



# Systems Integration: A Key Step Toward Strengthening Oral Health

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## THE CHALLENGE

A strong health system is critical if we are to improve health outcomes and accelerate progress toward increasing access to successful health programs and reducing disparities. Despite an established international consensus on the need to improve available health systems and/or create new ones, in general, there is no established framework for doing so no formula to apply for, and no package of interventions to implement. One may eventually note a lack of capacity to access weaknesses and constraints, and these existing omissions leave policymakers without scientifically sound ideas of how they should act, i.e., inform implementation and interventions. Transdisciplinary efforts are needed at the research, educational, clinical, and policy levels to bring together public and private sectors, citizens, clinicians, and researchers. A key operational element underlying integrated methods to advance healthcare for all communities is the use of system-based approaches.

## THE POTENTIAL FOR SYSTEM-BASED APPROACHES TO ADVANCE ORAL HEALTHCARE

In the context of this Grand Challenge (GC), we consider the concept of a system-based approach as defined by Wanjek (1). The perspective that a systematic approach may assist in improving healthcare by considering the multiple elements involved in caring for patients and multiple factors influencing health.

The system-based approach uses a collection of analytical tools aimed at examining a given problem and the context that it is embedded in (2–4), e.g., a number of interconnected factors including genetic and epigenetic information of an individual, microbial profile, ethnicity, gender, demographics, and access to healthcare programs. This complexity requires a system-based approach to recognize the role of social, economic, and environmental factors and their interactions to successfully tackle chronic conditions. Although systems thinking has been recognized for over 40 years, it has only recently begun to be used in clinical settings to assist in appropriate diagnosis, treatment, and expected outcomes (5–10). A good example of the use of a system-based approach in the dental settings is the report by Briggs et al. (11), in which the health impacts in the levy of a soft drink industry were investigated. Analyses were performed considering a wide range of elements, such as stakeholders, media and the public positions, consumer acceptability, and reformulation and consumption, along with the health impacts, as part of a complex system. A further example where value was added by using a system-based approach was the FiCTION trial (12). Taking everything into account, the system-based approach has unprecedented potential, first in decoding the complexity of an entire health system and then in employing such knowledge to support and evaluate new interventions that may improve health and health equity. In due course, the use of a system-based approach to oral health research will assist us in defining (i) challenges in the development of data-intensive analytical methods and theoretical models, (ii) areas where

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additional transdisciplinary research is needed, (iii) the required workforce, (iv) how to use data and theoretical approaches to guide regulatory processes, and (v) best practices for data sharing, data collection, and clinical trial designs to enable systems thinking across dental–oral–craniofacial ecosystems in the context of systemic diseases and conditions.

## ORAL–SYSTEMIC HEALTHCARE INTEGRATION: THE CONTINUOUS DEMAND FOR MORE COOPERATION

Following the conclusion of the studies by Flexner on medical education in 1910 (13), the Carnegie Foundation funded a similar survey on dental education. This process took about 5 years to be concluded, and in 1926, William Gies published his study, *Dental Education in the United States and Canada*, which tremendously impacted dentistry (14). One of the recommendations was a call for better integration between medicine and dentistry in order to best serve the needs of the population. Later, the 1995 report from the Institute of Medicine (IOM), *Dental Education at the Crossroads: Challenges and Change* (15), made 17 major recommendations, and a significant proportion of these recommendations focused on the relevance of better integration of educational programs between dentistry and other health professional programs, e.g., medicine, nursing, and pharmacy, in order to build a workforce that better reflects the diversity/needs of a given population. More recently, the IOM performed landmark studies to detail the oral health status in vulnerable and underserved populations of America (16, 17) and highlighted the need for the development of competent interprofessional teams to improve oral health. In this context, the relevance of integrating oral health into the overall health and the need for a closer alignment between dentistry and the other health professions stand clear.

Several initiatives worldwide have supported the move toward an integrated health system (IHS). At both levels, the educational and clinical care, the concepts of interprofessional educational initiatives (IPE) and interprofessional practice (IPCP) have been implemented at different levels to train future healthcare providers to facilitate and disseminate these models. The introduction of IPE programs has made significant progress over the years (18, 19). At the public health level, the recognition that integral healthcare (IHC) cannot be ensured without the inclusion of oral healthcare has led to the development of strategies in order to deliver better healthcare to a given population. The “Smiling Brazil” initiative is a good example of a strategy to integrate oral healthcare into a public healthcare system. In Brazil, nationwide surveys are used in order to generate epidemiological indicators, aiming at providing information for its public health decision-making process. In 2003, the National Household Survey (PNAD) detected that about 16% of the total Brazilian population (about 28 million people) had never visited a dental office, indicating, therefore, the urgent need to reassess the prevailing policies at that time. Thus, in 2004, the Smiling Brazil program was launched, and under this initiative, oral health was defined as one of the

priority areas of the Brazilian unified healthcare system. Ten years after implementing the Smiling Brazil initiative, oral health epidemiological indicators, professional development, and the building of an oral healthcare network are some of the positive outcomes (20). Under these initiatives, Roncalli and his group found a reduction in decayed/missing/filled teeth (DMFT) from 2.8 in 2003 to 2.1 in 2010, a DMFT decline in teenagers, and an increase in the number of caries-free subjects (21). In addition, compared to the 2003 data, Peres et al. (22) described a significant reduction in the prevalence of tooth loss in teenagers (22).

Other examples of the benefits generated by transdisciplinary collaborations include the following: (i) the creation of the field of periodontal medicine based on an understanding of common mechanisms linked to periodontal diseases and others, as well as the differences, ultimately leading to improved preventive and therapeutic strategies for oral and overall healthcare (23), (ii) the identification of salivary gland fluids as biomarkers (diagnostics) for certain diseases and most recently as a reservoir for coronavirus (24, 25), and (iii) the discovery of potential links between microbes in the oral cavity with an intestinal inflammatory response (26), colon cancer (27), and Alzheimer’s disease (28).

Importantly, healthcare providers will have to learn key skills, including communication, collaboration, humanism, and management of medically complex patients, in order to actively participate in this new era of exponential growth in the use of an evidence-based system integration approach to deliver healthcare.

## A CALL FOR INTERDISCIPLINARY AND TRANSDISCIPLINARY INITIATIVES

Oral health is a critical aspect of overall health, and there is a price to be paid for not considering it. Governments and professional associations now recognize that professional silos present across healthcare providers (e.g., physicians, dentists, and others) are not in the best interests of developing patient-centered care models (29, 30). There is a need to break down the existing silos between healthcare professionals (HCPs) at all levels, from education and research to clinical practice so that integrated models are enabled with the ultimate goal of improving overall healthcare for all communities. There are terrific opportunities to apply collaborative initiatives across areas and sectors through research on the broad spectrum of determinants of oral diseases, aiming at addressing and exploring strategic routes linking behavioral, economic, environmental, psychosocial, political, and biological factors among other factors to the processes and outcomes of diseases. Contemporary challenges are complex, and addressing them requires integration and collaboration between experts with distinct backgrounds (31, 32). “*We cannot resolve any of the big challenges we face in the future with just people who have sat in silos coming together*” [cited in (33)]. It is now recognized that different expertise is mandatory to renew science and to provide state-of-the-art service, and **interdisciplinary** and **transdisciplinary** expertise have been recognized as the more critical ones. Although **interdisciplinary** and **transdisciplinary**

efforts provide a great desire for bringing holistic, out-of-the-box thinking to an increasingly specialized workforce of experts, additional studies should be considered to better define the impact of interprofessional education and collaborative care on health outcomes for large populations. There is an opportunity for dental and other health professions to take the lead on such initiatives.

Despite the potential knowledge gained from interrogating dental–oral–craniofacial (DOC) conditions in the context of the whole body, physicians and dentists continue to be educated separately, employ a different language, and typically operate on different electronic file operational systems. As a result, oral healthcare has been left to the dentist, almost closing the doors for applying integrated care. A contemporaneous example of such a lack of collaborative strategies in resolving multidisciplinary health problems is the reports on a condition of exposed necrotic bone in oral surgery patients who were under antiresorptive agents named bisphosphonates (34). Patients described were patients with cancer being treated for hypercalcemia, metastasis, and other comorbidities, and although such patients were taking other medications, the use of intravenous bisphosphonates was a commonality. These cases were termed osteonecrosis of the jaw (ONJ). In the literature study, throughout these 18 years, dentists have been continuously called to work collaboratively with primary care physicians, endocrinologists, and oncologists to more comprehensively treat these patients. In contrast, dentists and scientists have been minimally asked to work as part of the team that will include immunologists, cancer researchers, and microbiologists to define the potential mechanisms involved with ONJ and also to establish scientific-based guidelines for care. Another illustrative example of the need for more intensive collaborative initiatives is the recognition that the mouth may serve as a reservoir of newly discovered bacteria and that leads to the design of more comprehensive therapies. Other examples underlying a call to action involve the emergence of new and/or little-known conditions that take the world by storm, including Zika virus and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic.

The Learning Health System (LHS) is an example of an attempt to integrate the disciplines of biosciences (36). The LHS is an IHS “*in which progress in science, informatics, and care culture align to generate new knowledge as an ongoing, natural by-product of the care experience and seamlessly refine and deliver best practices for continuous improvement*

*in health and healthcare*” [cited by Institute of Medicine (36)]. It is now time for a transformation where digitalized health files will go beyond simply accounting for portions of individual care. These documents must also make ongoing assessments available and provide information on therapy outcome, effectiveness, and the potential association between diseases that will later be collectively assessed and will be used to making informed decisions at the individual and collective levels. The advance of such systems will highly depend on the collaboration of several areas, such as education, innovation, and research, occurring at the convergence of multiple and distinct disciplines (35).

## FINAL REMARKS

It is evident that changes are necessary to improve the current healthcare systems, given their safety, quality, cost, and complexity challenges. In this context, a system-based approach to research, from basic to clinical, by increasing our understanding of how different parts of the system interact with one another and by developing models for implementation of evidence-based approaches will result in huge benefits for care delivery to all communities.

Despite all the actions and policy support, the transformational capacity and the possibilities of **interdisciplinary** and **transdisciplinary** research and healthcare approaches, as well as their critical role in shaping knowledge to approach future questions with regard to health professions, including dentistry and medicine, have historically developed independently, with separate education, clinical networks, records, funding, and insurance arrangements. We are convinced that it is critical to overcome this divide in order to perform better and maybe then we can put “*the mouth back in the body.*”

## AUTHOR CONTRIBUTIONS

FN prepared the manuscript, confirms being the sole contributor of this work and has approved it for publication.

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