; Zambian Ministry of Health. Monitoring frontline health services utilization and readiness during COVID-19 in Zambia, 2022 (presentation).

11   Unpublished reports include: World Health Organization Country Office for Afghanistan. Maintaining the Essential Health Services in the context of the COVID-19 pandemic in Afghanistan (January–March 2022) Study report, World Health Organization Country Office for Afghanistan. Frontline Service Readiness Assessment—Afghanistan (January–March 2022) (presentation).
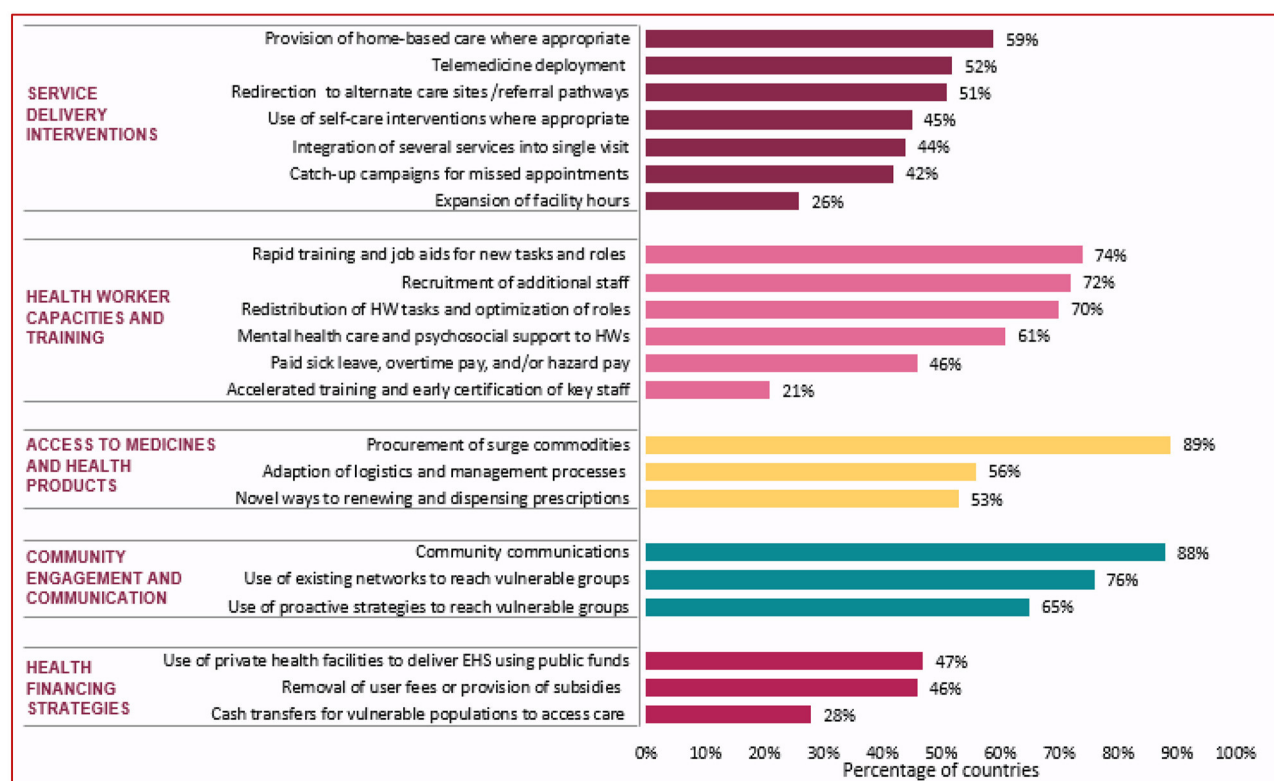
FIGURE 3
Percentage of countries implementing mitigation and recovery actions, November–December 2021 (*n* = 98). Examples of community communications included: communications to inform communities of changes to service delivery in the COVID-19 context communications to address misinformation and community fears of infection, targeted outreach where service utilization had declined, and the establishment of hotlines or community radios. HW, health workers; EHS, essential health services.

during the pandemic, including for maternal, newborn, child and adolescent health, HIV, tuberculosis, and malaria (65–68).

Successes and lessons learned

Limitations of the national, facility and community surveys should be considered. Firstly, responses provided by key informants reflect self-assessment, which may be prone to bias and lacks validation. For the pulse survey in particular, response rates reduced with each round, suggesting potential survey fatigue or reducing information gains for countries at different points of recovery. Furthermore, with a national focus, countries with considerable subnational variation may find the information less helpful. Dissemination of findings also presented difficulties in the rapidly evolving outbreak context, where traditional modes of data dissemination were not possible (e.g., in-person country workshops and policy dialogues).

Nonetheless, the methods and tools helped to fill critical gaps by generating actionable and dynamic data that was previously unavailable from global to local levels. The **pulse survey** offered one of the few globally comparable sources of country data on health service disruptions and system bottlenecks caused by COVID-19. In countries, the approach mitigated reporting burden and fostered cross-programme discussions, by offering one coordinated and comprehensive tool to assess different service areas. Moreover, to

the extent that validation has been possible, the findings have echoed other studies that found consistent but variable impacts on essential health services across health domains (4, 5, 69–73).

The frontline health service capacity surveys provided dynamic supply- and demand-side data on frontline health service delivery and capacities that was previously missing through routine country monitoring systems. Countries disseminated findings through virtual meetings and online communications to guide actions and investments to mitigate the potential impact of COVID-19 on health outcomes in the long-term. The online, phone-based format also allowed for rapid, safe and contact-less data collection during the COVID-19 context, using fewer resources and logistical requirements compared to other in-person assessments. Moreover, the streamlined implementation support materials enabled rapid turnaround of results.

Implementation was most successful when strong country leadership and ownership was present, when country capacities for tracking health service readiness and resilience were strengthened, and when methods and tools were integrated into broader national and local operational planning processes.

In this way, the approach successfully provided a low-cost, action-oriented method to collect critical operational information from national to local levels on health service readiness, resilience, and responsiveness during the COVID-19 pandemic, and highlighted the importance of building more responsive and resilient country monitoring systems for the future.

Implications for the future

Now, as countries review, recover and transform health systems to make them more robust and resilient in the event of future shocks, countries have expressed interest to more sustainably institutionalize core components of the methods and tools into routine country data systems.

The surveys are being evaluated further to inform their potential integration into regular country data systems. This includes reviewing the consistency of findings with other country data sources, particularly from RHIS. Publication of these results is forthcoming. To complement the breadth of these survey results, it may also be valuable to conduct in-depth studies to assess the impact of COVID-19 on essential health services using inferential statistics, and to assess the linkages between health service readiness and health impact more closely (9, 74, 75). Further testing on best practices for integrating the methods and tools into existing country data systems and aligning them with broader national and local policy and planning processes and dialogues will also be helpful.

Notwithstanding the need for further validation and testing, the rapid key informant tools and methods have successfully built country capacities, filled critical information gaps using minimal resources, and improved the use of data to inform actions, investments, and response from local to global levels in the pandemic context. They offer a promising approach to guide longer-term recovery efforts, to bolster routine health services monitoring systems, and to ultimately serve as health services surveillance and alert functions for future health crises.

Data availability statement

The data is not immediately shareable as there are other publications underway using the same datasets. In addition, country approvals are required before the data are shared publicly. Requests to access the datasets should be directed to KO'N, oneillk@who.int and BR-M, rivasb@who.int.

Author contributions

KO'N, HKa, BD, AR, HS, AT, and TZ: conceptualization and technical oversight. DH, BR-M, KV, RT-O, LN, MT, HKi, NH, DA, HD, and FT: coordination of survey implementation. CT, KV, AB, and BR-M: data curation, analysis, and synthesis. KO'N, BR-M, DH, KV, CT, and AB: writing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1102507/full#supplementary-material

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Check for updates

From fragility to resilience: A systems approach to strengthen primary health care

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Introduction

Twenty years of progress in service coverage has been estimated to be neutralized by the COVID-19 pandemic (1). 2022 marks the second consecutive year that the world has not progressed toward the 2030 Sustainable Development Goals (SDGs) due to multiple and often concurrent health and security crises (2). COVID-19 exposed the fragility of health systems in some of the wealthiest countries and demonstrated how inequities within and across countries are compounded by public health threats. Public health threats expand beyond disease outbreaks, to include climate change, conflict, and other shocks to the health system. Regardless of the threat, the fact remains that both sudden and slow-onset disturbances will happen and health systems need to be adequately prepared to mitigate disruptions to health care. Strengthening primary health care (PHC) systems is critical for bolstering countries' health systems' ability to effectively respond to and recover from new and recurring shocks, while preventing backsliding of health outcomes (3, 4). For purposes of this paper PHC is defined as a "*whole-of-society approach to health that aims at ensuring the highest possible level of health and well-being and their equitable distribution through comprehensive integrated health services that embrace primary care as well as public health goods and functions, supported by multi-sectoral policies and actions that address the social determinants of health and engage and empower individuals, families and communities*" (5, 6).

As reinforced in the 2018 Astana Declaration commitments (7), PHC and systems that support and facilitate it are central to strengthening and connecting UHC, health system resilience and pandemic preparedness within countries (8); this has been increasingly recognized in global efforts to improve preparedness and response to health emergencies (9). IA strong PHC platform with existing community trust can help support response efforts through early diagnosis and reduced demand on hospitals through accessibility (10). For example, in Indonesia climate change is increasing flooding, droughts, and erosion, in turn increasing health problems due to impacts on water quality, access to health facilities or increase in infectious diseases. Community based risk management programs supported PHC systems in communities facing changing patterns of vector and waterborne diseases. With only 8 years remaining to

achieve the SDGs, continued setbacks in improving equitable access and affordability of quality essential health services threaten to make universal health coverage (UHC) unattainable by 2030.

We must remember that people are at the heart of health care, and resilient, quality health systems are responsive to patient and population needs. Effective PHC can address 80% of a person's health needs by providing promotive, preventive, curative and rehabilitative services accordingly (11). An additional $200–370 billion (USD) a year is needed to scale PHC in low and middle income countries; WHO recommends that countries allocate or reallocate 1% of their GDP to PHC from government and external funding sources to help close this gap (5). Increasing funding levels to strengthen integrated PHC systems is necessary for bolstering health system resilience capacities, which can reduce the need to divert health funds away from essential routine services during times of crisis due to shocks or stressors. While increasing funding for PHC is important, it is not enough. Greater attention needs to be directed to methods that help understand the context-specific barriers to high performance of integrated PHC, including effective integration of essential public health functions (EPHFs) and integration across disease-specific inputs, so that it is more responsive and comprehensive for all people at every life stage, especially marginalized and vulnerable populations.

Discussion

Understanding how a system functions, including barriers to performance during each stage of shock, can provide a clear roadmap for improving health system resilience and strengthening high-quality integrated, people-centered services.[1] A systems approach uses systems thinking (15) to understand how health system components function, evolve, behave, and interact, enabling the identification of barriers to achieving equity, quality, and resource optimization (16). This discussion provides examples of how using a systems approach can strengthen PHC and increase health system resilience.

Effective integration of essential public health functions in primary health care systems

Developing flexible health systems that can make shifts to respond to shocks, yet maintain essential health services, requires strategic integration of PHC and EPHFs (17, 18). EPHFs (such as monitoring of health status, supporting efficient and effective multi-sectoral planning and preparedness, disease surveillance and response, and advancing public health research)

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1   See, e.g.: (12–14).

(19) are the minimum requirements and capacities for systems to ensure public health, and are recognized as key for health system resilience (20). Strong PHC systems that integrate EPHFs are better positioned to proactively detect shocks and respond to surge support needs. Thus, systems with integrated PHC and EPHFs can improve health security and resilience during crisis and recovery (5). Although it is recognized that EPHFs are an important part of PHC, there are few examples of countries that have integrated them well (18). Analyses that use a systems approach can help illuminate opportunities and pathways for investment in PHC integration with EPHFs, as structures and approaches differ across country and region (21). PHC should be strengthened to enable countries to rapidly adapt and transform both health system functions and public health functions to ensure adequate availability of human, financial and supply resources when and where they are needed the most before, during, and after crises.

Reducing fragmentation

Creating resilient health systems also requires a global shift away from predominantly siloed disease-specific inputs, which can limit countries' ability to effectively respond to shocks, and toward a balanced approach with integrated health system investments as well. Program experience has repeatedly shown the value of strengthening alignment and collaboration among country governments, non-governmental partners, donors, and multilateral institutions, in strengthening PHC and improving community trust (22). Countries are increasingly focusing reforms for high performing primary health care at the community level by applying a systems lens. For example, funding for community health worker programs has been historically heavily fragmented, and analyses in sub-Saharan Africa show that taking a strong systems approach is necessary to be impactful to reduce fragmentation and "establish mechanisms for accountability to encourage harmonization of donor funding". Investments toward building sustainable national CHW program delivery models should be embedded within the PHC system in order to be an efficient and effective use of funds and support better quality of care (23). Fifteen countries are engaging with the Community Health Roadmap partnership (24), an innovative collaboration between governments, funders, and partners, to advance national policy and systems priorities to accelerate progress toward health outcomes. Estimates indicate the lives of up to 2.4 million women, children, and newborns could be saved each year "if a complete package of evidence-based interventions was provided - and accessible - at the community level (25)". Examples of emerging priorities for institutionalizing community health that require urgent action across the fifteen countries include professionalizing the community health workforce, developing data systems, and engaging communities to build local

governance and accountability (24). A key cross-country priority is strengthening and sustaining CHW compensation, often by addressing political and financial challenges to institutionalizing CHW payment (26).

Improving equity and accountability

Systems approaches to strengthening people-centered PHC offer opportunities to engage in equity-oriented research and practice that can transform the health system, address power imbalances, and recognize key equity drivers within complex systems (27). Health inequities and health system shocks continue to disproportionately affect the most vulnerable, with 50% of the world's population lacking access to essential health and social services and 100 million people being pushed into poverty annually from paying for health care out-of-pocket (22). This is especially true in environments affected by protracted conflict, which often lack the requisite human, financial, and supply resources for basic PHC. Approximately 24% of the world's population, about 1.8 billion people, live in fragile contexts where delivering quality essential health services is challenged (28). Community engagement and multisectoral systems-based approaches are key to strengthening health system weaknesses to ensure continuity of essential services, increase flexibility during response and recovery, and addressing underlying social determinants of health. Evidence shows that PHC designed in an inclusive manner that integrates EPHFsbest addresses the broad range of health needs that individuals, their families, and communities require (29, 30).

PHC that does not meet the needs of users—due to issues such as insufficient funding levels for optimal system performance leading to health worker, medicine, equipment, and commodity shortages; lower quality care and accountability; inequitable access; and/or required out-of-pocket payments—can shift care-seeking behavior away from PHC providers to higher levels of specialized care (31, 32). Engaging relevant civil society and community based groups in governance of PHC at all levels creates more opportunity for accountability and reduces fragmentation of services (33). Building social accountability structures and increasing community ownership and engagement in planning, prioritization and delivery of PHC services can reduce the asymmetry of power between health system actors such as policy makers and providers and individuals accessing care (34, 35). In turn, social accountability can increase the provision of respectful care, which can improve health outcomes in communities through improved trust leading to more use of the healthcare system, minimized medication adherence issues, and even improve working conditions of health workers by reducing burnout (36). At the national level, policy dialogue efforts that are well-resourced, clear and collaborative can enable participants to effectively

engage in the process (37) and can lead to high levels of policy commitment (38).

Supporting system-wide process improvement

While access is important to ensuring equity, quality of care drives utilization. Health care services must be safe, effective, and person-centered. More deaths in low- and middle-income (LMIC) countries occur as a result of poor-quality care than from lack of access (35). Systems-practice includes incorporating principles of process improvement to continually assess and address identified gaps in health system performance. Country-led efforts to build absorptive, adaptive, and transformative capacities to mitigate the impact of shocks and stressors is an example of system-wide process improvement. As the context changes over time, processes within the health system need to be established, modified, or terminated in order to maintain optimal performance (39). For example, some LMICs were unsure of how best to include the private sector in planning for initial national response efforts to COVID-19 (40), exposing a systems process gap. In most LMICs, governments have focused on delivering public sector services themselves rather than establishing governing mechanisms and processes that integrate the public and private sectors in a mixed health system. National health sector planning should consider intentional and strategic linkages with the private sector to strengthen PHC to improve quality of care and expand access to services, especially as part of crisis responses.

Measuring impacts and learning

Finally, system-wide learning and measurement are also key to quality health system responses to a shock (41). Research and learning should inform longer term system transformation and improvement in policy and practice to support recovery and preparation for the next shock. For example, systematic analysis of bottlenecks to strengthen community health systems as part of PHC revitalization efforts in West and Central Africa identified a range of health system barriers related to health financing, essential medical technology and products, and integrated health service delivery, but only some of these barriers had been self-identified by participating countries. The systems analysis, which utilized a community health system bottleneck analysis tool, was critical to identifying the full range of opportunities to strengthen PHC (42). Further, though health systems collect data on health system inputs, such as workforce and logistics, countries often lack data about performance and processes used to improve equitable quality care (33). Incorporating measurement of performance-related indicators or perception

of quality of care can fill knowledge gaps to inform decision-making and can be used to strengthen political will to strengthen PHC platforms.

Conclusion

Systems approaches to strengthening people-centered PHC can enable context-specific understanding of health system needs and opportunities, and therefore can be an inclusive, effective and efficient approach to enhancing health and wellbeing and maintaining health system resilience and health security during crisis and recovery. Strong political leadership and commitment to engaging with stakeholders that impact health and its determinants at all levels and to adapting health systems to the social and economic contexts is needed to successfully develop and sustain resilient, integrated PHC systems and reduce inequities ([32]). Systems practice facilitates a whole-of-society approach to the investments needed for stronger health systems that can meet the needs of everyone, especially marginalized and vulnerable populations. As countries take stock of their roadmaps or commitments toward progress for UHC in 2023, reinvigorating PHC based on stakeholder engagement and alignment in support of country-led PHC platforms and longer-term health system goals will be essential for achieving the SDGs and mitigating adverse health consequences during future crises.

Author contributions

EL conceptualized and led the development of the commentary. RM, RB, FM, and NK provided technical inputs and made key contributions to the work. All authors reviewed the commentary. All authors contributed to the article and approved the submitted version.

Conflict of interest

EL was employed by Credence Management Solutions. RB was employed by Social Solutions International.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Developing technical support and strategic dialogue at the country level to achieve Primary Health Care-based health systems beyond the COVID-19 era

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'.

Pursuing the objectives of the Declaration of Alma-Ata for Primary Health Care (PHC), the World Health Organization (WHO) and global health partners are supporting national authorities to improve governance to build resilient and integrated health systems, including recovery from public health stressors, through the long-term deployment of WHO country senior health policy advisers under the Universal Health Coverage Partnership (UHC Partnership). For over a decade, the UHC Partnership has progressively reinforced, *via* a flexible and bottom-up approach, the WHO's strategic and technical leadership on Universal Health Coverage, with more than 130 health policy advisers deployed in WHO Country and Regional Offices. This workforce has been described as a crucial asset by WHO Regional and Country Offices in the integration of health systems to enhance their resilience, enabling the WHO offices to strengthen their support of PHC and Universal Health Coverage to Ministries of Health and other national authorities as well as global health partners. Health policy advisers aim to build the technical capacities of national authorities, in order to lead health policy cycles and generate political commitment, evidence, and dialogue for policy-making processes, while creating synergies and harmonization between stakeholders. The policy dialogue at the country level has been instrumental in ensuring a whole-of-society and whole-of-government approach, beyond the health sector, through community engagement and multisectoral actions. Relying on the lessons learned during the 2014−2016 Ebola outbreak in West Africa and in fragile, conflict-affected, and vulnerable settings, health policy advisers played a key role during the COVID-19 pandemic to support countries in health systems response and early recovery. They brought together technical resources to contribute to the COVID-19 response and to ensure the continuity of essential health services, through a PHC approach in health emergencies. This policy and practice review, including from the following country experiences: Colombia, Islamic Republic of Iran, Lao PDR, South Sudan, Timor-Leste, and Ukraine, provides operational and inner perspectives on strategic and technical leadership provided by WHO to assist Member States in strengthening PHC and essential public health functions for resilient health systems. It aims to demonstrate and advise lessons and good practices for other countries in strengthening their health systems.

Introduction

During the last decades, discussions and debates on how to strengthen health systems in order to operationalize the right to health have been running, without finding a common understanding of how to deliver accessible life-saving health services for all. Despite the commitments expressed in the Declaration of Alma-Ata for Primary Health Care (1) in 1978, reiterated in Astana in 2018 (2), and in the 2030 Agenda for Sustainable Development, as well as significant pieces of evidence linking Primary Health Care (PHC) to improved health outcomes (3), the WHO recently acknowledged that the implementation of PHC has been limited and diverse across countries due to a lack of a universally accepted definition (3).

In 2020, the Operational Framework for Primary Health Care (4) describes it as "a whole-of-society approach to health that aims to maximize the level and distribution of health and well-being through three key components: primary care and essential public health functions as the core of integrated health services; multisectoral policy and actions; and empowered people and communities" (4). It also refers to primary care as a "process in the health system that supports first-contact, accessible, continued, comprehensive and coordinated patient-focused care" (4). During the last few years, WHO's Member States have committed through several WHO resolutions (5) to use PHC as the fundamental programmatic engine to progress toward the Sustainable Development target 3.8 for Universal Health Coverage (UHC). UHC means that all people have access to the full range of quality health services they need, when and where they need them, without financial hardship.

The comprehensiveness of PHC ensures that any healthcare need is addressed through the direct provision of services at the primary care level or through referral to any other level of care, depending on the package of services defined for each level of the health system. This conceptual framework is broader than the health service delivery function alone and includes essential public health functions (health protection, health promotion, disease prevention, surveillance and response, and emergency preparedness); multisectoral policies to address the social, economic, and environmental determinants of health; and empowering processes to include individuals and communities in the health-related policy-making process.

However, at the beginning of the 2000s, while the largest vertical programs for health were established, disease-specific ventures were more prevalent than integration through health systems strengthening. At this stage, some countries did not develop any national health policy, strategy, or plan for health, and in many others, when elaborated, they were perceived as unrealistic documents and rarely operationalized (6).

From 2000 to 2019, the UHC service coverage has globally increased from 45 to 67 (7) and life expectancy by more than 6 years (8). In the same period until 2017, the maternal mortality ratio dropped by 38% worldwide (9) and the under-5 mortality rate dropped by 60% since 1990 (10). However, 30% of the world's population are still not able to access the essential health services they need, and almost 2 billion people are facing catastrophic or impoverishing health expenditure (11). Yet, 90% of these needs could be addressed by the PHC approach by providing promotive, preventive, curative, and rehabilitative services accordingly (12, 13). The world has, in consequences, made some great progress on global health; however, further work is still strongly required to reduce inequalities and achieve health for all by 2030.

To build a consensus on how to strengthen health systems, the World Health Organization (WHO) has strongly advocated for the integration of all health programs and functions in the Primary Health Care approach. During the last decades, global public health interventions and emergencies have also demonstrated the need to develop public health policies through an inclusive and multidisciplinary approach to ensure public confidence (14, 15). In addition, many normative documents have been published to develop the PHC approach to health system strengthening.

In 2007, the WHO's publication on the framework for health systems (16) through the building blocks lens marked a significant change in the admission of the need for an integrated approach, based on the recognition of strong interdependencies between each health system block (17). One year later, while the 2008 World Health Report was making a strong case for PHC (18), the leaders of G8 nations for the first time exchanged on health systems strengthening. In 2009, the World Health Assembly passed a critical resolution that emphasized the importance of Member States' commitment to "Primary Health Care, including Health System Strengthening" (19). Subsequently, the World Health Report (20) in 2010 outlined how Member States could adapt their health financing system to ensure that all people have access to health services and do not suffer financial hardship paying for them.

In this context, following the 2011 WHA resolutions on strengthening national policy dialogue to build more robust health policies, strategies, and plans (21), the WHO also created the Universal Health Coverage Partnership to enhance governance through policy dialogue with the aim to build resilient and integrated health systems to make progress toward UHC through a Primary Health Care approach. A decade on, the WHO has deployed a large network of more than 130 health policy advisers to support the provision of technical assistance for PHC and UHC in 115 countries. They have been progressively incorporated into the core workforce of WHO to create one of the largest and most effective technical operational platforms and networks for international cooperation on PHC and UHC.

Health policy advisers support policy dialogue and use strategic and technical leadership to enable governments to strengthen health systems, support the harmonization and alignment of partners on National Health Policy and Strategies, and facilitate the implementation of political declarations, such as the one adopted for

the High-Level Meeting on UHC during the UN General Assembly in 2019 (22). Furthermore, since 2020, the UHC Partnership has incorporated gender, equity, and human rights components to support the integration of these approaches into national health policies, strategies, and plans based on health inequality and equity monitoring and analysis dimensions.

In 2023, the UHC Partnership channels 10 sources of funds from Belgium, Canada, the European Union, France, Germany, Ireland, Japan, Luxembourg, the United Kingdom, and the WHO. This is to ensure the implementation of its activities and build a bridge between commitments at the global level and national health system strengthening priorities in 115 countries. Funded activities support the WHO's work plan across all three levels of the organization (country, regional, and headquarters) based on WHO's Thirteenth General Program of Work 2019–2023 (GPW13), and not as a stand-alone project. The UHC Partnership supports Member States with flexible funds and agile programming while adapting quickly to evolving contexts and priorities.

During the COVID-19 pandemic, Member States benefited from specific assistance to build and maintain sustainable country preparedness and response capacities, including the continuity of essential health services, the integration of innovations, as well as service delivery adaptations in response to COVID-19. Based on country experiences from Colombia, the Islamic Republic of Iran, Lao PDR, South Sudan, Timor-Leste, and Ukraine, in the context of health systems recovery following COVID-19, this policy and practice review provides operational and in-depth perspectives on strategic and technical leadership provided by WHO to assist Member States in strengthening PHC for resilient and integrated health systems.

Assessment of policy options and implications—Primary health care for resilient and integrated health systems

The COVID-19 pandemic has confirmed that every country is exposed to public health emergencies through direct impact on mortality and morbidity, disruption to health systems functions and essential services, as well as economic and social consequences at the national and global levels. Progress toward UHC and capacities for health security and health determinants are interdependent elements that influence population health. To sustain progress toward UHC, global health security and improved population health and wellbeing require the whole-of-government and social engagement to build the resilience of health systems through health in all policies, considering the complexity of health and the necessity to apply a wide systemic approach (23).

In times of emergencies, health systems are overstretched to respond efficiently to public health threats, while maintaining essential services and functions for the population in dire need. PHC favors integration, coherence, and alignment of health policy and strategies, as well as community engagement, which are critical to ensure that health systems are maintained and continue to deliver services in all contexts. It is also increasingly recognized that facilitating access to PHC is one of the most efficient and convenient ways to increase awareness of menaces to health in the community, by enabling early notification and mitigating and responding to potential threats (24).

Centered on people, PHC brings health systems closer to communities to consider their needs with respect to cultural norms and practices, enhancing trust between health service providers and the population, and also awareness of diseases and care pathways (25, 26). Many essential public health functions, such as surveillance, detection, and notification of diseases, are enhanced through community engagement. Furthermore, compliance with policies cannot be expected as absolute if populations and actors of health systems are not included in policy-making processes, especially in a world fragmented by inequalities (27). Inclusion, solidarity, transparency, and accountability as key components of health system governance are essential for recovering and sustaining progress toward UHC.

The PHC approach to health systems strengthening encompasses these requirements (28–30). The Declaration of Astana is clear about the objectives of PHC: "enhance capacity and infrastructure for primary care (…) prioritizing essential public health functions (…) to meet all people's health needs across the life course through comprehensive preventive, promotive, curative, rehabilitative services and palliative care" (31). The WHO has translated these resolutions into its 13th General Program of Work (32), recently extended until 2025, and focuses on promoting health, keeping the world safe, and serving the vulnerable.

In 2020, the WHO published the Operational Framework for Primary Health Care to clarify the renewed vision of PHC and support countries in scaling up PHC implementation. PHC is defined as a whole-of-government and whole-of-society approach to health that combines, in addition to its focus on primary care and essential public health functions, a strong emphasis on a multisectoral policy and actions perspective, as well as people's and communities' empowerment, including private organizations for and not for profit (Figure 1). The operational framework proposes operational and strategic levers to translate PHC commitments into actions. Furthermore, in 2022, a primary healthcare measurement framework

FIGURE 1
Key components of the PHC approach.

and indicators has been published to support Member States to assess, track, and monitor PHC performance to accelerate progress toward UHC and the health-related SDGs (33).

Health systems must be integrated and oriented toward PHC as the foundation for UHC and health security. The COVID-19 pandemic has kept the doors open to implementing PHC as one of the best ways to ensure progress toward UHC and health security (23).

Similarly, prioritization of preparedness and response capacities, or vertical disease programs, without considering building basic health systems functions, cannot deliver the essential health services required by the people. Health system integration can be considered as horizontal to cover a continuum of health services through a single delivery platform, and as vertical to ensure the coordination between platforms of health service delivery, such as between primary and referral care to hospitals, or between public and private, for and not for profit health facilities. Primary care facilities are keeping the gate and maintaining the path to specialty care and hospital care.

Methodology to analyze the role and the impact of the UHC partnership

Complexity is a significant element of the difficulty to demonstrate and comprehensively understand the results and effects of the intervention of the UHC Partnership (34, 35). Scholars and public health professionals recognized widely that evaluating complex interventions, especially when randomized controlled trials are not feasible, requires to use "non-experimental, mixed methods and process-based approach, appreciation of the different logics of causality, and use of case study research to understand context" (36).

To analyze the role and impact of the UHC Partnership in countries, a formative evaluation was conducted in 2016. (37) It focused on its actions that focus on lessons learned with regard to its role (convener, broker, and technical assistance), strengths (flexibility, bottom-up approach, seed/catalytic funding, and WHO's Joint Working Team three-level agile network approach), and weaknesses (roster of technical assistance and difficulties finding appropriate candidates).

In addition, a research approach was also initiated which led to a protocol for a realist evaluation aiming at analyzing policy dialogue processes in their context to understand what mechanisms have triggered health systems to move toward achieving UHC (38). The results report the theory of the underlying rationale of the WHO through the UHC Partnership (Figure 2) which supports the Ministries of Health (MoH) to lead inclusive, participatory, and evidence-informed policy dialogue (39). The support of the health policy advisers should result in mutual trust to strengthen stakeholders' collaboration, while the evidence and data provided should bring a shared understanding of needs and policy options. The evaluation also reveals the necessary conditions for successful policy dialogue such as dynamic local stakeholders, promotion of collaboration as a mode of action, involvement and leadership of the Ministry of Health, and synergy of messages and actions of WHO. The African Regional Office also published lessons learned on health policy dialogue led within the continent in the frame of the UHC Partnership (40).

To better understand the effects of the interventions, the implementation of activities and results achieved have been

described in a systematic manner (41) since the initiation of the UHC Partnership, through annual reports or diverse strategic and technical analytical deep dives. Furthermore, to improve transparency and mutual accountability, and ensure systematic monitoring of implementation and progress, as well as continuity and stability of the efforts at the national level, the UHC Partnership is established through a high-level governance structure and operational pillars.

The governance structure has two key oversight committees: a Multi-Donor Coordination Committee and a WHO high-level UHC Partnership Steering Committee. The operational pillar is composed of the live-monitoring mechanism; the communication and advocacy strategy; as well as the strategic and operational platform named the three-level Joint Working Team for PHC and UHC. All these mechanisms combined provide various opportunities for WHO and partners to actively engage in a regular dialogue on the provision of support to Member States and results achieved to deliver on their UHC goals.

This policy and practice review is a first attempt to formulate what has been observed over time through these diverse accountability mechanisms, in the frame of a larger contribution analysis (42) that should be implemented in the next phase of the UHC Partnership. Country examples have been selected to reflect the diversity of context where the UHC-P is operating, representing each of the six WHO regions, with a long engagement in four low-income countries (Lao PDR, South Sudan, Timor-Leste, and Ukraine) and a shorter one in two middle-income countries (Colombia and the Islamic Republic of Iran). This diversity of context also includes interventions in fragile and conflict-affected countries (South Sudan and Ukraine).

Each case study has been reported in two steps. First, country data for the tracer indicators 3.8.1 and 3.8.2 have been collected to observe the country's progress toward Universal Health Coverage. These quantitative indicators have been selected because they best reflect the ultimate objective of the UHC Partnership, to increase the coverage of health services and decrease catastrophic health expenditures. Two separate metrics are used to follow this objective, specifically indicator 3.8.1 on the coverage of essential health services and indicator 3.8.2 on catastrophic health spending.

The coverage of essential health services (3.8.1) is defined as the average coverage of essential services based on tracer interventions that include reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases, and service capacity and access, among the general and the most disadvantaged population. The indicator is measured as an index reported on a unitless scale of 0–100, which is computed as the geometric mean of 14 tracer indicators of health service coverage.

The proportion of the population with household expenditures on health >10% of total household expenditure or income (3.8.2) is estimated as the population-weighted average of the country-level share of people with such catastrophic health expenditures (10% threshold) for a reference year. Incidence at the country level for the reference year is estimated using different methods depending upon the availability of information for that country around or at the reference year.

In a second phase, the gray literature produced by the UHC Partnership (annual reports, evaluations, communication and advocacy documents, policy briefs, blog publications, and online
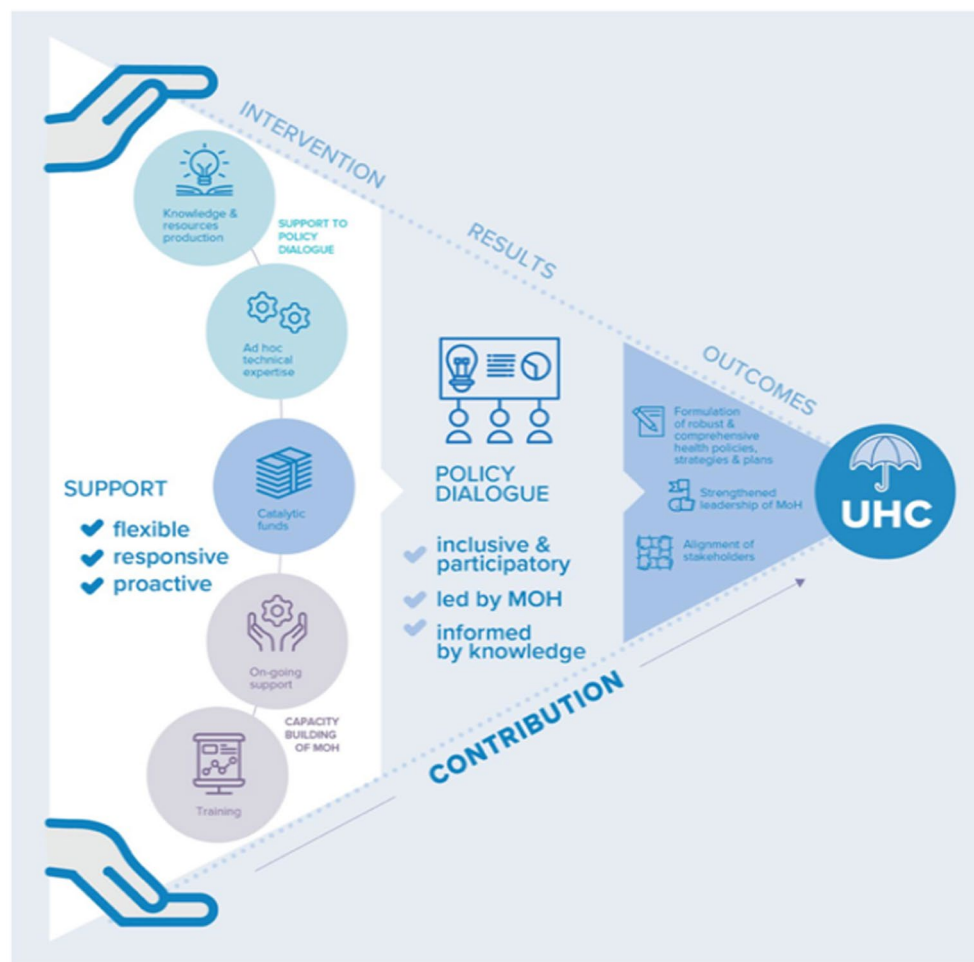
FIGURE 2
UHC Partnership theory highlighted by the realist evaluation.

presentations) has been reviewed to list qualitative and quantitative information that could support the establishment of a clear theory of change (activities supported, evidence generated, and output and outcome achieved) to explain the contribution of the UHC Partnership to the achievement of the tracer indicators 3.8.1 and 3.8.2.

The general hypothesis, articulated through this article, supposes that the health system guidance supported by the UHC Partnership aims at elaborating public health policies for UHC with a PHC approach, through policy dialogue while supporting the alignment of financial and human resources and coordinating national and international health partners. It is assumed that it can lead to improve health outcomes and outputs as described in the WHO GPW13 and to improve the tracer indicators 3.8.1 and 3.8.2.

Demonstrating the attribution of results from the technical support provided by the WHO to improve the leadership of both WHO and MoH, as well as governance of health systems and essential public health functions is challenging. This is because governance is complex and involves many different actors, spaces, and parameters, in many different contexts, where it is not straightforward to simply articulate how many lives have been saved because of the development of public health policies or the improvement of strategic frameworks for the health sector in a country.

If quantitative studies demonstrated a positive association between better governance and better health outcome through statistical analysis (43, 44), policy studies are not yet able to provide a reasonable and comprehensive theory that can explain with causality relations the different mechanisms leading to better health outcomes through governance. As the WHO and the Alliance for Health Policy and System Research stated in 2013: "despite abundant evidence of the efficacy of affordable, life-saving interventions, there is little understanding of how to deliver those interventions effectively in diverse settings and within the wide range of existing health systems" (45).

This policy and practice paper seeks to contribute to a plausible understanding of how to strengthen the health system by developing, negotiating, implementing, monitoring, and evaluating robust and integrated national health policies oriented toward UHC. It will also determine if the available evidence is sufficient, and if further investigations would be required, to establish strong theories of change in each country to explain the

contribution of the UHC Partnership to achieve Universal Health Coverage.

Results

Acting on lessons learned during the 2014–2016 Ebola Outbreaks in West Africa and from fragile, conflict-affected, and vulnerable settings (FCV), health policy advisers have been critical during the COVID-19 pandemic to support health systems' early recovery, to ensure the continuity of essential health services, and to strengthen PHC for health security, including surveillance and treatment of diseases and preventing routine local outbreaks from becoming larger disruptive emergencies. Due to the flexibility of the planification process, they have been able to adapt their support to the new context of the response to the pandemic and its socioeconomic consequences. Several country experiences have been selected among the 115 countries supported in 2022. They are introduced below to describe how increased PHC can support the resilience of health systems (Table 1).

Actionable recommendations— Strategic and technical support to move toward UHC and health security

The WHO GPW13 supports a differentiated approach based on capacity and vulnerability to strengthen the integrated health system approach, which defines four different kinds of modalities for WHO support to Member States (49).

1. Policy dialogue to develop health systems in future for the more mature health system.
2. Strategic support to build high-performing systems in advanced health systems.
3. Technical assistance to build national institutions in more fragile health systems.
4. Service delivery to fill critical gaps in emergencies, when national and regional capacities are not able to maintain essential health services.

The UHC Partnership *de facto* contributed to developing this strategy, operating in countries for the second and third modalities, while always advocating for bottom-up, flexible, catalytic, and long-term support to Member States and implementing a new model of transparency and accountability (consistent and regular annual reporting, communication strategy, live-monitoring meetings, multi-donor, and internal three levels coordination mechanisms).

This strategy quickly brought interesting results in the formulation of public health laws, national strategies, road maps, and national compacts for UHC. Endorsed and acknowledged by the WHO senior management and partners, these results led to constitute a positive environment for the UHC Partnership, which grew from 30 countries to 115 between 2017 and 2020. The UHC Partnership played a key role in highlighting health system strengthening as a fundamental technical priority for WHO and other global health actors. It continues to remain an organizational priority (50), while its strategic approach,

principles, and results are recognized by all WHO departments as well as financial and technical partners (51).

The first and most fundamental added value of the UHC Partnership is the long-term deployment of health policy advisers in WHO country offices. Health policy advisers are present in some countries for more than 10 years, and their positions are progressively integrated into the core workforce of the organization. They support the leadership of Ministries of Health in health policy-making processes for essential primary healthcare services and functions, according to WHO health-related guidelines, while convening national and international health stakeholders to build consensus around national health policies and orient human, financial, and technical resources to implement them.

Health policy advisers are senior generalist public health officers recruited to provide leadership and managerial support to country offices, as well as technical and policy advice to Ministries of Health, in the area of public health and health system strengthening, ensuring that the activities in these areas are carried out efficiently and effectively. They constitute the technical country reference for many technical areas and many partners with regard to health system strengthening. They are, for instance, involved in the development of PHC investment plans with the European Investment Bank, as primary providers of evidence and to coordinate technical discussions with National Authorities and partners.

In times of emergency, health policy advisers bring together all technical resources to ensure the continuity of essential health services, strengthen PHC for health security, including surveillance and treatment of diseases, and prevent routine local outbreaks from becoming larger disruptive emergencies. National health security plans can only be integrated into national health strategies to ensure that those specific functions to prepare, prevent, detect, and respond to disease outbreaks and other health emergencies are integrated based on basic health system functions and not separately.

Health policy advisers support the generation of evidence (34), for instance, the institutionalization of national accounts for health financing and workforce or the mapping of available resources and priority actions to increase preparedness capacities. They mobilize policymakers, civil society organizations, and international partners through evidence-based policy dialogues in order to reinforce strategic frameworks and increase resilience and coverage with essential health services, financial protection, and equity. Health policy advisers also encourage and support specific dialogues between Ministries, such as with the Ministry of finance to ensure the coherence and sustainability of the health budget according to national objectives, and to improve public financial management for health.

Policy dialogue between the Ministry of Health and other health stakeholders can lead to rationalizing the policy-making process with debates and decisions based on accurate representations of reality (52) and in the respect of international guidelines to strengthen Primary Health Care. This policy-making process can enable the alignment of health system objectives and resources to the needs of the population in order to make and sustain progress toward UHC and health security while enhancing social participation (27). Over the last decade, in many countries, road map, national compact, and legal frameworks for UHC and health security have been developed due to the support provided by the health policy advisers, according to the number of products and services supported by the UHC Partnership (Figure 3).

TABLE 1 Country examples of technical assistance for resilient and integrated health systems (46–48).

Colombia	UHC Service Coverage Index (SDG 3.8.1)					
Population – 51,265,841 (2021)	**2000**	**2005**	**2010**	**2015**	**2017**	**2019**
Income level – UMIC	51	64	69	76	77	78
HDI Index – 0.752 (2021)	Population with household expenditures on health >10% of total household expenditure or income (SDG 3.8.2) (%)					
WHO support modalities –	**1997**		**2008**		**2016**	
Strategic support to institutional transformation	21,31		20,01		8,19	
UHC Partnership Member for 3 years	**UHC Partnership actions during the COVID-19 pandemic**					
	While COVID-19 was spreading across Colombia, the country tried to prevent widespread transmissions in areas like the Alta Guajira desert, a remote region inhabited by some of the most vulnerable communities in the country. With the technical support of the health policy adviser, the Government has been enhancing access to primary health care that respects indigenous cultures and traditions to protect them from the pandemic and address common health conditions such as malnutrition, acute diarrheal disease, tuberculosis, acute respiratory diseases and maternal and neonatal morbidities and mortality. An intercultural health model has been implemented based on community health workers. Native and well trained, they are the best positioned to respect cultures, identify health risks and refer to appropriate services. Their close proximity with communities is also a substantial advantage to facilitate the early recovery of the health system. In addition, under COVID-19 guidance, all communities across Colombia were obliged to cremate people when they die, but an exception was made for the indigenous people of Alta Guajira while establishing a clear protocol to ensure the safety of populations.					

Islamic Republic of Iran	UHC Service Coverage Index (SDG 3.8.1)					
Population – 85,028,760 (2021)	**2000**	**2005**	**2010**	**2015**	**2017**	**2019**
Income level – UMIC	37	49	57	69	74	77
HDI Index – 0.774 (2021)	Population with household expenditures on health >10% of total household expenditure or income (SDG 3.8.2) (%)					
WHO support modalities –	**2005**	**2010**	**2015**	**2017**	**2018**	**2019**
Strategic support to institutional transformation	11,31	13,72	17,03	16,86	17	15,35
UHC Partnership Member for 2 years	**UHC Partnership actions before the COVID-19 pandemic**					
	Since 2020, the Islamic Republic of Iran benefits from the presence of a dedicated health policy adviser who supports the operationalization of Primary Health Care. "Each home one health post" is the name of the national PHC initiative implemented by the Ministry of Health to bring health and care closer to communities. A strong network of Primary Care facilities and community health workers serves as the first point of contact for communities.					
	UHC Partnership actions during the COVID-19 pandemic					
	Initially aimed to strengthen prevention and health promotion, the program has been crucial in the context of COVID-19 to raise awareness, support early case detection, contact tracing, triage and referral to hospitals. The health policy adviser assisted the Ministry of Health and Medical Education to pilot and scale up a PHC measurement and improvement model and accelerate the national response to COVID-19. Under this platform, assessments and analyses have been produced to implement changes and strengthen PHC. Primary care facilities were also supported to improve health literacy and health promotion by developing training packages, conducting virtual training and by engaging the public. They were critical to reduce overcrowding in hospitals, while continuing to provide essential health services.					

Lao PDR	UHC Service Coverage Index (SDG 3.8.1)					
Population – 7,379,358	**2000**	**2005**	**2010**	**2015**	**2017**	**2019**
Income level – LMIC	26	34	39	45	48	50
HDI Index – 0.607 (2021)	Population with household expenditures on health >10% of total household expenditure or income (SDG 3.8.2) (%)					
WHO support modalities –	**2002**		**2007**			
Technical assistance to strengthen health system foundations	3,07		2,98			
UHC Partnership Member for 8 years	**UHC Partnership actions during the COVID-19 pandemic**					
	In the People's Democratic Republic of Lao, the COVID-19 pandemic was increasingly affecting the mental health of the population either directly due to illness or due to economic hardships they experienced as a result. Over 95% of people with serious mental illness are untreated, and access to mental health facilities is uneven across the country. Out of the total health workforce, only 42 personnel were working in mental health facilities in the country. Following several emergencies in the past years, the Ministry of Health understood that mental health and psychosocial support is a critical part of any recovery phase, and especially with COVID-19 plan.					
	UHC Partnership actions beyond the COVID-19 pandemic					
	Primary care was identified as the best level to improve mental well-being and promotion in villages. The core of the strategy was to enhance the capacities of the existing workforce to deliver mental health services. Through the health policy adviser, the Ministry of Health engaged in the WHO's Mental Health GAP program to scale up mental health services (development of mental health and psychosocial support guidelines, trainings at all levels). The integration of mental health services with primary care is essential to ensure their availability whenever and wherever people need them.					

(Continued)

TABLE 1 (Continued)

South Sudan	UHC Service Coverage Index (SDG 3.8.1)					
Population – 11,381,377 (2021)	**2000**	**2005**	**2010**	**2015**	**2017**	**2019**
Income level – LIC	20	21	24	28	31	32
HDI Index – 0.385 (2021)	Population with household expenditures on health >10% of total household expenditure or income (SDG 3.8.2) (%)					
WHO support modalities –	**2009**		**2016**		**2017**	
Technical assistance to strengthen	8,72		11,71		13,37	
health system foundations	**UHC Partnership actions before the COVID-19 pandemic**					
UHC Partnership Member for	Since 2018, after 5 years of war, South Sudan is in a transition phase, as its government moved from a core focus of tackling a					
10 years	humanitarian and emergency situation toward reorienting the state's priorities to long-term development of the health sector. It is one of					
	the first fragile, conflict-affected and vulnerable context country which has been supported by the WHO to develop a health sector					
	stabilization and recovery plan (HSSRP 2020–2022). The health policy adviser played a convening and brokering role by Ministry of					
	Health to coordinate partners and developed an investment plan on catalytic actions to foster the recovery, growth and performance of					
	the health system. This allowed better bridging between humanitarian, emergencies and development partners and increased synergies					
	around the PHC strategic and operational levers.					
	UHC Partnership actions beyond the COVID-19 pandemic					
	As part of WHO's support, through a year-long funded project, the Ministry of Health implemented a PHC project in four states					
	(Jonglei, Western Bahr el Ghazal, Eastern Equatorial and Central Equatorial) with the technical support provided by the health policy					
	adviser. The project was established after the development of the HSSRP and aimed to address critical gaps in health systems					
	foundations, across all essential public health functions, to create a more enabling environment for the advancement of PHC. To achieve					
	this, an integrated approach was applied to synergize efforts related to health systems strengthening, emergency preparedness and					
	response and essential health services delivery. This includes emphasis on health services to vulnerable groups – particularly women,					
	girls, infants and under five children – and strengthening the country's capacity for early warning, risk reduction and effective					
	management of public health risks.					
Timor Leste	UHC Service Coverage Index (SDG 3.8.1)					
Population – 1,343,875 (2021)	**2000**	**2005**	**2010**	**2015**	**2017**	**2019**
Income level – LMIC	33	32	46	49	50	53
HDI Index – 0.607 (2021)	Population with household expenditures on health >10% of total household expenditure or income (SDG 3.8.2) (%)					
WHO support modalities –	**2001**		**2007**		**2014**	
Technical assistance for	2,59		2,36		2,61	
institutional	**UHC Partnership actions before the COVID-19 pandemic**					
transformation UHC Partnership	For almost 10 years, the Ministry of Health has benefited from technical assistance to strengthen its governance toward Primary Health					
Member for 10 years	Care based health system for UHC, including health financing and human resources for health. The government established legal					
	frameworks to promote inclusive decision-making processes and improve communities' representation. Thanks to the presence of a					
	health policy adviser, the national health sector governance was strengthened through the establishment of protocols and procedures for					
	partnership and governance (multisectoral policy dialogues and partners coordination mechanism), and the revision of national health					
	strategies (2011–2030 National Health Sector Plan, National Action Plan for Health Security, Human Resources Strategy for PHC).					
	Additionally, WHO provided strong support during the elaboration of a comprehensive service package for PHC through the "Saude na					
	Familia," the national program for PHC.					
	UHC Partnership actions beyond the COVID-19 pandemic					
	When the COVID-19 started to affect the country, the Government scaled up its investments in PHC to strengthen social protection,					
	close gender gaps and related inequalities and enhance digital connectivity. Within 5–6 weeks, it transformed to have in-country testing,					
	functional COVID-19 facilities, staff rapidly trained on COVID-19 management, a gradual increase in stocks of personal protective					
	equipment (PPE), expanded capacity for an expanded testing strategy and active surveillance capabilities. WHO's previous work with					
	Timor-Leste on governance and emergency preparedness paved the way for an effective response and coordinated and coherent support					
	from health partners to meet the government's needs including additional funding.					

In 2021, a survey has been conducted among health policy advisers ($n = 130$) to understand their contribution to the COVID-19 response. Roughly 98% of respondents stated being in almost daily contact with their counterparts at the Ministry of Health. The survey indicated that, on average, respondents had to allocate 50% (range: 3–90%) of their full-time equivalent to support COVID-19-related response activities, albeit the significant amount of work planned under the frame of the UHC Partnership. In addition, due to the UHC Partnership's flexibility, 90% of respondents were involved in and reinforced the in-country incident management support teams in response to COVID-19. Many of them (56%) even took up a specific position within the incident management support teams, either as an

TABLE 1 (Continued)

Ukraine	UHC Service Coverage Index (SDG 3.8.1)					
Population – 43,814,581 (2021)	**2000**	**2005**	**2010**	**2015**	**2017**	**2019**
Income level – LMIC	48	51	59	63	70	73
HDI Index – 0.773 (2021)	Population with household expenditures on health >10% of total household expenditure or income (SDG 3.8.2) (%)					
WHO support modalities – Technical assistance for	**2002**	**2005**	**2010**	**2015**	**2017**	**2019**
institutional transformation	12,41	8,2	6,91	7,13	7,3	8,32
UHC Partnership Member for 8 years	**UHC Partnership actions before the COVID-19 pandemic** Since 2014, Ukraine has been implementing one of the most ambitious programs of reform for Primary Health Care with the technical assistance of a dedicated health policy adviser. The WHO has been a strong supporter especially with regards to the health financing reform in 2016, the new public health legal framework and the law on state financial guarantee for provision of medical services in 2018, the revision of different services packages and the national rollout of the primary health care reform in 2020. All these reforms created a strong legal and political framework to implement new health financing arrangements and improve service delivery. A new payment mechanism was implemented for health care providers with a new purchasing agency to split the provider-purchased functions, while guaranteeing a package of health services with inclusion of the most prevalent NCDs. With the direct support of the health policy adviser, the Ministry of Health led several high-level policy dialogue meetings to ensure the required social cohesion to reform the national health sector. To support policy dialogues with credible data on health expenditure, WHO conducted a number of studies on the financial costs of health care in Ukraine. In addition, the country benefited technical assistance to establish an effective people-centred network of PHC providers. All these reforms were supported with provision of know-how, technical assistance and capacity building for translating the legislation into organizational setup, procedures, mechanisms and capacities to launch the health system transformation. With the extension of the war in 2022, health financing has been readjusted and PHC mobile teams deployed to ensure the continuity of efforts toward achieving Universal Health Coverage.					

Incident Manager or as a lead or focal point for one of the components of the country's strategic preparedness and response plan, particularly the pillar 9 on the maintenance of essential health services (53).

Through this network, the WHO has been able to extend its operational arm to bring coherent technical expertise to the Member States from the three levels and experiment with the transformation of the organization. Health policy advisers have enabled WHO country offices to strengthen technical support to Ministries of Health, other National Authorities, as well as Global Health partners by building technical capacities to lead health policy cycles and generate political commitment while creating synergies and harmonization between stakeholders and funding streams. Health policies can then be translated into processes, functions, and services to operationalize UHC, ensure Health Security, and serve population needs. Health policy advisers tend to reinforce all essential public health functions to ensure the minimum requirements to operationalize the right to health, one of the first responsibilities of Member States under the Universal Declaration of Human Rights and the constitution of the WHO.

Health policy advisers are described as crucial assets by WHO Regional and Country Offices in the integration of health systems to enhance their resilience through fostering coherence between essential public health functions and health outputs, always considering the social, economic, and political environment. Similarly, they are designated by the vertical program experts as key players to highlight the importance of integration of programs and provide related support, to move forward the UHC and SDG agenda in countries. The flexibility to adapt their terms of reference to each context and their continuous and long-term presence allow them to monitor policy processes, support technical analysis and participate in policy monitoring and evaluation processes, and use every opportunity to improve health governance. With their support, national authorities,

WHO countries, and regional offices are defining actions to be implemented in order to welcome innovations and design theories of change fit for the context.

Discussion

It is now increasingly clear for scholars that political economy is fundamental to understanding the appropriate ways for the implementation of UHC, health security, or essential public health functions as a political exercise (54), but also that "the political routes to UHC are diverse" (55). The WHO also acknowledged that health is primarily a political choice (56) and that a social contract for UHC and health security (27) is needed to ensure its implementation. Experiences from the UHC Partnership tend to confirm these hypotheses, demonstrating how this social contract can be renewed or built through evidence-informed policy dialogue mechanisms including all voices of the health system (57). In Timor-Leste, for instance, the institutionalization of the National Health Sector Coordination Committee leads to open a permanent health forum to oversee and discuss health policies and the implementation of projects and programs guided by one National Health Strategic Plan for all partners and stakeholders.

For a decade, health policy advisers funded by the UHC Partnership played the significant role of convener and broker to support key decision-makers in countries to develop UHC in their social, economic, and health policies for essential public health functions and align stakeholders and resources behind it. The work of the UHC Partnership around governance aims to integrate each essential public health function within its political environment. As demonstrated through multiple accountability mechanisms, supported policy dialogue in many countries has been leading to put
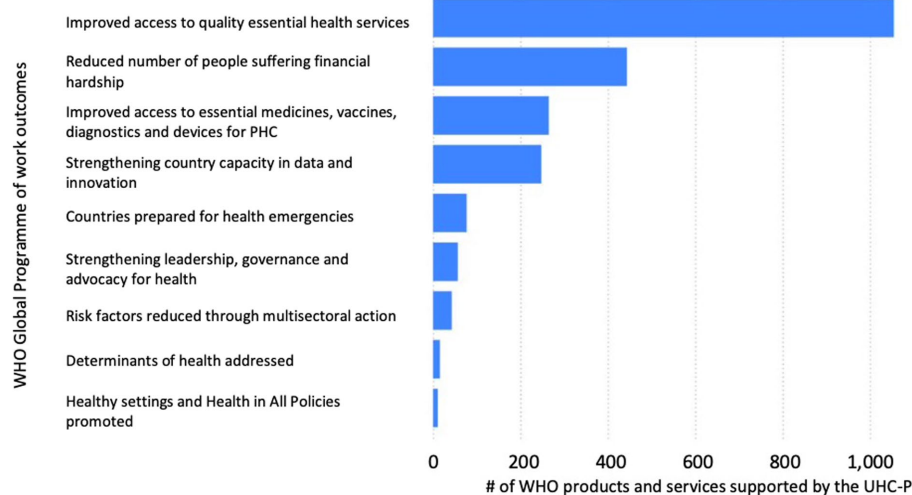
FIGURE 3
UHC Partnership support to the 13th WHO Global Programme of work, 2020-2021.

UHC and health security on the political agenda and to develop integrated systemic and programmatic policies through the PHC approach (39, 40).

Due to the role of health policy advisers, the WHO is implementing activities that illustrate how the policy-making process for Primary Health Care can be supported in the country. These activities aimed to influence contextual factors (governance, financial and delivery arrangements, institutions, interests, ideas, and external factors) that are shaping health policies (58). The example of Ukraine, for instance, illustrates how the technical assistance contributed to a major reorganization of the health system and especially with regard to the financial and delivery arrangements through the establishment of new payment mechanisms with a National Health Purchasing Agency and a State Guaranteed Benefit Package for Primary Health Care.

John Kingdon's concept of the window of opportunity (59) could be used to reflect and analyze the approach of the WHO. This classical policy-making model theorizes the setting of public policy agenda, as the intersection of three specific streams related to problem, policy, and politics. This intersection would open a window of opportunity for political decision-making and key reforms. The approach of the WHO to strengthen health systems could be described similarly.

While advocating for a PHC approach to reach UHC and health security, the WHO, through health policy advisers, makes positive propositions of concrete alternative policy and mobilizes policymakers to engage in reforms. Opening windows of opportunity for policy change based on renewed or innovative commitments, the WHO works on fundamental contextual factors for the health policy-making process to ensure that global or country-based strategic frameworks are in place to finally promote health, serve the vulnerable, and keep the world safe. In this perspective, the establishment of the Health Sector Stabilization and Recovery Plan in South Sudan aimed, for instance, to give a common framework to national authorities, humanitarian, and development actors in supporting the health system to move from an emergency situation to long-term development of the health sector.

The flexibility and the long-term presence of health policy advisers are critical to ensure that technical capacities are available when a window of opportunity for the policy-making process is opening, therefore, enhancing the presence and the operational capacities of the WHO. This was especially the case during the COVID-19 pandemic, where health policy advisers were immediately available to provide support to national authorities. Over the 10 years, the WHO has been able to create and sustain one of the largest and most effective platforms for international cooperation on Primary Health Care for UHC and health security. In 115 countries, the WHO has demonstrated what can be achieved through the reinforcement of strategic and technical leadership for health system strengthening and resilience attributable to a PHC-integrated approach, including more recently in the context of a pandemic and health emergencies.

In 2021, the WHO was the subject of the result-oriented monitoring (ROM) review by the European Commission. The role of health policy advisers has been especially distinguished to strengthen WHO support to Member States and deliver high-quality outputs in developing, implementing, and/or strengthening policies and actions of public institutions for health. The need for long-term partnership and financing support for the health reform process is also acknowledged, and the report finally recommends ensuring the sustainability of the intervention through the implementation, monitoring, and evaluation of health policies built during the first phases. The COVID-19 pandemic has nevertheless demonstrated that efforts to strengthen health systems are still mostly fragmented and do not ensure adequate commitment to or resourcing of essential public health functions to enable resilience, safeguard health, and insulate essential health service delivery.

However, as noticed in the 2019 UHC global monitoring report (60), all countries benefiting from dedicated technical assistance, through health policy advisers for health system strengthening from the WHO, have seen an increase in their UHC index during their involvement in the UHC Partnership prior to the COVID-19 pandemic. This progress is the result of the global movement for UHC and can be attributed to the National Authorities with the support of

international and national health partners, including the contribution of WHO's support on policy and strategic aspects for PHC and UHC.

This policy and practice review seeks to trace the first steps of longer research to understand the contribution of the UHC Partnership to the achievement of the Sustainable Development Goal target 3.8 for Universal Health Coverage. Available data, through the diverse accountability mechanisms of the UHC Partnership, have been adequate to demonstrate the contribution of the UHC Partnership to the institutionalization of health policy and strategies for PHC and UHC. The positioning of health policy advisers to provide direct in-country strategic and technical support to Members States, based on their needs, priorities, and strategies, is clearly a key actionable recommendation that needs to be duplicated and intensified to support the achievement of Universal Health Coverage.

However, these data are insufficient to establish a clear linkage between the activities supported by the UHC Partnership and the quantitative indicators 3.8.1 and 3.8.2. To establish stronger causality relations and introduce more reflexivity, a meta-narrative review (61) and deeper country case studies (35) could support a contribution analysis (62) during the next phase of the UHC Partnership. Moreover, the young and promising field of social epistemology demonstrates how political systems are shaping the distribution of population health (63). In an attempt to bridge political sociology and epidemiology (64), this discipline could provide relevant concepts and theories to understand the impact of the UHC Partnership on the social organization of power for health, and especially on health inequities, by supporting policy dialogue and including communities and minorities in policy-making processes.

Conclusion

For more than 10 years, the UHC Partnership has been supporting the establishment of health policies and strategies to elaborate solid health systems foundations for primary care and essential public health functions. As some countries still suffer severe foundational gaps, additional and complementary technical expertise is required to continue the development of health policies and operationalize UHC frameworks and National Actions Plan for Health Security. In addition, aid coordination, domestic resources mobilization, and improved public financial management can orient adequate assets to initiate financial protection services, the supply chain of essential health products, and the development of basic infrastructure for health.

The 2021 UHC global monitoring report (65) revealed that, prior to the pandemic, improvements in service coverage were driven by massive investments to tackle communicable diseases. While much work remains to be done, especially with regard to financial protection (Figure 4), we need to recognize the progress achieved by many countries in improving their UHC service coverage index toward very ambitious targets (Figure 5). On the other hand, the percentage of the total population with households' expenditures on health continues to be excessive and strong barriers remained, limiting access to healthcare for all, such as poor infrastructure without basic amenities, high level of out-of-pocket payments, shortages of health workers, or the unavailability of good quality pharmaceutical products.

Countries are in need to sustain the acceleration of their journey to UHC and health security. Such effort can benefit from the experiences and lessons learned from countries supported by health
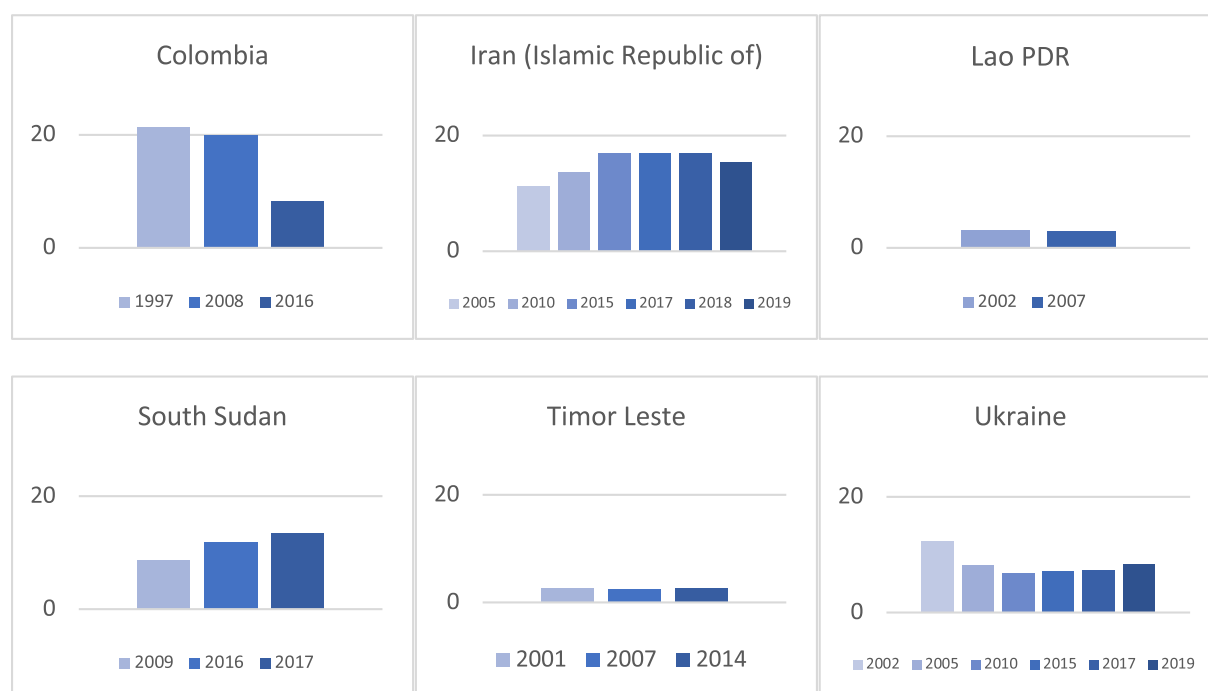

FIGURE 4
Evolution of the percentage of the total population with household expenditures on health >10% of total household expenditure or income (SDG 3.8.2).
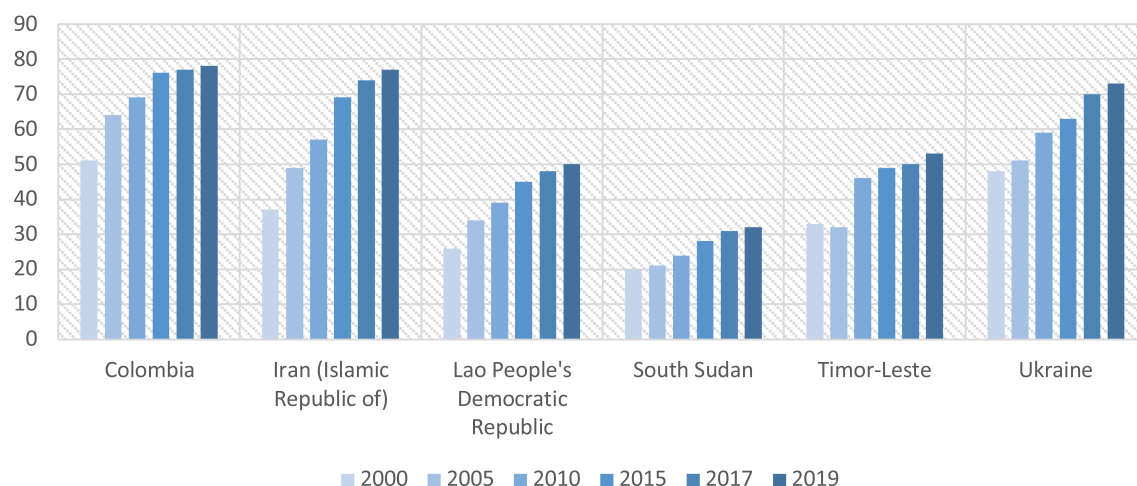
FIGURE 5
Evolution of UHC service coverage index in countries (SDG 3.8.1).

policy advisers and can be readily applied when governments implement their recovery plans. Furthermore, the COVID-19 experience has been a trigger for politicians and the public, in general, to further realize and understand the inexplicable linkages among health, socioeconomic development, and whole-of-society constraints.

Public health agencies, and particularly the WHO as a lead health organization, have an important role and responsibilities combined with development banks and multisectoral partners in reinforcing strategic and technical leadership for primary healthcare services and essential public health functions, especially in countries that still suffer from foundational gaps in terms of infrastructures, basic commodities, health financing, or health workforce, for instance. This includes institutionalizing mechanisms for the integration of efforts in health systems strengthening and health security as well as for multisectoral and multi-actor involvement with political commitment and resources for sustainability.

Following the 75th World Health Assembly, the WHO committed to increasing its budget for intensified PHC support to Member States and called for a radical reorientation of health systems toward PHC (66). This will only be possible if all health actors and organizations engage, align, and accelerate the movement to increase strategic and technical leadership, to strengthen health systems, and to make UHC and health security a reality for all.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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How to not revert to type: Complexity-informed learnings from the pandemic response for health system reform and universal access to integrated care

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'.

Background: COVID-19 has highlighted existing health inequalities and health system deficiencies both in Ireland and internationally; however, understanding of the critical opportunities for health system change that have arisen during the pandemic is still emerging and largely descriptive. This research is situated in the Irish health reform context of Sláintecare, the reform programme which aims to deliver universal healthcare by strengthening public health, primary and community healthcare functions as well as tackling system and societal health inequities.

Aims and objectives: This study set out to advance understanding of how and to what extent COVID-19 has highlighted opportunities for change that enabled better access to universal, integrated care in Ireland, with a view to informing universal health system reform and implementation.

Methods: The study, which is qualitative, was underpinned by a co-production approach with Irish health system leadership. Semi-structured interviews were conducted with sixteen health system professionals (including managers and frontline workers) from a range of responses to explore their experiences and interpretations of social processes of change that enabled (or hindered) better access to universal integrated care during the pandemic. A complexity-informed approach was mobilized to theorize the processes that impacted on access to universal, integrated care in Ireland in the COVID-19 context.

Findings: A range of circumstances, strategies and mechanisms that created favorable system conditions in which new integrated care trajectories emerged during the crisis. Three key learnings from the pandemic response are presented: (1) nurturing whole-system thinking through a clear, common goal and shared information base; (2) harnessing, sharing and supporting innovation; and (3) prioritizing trust and relationship-building in a social, human-centered health system. Policy and practice implications for health reform are discussed.

Introduction

> "*An understanding of change in the health field enables us to imagine and design alternative paths to the future*" [(1), p. 20].

Health system reform is a planned and purposeful process that involves attempts to (re)organize healthcare in a way that promotes the goals of equity, effectiveness, and efficiency (2). As Frenk [(1), p. 19] states, it is often initiated in response to the complexities posed when "nations are facing the simultaneous burdens of old, unresolved problems and new, emerging challenges". While different forces and contexts have prompted system-level changes in health over the last decade, one such challenge that has reoriented a sense of urgency toward addressing poorly functioning healthcare is COVID-19. At the same time, this renewed focus on health system deficiencies has also created opportunities for reflection, learning and change (3), with evidence suggesting that the pandemic has accelerated reform of "long-standing structural weaknesses and priorities" that may have previously lacked political will or funding [(4), p. 2].

This is demonstrated across OECD countries by notable shifts in care delivery models toward telehealth/telemedicine as well as more flexible funding and staffing models; however, perhaps most significant has been the prioritization of non-acute (community) care to better serve patients outside of hospitals, help maintain access to routine care and minimize spread of the virus (5). The goal of hospital avoidance via the linking of acute and community services arguably "reflects the interconnected nature" of health systems and underscores the importance of bolstering community capacity in the COVID-19 context [(4), p. 2]. Yet the aim of shifting left, where prevention and integration are key and delivery in community settings is preferable, has remained a challenge in many jurisdictions, often despite long-standing policy intent (6).

This is particularly the case in Ireland, where current government policy aims to progress a reform agenda to transition to a health system based solely on need rather than ability to pay and a reorientation of the system toward providing care in the most appropriate setting (7, 8). Ireland remains one of the few high-income countries where citizens do not have universal access to public healthcare; rather, a complex set of eligibility arrangements based on age, health and socioeconomic status continue to be in place, many of which have been critiqued as antiquated and not fit-for-purpose. Just under half of the population purchases voluntary health insurance for access to private health services, which are generally oriented toward elective acute hospital-based care.

A core goal of the 10-year reform roadmap currently being implemented - called *Sláintecare,* Sláinte being the Irish word for health - is to deliver universal healthcare by strengthening public health, primary and community healthcare functions while also tackling health inequities. Within this remit is the planned development of integrated care pathways, where care is delivered "at the lowest level of complexity whether at home, near home, in hospital or via integrated care structures" [(7), p. 23]. Some progress has been made in this area (9); however, critical understanding of how the pandemic response could better-inform improved access to universal integrated care is still emerging and largely

undeveloped. Access to universal integrated care is a policy goal in many health systems in high-income countries, including those in the UK, Ireland, New Zealand and numerous European regions (see, for example, (10, 11)).

Researching complex coordinated care models of this kind requires a whole-of-system approach [(12), p. 1]. System approaches acknowledge the interdependencies between health system levels and components, and recognize that the extent to which they are integrated or not will impact overall effectiveness (3). Incorporating understanding of the relationships between the organizations and agents comprising a health system, their interactions with the external environment and their ability to adapt to constantly evolving context(s), is therefore essential to guide health system change (1, 12, 13). Failure to do so can result in "silos of care", where little attention is paid to "the patient transitions and communication channels between them" [(14), p. 2].

It can be said that the success of COVID-19 responses largely – though not always - depended on how existing health systems were "organized, governed and financed across all levels in a coordinated manner" [(15), p. 964]. For this reason, there is a need to better understand and learn from the interconnected elements of national pandemic responses through a complexity (or complex systems) lens. Using Ireland as a case study, we mobilize a complexity-informed approach to generate research evidence that enables lesson drawing (16) to guide universal health reform, with a view to facilitating better access to universal integrated care in the COVID-19 context.

The aim of this paper is to contribute to the emerging academic discussion on how key learnings from health systems' pandemic responses can be used to inform health system change. Presenting data from a qualitative study of the Irish health system response to COVID-19, this research demonstrates the value of applying complexity to: (1) create a more nuanced, explanatory account of the processes that impacted on access to universal integrated care during the pandemic; and (2) generate policy and practice recommendations that seek to ensure solutions that emerged during COVID-19 are sustained in the longer-term. The structure of the article is as follows. First, the theoretical framework is outlined in some detail. Then, the qualitative study is described and the empirical findings are outlined. Next, the findings are discussed in light of the theoretical framework. The article concludes with commentary on the contributions made by the study for theorizing about health system change under stress.

Understanding integrated health systems as complex, social and context-dependent

> "*It is through relationships that an organization is able to make sense, learn, and improvise to manage the unpredictable trajectories of health*" [(17), p. 14].

Health systems are inherently complex (1, 14, 17); and this is in part because, like all other open social systems, they are comprised

of people and (re)produced by human action (18). It has been argued that health systems are themselves "social constructions" [(19), p. 1] and "social institutions" [(20), p. 1463], that are "brought alive through the relationships among the actors involved in managing, delivering, and accessing health care" [(19), p. 2]. As such, it is critical that research and policy analysis recognize health systems as dynamic cultural, socio-political phenomena and not merely as "delivery points for bio-medical interventions" [(20), p. 1463].

Understanding healthcare as a system that is both complex and human-centered provides a promising frame for health reform research that seeks to address health disparities (17, 21, 22). This is because it allows us to draw on complexity concepts to both explain why the system operates in the way it does, but also how it (and us as agents) can be steered in a "more favorable direction" to ensure better access to universal integrated care [(14), p. 1].

Central to theorizing health reform in this way is the importance of context and relationships (i.e., inter-dependencies) and how these contribute to the process of "emergence" that impacts on health system functioning. Emergence here refers to "the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems" [(23), p. 49]. In other words, emergent properties are the macro-level processes that occur in health systems due to the persistent interactions between system components via agents at the micro-level. That is to say, agent interactions combine together or act on each other to produce new processes, structures or components which are more than the sum of their parts. In the US, for example, [(14), p. 2] argues that the current fee-for-service system (context) discourages sharing of care responsibility between providers (self-organizing behavior via agent interactions) leading to reduced operational efficiency (an emergent property of a complex system).

Mitigating health system fragmentation by fostering effective communication, synergy and collaboration between and within organizations, sectors, teams and settings is paramount to developing accessible, universal, coordinated care systems (22, 24). Yet this process is complicated by the fact that integrated care is, in practice, "strongly context bound" [(25), p. 2]. Access to universal integrated care can therefore take different forms, require different facilitators and face different implementation challenges, depending on the existing health system and socio-political context in which it is being delivered (26). That is to say, a range of integrated care trajectories can develop that are evolutionary, historical and context-dependent (27).

In a complex (i.e. non-linear) health system of this kind that is sensitive to initial conditions (i.e., context) (17), new integrated care trajectories, then, are formed only when an enabling environment is created in and sustained by a health system over time. Such system conditions are generated when a specific mix of:

1. Strategies (actions enacted individually or collectively by health professionals);
2. Implementation mechanisms (processes or events through which strategies can be operationalized to achieve desired outcomes); and

3. Contexts (both internal and external to the health system).

Come together in a way that effectively connects a network of multidisciplinary, multisectoral and inter-organizational professionals to facilitate the provision of accessible, coordinated care (28, 29). In other words, it is a collective process and although working together, these actors may have different views, interests and objectives (30). For this reason, as Zonneveld et al. point out, "deeper understanding of collaboration and behavior in integrated care is needed" [(26), p. 2].

Linking the micro, meso, and macro levels: Functional and normative integration

Since integrated care links primary and acute functions "by using a team-based approach to address the needs of the whole person" [(31), p. 2], health systems form a dynamic web of human interactions where collaborative and joined-up thinking are critical to both patient/provider wellbeing and system performance. Yet, enabling relationship-building, cooperation and coordination processes that connect different parties across acute and community care settings is a complex process that requires "time, interaction, and focused attention" [(32), p. 231].

From a complexity perspective, we know that health systems operate on the micro (clinical), meso (professional and organizational) and macro (system) level. Because of this, understanding of the key types of whole-of-system integration that ensure connectivity between all system layers is critical to research on the development of enhanced community care and new integrated care trajectories in the COVID-19 context.

Drawing on the work of (33), we therefore focus in this study on: (1) functional integration i.e., key support functions and activities to coordinate and support accountability and decision-making between agents (e.g., financial, management and information systems); and (2) normative integration i.e., the development and maintenance of a common frame of reference between agents such as shared mission, vision, trust, values and culture.

Indeed health systems research and analysis from Ireland, the UK and the US - undertaken either prior to or in some cases following the onset of COVID-19 - has signaled that the presence or absence of features linked to functional and normative integration can significantly influence the extent to which collective or coordinated action is facilitated or not (4, 12, 20, 25, 31, 34).

Notably, a Delphi Study conducted in The Netherlands reported that features linked to functional integration were viewed as less appropriate for health system functioning by experts, while soft enabling or normative features (including those linked to collective attitude, reliable behavior, conflict management, shared vision, trust, linking cultures and visionary leadership) were considered to play "a crucial role in the development of various complex inter-sectorial, inter-organizational and inter-professional service models of integration" [(29), p. 10].

Research aims and objectives

This study forms one work package within the Health Research Board (HRB)-funded Foundations' applied research project that aims to harness key learnings from Ireland's health system response to COVID-19, with a view to informing the implementation of Ireland's ten-year health reform plan: Sláintecare (6, 35–39).

In its broadest terms, this "arm" of the research aims to advance understanding of how and to what extent COVID-19 has highlighted opportunities for change that impacted on access to universal integrated care in the Irish health system. More specifically, we set out to:

1. Generate in-depth insights into how and why particular health system responses emerged, scaled or pivoted during COVID-19;
2. Identify key strategies, implementation mechanisms and contexts that enabled or hindered better access to universal integrated care during COVID-19; and
3. Discuss key learnings for Ireland and internationally for health system reform in the COVID-19 context.

Applying complex systems thinking directly to the empirical, primary data described above, this study generates evidence that can steer health reform via strengthening public health and primary care functions while also tackling health inequalities. A common critique of complex systems theory in the field of health is that it is based largely on abstract discussions and is metaphorical in nature (21). By examining health system elements and effects that have been the subject of prior theorizing but not of prior empirical study, we provide important insights from Ireland's pandemic response that shed light on how we might better disentangle, understand and find novel solutions to implementing effective health system change in the longer-term.

Methodology

Study design

Complex systems research in the health field typically requires approaches and methods that are "situated in the qualitative paradigm" [(17), p. 6]. This is because in the complexity worldview, the non-linear, dynamic, co-adaptive and emergent character of social systems means that "we can never establish general non-contextual laws" [(40), p. 2]. From this perspective, quantitative approaches analyzing relationships between discrete variables are limited since they cannot explain how or why a health system trajectory, for example, changes from one state (unintegrated) to another (integrated) (18). Further, it was proposed earlier that health systems are inherently human-centered and socially constructed since they are derived "through human behavior and interpretation, rather than existing independently of them" [(19), p. 2].

As such, this study adopted a qualitative approach to explore Irish health professionals' experiences and interpretations of social processes of change that enabled or hindered better access to universal integrated care during the pandemic (41). Rather than seeking generalization, the use of open-ended questions facilitated the production of contextualized and in-depth insights into how (and why) specific circumstances and events impacted access to integrated care following the onset of COVID-19.

Unlike quantitative methods that necessarily decontextualize data to generate testable variables, qualitative methods employ a whole-person and dynamic perspective that situates individuals in their real-world settings (42). A nuanced and complexity-sensitive approach of this kind is critical to health systems research since, as [(43), p. 45] reminds us:

> From one person we can recover social processes and social structure, networks, social change and so forth, for people are located in a social and cultural environment which constitutes and shapes not only what we see, but also how we see.

Sampling and recruitment

The purpose of this study was not to generalize but to produce thick context-specific descriptions that provide explanatory insights into the processes that influence access to integrated care following the onset of COVID-19 in Ireland (44). As such, fewer cases were preferred to facilitate intensive engagement as well as deep case-analysis within the time available (45). Equally, it was important to ensure that the qualitative sample was not so small as to preclude the telling of a rich story, often referred to as informational redundancy (46). In keeping with the recommendations of Braun and Clarke (47), who suggest 10–20 participants to facilitate thematic analysis in medium-sized research projects, a total sample size of 16 health professionals was therefore considered sufficient to identify themes across the data.

Inclusion criteria for the study determined that those eligible to participate were frontline health professionals or senior health system managers from either acute and community settings, who were involved with one or more health system responses that: (1) pivoted, scaled up or emerged following the onset of COVID-19; and (2) could provide important insights into universal access to integrated care. This approach was underpinned by the belief that these health professionals were experts with specialist knowledge on the topic given their lived experience of working in and with the health system to provide access to integrated care during COVID-19.

Purposive sampling techniques (48) were employed to ensure diversity of experience across the sample in terms of context, system/seniority levels, settings (i.e., acute vs. community) and outcomes (i.e., responses that experienced both successes and significant challenges in providing better access to integrated care). As part of the parent study's co-production approach (35), the research team liaised extensively with the Project Steering Group including partners in the Health Service Executive (HSE) and Department of Health to identify a range of bottom-up[1] (n

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1 Bottom-up responses refers to those which emanated from the frontline, often from professionals providing on-the-ground care/services, who developed and implemented new and innovative ways of providing care to the public.

TABLE 1 Sample profile.

Sample background/summary data	Female	Male	Total
Health system workers recruited from bottom-up responses	5	4	9
Charitable organization			
Management/admin	1	0	1
Psychology	1	0	1
HSE			
Consultant	1	2	3
Nursing	2	0	2
Occupational therapist	0	1	1
Private company			
Management/admin	0	1	1
Health system managers recruited from top-down responses	4	3	7
HSE			
GP	0	1	1
Management/admin	1	2	3
Occupational therapist	1	0	1
Physiotherapy	1	0	1
Public health physician	1	0	1
Grand total	9	7	16

= 7) and top-down[2] ($n = 4$) responses to use as recruitment sites. This process began in April 2020 and, following a rigorous short-listing process where the most relevant responses were selected, resulted in the inclusion of GP Access to Diagnostics, the national vaccination roll-out, Chronic Disease Management programmes and Sláintecare Healthy Community programmes as well as initiatives in, for example, unscheduled acute and cardiac rehab care.

Table 1 presents background/summary data of the sample, broken down by gender, in terms of their role and function in the health system as well as the type of organization from which they were recruited. Amongst the sample as a whole, estimated years of experience working in the health system included 10+ ($n = 1$), 15+ ($n = 6$), 20+ ($n = 5$) and 25+ ($n = 4$).

Data collection and analysis

Semi-structured interviews were the study's core method of data collection. Acting as a conversation with purpose (49), this method provided a means by which to thoroughly explore health professionals' experiences and perspectives by allowing for elaboration of topics deemed personally significant, while also ensuring that the major and most relevant topics were covered

(50). Qualitative interviewing can pose challenges related to recall and selective memories; however, these issues are tempered since qualitative research is not concerned with the positivistic search for objective facts. Rather, it is considered both valuable and valid "for the express purpose of understanding people's interpretations of their world" [(51), p. 9].

Following ethical approval from the Research Ethics Committee of the Centre for Health Policy and Management and Center for Global Health in Trinity College Dublin's School of Medicine, data collection took place over a three-month period between March and May 2022. The interviews took place via online video conferencing and due to the understandably busy schedules of participating health professionals, ranged between 36 and 75 minutes, with most lasting between 45 and 60 minutes. The interview schedule covered a range of topics, including the background and triggers for the response, the impact of COVID-19 on its development or direction, facilitators and barriers to implementation and key learnings or reflections on enabling better access to universal integrated care during a crisis (see Supplementary material for more detail).

With participants' consent, all interviews were digitally recorded and transcribed verbatim (assisted by otter.ai).[3] Adopting

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2 Top-down responses refers to national responses which came from central Government/HSE and are implemented via a policy instrument (legislation, funding, regulation, guidance).

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3 While the AI technology utilised provided relatively accurate transcriptions, some inconsistencies were present. For this reason, the transcripts were revisited and cleaned by the interviewing member of the research team. On the whole, this resulted in a process that was significantly less time consuming than transcribing by hand.

a team-based approach for applied researchers, we used word processing and spreadsheet software (Microsoft Word and Excel) via an online document management and collaboration platform to structure and organize the data for analysis (52, 53). Two researchers (SP and LMC) analyzed (i.e., coded) the data, while a third member of the team (SB) coded ∼10–20% of same. Following numerous in-depth team discussions, this culminated in the development of coding categories related to themes and conceptual constructs that were emergent and grounded in the data rather than developed a priori (54). The coding process meant that data related to a range of specific topics could be extracted from each participant's narrative and collated into corresponding codebooks or files (55).

Salient patterns and observations were teased out through an in-depth analysis of the data in each topic-specific codebook, which facilitated the interrogation of key concepts and themes (56). Adopting a complexity-informed approach, dedicated analytic attention was also paid to the interactions between different components of the health system via agents to help explain the patterns observed (57).

Although complexity had been identified as potentially relevant to the analytic approach prior to data collection, an inductive approach to theorizing was used throughout the analysis stages of the research. Theorizing, in the social sciences, refers to attempts to understand or explain phenomena and is distinct from theory, which is the final or fixed articulation. In this study, transcripts were analyzed for themes and concepts relevant to answering the empirical research questions outlined above. During this process, the research team regularly discussed the continued relevance of complexity in light of the emerging patterns of observation. This led to the identification of emergence, inter-dependedness and self-organization as key principles to be utilized and ensured that the conceptual framework employed was ultimately driven by the findings.

In keeping with recommended practice and procedures for qualitative analysis, a number of measures were taken to ensure the trustworthiness and credibility of the interpretation of data (58). These included checking data for negative cases (i.e., outliers) (59) and regular discussions between the researchers that enabled multiple perspectives, insights, and interpretations to be considered (60). The analytic approach was also guided by the perspective that saturation was achieved when no new information on dimensions of experience or meaning were emerging from the data (61).

Findings

We present three themes developed through in-depth interrogation of the data. Following this, we use a complexity lens to discuss key implications for health reform in Ireland and internationally.

Theme 1: The pandemic response fostered opportunities for integration by providing a shared goal that helped to break down boundaries between previously fragmented care sectors, settings and cultures.

Effective responses to COVID-19 required quick, collaborative and large-scale actions. While several participants noted challenges related to redeployment in the community sector, most spoke repeatedly about how the pandemic brought diverse teams and organizations across acute and community settings together, often for the first time, to provide better access to integrated care: "*I think that the very notion of the integration is, is probably the biggest shift*" (Health System Worker 2); "*COVID has taught us people don't want to be going in there [hospital]. So I think it's wonderful, the concept of integrated care. We've all been in our silos for years*" (Health System Worker 1). In fact, many discussed how, prior to COVID-19, they did not "*know about*" or "*fully understand*" other sectors or organizations in terms of how they worked or the structures that underpinned them, while a smaller number noted a history of mistrust and lack of information-sharing between, for example, the public and private sector.

Yet, during the pandemic, participants said that health professionals "*just threw off the labels*" and developed a "*we're all in this together*" perspective to enable effective collaboration of their shared purpose: providing effective and universal coordinated care during a crisis. Through repeated interactions between agents across different parts of the health system that would have previously had little contact, the pandemic response thus facilitated the development of what participants often described as a joint awareness of each others role in the health system as-a-whole.

Critically, this more nuanced, co-produced and macro-level understanding of the health system: (1) led to knowledge-generation about existing gaps and how the different parts of the system could work better together to address them; (2) empowered and energized health professionals by showing them that health system reform via integrated care structures was possible; and (3) challenged long-standing cultural mindsets by engendering a strong appreciation of the need for and value of, community services in providing better access to universal integrated care:

> "*I couldn't see the gaps before, not until you're in it. So it's helped us kind of see where we could be more supportive to the community, but also how we can improve the interactions of community-based services with the unscheduled care system.*" (Health System Worker 3)

> "*I suppose, for me, it reaffirmed my faith in the people working in the system, because we said, 'Look, we're focused on the patient here'. What's encouraging is that people talk about person-centered care, but this was a real manifestation of it.*" (Health System Worker 1)

> "*When COVID hit we were only bringing in the sickest of the sick. Whereas before, there definitely would have been a mindset among people working in the acute environment, that 'Oh, no, everybody has to come into us we'll see them in clinic'. So that's definitely the shift in mindset that, you know, we [in the community] can look after them now. It doesn't work for all patients. But it certainly worked well in this particular project.*" (Health System Worker 8)

COVID-19 therefore not only validated the need for agents across all components of the health system to work together, but also tangibly demonstrated the value of doing so, if only temporarily. Indeed, many spoke about how they felt the "*momentum*" generated through the pandemic response was already lessening and expressed strong concerns about a return to traditional silos of care post-COVID-19: "*If I'm honest, I'm concerned that when the light dims on the [community] sector, people will start going back into their old ways of doing business. That is a real concern, from my perspective*" (Health System Worker 8).

Health professionals discussed how embedding a complex or interdependent understanding of the health system would also help to mitigate many issues that can hamper the goal of achieving better access to universal integrated care. For instance, some talked about how their response did not fit neatly into the category of acute or community and felt they would have benefited from clarity in terms of where they fall under current governance structures during the pandemic, while, on the day-to-day side of things Health System Manager 1 summed up the importance of whole-of-system visibility for integration by saying: "*you' can't send a patient to services that you don't know exists, or you don't know how to access*", reiterating that "*the key to unlocking the door to a referral pathway is knowing who's the person that you talk to*".

Several also emphasized how greater awareness of the interdependent nature of the health system could help prevent overreliance on particular responses or sectors. For instance, Health System Manager 3 talked about how an unscheduled care initiative was so impactful in terms of hospital avoidance during COVID-19 that it became a victim of its own success, noting that: "*yes the [response] is good, it has a place, but it's not a panacea*". In other words, no one response, service or sector should be viewed as a magic bullet; rather, better access to universal integrated care will require agents to collaborate effectively across care settings and disciplines to build a more connected health system. As Health System Worker 7 put it:

> "*[COVID led to the realization that] the acute hospital is more than its walls, that you can't be limited by the buildings of an institution in what you do. And I do think the whole hospital is much more attuned to that now. And that's the biggest reform, I think, the use of increased community-based services.*"

Finally, the narratives revealed how clarity from leadership about commitment to universalism – a core plank of which is integration - was necessary to maintain the shared goal of a fairer system that was mobilized during COVID-19, as was the need to communicate this message effectively:

> "*I think clarity from the system around our commitment to the universal piece is probably important. We've got a taste for it now [referring to the universal nature of the pandemic response] it's created a fairer health system. And I think that's an important thing to people; that they feel this system is fair. But are we serious? Are we really committed to that? Hopefully that's a value that we can keep hold of and people will continue to buy into.*" (Health System Manager 7)

> "*We struggled to communicate down our system in a cohesive way [during the pandemic]. There's different levels of our system - some understand, some don't and some don't know or are just learning. So how you translate something and engage people becomes very significant.*" (Health System Manager 6)

Theme 2: The pandemic response created system conditions that enabled innovations to foster integration; yet, funding (and other) structures to maintain these solutions in the longer-term remain unclear.

Many health professionals talked about how the pandemic forced them to think outside-the-box in developing new ways of working or providing care: "*[COVID showed us] that you can no longer think that the service can only be delivered one way, you have to think of other ways*" (Health System Worker 3). A majority of these strategies involved telemedicine, access to resources and technology and flexibility, adaptability and the use of virtual platforms to facilitate communication channels between multi-disciplinary teams (MDTs). However, a core overarching theme was a shift in focus toward patient wants and needs – i.e., moving services from hospital closer to home - rather than simply managing an institution as a place of care: "*We realized a lot of our models just weren't fit for purpose because they were face-to-face, so we had to adapt*" (Health System Worker 7). Equally important was the system- and organizational- level modifications – such as changes in procurement processes and procedures - that *enabled* innovation and rapid change in direct response to the crisis. As one health system worker explained:

> "*[COVID] allowed stuff to progress much more quickly than it would otherwise have done, because it circumvented a lot of those institutional barriers … anything we thought would improve and innovate was facilitated, and they've been proven to be correct. Whether it was equipment, whether it was small infrastructural issues, whether it was staff, you know, and it really did change it.*" (Health System Worker 4)

In other words, the open and flexible system conditions created in and by the pandemic response meant that health professionals felt encouraged (and supported) to not only develop solutions that were effective and responsive to their community's needs, but to also figure out what worked and importantly, what did not and why. In fact, several spoke about how innovation flourished since it was largely facilitated by a hands-off top-down approach, where the health system provided funding and other necessary structural supports, but then "*let the frontline get on with it*" in responding to the crisis. Yet, a number observed that such system conditions were already starting to show signs of reverting to type, with one participant noting that "*now we're back to budgets, adherence, staff cuts. The system is like 'You've got to watch your WTEs. What's your agency spend? What's your overtime spend?' It's just revert to type*" (Health System Worker 4).

Moreover, while health professionals agreed that the pandemic response gave them "*permission to be innovative*", they often described funding models – including those that existed pre-COVID-19 - as posing challenges since they tended not to be prospective and/or long-term in nature. For instance, several health

system workers spoke about the challenges associated with funding drops that were often unexpected and politically charged, therefore fostering competition and hasty planning rather than iterative and sustainable solutions. As Health System Worker 5 from a bottom-up response put it: "*We got 2 weeks' notice there's suddenly money, we suddenly have to spend it and therefore we put in these projects that could have been done a lot better and planned a lot better if you ask me*". Likewise, this problem also manifested in the top-down responses and was often linked to a lack of certainty in terms of multi-year funding. As Health System Manager 2 described, their current funding model led to job insecurity for their staff, which ultimately undermined the effectiveness of the response: "*The Programme is run by peer leaders that we train. It works much better that way. But because of the way we fund, there is a huge risk around continuously losing people.*

Health professionals also pointed to the importance of both creating and embedding mechanisms to share information in a systematic way, so that proven models and innovation from the pandemic response can be adapted across different settings and organizations where appropriate. Several participants talked about how this kind of information was not currently or sufficiently being communicated *to* the system *by* the system. As a consequence, healthcare workers were devising new ideas and business plans from scratch, rather than building on what was already there, sometimes leading to additional stress and burn-out. In the following quotes, a health system worker reflected on how this approach was perceived as neither effective nor efficient for fostering integration in the longer-term, while a health system manager reiterated the importance of documenting pandemic innovations of this kind so that they can be fed directly back into the system to bolster health system preparedness:

> "*We don't need to be reinventing the wheel all over the country; just look at examples of good innovation and good integration and try and replicate that … It's only by me sourcing it or seeing it on Twitter when I say 'jeez, I could do that'. And that's where I get a lot of my ideas, but it's not the system telling me.*" (Health System Worker 3)

> "*We need to be looking at multiple elements - the ICT [information and communication technology], the workforce, the procurement, the logistics - so that you're not going back to scratching your head if another pandemic happens … lesson number one is that intelligence is documented so you'll never be back at zero.*" (Health System Manager 1)

Theme 3: The pandemic response highlighted the importance of relationship-building and trust in facilitating effective collaboration to improve universal access to integrated care.

Interpersonal relationships and relational efficacy were frequently described as equally if not more important than practical enablers (such as ICT and procurement processes) among those working on the frontline and at a more senior managerial level in the health system during the pandemic: "*Far and beyond technical issues, it's people coming together and actually seeing that it works and that there are benefits to them that made the biggest difference*" (Health System Manager 6). This largely stemmed from the belief that you can have all the right procedures and structures in place for integration, but without collaborative relationships they will not be effective because the system is ultimately made up of and run by people who must work together to implement change.

In fact, participating health professionals framed almost all system interactions as relational, with some emphasizing how informal networks can sometimes be just as influential as formal ones when it comes to information-sharing and decision-making: "*It's a very human thing … you can be sure that various people [in the health system]pick up their phone to talk to their buddy [to gain clarity on certain issues] and that's very understandable*" (Health System Manager 1). And while the findings presented in Theme 1 highlighted the importance of increased contact between diverse settings and sectors to enable better access to universal integrated care during COVID-19, what was perceived as equally critical by participants was the nature and quality of those interactions.

For instance, many health professionals observed that during the pandemic, communication between different sectors, settings and organizations was greatly improved in that it was regular, ad hoc and conducive to immediate problem-solving. For example, several spoke about how they were picking up the phone to ring senior health managers directly when issues arose, while others were having frequent meetings with wider MDT teams that would not have met prior to COVID-19. Participants explained that engagements such as these helped to build a level of trust that facilitated cooperation and coordination between different system levels that enabled better access to integrated care in the midst of the crisis that will hopefully continue post-COVID-19. As Health System Worker 4, from a nursing home response team, explained:

> "*We've a weekly meeting, which has gone to two weekly with public health and the local care area. That started out in COVID and it's been really good, because we still meet regularly and now we're talking more about monkeypox and things like that, and the implications for the system. So that link has been so useful, because we've all developed this whole kind of, you know, we all trust each other, we all understand what we're trying to do.*"

Others reflected on the importance of sensitizing each other to organizational and cultural differences to ensure effective collaboration between integrated services, such as conflict management and communication styles: "*We didn't really have any understanding between the two organizations in terms of differences between how people managed conflict, how people managed things when they go wrong and things like that. [So] there was big learning there*" (Health System Worker 8). Just as importantly, the development of trust and strong relationships during COVID-19 bolstered buy-in and a belief that certain responses could and should work, which was ultimately seen as contributing to their success. As Health System Manager 6 put it: "*[COVID] showed us that if you have a model that people buy into and believe in, no matter how challenging, you'll get it done … and that's to do with winning hearts and minds*". However, as was noted numerous times amongst participants, the goal of winning hearts and minds was not something that happened by chance; rather, as Health System Manager 6 reiterated: "*It takes constant work … it's about building*

capacity and capability [in the system] to actually engage, negotiate and plan a strategy [to facilitate trust- and relationship-building] in a programmatic way".

What emerged strongly from the narratives was the role of honesty in this process and, more specifically, the need to build a culture of honesty across all system levels to facilitate effective collaboration, problem-solving and sustainable solutions. In the following quotes, a health system worker from a bottom-up response and a health system manager from a top-down response both reflect on how honesty was critical for conflict management between different organizations working together to provide better access to integrated care during the pandemic:

> *"The relationships from the start were really good and have remained so. And that was because of the tone set by a couple of the senior people involved … there was a huge degree of trust needed and honesty is linked to trust and there was an honesty on both sides … for example, there was an expectation around a piece of funding that didn't arrive but we got over that, because there was an honesty there."* (Health System Worker 8)

> *"We used the process of negotiation to build the relationships and we started to get to the place of a fair and honest engagement, where trust was built across the table, but also it wasn't all one sided … Doesn't mean that we don't have significant disagreements, but when the relationships are solid, we get through them."* (Health System Manager 7)

Others, however - particularly those on the frontline - pointed to ongoing issues related to a perceived lack of transparency in leadership and engagement in decision-making that negatively impacted trust and relationship-building during COVID-19: *"I understand the structure [of the health system] and who's at the top, but it's never clear how exactly decisions get made"* (Health System Worker 9); *"Nobody sought any advice or opinion on how this particular project can be transitioned to [existing national programme]* (Health System Worker 1). This points to the need to build what one health system manager described as a "*coalition of support*" across all system levels - i.e., where leadership, organizations, the political system and frontline workers are engaged and brought to the table: "*During COVID, we developed relationship managers who manage the process with us. So that's an interesting innovation, which has to do with relationships*" (Health System Manager 6).

Discussion

This research examined how and to what extent COVID-19 highlighted opportunities for change that enabled better access to universal integrated care in the Irish health system. A qualitative study was undertaken through interviews conducted with health system workers and managers directly involved in the pandemic response. Adopting a complexity-informed lens, we now interpret the findings by applying complexity concepts and principles to better understand how new integrated care trajectories emerged during COVID-19 and discuss the policy and practice implications

for health reform. Three key learnings from the pandemic response are presented: (1) nurturing whole-system thinking through a clear, common goal and shared information base; (2) harnessing, sharing and supporting innovation; and (3) prioritizing trust and relationship-building in a social, human-centered health system.

Nurturing whole-system thinking through a clear, common goal, and shared information base

While it is acknowledged that redeployment in the community sector posed challenges in some cases (39, 62), enabling better access to universal, integrated care during COVID-19 was nevertheless a complex process that took place at multiple levels across various interventions and involved numerous stakeholders and contextual nuances. The pandemic – which in complexity terms would be characterized as a "substantial perturbation of the system" [(18), p. 3] – engendered a shared goal amongst health professionals: to provide access to universal, holistic care in the midst of a crisis (13, 63). This, in turn, precipitated rapid and mutual adaption in the form of strategic efforts to foster emergent inter-organizational and cross-sector collaborations between previously disconnected "parts" of the system – a self-organizing process that Comfort et al describe as "coordination in practice" [(64), p. 64]. In this way, health professionals became "conscious of the system in which they reside" [(18), p. 3]; they demonstrated an awareness of the complexity or interdependent nature of healthcare by acknowledging that action (or inaction) in one part of the system had the potential to impact others in significant ways.

From this perspective, enabling better access to universal integrated care during COVID-19 involved inter-professional coordination that was largely a voluntary activity sustained by a clearly articulated and shared vision or purpose (64). The findings thus reiterate the power of creating (and embedding) a shared goal to drive change in complex (social) health systems that are sensitive to initial conditions. It is generally accepted that this process should involve a "participative and focused dialogue" among diverse stakeholders [(65), p. 99]; however, further research on what this unifying message should be outside of crisis periods and how it should be created (and communicated) in ways that take account of critical contextual factors, and how they interact and change over time, is needed (66).

Moreover, health professionals providing integrated care during the pandemic required timely, accurate and relevant information that empowered them to adapt their actions in response to changing conditions and shifting priorities (64). The findings suggest that an important route for reform in this area would be to mobilize collective action by nurturing a whole-of-system perspective (67). This could be achieved by developing an active, living map of the health system that clearly identifies (and regularly updates) key components, governance structures, services and access-points and is accessible both during and outside times of crisis.

In Ireland, this has been successfully achieved for some specific population groups and/or within certain clinical programmes [e.g.,

(34, 68)]. Yet a shared knowledge base that links the health system as-a-whole does not currently exist. Critically, such a tool would allow for the exploration of multiple potential solutions by improving system awareness, identifying interdependencies, providing clarity in terms of accountability and fostering inter-professional collaboration and learning (65); all of which would help to enable better access to universal, integrated care in the COVID-19 context and beyond.

Harnessing, sharing, and supporting innovation

The pandemic response necessarily led to significant system change to allow for agile, speedy solutions to emerge in response to the crisis, primarily with regard to increased funding and the relaxing of procurement processes and fast-tracking of digital health responses (35). Traditional, formal structures and hierarchies were therefore removed which in turn, enabled "more horizontal collaboration" and decision-making that sparked innovation [(26), p. 3]. Innovation, then, was an emergent (macro) property of the health system (69) that occurred from the bottom-up as a result of agents interacting to facilitate shared sense-making, a process that is "fundamental to supporting adaptation" in complex systems [(18), p. 5]. In this way, the lifting of procedural barriers represented a small change or perturbation in system conditions (acceleration) that led to a significant or non-linear emergent effect (innovation) that occurred due to the self-organizing behavior of agents (1). Through these complex processes, uncertainty was harnessed into positive adaptation and innovative practices to enable better access to universal integrated care during COVID-19.

However, since innovation of this kind can be characterized as an emergent and evolutionary process that unfolded in an unpredictable and unplanned way, key learnings should be constantly refined, developed and fed back into the system to maintain their relevance and maximize their impact post-pandemic (70). Indeed, the findings indicate that the pandemic response created a space for out-of-the-box thinking or in some cases, an avenue through which to action previously and sometimes long-held ideas about how to enable better access to universal integrated care. This ensured that the system remained adaptive during the crisis by empowering health professionals through top-down support, encouragement and trust to build on their strengths, to engage in important trial and error solutions (viewing failures as opportunities for learning and improvement) and to generate a sense of ownership in decision-making (22, 26, 71). Yet the narratives revealed that the health system was already starting to revert to type by reinstating priorities and procedures that can potentially undermine the non-hierarchical collaboration, adaption and information-sharing necessary to develop and importantly expand novel solutions.

Systems theory teaches us that in situations where a low level of uncertainty exists with regard to problem-solving, standardization and traditional hierarchical structures are important and necessary to enhance efficiency (72). However, where a *higher* level of uncertainty exists – such as in response to complex challenges

- leadership should consider tasks and approaches that are accomplished by emergent, relational dialogue among diverse health professionals (73). Both approaches can and should be able to theoretically co-exist in a health system, whereby: (1) adequate space, time and resources are provided to stimulate and curate innovation on the frontline to identify "sustainable solutions hidden within plain sight"; and (2) such innovations are then institutionalized through top-down (traditional) control mechanisms [(18), p. 5].

Health system change should thus recognize that social dynamics, reciprocal learning, effective communication processes and the promotion of exploration are all foundational to developing adaptive, innovative solutions (73). Perhaps, then, a critical learning for health system leadership and reform from the pandemic response is the importance of not only providing answers, but also asking questions (74).

Prioritizing trust and relationship-building in a social, human-centered health system

Enabling better access to universal integrated care during the crisis meant that professionals across a diverse range of health sectors, settings and services had to work together and collaborate, often for the first time in the Irish context. Collaboration necessitated interaction; and all interactions that occur between humans operating in a complex social (health) system – whether formal or informal - are relational (20, 75). However, what emerged strongly from the findings of this study was that effective collective action during the pandemic went beyond physical, electronic or structural proximity within and across acute and community settings; rather, basic human connection, relationship-building/management and the development of trust were all considered fundamental enablers to coordination (22, 26, 76). Thus, health reform efforts to improve access to universal integrated care in the COVID-19 context should not only focus on integrating structures or improving individual components but should equally consider strengthening relationships among those working together across all system levels (17, 22).

Yet as Adam and Donelson point out, trust and other relational issues can be difficult to define and measure in the context of health system change since they lie in-between; "in-between people and people, in-between people and organizations, and in-between people and events" [(75), p. 119]. Nevertheless, research evidence points to several ways health systems can engender an environment (that is, initial conditions, to use the language of complexity) that enables the development of various sets of mutual, trusting relationships. This includes, for example, a paradigm shift that is translated into cultural norms and a shared narrative where healthcare is (re)framed as relational rather than transactional (71). Culture and leadership are interdependent, synergistic and co-developed (77); as such, the need for compassionate, inclusive and collective leadership is central to this process, particularly at a time when health professionals are experiencing fatigue and burn-out post-pandemic.

An approach to health reform of this kind aligns with the complexity perspective by reorienting attentiveness to

the nature and interactions of health professionals (system agents) to determine how uncertainty can be harnessed into positive adaptation (18, 22). Complexity-inspired leaders foster collaborative relationships and shared goals while also embracing chaos and creating a space for people to express their dissent or frustration. This, in turn, promotes "shared sense-making, exploration of strategic options through action and learning from those actions" (74). Begun and Thygeson suggest that to encourage this kind of interconnectivity between health professionals, leadership must enable collective and transparent decision-making to allow all voices to be heard, whilst also ensuring that quality standards are met and adhered to (73). Equally, to facilitate respectful interactions and minimize possible communication breakdown, policy and practice decisions need to be co-produced, with a focus on "enhanced communication flow and perhaps more importantly enhanced understanding of the information communicated" [(78), p. 23–24].

Conclusions

This work conceptualized health systems as social and complex, and applied complexity concepts to advance understanding of how (and why) integrated care trajectories emerged following the onset of COVID-19 in Ireland. In doing so, we emphasize the role of reflexivity in system functioning, where human perceptions and actions are framed as both the cause and consequence of system dynamics (18). It is acknowledged that health reform is further complicated by the fact that health systems are constantly evolving, changing and adapting, both to internal and external stimuli such as the current health crisis. Health systems are context-sensitive and context-dependent; however, variability and uncertainty (i.e., complexity) of this kind is arguably a sign of system health (13).

By opening an active dialogue between empiricism and explanation to better understand the processes of change that enabled universal access to coordinated care during the pandemic, we have strengthened the potential contribution of the findings for informing health reform in Ireland and internationally. Unlike traditional health system approaches to reform that aim to reduce uncertainty, the findings open up new ways of thinking about health system change by encouraging health system leaders and policy-makers to embrace complexity. This, in turn, can enable alternative approaches to transformation that allow for exploration of multiple potential solutions to facilitate better access to universal integrated care in the COVID-19 context and beyond.

Strengths and limitations

Using an in-depth qualitative approach, this study draws attention to both the extent of health system change as well as the complex dynamics of health system change that occurred following the onset of COVID-19 in Ireland. The seismic impact of the pandemic was experienced by all health professionals worldwide; yet, understanding of what this change looked like at a country-level, as well as the implications for access to universal integrated care, has hitherto been underexplored in the research literature. By applying a complexity lens to the study findings, the insights and analysis presented in this article provide a useful foundation for discussion and debate amongst health policy-makers, leaders, planners and academics. What is important now, is drawing on these lessons from the pandemic response to inform universal health system reform in a way that makes such solutions pragmatic and sustainable in the longer-term.

Notwithstanding, this study's insights should be understood in light of its limitations. The research was both undertaken in and specifically examined the COVID-19 context. The processes of change that occurred during this time within the Irish health system were therefore unique since it was responding to an acute and unprecedented crisis. Nevertheless, the findings demonstrate that the individual, organizational and system level changes required for large-scale health system reform to enable better access to universal integrated care are indeed possible, even if only temporarily. Moreover, critical insights have been gleaned that have important policy and practice implications for the development and implementation of health reform both in Ireland and internationally, especially in countries that have adopted (or are in the process of transitioning to) a universal health system.

As stated earlier, generalization was not the purpose of this (or any other) qualitative study. However, it is acknowledged that this research was unable to include accounts from health professionals working across all health system responses active during the pandemic. As part of the co-production process, the researchers worked extensively with health system leaders and experts to identify the responses considered most relevant, with a specific focus on those that enabled (or sought to enable) better access to universal, integrated care during COVID-19. Following this, and in keeping with the nature and rationale of the broader study within which this study is situated, the sampling approach prioritized diversity of experience and convenience to produce research evidence at speed that can be fed directly into the health system in real-time to inform health system change.

Finally, this study's findings are based on data from Ireland and cannot, therefore, be assumed to be applicable or transferable elsewhere due to contextual differences. Nevertheless, since relatively similar pandemic experiences have been, and continue to be, found across the developed world, it is reasonable to suggest that corresponding integrated care trajectories may well emerge in other countries. To this end, comparative studies may be a fruitful avenue for further research that aims to fully interrogate the contexts, strategies and mechanisms that influence the social processes of change necessary to drive health reform and enable better access to universal, integrated care in the COVID-19 context.

Data availability statement

The datasets presented in this article are not readily available because due to the nature of this research, participants of this study

did not agree for their data to be shared publicly, so supporting data is not available. Requests to access the datasets should be directed to SB, burkes17@tcd.ie.

Ethics statement

The studies involving human participants were reviewed and approved by the Research Ethics Committee of the Center for Health Policy and Management and Center for Global Health in Trinity College Dublin's School of Medicine. The patients/participants provided their written informed consent to participate in this study.

Author contributions

SP conceptualized the study design and methodological approach, collected the data, conceived the analytical, theoretical approach, performed the analysis, and prepared the original manuscript. LM conceptualized the study design, methodological approach, collected the data, and reviewed and edited the manuscript. RS reviewed and edited the manuscript. SB conceptualized the study design, methodological approach, acquired the funding, supervised the data collection, contributed to data analysis, and reviewed and edited the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1088728/full#supplementary-material

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Multisectoral action towards sustainable development goal 3.d and building health systems resilience during and beyond COVID-19: Findings from an INTOSAI development initiative and World Health Organization collaboration

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'.

As the world faces global health crises such as pandemics, epidemics, climate change and evolving disease burdens and population demographics, building strong and resilient public health systems is of critical importance. The need for an integrated approach to building health system resilience; the widening of inequalities; and fears of vulnerable populations being left behind are critical issues that require Supreme Audit Institutions (SAIs) enquiry as independent public oversight bodies. Each country has a Supreme Audit Institution with a remit to audit public funds as an effective, accountable, and inclusive institution. Government audits are key components of effective public financial management and Good Governance. SAIs contribute to the quality of government engagement and better state-society relations through their work. As SAIs provide independent external oversight and contribute to follow up and review of national targets linked to the Sustainable Development Goals (SDGs) in their respective countries, they can play an important role in national recovery efforts. WHO and INTOSAI Development Initiative (IDI) have been collaborating in facilitating SAIs' audits of strong and resilient national public health systems linked to the national target of SDG 3.d in 40 countries across Africa, Americas, Asia and Oceania between 2021 and 2022. This paper aims to convey key lessons learned from the joint multisectoral collaboration for facilitating the 3.d audits that can contribute to building health systems resilience in ongoing recovery efforts. The collaboration included facilitation of the audits through professional education and audit support using a health systems resilience framework. The 3.d audits are performance audits and follow IDI's SDG Audit Model (ISAM). Following the ISAM implies that the SAI should focus on a whole-of-government approach, policy coherence and integration, and assess both government efforts at 'leaving no one behind' and multi-stakeholder engagement in implementing the chosen national SDG target linked to 3.d. WHO's Health Systems Resilience team has supported IDI and SAIs by delivering training sessions and reviewing working papers and draft reports of the SAIs from a health systems resilience perspective. IDI has provided the technical expertise on performance audits through its technical team and through in-kind contributions from mentors from many SAIs in

the regions participating in the audit. In the 3.d audit, SAIs can ask how governments are acting to enhance capacity in some or all of the following, depending on their own national context and risk:

- forecasting, preventing and preparing for public health emergencies (PHEs) and threats
- adapting, absorbing and responding to PHEs and threats
- maintaining essential health services in all contexts (including during emergencies/crises).

The audits are expected to highlight current capacities of health systems resilience; the extent to which a whole-of-government approach and policy coherence have been utilised; and government efforts related to multistakeholder engagement and leaving no one behind in building health systems resilience related to progressing towards achieving the national target linked to 3.d by 2030. An overall positive achievement noted was that undertaking a complex health audit in the middle of a pandemic is possible and can contribute to building health systems resilience and recovery efforts. In their review of audit plans, draft summaries, and other work by the SAIs, both WHO and IDI have observed that SAIs have used the training and supplementary materials and applied various parts of it in their audits. This collaboration also demonstrates key considerations needed for successful partnership across multisectoral partners at global, regional and national levels. Such considerations can be applied in different contexts, including socioeconomic and health system recovery, to ensure whole-of-society and whole-of-government action in building health systems resilience and monitoring and evaluation to maintain and accelerate progress towards the national target linked to SDG3.d, health security and universal health coverage (UHC), as well as broader socioeconomic development.

Introduction

The INTOSAI Development Initiative (IDI) and the Health Systems Resilience team at the World Health Organization (WHO) have been collaborating in facilitating 40 Supreme Audit Institutions' (SAIs)[1] performance audits of strong and resilient national public health systems linked to the national target of SDG 3.d across Africa, Americas, Asia and Oceania. INTOSAI Development Initiative is an INTOSAI[2] organ that supports capacity development of SAIs mainly in developing countries. In this context, IDI has provided support to SAIs in conducting the 3.d audits and engaged with WHO to provide technical support to SAIs.

The audits were conducted during the COVID-19 pandemic and in the context of health systems recovery with relevant lessons within and beyond the health sector. Each country has a Supreme Audit Institution whose job is to audit public funds as an effective, accountable and inclusive institution. SAIs are oversight bodies in their respective countries and effective external government audit by SAIs is a key component of public financial management (PFM) and good governance. SAIs can contribute to the quality of government engagement and better state-society relations through their work. SAIs can also be key stakeholders in implementing the SDGs by undertaking audits related to the government implementation of efforts to reach SDG targets.

Health system resilience is defined as the capacity of health actors, institutions, and populations to prevent, prepare for, absorb, adapt, respond, and recover when faced with a wide range of risks and shocks in a timely, effective, and efficient manner while maintaining essential functions and services in all contexts and informed by lessons from the experience, transform and improve, as necessary (1–3). Past and ongoing public health challenges have highlighted that lack of health system resilience has profound impact on population health (e.g., COVID-19 related and excessive deaths, disruption of essential health services), socioeconomic development (e.g., global recession,

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1   Participating SAIs include Algeria, Aruba, Bahamas, Bangladesh, Bhutan, Egypt, Fiji, Grenada, Guyana, Indonesia, Iraq, Jamaica, Lao PDR, Libya, Malaysia, Mongolia, Montserrat, Morocco, Myanmar, Nepal, Oman, Pakistan, Peru, Philippines, Palestine, Saint Lucia, Saint Vincent and The Grenadines, Sri Lanka, Syria, Tajikistan, Thailand, Tonga, Trinidad and Tobago, Tunisia, and Sudan.

2   The INTOSAI stands for the International Organization of Supreme Audit Institutions and is a membership organisation of 194 SAIs from all over the world. INTOSAI recognised the importance of the 2030 Agenda for Sustainable Development and included SDGs as cross cutting priority in its Strategic Plan 2017–2022. IDI collaborated with the INTOSAI Knowledge Sharing Committee (KSC) and INTOSAI Regions (ASOSAI, ARABOSAI, CAROSAI, PASAI) and other key stakeholders to support a cooperative audit of strong and resilient national public health systems (linked to SDG target 3.d).

widespread loss of livelihoods and income, regressing gains made towards universal health coverage (UHC) and in other SDGs) (4). Building back better, more resilient health systems has been a global priority in the context of recovery from COVID-19, humanitarian crisis and other public health events (5–8). Resilient health systems have the necessary capacities for managing complex and diverse health challenges every country is facing.

The SDG 3.d audits are performance audits and follow the International Standards of Supreme Audit Institutions (ISSAIs) for performance audits. The content of the support rendered to SAIs within the multisectoral collaboration between IDI and WHO followed these standards and IDI's SDG Audit Model (ISAM) (9). As per ISAM, a performance audit of SDG implementation is "an audit of the implementation of the set of policies that contribute to the achievement of a nationally agreed target linked with one or more SDG targets. It concludes on the progress made towards the achievement of the nationally agreed target; how likely the target is to be achieved based on current trends; and the adequacy of the national target in comparison with the corresponding SDG target(s)." Moreover, an audit of SDGs implementation needs to be conducted using a whole-of-government approach. It needs to conclude on the extent of coherence and integration in the implementation of policies and to the extent possible, the audit could include objectives and questions that allow the SAI auditor to conclude on leaving no one behind and multi-stakeholder engagement.

While regular performance audits assess entities, projects, programmes or processes, the SDG audits, however, focus on the interplay between these components for achievement of cross-cutting results. Any performance audit that follows the international standards, include the following processes (Figure 1): (1) planning phrase often involving selection of topics and design of the audit; (2) conducting phase involving obtaining adequate and appropriate evidence to develop findings to answer the audit objectives and questions, conclusions and recommendations; (3) reporting phase involving preparing and developing an audit report to communicate audit results to the target audience; (4) follow-up actions on audit findings and recommendations to determine processes to address recommendations, assess if problems are resolved, and identify topics for future audits (10).

The collaboration between IDI and WHO covers the first three phases, as the follow up actions will happen after the reports have been
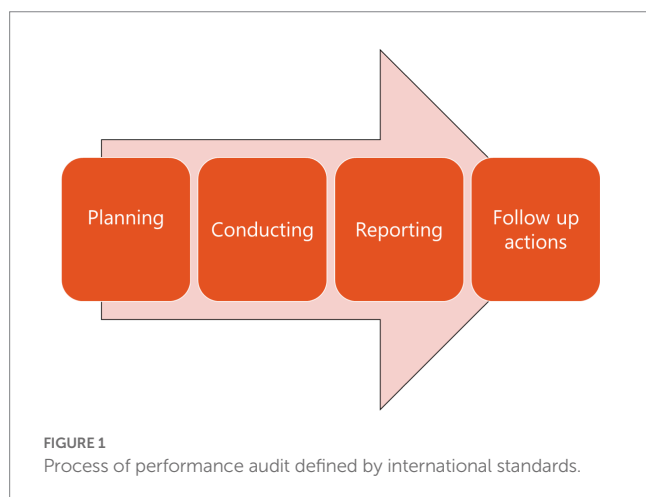
published and will continue for two or 3 years pending on the nature of the recommendations in audit reports.

The objective of the collaboration between IDI and WHO was to facilitate the provision of technical expertise for integrated education on strong and resilient national public health systems in reference to the SAIs' 3.d audits. By providing the technical support to IDI, WHO built the necessary capacity in IDI to support SAIs in exercising their follow up and review linked to SDG target 3.d. The aim of this article is to reflect on the project findings from the collaboration between IDI and WHO with a view to informing enhanced multisectoral action and policy options towards building health systems resilience and enhanced recovery, including from the perspective of the role of the supreme audit institutions in multisectoral collaboration efforts for building health systems resilience. The importance of multisectoral collaboration, communication and partnership is widely recognized for building health system resilience. However, our literature review found no focus on studying the role of audit institutions as a contributor to building health systems resilience through performance audits. Hence, this article represents a novel contribution in shedding light on SAIs' important role in this area.

Literature review

The importance of multisectoral collaboration in building health systems resilience

A multisectoral approach to health can be understood as deliberate collaboration among various stakeholders both within and beyond the health sector, towards a shared vision on desired health and socioeconomic outcomes (11, 12). The importance of multisectoral collaboration, communication and partnership is widely recognized for building health system resilience (13–17). For example, Nabyonga-Orem et al. (18) found that stakeholder empowerment, competency development and proper information sharing are needed to strengthen policy dialogues between multisectoral actors across all levels in the context of Ebola outbreak. Moussallem et al. (19) found that the power relations between the health actors and stakeholders in other sectors affected the uptake of evidence in policy-making regarding Lebanese health system for the COVID-19 pandemic. However, there are not many studies examining the roles and mechanisms of specific non-health sectors in building health systems resilience. Response partners related to public health emergencies, communities, humanitarian support, and non-governmental organizations are the often-mentioned actors other than the health sector in the literature. Barker et al. examined how community engagement facilitates health systems resilience in low-resource settings during Ebola (20). Marome et al. (21) suggested the governments to strengthen governance across national to community levels for resilience engaging with multisectoral stakeholders including grassroots and community networks. The limited findings on incorporating actors out with the health sector is not altogether surprising as the concept of health system resilience is relatively new and not widely understood beyond the health policy and systems community. Furthermore, how to operationalise health systems resilience with multisectoral collaboration consideration is not well described in the literature (22–24). Ling et al. (25) suggested to gather

The four process boxes shown in Figure 1: Planning, Conducting, Reporting, Follow up actions.

evidence from organisations and individuals in other sectors that are more separated from health activities to assess how to maintain essential functions and services for health systems resilience. Resilient health systems can meet population health needs in both "peace" and emergency contexts; nevertheless, most of these studies have been conducted in the context of the Ebola epidemics, refugee crises and the COVID-19 pandemic.

Lack of studies of auditing communities' role in building health systems resilience

Monitoring and evaluation and accountability mechanisms are key to build health systems resilience. Woodward et al. (26) identified actors and accountability as a key research agenda in health system resilience. A Supreme Audit Institution (SAI) is a public body of a state or a supranational organization, exercises, by virtue of law, or other formal action of the state/the supranational organization, the highest public auditing function of that state/supranational organization in an independent manner (27). SAIs been an important factor in country's accountability systems within and beyond the health sector. Their roles are traditionally known for the oversight of public financing; but SAIs are increasingly taking on performance auditing, which is defined as "an independent, objective and reliable examination of whether government undertakings, systems, operations, programmes, activities or organisations (28). Such audits to assess the government's efforts at implementation of SDG commitments demonstrate SAIs' expanding role and functions in the attainment of SDGs. SAIs' audits of health systems resilience and important health-related SDGs such as UHC can be a powerful process to monitor and promote governments' actions for achieving SDGs by 2030. However, in our searches of peer reviewed literature databases, we did not come across any literature with a focus on studying the role of audit institutions as a contributor to building health systems resilience through performance audits.

Methods

With the aim to examine the IDI-WHO collaboration in health systems resilience and find out the role of the supreme audit institutions in multisectoral collaboration efforts for building health systems resilience, this paper draws on information and evidence from the collaboration between IDI and WHO in the SDG 3.d audit project. This project represents a multisectoral collaboration between the audit community and the international organizations of IDI and WHO in an SDG implementation audit.

For this paper, we draw on three sources of information throughout the SDG implementation audit process. First, the core IDI-WHO project team held live trainings and webinars and established an on-request communication channel, where the country-based audit team provided reflections and questions related to their understandings and application of health systems resilience in designing audit plans and reporting audit findings through focused-group discussions, surveys and question and answer sessions in an iterative base. Second, the core IDI-WHO project team provided ongoing written feedback on auditing team's draft audit plans including audit design matrix, ecosystem mapping, risk profiling, as

well as draft audit reports. IDI and its mentors also had frequent meetings with the audit teams to advise them in all processes of the audits. These audit plans and audit reports are not publicly available at this stage and therefore were not included in this article. Lastly, the core IDI-WHO project team provided both retrospective and prospective reflections on the innovative SDG audit model through semi-open discussions within the project team guided by guiding questions and in the project reporting.

These three sources of information can support the understanding of the process and impact of the multisectoral collaboration of IDI-WHO for building health systems resilience in recovery context. The information also enables to understand the audit sector's role in multisectoral collaboration for building health systems resilience in many aspects, including improvement of conceptual understanding and prioritization of health systems resilience; identification of the baseline health systems capacities, strengths, gaps and needs; leveraging of strengths and opportunities and mobilization of support for building health systems resilience; creation of an enabling environment for health system resilience; and monitoring and evaluation of progress for evidence-informed follow-up actions. The authors analysed the qualitative data and identified emerging themes and key findings.

Results: Modality of collaboration between IDI and who in audits of SDG 3.D linked to national public health system resilience

Result 1: Collaboration provided a consolidated multisectoral overview and built audit teams' knowledge base on an integrated approach to health systems resilience, needed for SAIs to audit their government's efforts related to national public health systems resilience

The collaboration in audits of SDG 3.d started with professional education to build the knowledge of country-based Supreme Audit Institutions in the subject matter. IDI and WHO leveraged respective expertise in the design, development and delivery of 3.d Education content on Health Systems Resilience and SDG 3.d. WHO, as the subject matter expert, first developed a compendium of health systems resilience technical reference materials for self-learning, and IDI distributed technical materials to SAIs through IDI's platforms and networks.

A fit-for-purpose training package on an integrated approach to building health systems resilience (linked to SDG 3.d) was subsequently developed based on online training on health systems resilience[3] aimed to decision makers of health policies and managers of health services (29), and delivered in the format of four online interactive webinars and offline quizzes. The training material integrated key requirements, considerations, and general principles of

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3   Online training: An integrated approach to building health systems resilience. Available at: https://openwho.org/courses/health-service-resilience.

building health systems resilience, e.g., multisectoral approach, public health-oriented planning, maintaining essential functions and services. IDI organized and mobilised a primary audience of over 130 auditors from SAIs in 40 countries as well as mentors from the regions from the participating SAIs.

The collaborative delivery of 3.d audit education contents on health system resilience leveraged the technical expertise of IDI and WHO, respectively. The compendium of resources aimed to support SAIs to familiarise with basic concepts and principals related to capacities of resilient health systems and the importance of health systems resilience in response to public health challenges. The training aimed to develop an in-depth understanding on the relationship between health systems resilience and SDG 3.d, requirements of building health systems resilience, key stakeholders, and assessment of health systems resilience, which are necessary for developing audit plans. Both education components supported SAIs at the audit planning stage as the critical considerations of building health system resilience are widely reflected in audit questions.

Collaborative activities on enhancing the knowledge base of SAIs continued after training sessions. Translating the general concepts of national public health systems resilience to what it implies in practice appeared to be challenging throughout the audit process but managed by collaborative efforts. For example, resilient health systems' capacity to transform and improve informed by lessons from experiences was translated into audit questions and criteria such as: existence of national action plans to address the gaps identified in the International Health Regulations monitoring and evaluation and other health system assessment efforts, evidence of simulation exercises being conducted regularly, and evidence of after-action review or intra-action review being conducted. WHO continued to provide technical support through IDI in the format of document review, webinar and Q&A.

An overall positive achievement noted was that undertaking a complex health audit in the middle of a pandemic is possible and can inform health systems strengthening and recovery. In their review of audit plans, draft summaries, and other work by the SAIs, both WHO and IDI have observed that SAIs have used the training and supplementary materials and applied various parts of it in their audits.

Result 2: The development and provision of the audit matrix by IDI and WHO facilitated a multisectoral approach to audit health systems resilience

Based on the audit design matrix reference provided by IDI, WHO and IDI co-developed a template of an audit design matrix for the 3.d audit. Audit objectives and questions are the foundation for an effective planning of any performance audit. Formulating objectives and questions requires to be based on key considerations for assessing progress of implementation of the nationally agreed target selected for the audit.

"A resilient health system is one that can prepare for, respond and adapt to disruptive public health events while ensuring the continuity of quality, essential health services at all levels of the health system" (3, 14). To support SAIs in formulating their audit questions suitable for national contexts, WHO developed a set of general questions in line with the capacities and attributes of resilient health systems for SAIs' consideration and adaptation based on their national contexts and

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BOX 1. Initial audit questions and sub-questions for SAIs' consideration and contextualisation

Audit objective 1: To what extent does the government strengthen health system's capacities to forecast, prevent and prepare for public health risks building on emerging lessons learnt from recent public health events?

1.1 How is the government putting in place processes and institutional arrangements to take forward the lessons to enhance capacities to forecast, prevent and prepare for public health risks through the country's legislation, policy, plans, budget and programmes, including the country's existing sustainable development strategy, if there is one? Is the government putting in place covid policy framework, processes, and institutional arrangements (whole-of-government approach)?

1.2 How is the government ensuring inclusive, collective and whole-of-society approaches (all stakeholders) in building health system's capacities to forecast, prevent and prepare for public health risks at all levels?

1.3 How does the government routinely assess its capacities to forecast, prevent and prepare for public health risks, in line with meeting SDG 3.d targets?

Audit objective 2: To what extent does the government take proactive measures drawn from lessons learnt from recent public health events, to strengthen health system's capacities to adapt, absorb and respond to PHEs, while maintaining essential health services?

2.1 How does the government ensure a multi-sectoral coordination mechanism in place to adapt, absorb and respond to PHEs?

2.2 How does the government maintain essential health services, including adequately addressing the health needs of marginalised groups?

2.3 How does the government apply lessons from monitoring and evaluation processes to strengthen health system's capacities to adapt, absorb and respond to PHEs?

Audit objective 3: To what extent does the government learn from recent public health events, to plan for health system recovery and transformation towards resilience?

3.1 How does the government learn from recent public health events and apply lessons learnt in reviewing, updating and aligning health system strengthening and health security institutional arrangements, strategies, policies, plans, and interventions?

3.2 How does the government ensure "sustainable development" and "building back better" principles applied in health systems recovery and transformation?

3.3 How does the government ensure adequate resources allocated for sustainable health system recovery and transformation towards resilience?

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institute capacity (Box 1). Sub-questions which are more specific and manageable to answer were developed with a focus on the government's compliance to SDG principles (e.g., leaving no one behind, whole-of-society engagement, policy coherence), general principles for building health systems resilience (e.g., public health orientated health system strengthening, all-hazard approach, applying an integrated approach to avoid, and perpetuate, fragmentation in health systems), and resilience building efforts at different policy stages (e.g., policy and planning, operationalisation and implementation, and assessment) (Box 1).

An audit design matrix is a tool for systemising the entire auditing process. The matrix often includes audit questions, criteria (i.e., the ideal situation in relation to the audit questions), and methods (i.e., how the audit team assesses the audit questions in relation to criteria) as main elements connected as a logical chain of reasoning (30, 31). The matrix must be developed for all sub questions. IDI and WHO took the approach of co-developing the matrix by leveraging each other's comparative organisational advantages and technical expertise in the subject matter and audit, respectively. The matrix provided a

generic example that was customised by SAIs to fit their national context and scope of the audit.

Audit criteria were developed based on requirements of building health systems resilience linked to SDG 3.d, in aspects of institutional arrangements for resilience building, accountability of health authorities and allied sectors, integration and coherence of health sector policies including those with a focus on health security, dedicated consideration of vulnerable and marginalised populations and communities in health system strengthening, comprehensive mechanisms for identifying and utilising lessons from public health events to improve health systems and sustainable resources for health system resilience building.

Building back better and more resilient health systems is not solely the responsibility of the health authority but requires coordinated whole-of-society efforts. Therefore, in the methods, recommended sources of information span from traditional health actors (e.g., ministries of health and national public health institutes) to actors in other sectors who contribute to health system recovery and resilience (e.g., ministry of finance, disaster management agencies, the private sector). Information from a wide range of sources would allow triangulation and verification of whole-of-governments' and -societies' actions and commitments.

Result 3: Stakeholder mapping is useful for identifying national and local level players involved in building public health systems resilience, supplementing the ecosystem and enables an assessment of the government's multistakeholder engagement

As an SDG audit, by definition, should include objectives and questions that allow the SAI auditor to conclude on multi-stakeholder engagement by the government, IDI provided the teams with examples of stakeholder analysis and RACI analysis (i.e., responsible, accountable, consulted, and informed) in the ISAM guide (9). These supplemented the eco-system map that WHO provided (described in "Result 4") and the tools have been widely used by the audit teams. Stakeholder mapping can form an integral part of an ecosystem map as a first step and can also be used as input to initiate the assessment of whole-of-government and -society efforts to engage stakeholders in implementation of any SDG goal or target, as it provides an overview of who is involved and their interests in the area being audited.

Result 4: The IDI-WHO collaboration fostered application of a whole-of-government and whole-of-society approach to auditing the SDGs through an ecosystem approach and map

After designing the audit design matrix, conducting a stakeholder mapping and making an audit plan, SAIs start approaching key actors to gather information to answer audit questions. Operationalising health systems resilience requires using a system and multisectoral approach with public health underpinning (3, 32). To support SAIs to better understand the dynamics in health systems resilience and map

and access the key actors and sources of information for this audit, an ecosystem map is utilised as a tool for SAIs to understand interconnected and interdependent actors for health agendas (e.g., ministry of health, other ministries like agriculture and transportation, national and local parliamentarians, international agencies, communities); conditions underlying context in the health system and wider society (e.g., broader determinants of health, available recourses and baseline health system capacities, current risk and vulnerable profiling); and processes that indicating how actors interact in policy and planning, implementation and monitoring and evaluation (e.g., intersectoral fora, national priority setting, after action reviews), that are crucial in building health system resilience to meet SDG 3.d and other SDG targets. Multisectoral collaboration and conducive legislative and policy environments are examples to enable and maintain a healthy ecosystem for health system resilience and recovery. WHO supported SAIs by developing an example of an ecosystem map for SAIs to consult in making their own map. The map was based on the three elements of conditions, actors and processes (Figure 2).

Result 5: Collaboration for agile technical support provided from WHO to IDI and SAIs enabled SAIs to audit a new technical area and helped timely identification and clarification of misunderstanding on applying health system resilience concepts in audits of SDG 3.d

As SAIs have planned and conducted the 3.d audits, WHO provided follow-up targeted technical support and expertise on health systems resilience, including both on-request support in the process of national audits, through dedicated webinars, reviews (including review of audit design matrix, audit plans and draft audit reports), and *ad-hoc* responses to SAIs' technical questions on resilience; and on-demand technical support materials based on the needs of SAIs that are commonly or frequently raised in the process of national audits. This is complementary to planned training sessions to all SAIs and in response to country-based SAIs' specific needs as each audit teams adopt different audit objectives and plans.

The FAQ document and webinar session and agile support to audit teams help address and clarify key conceptual and operational aspects of health systems resilience. For example, one misconception was that "strong health systems" are always resilient. However, many health systems that have been seen as strong do not necessarily possess the attributes to be resilient to disruptive public health events (such as those of many high-income country health systems during COVID-19) and chronic stressors (such as health systems' capacities to meet the needs of growing and evolving population demographics) (2, 33). Another misconception was that building resilience requires excessive costs. However, health system resilience is not attributed to resource levels but how well the available resources are used to intentionally design, orient, and develop the health system (5). There was also a wider misapprehension that resilience is only relevant to emergency or acute situations; however, a resilient health system is that which can perform its functions both within and beyond the contexts of shock events. Resilient health systems are capable of responding to both acute and chronic shocks as well as everyday challenges to the health system (e.g., payment delays, unpredictable staff and evolving patient and community expectations). Through tackling these misconceptions
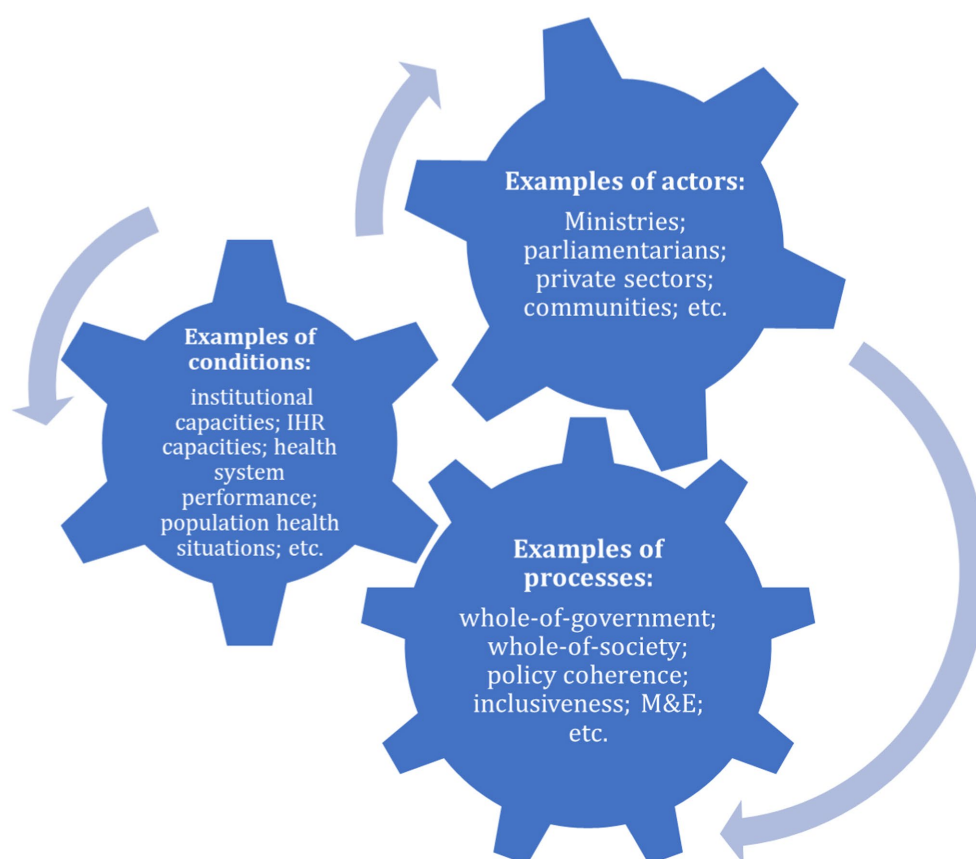
FIGURE 2
Ecosystem map in relation to health systems resilience with examples.

in audit institutions through agile and timely technical support, SAIs were equipped to conduct SDG 3.d audits as well as playing a stronger role in advocating key messages to national governments and other multisectoral actors. Furthermore, as a result, SAIs are also better equipped to play a key role in audit follow-up and thereby contributing to long term, sustainable building of health systems resilience with broader societal benefit (e.g., reduced excess mortality and morbidity and socioeconomic disruption).

Altogether, the support provided through the multisectoral collaboration equipped SAIs to undertake an audit of a new technical area demonstrating the mutual benefit and added value to society of multisectoral and multi-actor collaboration.

Result 6: Audits provide key evidence to inform resilience building

SAIs through conducting the 3.d audits can also provide critical evidence to inform what works and what needs to be improved in building health systems resilience. While the concept of resilience is widely appreciated and supported with a rapidly growing knowledge base and in global and national health declarations, resolutions, and strategies, it requires further clarity for countries in terms of how to operationalise resilience at national and subnational levels and for global actors to support countries. Since COVID-19, there have been heightened political and public attention as well as the need for operational clarity in support of socioeconomic and health system

recovery. SAIs conducting the 3.d audit provide valuable first-hand information on what countries are doing to build health systems resilience, what is going well and what major gaps exist. For example, the preliminary audit reports show that audits conducted usually identified duplication, fragmentation, gaps and overlap across health and allied sectors' policies, planning and programmes for population health. The case examples and identified gaps can inform national governments' policymaking as well as global actor's strategic direction setting. This is especially the case in the context of participating SAIs which cover countries facing frequent and severe public health challenges relating to conflicts and climate change or natural disasters. Their audit reports contribute to the evidence base informing national and global actors' targeted support to build health system resilience in these vulnerable countries, such as small-island developing states, and countries in fragile, conflict-affected, and vulnerable settings.

Result 7: SAIs can contribute to resilient recovery in their forward-looking orientation of the audits—supporting government efforts in building back better and build health systems resilience going forward

Performance audits are usually backward-looking in nature, as they assess government performance in implementing efforts in an area/project/programme/entity. With their focus on current efforts by

governments to strengthen health systems resilience based on lessons learnt from previous pandemics, the 3.d audits are forward-looking. ISSAI 300 calls for dialogue with audited entities and relevant stakeholders from the start of the audit. As to the reporting phase of a performance audit, "audited entities should be given an opportunity to comment on the audit findings, conclusions and recommendations before the SAI issues its audit report" (28). In the SDG 3.d audits, this dialogue with ministries of health and other involved ministries/agencies/other public sector bodies involved in efforts related to national public health systems resilience can inform ongoing policymaking and implementation in this area. The findings and recommendations of these audits may thus contribute to strengthening the resilience of public health systems to current and future threats, providing that the audited entities act on these findings and recommendations.

Discussion: Future impact of 3.d audit and SAI contribution to health systems resilience in recovery context

As audit impact is a shared responsibility among SAIs and its ecosystem, SAIs rely on the uptake of the audit report findings and recommendations by other stakeholders for the reports to contribute to impact. As the 3.d audits are forward-looking in nature, there is an immense potential for governments, development partners and other stakeholders engaged in health systems strengthening efforts at the country, regional and international levels to use the reports in taking stock of the current situation and consider how they may best follow up on the recommendations of the audit reports, given their role and responsibilities in protecting and promoting population health and wellbeing, at their respective levels.

As per the performance audit standards, the "auditor shall provide constructive recommendations that are likely to contribute significantly to addressing the weaknesses or problems identified by the audit, whenever relevant and allowed by the SAI's mandate" (34). Recommendations will differ among the 3.d audits as the situation found in the countries varies. However, they will all deal with relevant aspects to be addressed to create more resilient health systems, with a focus on whole-of-government efforts. Hence, the recommendations may potentially influence cross-country and region learning and future policies, e.g., in terms of these becoming more multisectoral in character. As some SAIs undertake follow up actions on the audit reports after a certain period, the reports may influence future policies as governments know that they will be held to account for their actions in implementing efforts to meet the audit recommendations.

Moreover, audits in the health sector may have a deterrent effect on negative government actions within the sector, as governments may anticipate that SAIs will audit areas with specific high risks and issues, thus making governments act to address and mitigate such risks to avoid an audit in the first instance.

As the recipients of the 3.d audit reports in many of the countries involved in this audit, parliaments also have a role to play in the accountability chain. Parliaments may request audited entities to act upon the recommendations and follow up on their implementation of the recommendations in later parliamentary debates and through other follow-up measures. Multisectoral fora at national and subnational levels can also be leveraged to promote and sustain the

audit impact to build health system resilience in tackling shock events as well as during periods of relative normalcy to enable better resilience to future public health events.

Supreme Audit Institutions have a role to play in *other* health areas as well through conducting performance audits of other SDG 3 targets or by undertaking regular performance audits on health (outside the SDGs). A related target that would be relevant for future audits is UHC given that such coverage constitutes part of a resilient health system and is a global health priority. Financial audits and compliance audits are also relevant audits that may contribute to a more resilient health system. In general, by exercising their oversight functions through auditing the area of health, whether it is performance, financial or compliance audits, SAIs may contribute to more efficient resource allocation and use in the health sector, improved performance of health sector interventions and adherence to laws and regulations relating to health. While there are a plethora of topics and approaches that SAIs may audit and the relevant themes will depend on the country context, all SAIs have a significant role to play in their respective countries—shedding light on existing deficiencies that hamper health sector resilience.

Participating SAIs are investing their resources in learning from global knowledge of health systems resilience and applying the knowledge in their audits. SAIs have formulated value-added recommendations, such as those relevant to investing in strengthening foundational health system capacities for resilience, defining clear roles and responsibilities in government structures for health system resilience, and mobilising and utilising whole-of-government and whole-of-society efforts and resources for health system resilience. These audit recommendations facilitate translating and bringing global knowledge to national contexts, which can inform governments' high-level decision-making to make sustainable impact. For example, it is important for national actors to understand that resilience is not merely a biproduct or an inevitable outcome of any investment in the health sector; resilience must be proactively and intentionally programmed into health systems strengthening and other complementary efforts such as those targeting health security, specific diseases, life-course-related and environmental issues.

The SDG 3.d audit linked to health systems resilience can be seen as one novel approach contributing to the monitoring and evaluation of the government's commitment and actions to building health systems resilience. SAIs' current and potential future audits of health systems resilience and important health-related SDGs such as UHC can be a powerful process to monitor and promote governments' actions for achieving SDGs by 2030. There is a gap in measurement and monitoring mechanisms of health systems resilience (35, 36); SAIs conducting this audit could support the trending global acknowledgement of the importance of measuring and monitoring health systems resilience, where different global actors are forming technical collaboration to reach global consensus, inform country-focused support, and advocate for government's actions.

The SAIs brings audit as an accountability mechanism to whole-of-government efforts in strengthening health systems. Multisectoral accountability mechanisms are often lacking in promoting and protecting population health (37). Such an accountability mechanism is key to ensure sustained whole-of-government approach to health/health-in-all-policies approach for resilient health systems. In the recovery context, and with resource restraints, all ministries must work together, often pooling resources, and put health at the centre in

recovery efforts due to health's fundamental role in the normal functioning of society, travel and trade. This is complementary to country's self-assessment and reporting. With a pandemic treaty on the way, WHO's position paper on building health systems resilience, and other global and state commitments to population health, accountability is key to translating commitments into sustained and integrated and coherent actions.

Building health system resilience is pertinent in the recovery context. Health should not be viewed as a cost but as an investment by policymakers. An additional investment of one dollar per person per year in the prevention and treatment of noncommunicable diseases, could save 7 million lives in low- and lower-middle-income countries (38). Health is at the centre of recovery efforts. Lessons identified in COVID-19 highlight there is no socioeconomic development if population health cannot be protected. However, health is often underinvested in and where investments and efforts are made, they can be fragmented (39–41). Audits of health-related SDG targets could strengthen the accountability of the government to public health. As the audits have applied a whole-of-government approach to examine health systems resilience, they could also contribute to government efforts at enhancing multisectoral coordination for a less fragmented future approach to preparedness for future public health risks.

Despite health system resilience being increasingly discussed as a concept since the Ebola outbreaks in 2014–2016 and more recently during the COIVD-19 pandemic, operationalising health system resilience remains a challenge. SAIs required support in understanding the concept of health system resilience in the context of implementation and monitoring. Some common misconception includes that building health system resilience requires high costs; health system resilience is only relevant to emergency preparedness and response; and a strong health system is always resilient. WHO reemphasized key messages, such as health system resilience is not attributed to resource levels but how well the available resources are used to intentionally design, orient and develop the health system; resilience must enable response to both acute and chronic shocks and everyday challenges to the health system; and many health systems that have been perceived as strong do not necessarily develop attributes to be resilient to disruptive public health events and chronic stressors. The process of tackling these challenges through education (e.g., training sessions), two-way communication (e.g., interactive webinars and Q&A sessions), and engagement (e.g., exercises and practices in developing and applying audit design matrix) could shed light towards the operationalisation of health system resilience within and beyond the health sector.

Moreover, as SAIs can follow up on the implementation of audit recommendations, the reports and follow up of them provide an instrument for taking stock of any improvements in a government's efforts related to health systems resilience to meet the SDG 3.d target by 2030.

As SAIs' audit reports are an independent and authoritative source of information, WHO and other international organisations at the national and international level may also take a multisectoral view by utilizing these audit reports on health systems resilience as well as other audit reports on health in the health sector assessments they regularly undertake.

Audits can furthermore serve as an accountability or monitoring and evaluation mechanism supporting the global health agenda in

recovery from COVID-19 and other crises as they are external reviews by an independent public oversight body at the country level. Furthermore, the multisectoral collaboration as seen between IDI and WHO providing support to the SAIs in undertaking such audits facilitates knowledge transfer from international to national levels. WHO Director-General's outlines five priorities for the world and for WHO going forward at the 150th session of the Executive Board (42), including making an urgent paradigm shift towards promoting health and well-being and preventing disease by addressing its root causes, a radical reorientation of health systems towards primary health care, as the foundation of UHC, and harness the power of science, research innovation, data and digital technologies as critical enablers. This necessitates monitoring and evaluating governments' commitments and actions in these health areas. Resilience is built over time and requires intentional design to health systems and multisectoral efforts. Auditing health-related SDG targets and facilitating audit impact of such audits by other players at national and international levels will strongly support government planning, financing and implementing health and intersectoral strategies for health.

Conclusion

Multisectoral collaboration is essential to meet global health goals in times of normalcy as well as during periods of emergency or crisis. The need for multisectoral collaboration at the country level and at the international level is critical to building and sustaining health systems resilience for UHC, health security and the SDGs. Lessons from health systems shocks highlight the need to position health as central to national agendas for socioeconomic development, with participation of all sectors because when health is affected, everything is affected. As key independent external oversight bodies of government funds, SAIs can play a critical role in recovery and in building future health systems resilience across sectors. SAIs can contribute by issuing independent audit reports that assess the performance of government efforts and by following up on the implementation of the recommendations in such reports after some time. However, potential impact generated from the audits is a shared responsibility among SAIs, audited entities, legislative bodies, civil society organisations and other stakeholders in the country context in which the SAI operates. WHO and other international, regional, national and local stakeholders may use the audit reports as a valuable authoritative source of independent information about the status of national public health systems resilience in the respective countries. They may also try to facilitate audit impact of the reports by acting on the recommendations wherever applicable to them. As the world moves towards recovery after the pandemic, multisectoral collaboration across all levels remains pertinent for creating a path towards resilient national public health systems and making and sustaining progress towards the SDGs and key global health goals.

Data availability statement

Requests to access data presented in this article should be directed to saikats@who.int.

Author contributions

SH, SM and YZ contributed to the conception, design of the research and developed the first draft of the manuscript. SH, SM, YZ, SS and AS collected information and conducted the analysis. SS reviewed the manuscript and provided key inputs on health systems resilience. SH and SM coordinated inputs from all authors. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Towards applying the essential public health functions for building health systems resilience: A renewed list and key enablers for operationalization

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The COVID-19 pandemic, climate change-related events, protracted conflicts, economic stressors and other health challenges, call for strong public health orientation and leadership in health system strengthening and policies. Applying the essential public health functions (EPHFs) represents a holistic operational approach to public health, which is considered to be an integrated, sustainable, and cost-effective means for supporting universal health coverage, health security and improved population health and wellbeing. As a core component of the Primary Health Care (PHC) Operational Framework, EPHFs also support the continuum of health services from health promotion and protection, disease prevention to treatment, rehabilitation, and palliative services. Comprehensive delivery of EPHFs through PHC-oriented health systems with multisectoral participation is therefore vital to meet population health needs, tackle public health threats and build resilience. In this perspective, we present a renewed EPHF list consisting of twelve functions as a reference to foster country-level operationalisation, based on available authoritative lists and global practices. EPHFs are presented as a conceptual bridge between prevailing siloed efforts in health systems and allied sectors. We also highlight key enablers to support effective implementation of EPHFs, including high-level political commitment, clear national structures for institutional stewardship on EPHFs, multisectoral accountability and systematic assessment. As countries seek to transform health systems in the context of recovery from COVID-19 and other public health emergencies, the renewed EPHF list and enablers can inform public health reform, PHC strengthening, and more integrated recovery efforts to build resilient health systems capable of managing complex health challenges for all people.

KEYWORDS

essential public health functions, public health, health system resilience, universal health coverage (UHC), health system strengthening (HSS), population health needs

Introduction

The health, social and economic costs of health systems shocks continue to underscore the need for more focus on public health (1, 2). Despite bringing high returns on social and health investments (3–5), public health has often been obscure in planning and accorded low priority, limited political support and inadequate funding. As many countries move from the acute phase

of the COVID-19 response after over 2 years of the pandemic, governments are planning for socioeconomic recovery in the context of likely fiscal pressure. To ensure sustainable impact and efficiency from investments, global and national policies must put public health and health systems at the heart of recovery efforts by addressing critical gaps in health systems foundations and strengthening multisectoral collaboration for health.

The essential public health functions (EPHF) are a set of fundamental and interconnected activities and capacities both within and beyond the health sector, required to ensure effective public health actions (6–8). Pre-COVID-19, strengthening EPHFs to ensure global health security, universal health coverage (UHC) and greater health equity was a key recommendation in several health resolutions and declarations (9–11). The Declaration of Astana in 2018 affirmed world leaders' commitment to strengthen primary health care (PHC) towards UHC (10); the Operational Framework for Primary Health Care provides support to achieve the goals and objectives of the declaration (12). The framework highlights EPHFs as core to meeting population health needs (12). While there has been an increased momentum in application of EPHFs for health systems resilience and UHC, for example, in the Americas since 2020 (13), historically, EPHFs have been utilized primarily in national public health capacity assessments (14–16), health workforce planning and education (17), and the development of public health institutes (18), with limited systematic application in health system strengthening (8). Their impact as an integrated approach to strengthening public health capacities at national, subnational and service delivery levels including primary care, and bridging programmes and sectors for health systems resilience has been undermined by a failure to operationalise their interconnectedness, together with the lack of an up-to-date unified list to facilitate global consensus on defining the operational scope of and catalyzing meaningful investments in public health. When sufficiently resourced and applied holistically, EPHFs can provide an operational approach to promoting and protecting individual and population health that is both sustainable and affordable (9).

The unprecedented scale of the impacts of COVID-19 has demonstrated that traditional and siloed approaches to health systems, including traditional health system strengthening focused on clinical services, vertical programmes, health security programmes and humanitarian responses (Supplementary Figure 1), while providing dedicated focus and short-term visibility of impact, have failed to achieve the long-term system strengthening required to attain efficiency, optimize health outcomes and maintain services during shock events (19–22). This has brought a renewed focus to EPHFs, with global and national actors reviewing their performance and seeking a recovery that builds health systems capable of preventing, responding to and learning from evolving health challenges including emergencies (13, 23–25). In this context, this perspective article, based on a WHO discussion paper published early this year which synthesized the best available global evidence on operationalizing EPHFs (8), informs a comprehensive and integrated approach to EPHFs through a renewed list of EPHFs and the identification of key enablers for effective operationalization. These can inform national health authorities and global actors that provide country support (e.g., WHO, international donors, intergovernmental organizations) in health system strengthening, reform and recovery that promotes resilience.

Essential public health functions — a renewed global reference list

The concept of EPHFs emerged in the context of a rapidly changing health, social and political landscape in countries worldwide in late twentieth century (7, 26, 27). Since the 1980s, EPHFs were developed in the Americas to define fundamental State functions for efficient and effective public health programmes; this responded to the need to strengthen health authorities' stewardship role in the context of weakening public health in health sector reforms (7, 27). At the same time in Eurasia, the newly independent states of the former Soviet Union experienced dramatic system changes and health consequences, and many other countries also experienced fast shifts in epidemiological and demographic landscapes. There was a demand to identify a set of essential functions (i.e., EPHFs) to ensure public health systems could function and deliver public health services in an optimal way to respond to emerging and priority population health needs (7, 26).

The EPHF list defined by WHO through a Delphi exercise in 1997 represented the first global reference against which countries could benchmark their public health capacities (26, 27). Since then, several global health actors and national health authorities[1] have developed their own lists and approaches, including assessments of EPHFs to identify gaps in technical capacity or inform country-focused support. After entering the twenty first century, global experience with public health emergencies (e.g., SARS, MERS, Ebola, Zika, and COVID-19) and other emerging health issues (e.g., increasing burden of noncommunicable diseases, rising antimicrobial resistance threats and environmental hazards) has continued to reveal insufficient baseline public health capacities and the lack of an integrated approach to managing the wide range of public health challenges (8). This necessitates a re-examination of existing EPHF lists to ensure they reflect the present understanding of public health and evolving population health needs, while also reflecting the different dimensions and scope of various approaches to the application of EPHFs. The resultant unified list can provide a focal point to draw the required attention from decision makers globally to influence the direction of national priority setting.

A crosswalk analysis of existing authoritative lists[2] was conducted and results were presented in the discussion paper "*Twenty first century health challenges: can the essential public health functions make a difference?*" (8). Findings indicate a consensus on the

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1   This includes a number of WHO regional offices, the World Bank, Brazil, Canada, China, the United States, etc.

2   The analysis included lists of EPHFs or equivalent frameworks developed by the Centers for Disease Control and Prevention of the United States in 1994, 2012 and 2020; the WHO in 1998; the National Public Health Partnership of Australia in 2000; the Pan American Health Organization in 2001 and 2020; the National Health Service of the United Kingdom in 2001; the WHO Regional Office for the Western Pacific in 2003; the World Bank in 2004; the Ministry of Health of Indonesia in 2004; the Ministry of Health of British Columbia in 2005; the Ministry of Health of Brazil in 2006; the Public Health Clinical Network of New Zealand in 2011; the Israeli Association of Public Health Physicians in 2012; the European Commission in 2014; the WHO Regional Office for Europe in 2014; the National Health Commission of China in 2015; and the WHO Regional Office for the Eastern Mediterranean in 2017.

fundamental operational remit of public health which formed the basis of developing the new consolidated list of 12 EPHFs (Box 1) (8). This list consists of activities commonly recognized as essential, such as monitoring, evaluation and surveillance, public health emergency management, health promotion, and disease prevention. It also contains activities underrepresented in earlier lists that are increasingly recognized as necessary to meet population health needs, such as the rational and equitable use of health technologies and the public health workforce (8, 27).

BOX 1 A consolidated list of EPHFs (adapted from the WHO discussion paper) (8).[3]

Monitoring and evaluating population health status, health service utilization and surveillance of risk factors and threats to health *(public health intelligence)*

Managing public health emergency *(emergency management)*

Assuring effective public health governance, regulation, and legislation *(public health governance)*

Supporting efficient and effective health systems and multisectoral planning, financing and management for population health *(public health planning and financing)*

Protecting populations against health threats, including environment and occupational hazards, communicable disease threats, food safety, chemical and radiation hazards *(health protection)*

Promoting prevention and early detection of communicable and noncommunicable diseases *(disease prevention and early detection)*

Promoting health and well-being and actions to address the wider determinants of health and inequity *(health promotion)*

Ensuring community engagement, participation and social mobilization for health and well-being *(communication participation)*

Ensuring adequate quantity and quality of public health workforce *(public health workforce)*

Assuring quality of and access to health services *(quality and access)*

Advancing public health research *(research)*

Ensuring equitable access to and rational use of essential medicines and other health technologies *(equal and safe access to medical products)*

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3   The texts in brackets represent short names of each function in Box 1.

While all EPHFs contain both service delivery and enabling elements, to inform operationalisation, the EPHFs can be further grouped according to activities that are primarily service focused and those that essentially enable the delivery of public health services (Figure 1). This differentiation is based on the experience of applying EPHFs in different regions (15, 16, 27). The service-oriented activities include promotive, preventive, and protective public health services for populations that should be integrated into service delivery platforms at all levels including a focus on primary care. The enabling activities include activities embedded in health systems, communities and beyond the health sector required to foster and facilitate the delivery of public health services. Public health intelligence is a crosscutting activity that is both service oriented and has an enabling characteristic. By identifying all activities required for effective public health practice, the consolidated list of EPHFs can serve as a renewed global reference for countries reforming their national public health architecture and capacities as part of recovery from the COVID-19 pandemic and other shock events.

BOX 2 An overview of the EPHFs as a bridge between global efforts to promote UHC and health security.

A further comparative analysis of the updated EPHF list against a number of global frameworks[4] was conducted to assess the potential of EPHFs to provide conceptual bridging between approaches to achieve UHC and health security (8). A portion of this analysis, presented below, indicates complementarity across these agendas, highlighting opportunities where investment in EPHFs strengthens health systems and promotes health security in tandem (Supplementary Figure 2).
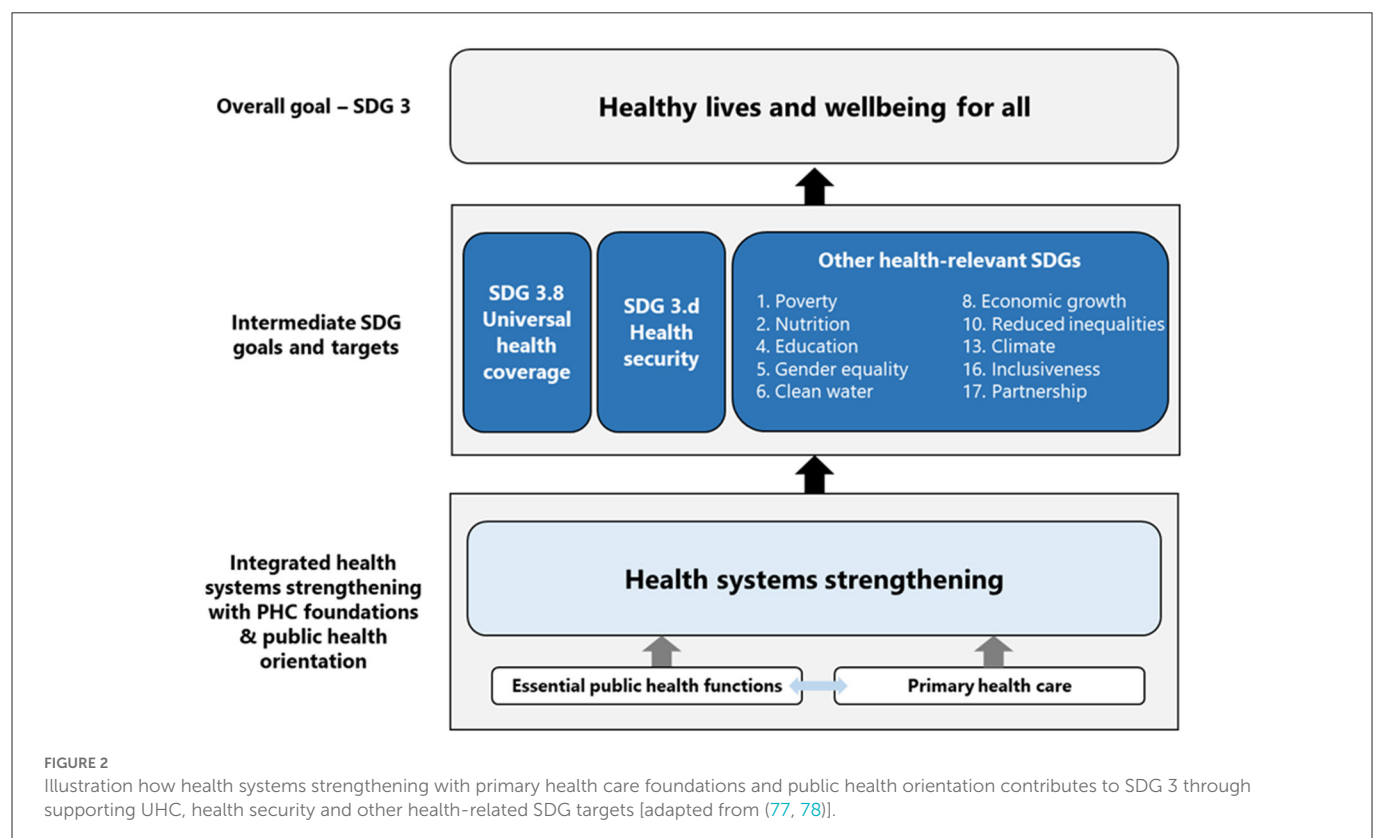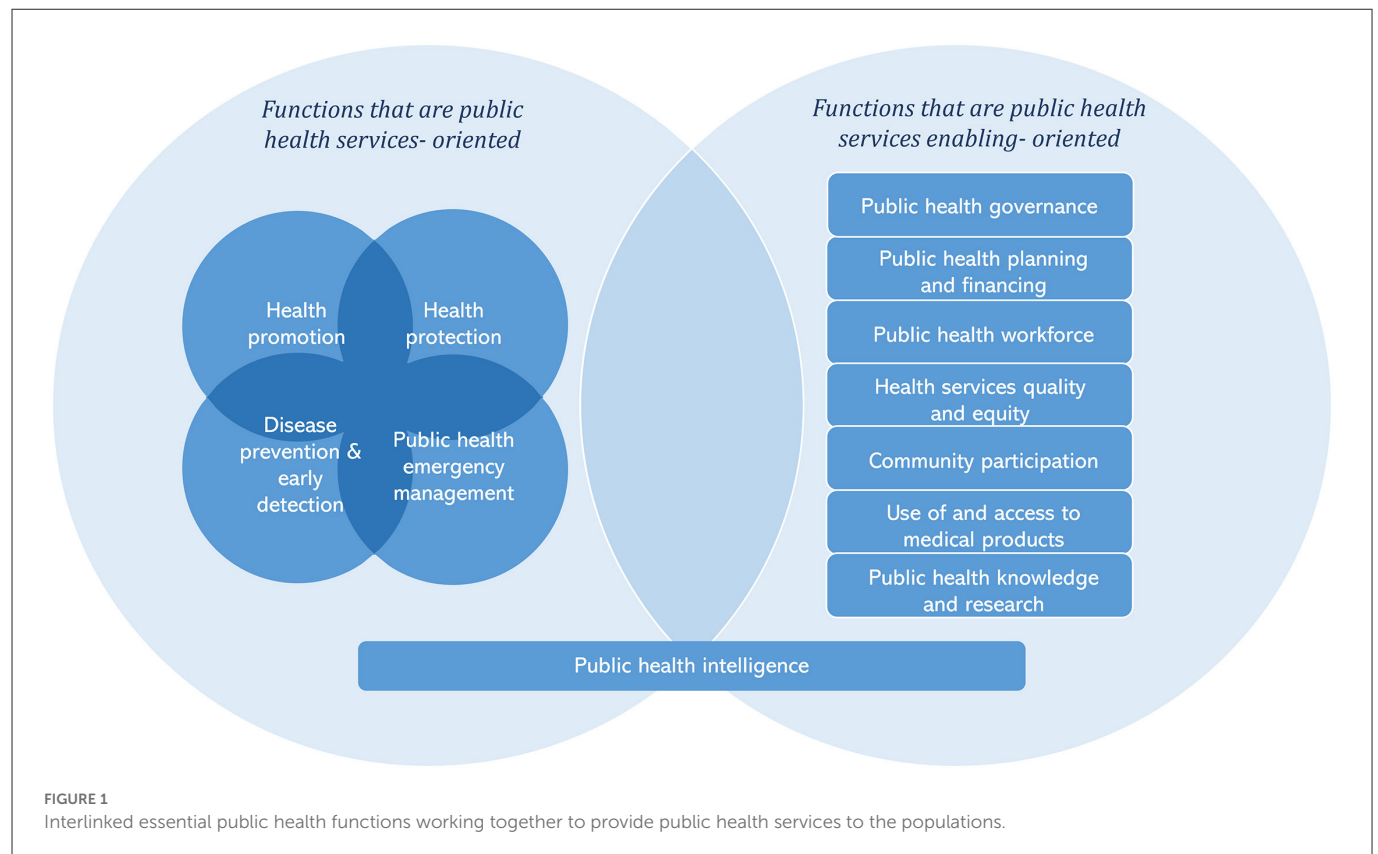
For example, the Primary Health Care Operational Framework identifies 14 levers that are required to accelerate progress in strengthening PHC-oriented systems and advancing UHC (12); the IHR [2005] defines core capacities required to detect, assess, notify and report events and respond to public health risks and emergencies of national and international concern (28). Investing in EPHFs can recognize and strengthen the role of PHC in emergency preparedness and response, supporting health security by strengthening PHC based surveillance, triaging and case management. Strengthening emergency surveillance and response capacities, as a public health function, meets IHR requirements and helps to reduce the burden on secondary and tertiary care during public health events, promoting resilience. This highlights the potential role of EPHFs in bridging the currently siloed efforts towards achieving these interdependent global health targets, and building more integrative, holistic and equitable health systems.

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4   These frameworks include health system building blocks, the primary health care operational framework, the International Health Regulations (IHR 2005) core capacities and health emergency and disaster risk management framework.

Operationalising the essential public health functions – key enablers for integrated health system strengthening unpinned by public health

There are various entry points into health systems for policies, planning and investments, including disease and life course focused efforts and emergency response and humanitarian efforts. However, these traditional routes have not developed public health capacities sufficiently or comprehensively enough to ensure health systems resilience. EPHFs represent an integrated approach to health system strengthening across the multiple entry points to health systems, providing a bridge between these efforts in policies, planning, implementation and assessment (Box 2). Focusing on the EPHFs and primary health care as the foundation for health systems strengthening supports the objectives of the individual programmes while also contributing to health system resilience and broader health goals including equity and efficiency.

While the EPHF list provides a foundation, the use of EPHFs as an operational approach to integrated health system strengthening requires actions across specific areas or enablers. In the discussion paper *"Twenty first century health challenges: can the essential public health functions make a difference?"*, several interconnected enablers, which are recurrent themes in literatures and based on a review of available global experience with EPHFs, were identified as necessary to ensure adequate investment in and delivery of EPHFs (8). In this section, we further discuss and expand on three key enablers: high-level political commitment to public health with EPHFs, multisectoral accountability mechanisms for delivering EPHFs, and assessment of EPHF provision.

FIGURE 1
Interlinked essential public health functions working together to provide public health services to the populations.

FIGURE 2
Illustration how health systems strengthening with primary health care foundations and public health orientation contributes to SDG 3 through supporting UHC, health security and other health-related SDG targets [adapted from (77, 78)].

High-level political commitment to strengthen public health with the essential public health functions

Several reviews have highlighted the critical role of political commitment in determining the success or failure of public health initiatives, from implementation of the IHR (2005) (29) to vector-borne disease elimination (30). Strengthening public health with EPHFs also requires sustained high-level political commitment to ensure long term health sector and intersectoral actions that optimize population health (8). This can be a challenge when governments are driven by short-term wins while returns on public health investment tend to be less visible or seem more long term by comparison (31, 32).

Political commitment can be solidified through including EPHFs in health legislation, prioritizing EPHFs within health policies, strategies and plans; allocating dedicated funding to EPHFs in multi-year budgets; establishing clear governance structures to lead, coordinate and oversee the delivery of EPHFs, etc.

One of the approaches to solidifying political commitment to strengthening public health can be establishing or capacitating a national public health institute (NPHI). An NPHI is a government organization or a network of organizations that are science-based and provide national leadership and coordination of public health efforts to improve population health outcomes (18, 33–35). EPHFs provide guidance for defining the scope and functions of NPHIs (18, 36, 37). Organizing public health leadership and expertise within an NPHI can support to improve the efficiency of the implementation of public health functions (including health security) and improve public health stewardship and accountability (36, 38–40).

Informed by lessons learned from recent public health events, several countries have established or reformed NPHIs to provide the oversight of a number of EPHFs (if not all of these functions) (35–37, 41). This has often been in response to acute health threats or enduring public health challenges as well as the growing need to consolidate public health functions under one roof (33, 35–37). For example, with the demand to enhance commitment and leadership of the EPHFs under a single focal point to respond to multifaceted public health threats, Kenya National Public Health Institute was established to bring together EPHFs from across the government and health system, following the *Kenya National Public Health Institute Order, 2021* (42, 43). To be effective NPHIs need to be capacitated with adequate visibility, authority, independence, legitimacy, and resources, and supported by structures at subnational levels (8, 35, 45, 46). This further strengthens the stewardship role of health authorities in planning and oversight of EPHFs, which span health and allied sectors (referring to stakeholders in public health outside Ministry of Health, such as environment; food and road safety; urban planning; and local authority services), from national to community levels (27).

Global and regional networks and cooperative bodies, such as the International Association of National Public Health Institutes, Africa Centers for Disease Control and Prevention, the European Centers for Disease Control and Prevention have been supporting countries to foster a coherent approach to building public health capacities with strong stewardship for EPHFs, including developing or strengthening NPHIs towards a more systems-oriented role that is reflective and responsive to the growing and evolving profile of global health challenges (27, 37).

Multisectoral accountability mechanism for delivering the essential public health functions

The broader determinants of health (including social, behavioral, environmental, commercial determinants) and multisectoral nature of public health actions necessitate an approach to public health that goes beyond health systems. Such a public health approach would support intersectoral planning, budgeting and actions to address determinants of health. The EPHFs promote a whole of government and whole of society orientation towards health and wellbeing. The PHC approach also requires governments at all levels to enable actions and accountability beyond the health sector to deliver the EPHFs needed to meet population health needs in peacetime and during emergencies.

Accountability is a matter of knowing and agreeing; acting and being responsible; being answerable; and reporting and monitoring (47–49).

A multisectoral approach to accountability provides a means to define the commitments and actions that governmental and non-governmental entities within and beyond the health sector are accountable for and how they might be held accountable within public health agendas (50, 51). This is to ensure intersectoral action for health, which is recognized as essential to support health and wellbeing but is often hindered by a lack of adequate accountability mechanisms to support implementation (27, 52–54).

Establishing multisectoral accountability mechanisms for EPHFs can learn from experiences in existing multisectoral coordination mechanisms in specific areas including One Health platforms. Informed by lessons learnt from the 2014–2016 Ebola crisis, Guinea, Liberia, and Sierra Leone established their national One Health platform structures anchored in the offices of the state head, inter-ministerial committees, or ministries of health; these platforms have facilitated development of national intersectoral action plans for antimicrobial resistance, zoonotic diseases, etc (55). Coordinating efforts through One Health mechanisms can improve resource efficiency (55), though national One Health mechanisms often need strengthening including broadening stakeholder representations (56, 57), the addition of a solid monitoring and evaluation component (56), and integrated structures for different One Health areas (58).

A recent effort at the international level towards fostering multisectoral accountability for EPHFs in countries involves a global roadmap to build an integrated and multisectoral public health workforce to implement EPHFs. This roadmap recognizes that various occupations in health and allied sectors deliver EPHFs and calls for mapping, measurement and development of this workforce across sectors (59, 60).

Systematic assessment of delivery of the essential public health functions

The systematic assessment of EPHF delivery identifies baseline public health capacities and areas for improvement (8). There are a number of self-assessment tools that focus on the evaluation of each public health function and its sub-functions through stakeholder workshops and scoring with national and external stakeholders (15, 16). Most recently, Armenia (61) and Slovenia (62) conducted

> **BOX 3   Assessing EPHFs to strengthen public health stewardship and capacities.**
>
> In January 2022, Ireland embarked on a reform process with the aim of strengthening public health capacities in light of national and international lessons identified from experience with COVID-19 (44). A thematic approach to assessment using the EPHFs as a lens, was used to review the current delivery of public health with respect to policy and planning, infrastructure, service delivery and integration and coordination (69). The resultant analysis was used to identify strengths to be leveraged and actionable policy options to optimize the delivery of public health through improved stewardship and operationalisation of EPHFs (69). The findings of the analysis have been used to support high level advocacy to support the strategic shift towards public health needed to ensure resilience. Ireland is now using the EPHFs to define the operational scope of public health in Ireland and to identify the scope and functions of a new national public health institute.

self-assessment of EPHFs, which identified strengths and priority areas for improvement in public health capacities and services and formed recommendations to stakeholders. Experiences of joint EPHF self-assessment in the Americas, Central Asia, Europe, Middle East and North Africa showed that this approach contributed to evidence based priority selection for public health reform and promoted a greater intersectoral understanding of public health but can be somewhat unwieldly and follow-up actions to implement recommendations are not well documented (27, 63–65).

A new approach recently developed in collaboration between WHO and Ireland focuses instead on assessing EPHFs as a whole and at a strategic level (Box 3). Another recent example of high-level assessment is the integration of EPHFs in to primary health care measurement frameworks to monitor institutional capacity to deliver EPHFs (66). In addition, building the capacity of health information systems to incorporate and collect data from a population perspective and leveraging existing information systems can also enhance monitoring and evaluation of EPHFs. Routine health information systems such as District Health Information Software (67, 68) provide rich information on population health needs (which supports the prioritization of public health action), performance of public health system and programmes (which are public health functions themselves), and population health outcomes (which reflects the effectiveness of EPHFs implicitly). Utilizing the results of assessments to build institutional capacities is crucial to support health systems resilience for public health (27, 64).

Conclusion

COVID-19 and other public health challenges have repeatedly proven that health systems are vital for social and economic stability and development. Years of underinvestment and lack of a comprehensive public health approach to strengthening health and allied systems have had significant consequences. The majority of countries lack sufficient public health capacities for effective prevention, early warning and case management, and have struggled to maintain essential health services while responding to COVID-19. In addition, countries continue to face other public health challenges, such as noncommunicable diseases, antimicrobial resistance, climate change, an aging population and health inequity, that place increasing demands on already struggling health systems.

The case for investment in public health capacities and institutions is increasingly clear (4, 32, 70). The current political and

public impetus for public health, resulting from the global experience with COVID-19, represents a brief, yet valuable opportunity for countries to rethink their approach to investing in public health for building health systems resilience. EPHFs can serve as a holistic and integrated approach to enhancing public health capacities within and beyond health systems. Lessons identified from COVID-19 also highlight that the way PHC changes, adapts, and re-designs its organization to respond to the needs of the population is key to effective response to infectious disease outbreaks (71–74). The EPHFs can be utilized to strengthen primary health care by supporting planning and holistic integration of public health services to primary care to constitute integrated health services as outlined in the operational framework for primary health care. In many countries, primary care is often the first contact point with the health systems. Improving integration of public health and primary care benefits individuals as well as wider populations. Further work is needed to delineate an essential package of public health services as part of integrated health services to be delivered at primary care level from the EPHFs lens.

The COVID-19 pandemic is threatening years of progress in global health as backward sliding of the Sustainable Development Goals (SDG) targets has been seen or predicted. COVID-19 reversed the progress made in the fight against tuberculosis, with a 19% drop in number of people treated for drug-resistant tuberculosis in 2020 compared to in 2019 (75). COVID-19 also caused widespread disruption of essential health services with 92% of the countries still reporting service disruption in late 2021; this is likely to halt the progress made towards UHC which had already fallen behind reaching SDG target 3.8 in pre-COVID times (21, 76). Countries need to reaffirm the commitment to reaching SDGs by 2030. In this context, complementary to primary health care, the EPHFs can support countries in strengthening health systems foundations that are public health oriented for UHC, health-related SDGs and health security (Figure 2).

In this perspective article, we proposed several key enablers for applying EPHFs to strengthen health system with strong public health orientation. One of the limitations is grounded in the fact that there are limited resources documenting the application of EPHFs to decision-making and high-level policies and planning in countries, besides EPHF assessment. As more national authorities in Europe, Americas, the Middle East, etc. are utilizing EPHFs or planning to embark on applying EPHFs, we will be able to learn from their experiences. With the consolidated EPHF list as a reference, countries need to secure political commitment to public health and a more integrated approach to health systems strengthening unpinned by EPHFs; reform government structures to ensure clear public health leadership and coordination of intersectoral action for health; strengthen multisectoral accountability for delivering EPHFs; and assess the current state of EPHF stewardship and provision. Action on these interconnected enablers within countries can facilitate greater efficiency, effectiveness and equity in addressing the complex public health challenges of today.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material,

further inquiries can be directed to the corresponding author.

Author contributions

SS, YZ, and GM contributed to the conception and design of the research. YZ and GM collected information and led the analysis. YZ, GM, RS, SM, and SS developed the first draft of the manuscript. SD, GS, NA-M, JF, AM, and EB reviewed the manuscript and provided inputs to reflect global and regional practices. SS coordinated inputs from all authors. All authors read and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

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A synthesis of concepts of resilience to inform operationalization of health systems resilience in recovery from disruptive public health events including COVID-19

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This article is part of the Research Topic 'Health Systems Recovery in the Context of COVID-19 and Protracted Conflict'

Health systems resilience has become a ubiquitous concept as countries respond to and recover from crises such as the COVID-19 pandemic, war and conflict, natural disasters, and economic stressors *inter alia*. However, the operational scope and definition of health systems resilience to inform health systems recovery and the building back better agenda have not been elaborated in the literature and discourse to date. When widely used terms and their operational definitions appear nebulous or are not consistently used, it can perpetuate misalignment between stakeholders and investments. This can hinder progress in integrated approaches such as strengthening primary health care (PHC) and the essential public health functions (EPHFs) in health and allied sectors as well as hinder progress toward key global objectives such as recovering and sustaining progress toward universal health coverage (UHC), health security, healthier populations, and the Sustainable Development Goals (SDGs). This paper represents a conceptual synthesis based on 45 documents drawn from peer-reviewed papers and gray literature sources and supplemented by unpublished data drawn from the extensive operational experience of the co-authors in the application of health systems resilience at country level. The results present a synthesis of global understanding of the concept of resilience in the context of health systems. We report on different aspects of health systems resilience and conclude by proposing a clear operational definition of health systems resilience that can be readily applied by different stakeholders to inform current global recovery and beyond.

1. Introduction

While the term resilience has been used within academic literature and global health discourse for some time, the specific concept of "health system resilience" did not gain prominence in academic literature before 2011, following the World Health Assembly resolution advocating building health systems resilience (1). It did not become widespread within global discourse until the Ebola outbreaks in West Africa and the excess mortality associated with disruptions to health services it caused (2–4). Since the start of the COVID-19 pandemic and the widespread health service disruptions associated with it, the concept of health system resilience has become ubiquitous, specifically with respect to its contribution to health security, Universal Health Coverage (UHC), and health system strengthening (5). By highlighting the mismatch between traditional health system monitoring including the UHC and global health security indices and the ability to maintain essential services in the context of a shock event, COVID-19 has demonstrated the ineffectiveness of existing approaches to strengthen health systems and promote their resilience (6). This failure to adequately consider and apply the requirements for resilience in health system planning is a factor in the persistence of foundational gaps in health systems and their continuing susceptibility to shock events despite continuing health sector investment, as seen in countries irrespective of their income groups.

A lack of clarity around the operationalization of resilience in health systems has also contributed to the global failure to build resilient health systems, by hindering effective advocacy and support to countries in building and measuring resilience. As countries and global institutions look to recovery, there is an urgent need to move beyond the conceptual, and focus efforts and resources on operationalizing resilience to ensure recovery efforts build resilience into "systems for health"[1] and enable effective action on evolving public health challenges. This study aims to bring clarity to the concept of health systems resilience and its application, presenting a synthesis of global understanding and unpacking the key requirements for operationalization, to ensure the promotion of sustainable recovery.

2. Materials and methods

This paper represents a synthesis of key conceptual issues concerning health system resilience and proposes three practical areas of focus to build health systems resilience. The practical proposals draw on findings from the conceptual synthesis and critical gaps identified; and the co-authors' considerable operational experience in

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1   Systems for health refers to an emerging conceptualization of health systems that moves beyond traditional approaches to measuring achievement of Universal Health Coverage (UHC) to include actions within and beyond health systems to promote healthier populations and ensure health security; World Health Organization, et al., *Systems for health: everyone has a role: flagship report of the Alliance for Health Policy and Systems Research*. 2022, World Health Organization: Geneva.

health systems strengthening for resilience and recovery at country level, primarily within South Sudan, Iran, Thailand, Ireland, Liberia, and Ethiopia.

The documents included in the conceptual synthesis were initially drawn from a rapid literature review on health systems resilience in disruptive emergencies conducted in 2017 and updated in 2020. The timeline of these reviews was limited to post 2013 in order to capture literature on significant recent public health events such as Ebola and the early stages of COVID-19 (5, 7). Both reviews served to underpin WHO technical products[2] on health systems resilience (8–10). Details of the approaches to these reviews are contained in the documents (5, 7). In summary, the core literature searches were conducted in PubMed, with supplementary searches of the websites of major organizations working in global health, including United Nations International Strategy for Disaster Reduction (UNISDR), United Nations International Children's Fund (UNICEF), the Organisation for Economic Co-operation and Development (OECD), the Rockefeller Foundation, the UK's former Department for International Development (DFID), Oxfam, the European Commission, United States Agency for International Development (USAID), World Health Organization (WHO) including Regional Offices and Headquarters, etc. Publications were limited by English language.

These searches were supplemented in September 2022 with a highly focused search in PubMed, aiming to identify publications which explored health systems resilience as a *concept* (theory, model, etc.). The final search string used was "resilien*" [title] AND ("concept" [Title] OR "theor*" [Title] OR "concept formation" [MeSH Terms]. Out of 274 articles retrieved, 98 underwent screening with a further 12 included in the analysis.

A total of 81 documents were reviewed as full text, with data extracted from 45; 33 from previous reviews and 12 from the updated focused search. The most common reasons for exclusion included insufficient articulation of definitional and/or conceptual issues around health systems resilience or a lack of a specific focus on resilience as it relates to health systems. Data were systematically extracted into Excel (Supplementary material Table S1). Documents were reviewed in order of perceived relevance with heavy conceptual saturation reached early in the process, with indications of saturation as early as paper 10 (11).

Findings from the conceptual synthesis were complemented with considerations arising from the co-authors' considerable operational experience in health systems resilience and recovery. The latter has been accumulated through the implementation of a number of country level projects including the Tackling Deadly Diseases in Africa Program (TDDAP), an ongoing multi-year project on building health systems resilience funded by the Korea International Cooperation Agency (KOICA) in Ethiopia and Liberia and the pioneering of a strategic approach to the essential public health functions (EPHFs) in Ireland (2022) as well as the collaborative development of a number of technical products in support of health systems resilience including a Health Systems

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2   WHO technical products to the documents and tools produced by the WHO in support of strengthening health and health systems in Member States.

Resilience toolkit (8), the Primary Health Care Monitoring and Evaluation Framework (10), and a Health Systems Resilience Indicators Package (9).

3. Results

Results are organized in three parts. First we discuss three key thematic areas that emerged from the document review: (1) the evolution of the concept of health systems resilience; (2) definitions and attributes of health systems resilience; and (3) the operationalization of the concept, or the translation of the conceptual into tangible, measurable actions. The synthesis of ideas at this high level demonstrated that while there are a variety of disciplinary perspectives, terminology and specific considerations within the literature, there is also meaningful consensus that can form the basis of practical action. Drawing on this consensus, we then propose three key required areas of focus to foster health systems resilience: (1) embedding consideration of resilience within health system strengthening efforts; (2) ensuring the systematic capture of learning within health systems and the translation of that learning into practice; and (3) ensuring health systems have a public health orientation, such as through operationalizing the essential public health functions. The identification of these areas to promote resilience draws from critical analysis of the available literature, including gaps, in conjunction with the field experience of the co-authors in strengthening health system resilience when recovering from both acute and chronic shocks and stressors. Finally, an operational definition of health system resilience is proposed that supports the translation of the concept of resilience into tangible and measurable actions within health systems.

3.1. Evolution of the concept of health systems resilience

The concept of resilience as applied to systems generally emerged from the physical sciences literature in the 1970s as the ability of a system to absorb change and disturbance while still maintaining the same relationships between variables (12, 13). The promotion of absorption, adaptation, and transformation as key resilience strategies emerged from ecological literature shortly thereafter, with the strategy employed depending on the size and duration of the impact (13, 14). These three key themes remain central to health systems resilience whether they are presented as strategies, capacities, levels, or dimensions (14–16). The concept of health systems resilience has been influenced by different thematic approaches as well as global experience with public health emergencies (PHEs). Early conceptualizations presented it as the opposite of system vulnerability, which represents a mix of political, social, economic, health, cultural, and other determinant factors (17). There was an initial focus on the maintenance of infrastructure, functionality of health facilities, and continued service delivery, with this evolving to encompass what has been described as "software," including social networks and workforce motivation (5, 18). Community resilience as a contributor to health system resilience has been increasingly reflected since the Ebola outbreaks in West Africa as has the contribution and even the agency

of the individuals within the system, to overall system resilience (14). Experience with the outbreaks reemphasized the centrality of the maintenance of quality in health services and the link between health system resilience and health system strengthening (14, 19). Although the link between a lack of resilience and weak public health capacities was identified following experience with Ebola, the recognition of the strong relationship between the two has only become widespread due to the prolonged and significant disruptions associated with COVID-19 globally (12, 20). Experience with the COVID-19 pandemic has also brought the focus back to the inherent interconnectedness between multiple complex systems apparent within the concept of vulnerability, i.e., the social, economic, and political systems in which health systems are embedded (21–24). More recently resilience has been associated with recovery, transformation, the building back better agenda, and with health system strengthening more broadly (15, 25–29).

The type of shocks and stressors dominating the literature has also shifted in response to global experience with PHEs. While there is a differentiation between chronic events such as repeated reform, insufficient funding and human resources within the literature, and acute events such as natural or man-made disasters, they share the underlying principle of a disruption, which may vary in size, onset, and nature. Interestingly, response to slow onset or chronic challenges, or what has more recently been become known as "everyday resilience," predominated the literature prior to 2011, when the focus shifted to natural disasters (5). Everyday resilience emphasizes the resources available to individuals within the system to support the daily provision of services (14). Infectious diseases have dominated the discourse since the Ebola crisis, with migration becoming more prominent since 2017 in response to mass displacements (13, 14, 30). The idea of everyday resilience has also reasserted itself within global discourse in recent times reflecting the chronicity of health system challenges that often exacerbate the impact of larger or more acute stressors like COVID-19 on the health system (18, 27, 29).

3.2. Definitions of health systems resilience

Explicit definitions of "health systems resilience" were sparse before Kruk's widely cited definition from 2015; "the capacity of health actors, institutions and populations to prepare for and effectively respond to crises, maintain core functions when a crisis hits, and informed by lessons learned during a crisis, reorganise if conditions require it." While this definition recognizes health systems as complex adaptive systems with both a reactive capacity to react to disturbances and a proactive capacity to anticipate and prepare for shocks and stressors, it fails to explicitly recognize prevention or recovery (2, 31, 32). Despite these limitations, this definition or variations on it have been central to the development of research in health systems resilience since, with the central focus being the ability to effectively manage change while maintaining essential services.

While enriching the discussion and understanding, differing perspectives have contributed to conceptual ambiguity with different authors presenting the same or similar concepts in different ways, i.e., absorption, adaptation, and transformation are presented as strategies, capabilities or levels by different authors and resilience itself presented as an outcome and a process (8, 20, 25, 26). Despite this lack of clarity,

there is broad thematic agreement around what constitutes health systems resilience with a number of key themes consistently reflected, often presented as capacities. These include prevention and preparedness, response, maintenance of core or essential services or functions, and recovery (4). The majority of the definitions are focused on response, which is often equated with the strategies of absorption, adaptation and transformation, taken from the physical science literature or similar strategies or capacities seen as attributed to or promoting resilience (6, 18, 21). Despite the focus on response within definitions, there is a recognition within the accompanying narratives that resilience entails proactive and continuous action rather than just the reaction to a crisis (18). Learning, and its relationship with health system transformation and reconfiguration, is a key element of much discourse though it is often overlooked within definitions and research (7, 16, 20). Recovery is also explicitly mentioned in many formal definitions of health systems resilience, though there is a paucity of examination or measurement of the recovery aspect of health systems resilience (2, 12, 30, 31). The delivery of core or essential services or functions in all contexts is central to the demonstration of resilience, and exclusively measured during shock events, with consideration for quality (infection prevention and control; patient safety; occupational health) becoming more prevalent post Ebola (2, 11, 14).

3.3. Operationalization of health systems resilience

There has been broad agreement around the key attributes of a resilient health system (22, 33, 34). These are the core and interconnected features or characteristics that allow resilient health systems to prepare, respond, recover, and transform in response to shocks or stressors. The attributes most frequently cited include awareness, mobilization, self-regulation, integration, diversity, and transformation (Box 1) (23, 29, 30). Despite this convergence, there has been a relative failure to decisively move beyond the attributes to tangible and measurable actions, with critics blaming the lack of conceptual clarity for this failing. While this may certainly be a factor, health systems resilience is also complex and cross cutting with a diffusion of responsibility and accountability. Because health systems resilience is essentially everyone's business, it becomes nobody's business, with a lack of supporting institutional structures and a lack of targeted funding (18, 30).

Multiple frameworks have been applied within academic literature to demonstrate, measure, and classify resilience strategies, attributes, and capacities, with no single framework gaining prominence and no agreement regarding how to measure health systems resilience, although a number of "resilience indices" have been proposed (29, 35). While different, many frameworks are grounded within the WHOs health systems frameworks, using the health system building blocks as the unit of analysis or at least as a starting point (21, 24, 36, 37). Despite the prevalence of the WHO framework, the academic literature maintains a strong focus on governance, workforce and health service delivery rather than taking an integrated approach to the health system (38). A number of frameworks recognize health system strengthening as a prerequisite to the development of resilience and the resilience attributes as foundational elements of the health system (15, 17, 31). While the various frameworks present different perspectives, the majority do

BOX 1 Commonly recognized resilience attributes (2, 29).	
awareness	the recognition of health system capacities and risks including population health needs assessment, mapping of health system assets, and mapping and modeling potential health risks
mobilization	the ability to mobilize and coordinate resources and support including functional mechanisms to support communication and engagement between health system levels and partners including allied sectors and mechanisms for resource sharing between various stakeholders
self-regulation	making required decisions in response to threats, including the technical capacities required to identify and isolate threats, management mechanisms to support the direct targeting of resources toward identified threats and the identification of additional capacities to support response and the maintenance of services when required
integration	integration between health systems strengthening and health security and preparedness including the necessary training to recognize emergency events and activate the appropriate plans at service delivery levels across all providers and integrated surveillance systems for priority risks and threats to health
diversity	providing the range of individual and population-based services required to meet population need including the provision of agreed essential packages of services with minimization of physical, financial and social barriers and the training necessary to recognize uncommon events when they occur
transformation	identifying and applying lessons including the presence of protocols to monitor the changing performance of the health system during shock events and guidance on comprehensive recovery planning based on sector-wide assessment

not stray far from the original resilience strategies of absorption, adaptation and transformation and tend to include at least some of the commonly recognized attributes.

3.4. Key requirements to support health systems resilience

The remainder of the results represent an expansion of the consensus on health systems resilience summarized above informed by critical reflection on the literature and considerations drawn from the co-authors experience of operationalizing health systems resilience. This seeks to address a critical block in the operationalization of health systems resilience by suggesting practical actions to be taken by policy and decision-makers working toward building health systems resilience across three key areas: integrated and resilience-focused health systems strengthening, systematic learning systems, and a system wide public health orientation. These are then incorporated into a working operational definition and aligned with existing health systems resilience indicators.

3.4.1. Integrated and resilience-focused health systems strengthening

Resilience is built over time, ideally before response is required, and should be continually developed and enhanced with experiences from all contexts. While resilience is not limited to emergency response, much of what we know about resilience is taken from this context as resilience, or its lack, is most easily demonstrated during shock events (18). This has had an impact on how resilience is viewed, measured, and implemented, with a tendency to focus primarily on the delivery of health services and the development of specific emergency response capacities rather than broader health system strengthening or what has been coined "inherent system resilience" (29). While emergency response capacities are necessary to address the direct effects of system shocks, inherent system resilience is required to address the indirect effects, by supporting the daily provision of services and enabling acute response in tandem. The strengthening of existing and foundational health system elements recognizes health systems as the basis for the daily provision of services while also providing capacities that can be leveraged whenever needed to address a range of shocks and stressors, acute or chronic (Box 2) (29, 39). If not previously addressed, this requires explicit focus from early in recovery to identify and address underlying weaknesses in these foundational elements that may have contributed to the impact of the shock (40).

Despite the focus on health service delivery, international experience has demonstrated that we need to strengthen governance and leadership, ensure adequate and sustainable financing, improve health information and surveillance systems, and strengthen human resources management and capacity (31). In short, we need a systems approach that embeds consideration of resilience within the health system building blocks as routine practice as well as in times of crisis and recovery (Table 1). This must start with high level commitment as this drives the legislative and policy environments and ultimately determines resourcing (18)(Box 3).

3.4.2. Systematic learning systems

Learning and transformation are consistently highlighted as central to the development of resilience but receive limited attention as an outcome or output, often attributed to difficulties in measurement (18, 36). Learning is key to health system strengthening and yet, the failure to implement lessons captured from prior experiences with PHEs at both national and global levels became quickly evident when COVID-19 appeared late in 2019 (38). Countries that did utilize lessons from previous PHEs, improved their health systems with strengthened public health capacities and had early success in reducing the spread of COVID-19 (Box 4) (29). Transformation is closely aligned with the goals of recovery which include rebuilding, restoration, and improvement of health system components, and relies on the ability to learn from experience (18, 36). As countries move beyond the acute phase of the pandemic the tendency is to fall back to pre-pandemic baseline levels of functioning, or back into the recognized panic and neglect cycle of emergencies (41). The systematic capture and translation of lessons identified from all contexts supports continuous improvement in services in routine times while helping to identify the new and ideal baseline for health systems in recovery to build resilience. It is this active transformation to a new sustainable baseline, above the pre-shock level but below that developed for response that supports resilience (Figure 1) (2).

> **BOX 2 The legacy of an integrated approach to health systems (8).**
>
> At the start of the Syrian refugee crisis, Lebanon had no clear policy to address the health needs of the displaced Syrian population. The Ministry of Public Health (MPH) provided immunization and primary health care services through existing structures while international donor agencies created parallel systems, leading to fragmentation and poor coordination of the health systems response to the crisis. The MPH called for an integrated approach to planning, financing and service delivery by embedding refugee health care within the national health system. A steering committee led by the ministry and including all international and local partners, guided the response. This was supplemented by targeted recruitment to primary health care, dispensaries and public hospitals to strengthen surveillance and emergency response capacities while catering to the health needs of the refugee population. This alignment and targeting of all available resources toward strengthening existing delivery structures highlights the systems legacy made possible by an integrated approach.

The need for health systems to become learning health systems that systematically generate and apply knowledge to promote continuous improvement in the behavior of the system has been long recognized (42, 43). However, learning focused activities are generally not prioritized as compared to more immediate health system pressures (42). Globally, there are systematic processes to capture lessons including Intra-action and After-action Reviews (IARs/AARs) and other post-incident reviews in virtually all countries but the majority of the recommendations remain un- or partially funded or implemented (44). The extent of implementation of lessons identified is a clear and measurable dimension of transformation, and while systematic methods to support the identification of lessons in all contexts exist, the mechanisms to ensure these lessons are incorporated into planning and budgeting cycles are often lacking.

3.4.3. System wide public health orientation

Global experience with PHEs including COVID-19 has also demonstrated the historic and widespread under prioritization of public health with respect to resourcing, planning, and overall health system reform. Even within public health efforts, preventive, health promoting, and other proactive measures have been under-prioritized compared to reactive elements such as emergency response and epidemiologic capacities. This has contributed to the false perceptions that health services, including PHC, consist only of individual, and disease focused aspects of care and that public health involves only health protection and has led to the failure of health systems to fulfill their public health remit in response to current public health challenges. The failure to adequately resource public health has also prevented health systems from harnessing the benefits of preventive and promoting interventions both within and beyond the health system, to reduce the burden on secondary and tertiary care in routine emergency situations by lowering the disease burden and overall population vulnerability. As demonstrated by COVID-19 and experience with other PHEs, piecemeal or *ad hoc* development of public health capacities is insufficient and leaves populations and therefore health, economic and political systems vulnerable to shocks events (29). In the context of recovery, EPHFs and their consideration within PHC is not only critical to achieve UHC but also health security. Primary care facilities provide the first point of contact between individuals and community and national health systems, constituting a critical interface with health security and a precursor to

TABLE 1 Example of integrated and systems-based approach to health system strengthening for resilience with implications for recovery.

Health system building block	Examples of resilience-focused actions	Examples of implications for recovery and transformation efforts
Leadership and governance for resilience	• Relevant authorities are enabled and provided with necessary mandate and resources to implement multisectoral national policy and strategy for protecting and maintaining population health and essential services at all administrative levels • Existence of a multisectoral coordination mechanism /platform to ensure coherent actions and multisectoral accountability for public health	• Establishing and strengthening dedicated institutional capacity for resilience can ensure policies, plans and regulations mandate systematic learning and application and follow-up of lessons identified. • Enables the leveraging of political momentum generated during response to make policy changes that promote recovery and resilience
Resilience-focused financing	• Financing models that support UHC and PHC with EPHFs and ensure proportionate investment in public health capacities • Financing mechanisms that promote rapid access to funding to ensure services, workforce and supply chains in all contexts	• Ensures engagement with vulnerable populations during acute response and recovery to identify and meet individual and population health needs • Ensures sustainable financing for the maintenance of essential individual and population-based services in all contexts with essential social protection.
Population focused quality and accessible individual and population health services	• Services oriented to identified population health needs • Recognition and strengthening of PHC for UHC and essential public health functions and services encompassing emergency preparedness and response	• Promotes efficient use of available resources in all contexts • Strengthening primary care to deliver essential public health services can reduce the dependence on hospitals and improve community participation.
Agile and adaptable workforce	• Ensure sufficient number, balanced geographical distribution and training of workforce to ensure quality and service maintenance in all contexts • Consideration of surge capacities and or redeployment within training	• Using recovery as platform to address gaps and improve health workforce competencies based on lessons identified • Supports workforce competence and wellbeing during response and recovery
Integrated and comprehensive surveillance and monitoring of health threats, status and services	• Integrated collection, analysis and interpretation of surveillance and health status and health system monitoring data • Data interoperability and mechanisms that support appropriate data sharing, including pre-positioning data sharing agreements and/or strengthening and updating these during recovery.	• Supports identifying health system capacities and performance baseline to inform planning with clear targets for recovery and building back better. • Ensures interoperability of surveillance and health information systems and sharing of data to support decision-making
Equitable and rational access to medicines and technologies in all contexts	• Equity considerations in national health service planning, delivery, and implementation • Monitoring of use of medicines and technologies with specific reference to access and equity	• Supports prioritization of older adults, vulnerable and marginalized populations in the recovery and transformation agenda • Allows mainstreaming and scaling up relevant response-related innovations, e.g., data, supply chain management, infrastructural innovations to support recovery

Ethiopia is promoting resilience by strengthening collaboration between the health authorities and technical teams responsible for health systems strengthening and service delivery at the ministry of health and those responsible for health security in the national public health institute. Activities include joint training, risk profiling, preparing for and responding to emergencies, and planning for health service continuity, simulation exercises, post-emergency evaluations, and the establishment of governance and coordination fora. This integrated approach has ensured that each activity draws on the interconnected inputs of all health system building blocks with multisectoral participation while enabling synergies between emergency management and health systems strengthening at all administrative and service delivery levels. This has led to better alignment between health systems strengthening and health security including the establishment of an institutional focus on health system resilience in the Ethiopian Public Health Institute and adopting resilience-focused activities in national public health activities and public health emergency management guidelines as well as the identification of health service continuity as a priority with clear representation of health system and services focused teams in the COVID-19 incident management structures.

The performance of South Korea and Vietnam stood out in their response to the first wave of COVID-19. Learning from experience with Middle East respiratory syndrome, the South Korean government took a decisive and aggressive strategy to detect, screen, and isolate cases with support of surge capacities. The public was willing to follow public health advice including wearing masks and cooperating with contact tracers, and took precautionary measures.

Vietnam had both the knowledge and infrastructure to take appropriate action in early 2020 from its experiences of severe acute respiratory syndrome in 2003 and human cases of avian influenza between 2004 and 2010. For example, Vietnam took a targeted approach to testing (e.g., scaling up testing in areas with community transmission) and conducted three degrees of contact tracing for each positive case.

health emergencies. In this context, the essential public health functions (EPHFs) offer a holistic and integrated approach to operationalizing public health, including emergency preparedness and response capacities, into everyday services and functions (Box 5) (30).

3.5. Moving beyond definitions and attributes

A resilient health system can prevent, prepare for, respond to, and recover from different kinds of shocks and stressors while providing quality services. This may involve absorption, adaptation, or transformation depending on the nature, size, or duration of the shock or stressor and is expressed through key capacities which again are broadly accepted. This conceptual agreement has been sustained over time and across different thematic literatures and represents a clear consensus on what defines health systems resilience: utilizing lessons and experience to effectively prevent, prepare for, respond to, and recover from a wide variety of shocks and stressors in order to deliver high-quality individual and population health services in all contexts. Despite this consensus, recent experience with COVID-19 has demonstrated that agreement alone has been insufficient to ensure it. The effective operationalization of health system resilience must translate this consensus in definitions and attributes into the promotion of resilience through strengthening of health system foundations and public health capacities based on learning from experiences in all contexts.

3.6. An operational definition of resilience

These three key requirements (Figure 2) present us with an operational definition of health systems resilience that can be applied within recovery efforts to ensure the development of health system resilience: the process of strengthening health systems to deliver quality
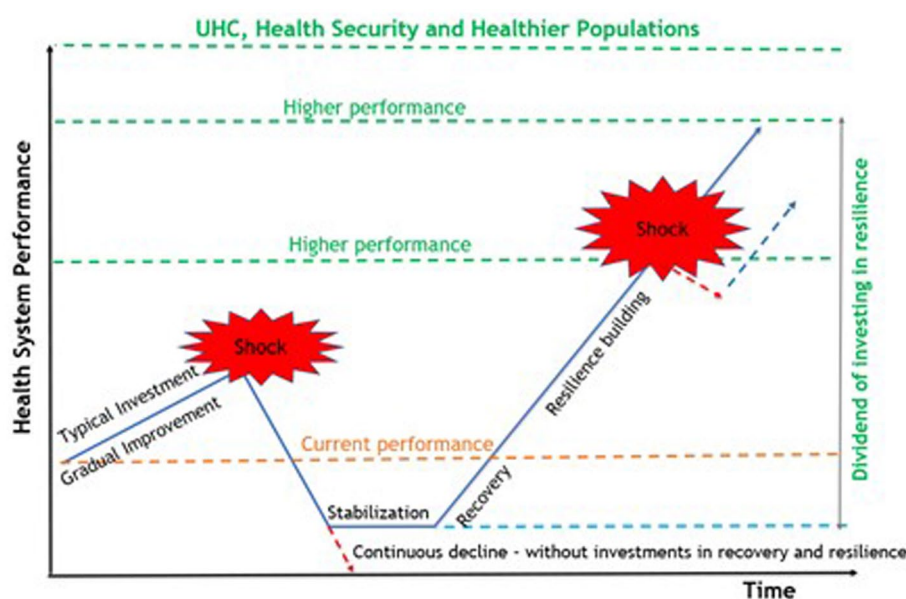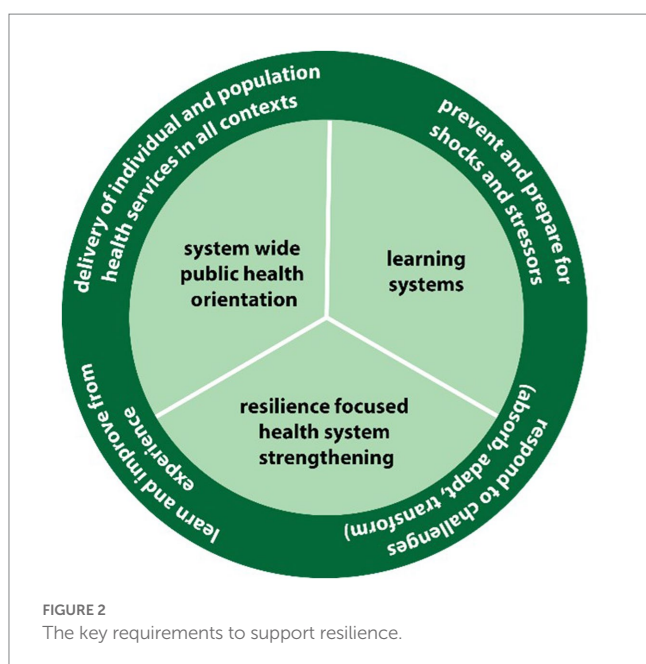

FIGURE 1
The resilience dividend.

FIGURE 2
The key requirements to support resilience.

BOX 5 The Essential Public Health Functions (EPHFs) (47).

The EPHFs are a set of interconnected activities that provide a health system with a public health orientation. A public health orientation is advantageous as it orients health systems toward population need and governments and societies toward health and wellbeing. The EPHFs provide an integrated approach to health systems strengthening and a multisectoral approach to health focused on the wider determinants of health and equity. Investment in EPHFs strengthens core IHR (2005) and health system capacities while recognizing and strengthening the role of PHC in public health, including emergency preparedness and response and promoting multisectoral accountability. This integrates emergency preparedness and response capacities into everyday health system functioning, strengthens PHC and builds resilience.

individual and population health services oriented to population need, in all contexts by embedding considerations for resilience within all health system elements, ensuring comprehensive and integrated delivery of public health capacities, and ensuring the systematic capture and translation of lessons identified from all contexts (Figure 2). This definition recognizes that while resilience is a desired outcome, building resilience is a process dependent on three interconnected actions, which are measurable in all contexts (22). To demonstrate this, examples of indicators drawn from ongoing work on measuring health system resilience, are presented in Table 2. By making resilience measurable in all contexts, this operational definition can be used to support global advocacy toward building resilient health systems as well as enhancing recovery efforts by providing a means of embedding resilience within recovery efforts (Table 2).

4. Limitations

The synthesis was built on two rapid literature reviews that informed WHO technical products (5, 38). These reviews involved focused searches using PubMed for academic literature, and as a result, some relevant sources may have been missed. However, the synthesis was supplemented and brought up to date with a further focused review within PubMed, including a targeted search of relevant references which included a number of literature reviews of the topic. Data saturation was reached early in the updated review. The searches were additionally supplemented by searches of international organizations involved in health systems, emergency preparedness and response, and humanitarian response. While quantitative approaches to measuring resilience were identified, their scope was not sufficient to justify an independent theme and they were included within the framework section (29, 35). A detailed scoping and comparison of these was also beyond the objectives of this synthesis.

TABLE 2 Key elements of resilience with example indicators for measurement in all contexts.

Key elements of resilience	Example indicator(s) (9)
Delivery of quality individual and population services oriented to need	• Health service prioritization process underpinned by population health needs assessment and risk profiling • Availability of a protocol or guidance for prioritization of services to be maintained in all contexts • Service package for essential health services and public health functions is developed and meets criteria
Health system consideration of resilience	• Proportion of health facilities including primary care that participated in any simulation exercise conducted in the last 12 months to test health system and service resilience • Structures in place to support emergency management using all hazards approach • Availability of a designated authority for health service/system resilience functions
Delivery of public health capacities	• Strategic assessment of delivery of the EPHFs including at primary care level • Existence of a national public health coordinating entity that is responsible for the integrated delivery of the EPHFs • Essential public health functions are integrated into broader national health and allied sectors' planning • Health financing arrangement includes public funding of population-based services
Systematic capture and translation of lessons in all contexts	• Implementation of recommendations of multi-sectoral reviews and intra and after incident assessments including a recognized budget line for activities and accountability framework • Percentage of health facilities that participate in a platform to share good practices and lessons learned from emergencies from the local context and beyond • Percentage of facilities that have guidance on comprehensive health system recovery planning and actions informed by situational reviews and analyses

5. Conclusion

The current global focus on health system recovery from COVID-19 and other shocks and stressors has been intertwined with the global discourse on resilience. While recovery is an inherent aspect of resilience, like resilience it is often overlooked in health system planning and budgeting, with health systems tending to passively fall back to baseline or near baseline functions during the recovery period. This is at odds with the active improvement envisioned within definitions of recovery and contributes to the chronic 'panic-neglect' cycle that has dominated emergency response efforts for decades. This has been demonstrated on a large scale in the response to the current pandemic (8, 48). With global economic costs in the trillions, and far-reaching social impacts including rising inequity and poverty, it must be clear that this approach is no longer sustainable (46).

As we enter what has been called a "new age of pandemics," current recovery efforts present us with the opportunity to learn from the past as well as an urgency to do better for the future (30, 48). The goal of recovery efforts is to build back better and transform health systems in ways that build resilience, but this process requires that the entities tasked with responsibility for the publics' health are appointed with the authority and mandate to draw the attention and resources to target the key requirements for building resilience when establishing the new system baseline. Harnessing recovery efforts to build resilience is among the key policy recommendations of the WHO's unified position paper on recovery and aligned with the regional priorities set out by the Regional Committee for the Eastern Mediterranean, and while there is no doubt that investment will be required, resilience is less about the absolute availability of resources and more about the smart use of all available resources within and beyond the health sector (12, 39). Ensuring all recovery investments contribute to wider system strengthening, reorienting health systems toward more cost-effective approaches including PHC and the essential public health functions and investing in learning systems are the key investments required today to ensure health system resilience for the future.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

GMD provided substantial contributions to the drafting and revising of the manuscript from conception to delivery. RS provided substantial contributions to the intellectual content of the manuscript and contributed to the revising of the manuscript and was responsible for the acquisition of significant data informing the work. YZ provided substantial contributions to the intellectual content of the manuscript and contributed to the revising of the manuscript. SM provided substantial contributions to the intellectual content of the manuscript and contributed to the revising of the manuscript. MP provided substantial contributions

to the intellectual content of the manuscript and contributed to the revising of the manuscript. GS provided approval for conceptualization and design of the work including approval for publication of content. DP provided approval for publication of content. SD provided approval for conceptualisation and design of the work including approval for publication of content. SS provided overall stewardship of conception as well as the acquisition of significant data informing the work as well as contributing to manuscript revision. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1105537/full#supplementary-material

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