



Building Emergent Cycling Infrastructure During the COVID-19 Pandemic: The Case of Zapopan, México

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The COVID-19 pandemic has led to strict measures intended to limit people's movement and slow viral spread. The subsequent need for social distancing when traveling has driven many cities to reduce public transport services, as urban residents simultaneously stay at home and avoid crowded spaces. As a result, cities are turning to cycling to meet the mobility needs of their inhabitants, particularly those who lack access to a private vehicle. Infrastructure plays a critical role in encouraging cycling by protecting cyclists and providing safe and comfortable conditions for users of various confidence levels. Due to the pandemic, this infrastructure has been rapidly constructed, in many cases, as pop-up or temporary installations. In this article, we present and examine the design methods and community response to an emergent bike lane along Avenida Guadalupe in Zapopan, México during the COVID-19 pandemic. Through this examination, the paper distills and highlights the key features of a successful emergent bike lane in the urban Global South and identifies gaps in need of filling. The emergent intervention is 4.2 km and includes a number of traffic calming elements such as bollards and markings, connecting the peripheral part of the city to the existing cycle infrastructure. This case study shall contribute to a greater understanding of emergency mobility planning practices during crises such as the COVID-19 pandemic, as well as future directions for the expansion of cycling infrastructure and networks, especially in Latin America and the broader Global South.

Keywords: cycling infrastructure, COVID response, global south, active mobility, road safety, bike lane design, transport planning

INTRODUCTION

The COVID-19 pandemic has both highlighted the importance of urban mobility and radically re-shaped it. Social distancing measures intended to limit viral spread have dictated global mobility patterns for over a year and their effects could persist long after the pandemic passes. Public transport has seen significant changes in ridership, with cities reducing services to mitigate the risks associated with close contact in enclosed spaces (De Vos, 2020; Gkiotsalitis and Cats, 2021). Faced

with this crisis, cities have turned to cycling to not only provide for the immediate mobility needs of their residents, but also for advancing sustainability initiatives, namely, to reduce greenhouse gas emissions (Pucher and Buehler, 2017).

In Latin America, cities are poised to advance cycling due to their density and mixed land uses that would ensure high accessibility to various resources and services via bicycle (Jirón, 2013; Jaitman, 2015). Already, several urban metropolises in the region have begun their cycling journeys, by adopting bike friendly policies and investing in cycling initiatives (Sibilski and Targa, 2019). The COVID-19 pandemic has also fast-tracked cycling agendas by presenting an opportunity to rapidly construct pop-up bike lanes that many cities hope to make permanent (Rauls, 2020; Schwedhelm et al., 2020; Estrada and Zavala, 2021).

Like much of the existing literature on cycling, emerging studies on cycling during the COVID-19 pandemic are skewed toward developed countries (Torres-Barragan et al., 2020; Nikitas et al., 2021). The following paper begins to bridge this gap by contributing not only to a greater understanding of emergency planning practices, but also to the understanding and future expansion of cycling infrastructure in cities of the Global South. It does so by shedding light on the case of the emergent cycle lane on Avenida Guadalupe in Zapopan, México.

This paper first analyzes the design of the cycle lane using the renowned design principles from the Dutch CROW Design Manual for Bicycle Traffic, followed by a discussion and recommendations for some of the challenges of transport planning in the Global South that can be identified from Zapopan's example. The paper also discusses community opposition to the bike lane within the concept of "bikelash."

Role of Safe Cycling Infrastructure

Cycling ridership is acutely influenced by the natural and built environments. Cycling infrastructure has a key role in promoting cycling by upping its safety and drawing in new cyclists (Buehler and Dill, 2016). Segregated bike lanes, meaning those physically separated from traffic, are especially associated with improved actual and perceived comfort and safety by riders (Lusk et al., 2011; Jacobsen, 2015; Ling et al., 2020).

Existing literature has largely focused on the importance of bike lanes for encouraging cycling (Hull and O'Holleran, 2014; Mölenberg et al., 2019), and evidence shows that there is a positive correlation between segregated cycle lanes and increased cycling trips (Garrard et al., 2008; Dill, 2009; Monsere et al., 2014). However, less is known about whether these relationships persist in cities of low- and middle-income countries (Savan et al., 2017; Sabyrbekov and Overland, 2020). Despite economic progress in Latin America, poverty remains widespread and for many urban residents, walking and cycling are essential forms of mobility, regardless of the safety or comfortability of the environment (Hidalgo and Huizenga, 2013).

The remainder of this paper is divided as follows: Section Case Context: Zapopan, México presents the context of the emergent bike lane, Section Discussion discusses the bike lane through application of the CROW Design Manual, Section Lessons Learned and Practical Implications details lessons learned and

practical implications, and, finally, Section Conclusion concludes with a summary of the main takeaways.

CASE CONTEXT: ZAPOPAN, MÉXICO

Zapopan is a city and municipality, located in the state of Jalisco in central México and forms part of the Guadalajara Metropolitan Area (AMG). Zapopan also has the largest index of wealth and income GDP in the state of Jalisco (City of Guadalajara, 2019). However, Zapopan retains the highest numbers of people living in poverty in the state (28.1% of the population is in poverty and 1.9% of the population is in extreme poverty) (CONEVAL, 2020).

In Zapopan, approximately 55% of trips are via bus or BRT in the AMG, 30% are by private vehicle, and 3.4% by bicycle (Jalisco Cómo Vamos, 2020). A survey undertaken by the city in 2018 also revealed that residents spent an average of MXN\$15.97 on public transport (Polymetrix, 2018), amounting to ~11% of daily income if the person is earning minimum wage.

A ranking by the Institute for Transportation Policy and Development, known as the Ciclociudades Ranking, recently placed Jalisco and its cities at the top. The Ciclociudades Ranking is a tool that generates information on bicycle use as a transport mode and measures the performance of bicycle mobility policies in Mexican cities (ITDP, 2021). In 2020, Guadalajara took first place—officially unseating the capital, México City, from its tenure at the top (ITDP, 2021).

For road traffic crashes involving cyclists, Guadalajara has historically led Jalisco for fatalities and injuries followed closely by Zapopan. According to data from Jalisco's Ministry of Transport (SETRANS, 2020), Guadalajara has witnessed 131 cyclist deaths and injuries from 2017 to 2019 and Zapopan has witnessed 87. In 2019, there were 27 cyclist deaths and injuries in Zapopan alone (SETRANS, 2020).

The Emergent Bike Lane

With the onset of the COVID-19 pandemic, Zapopan was faced with finding ways to meet the mobility needs of its residents while limiting viral spread. To ameliorate this problem, the Municipal President of Zapopan, Pablo Lemus, presented an emerging cycle lane strategy (Government of Zapopan, 2020a). The strategy consists of three bicycle lanes that will connect Zapopan with Guadalajara, totaling 15.3 km of new infrastructure (Government of Zapopan, 2020a) and an investment of MXN\$30 million (Ochoa, 2020). The first of these lanes was built on Av. Guadalupe from May to July 2020, linking southwest Zapopan to central Guadalajara. The selection of Av. Guadalupe for the strategy was primarily based on a 43% increase in ridership in the morning and a 33% increase in the evening on the corridor over the past 3 years (Government of Zapopan, 2020b).

Since 2008, the bike lane along Av. Guadalupe has been part of the AMG's long-term transport plans (Government of Jalisco, 2009; Government of Guadalajara, 2010). In 2015, the bike lane became a government priority (Government of Zapopan, 2020c) due to the connection it would bring from the west part of Zapopan, known for high rates of poverty, to the metropolitan center, where greater economic opportunity exists (IMSS, 2021). A survey has also shown that within a 5 km radius, approximately



FIGURE 1 | Before (left) and after (right) installation of the bike lane on Av. Guadalupe.

20% of households do not own a car or truck and approximately 27% use a bicycle as a mode of transport (INEGI, 2010).

With an investment of MXN\$14 million, the emerging bike path on Av. Guadalupe stretches 4.2 km and is equipped with traffic calming measures. As part of the project, the width of the corridor was reduced from six car lanes to four. The city initially began with horizontal markings and temporary segregation elements, such as cones and meshes, to expedite use of the lane (Government of Zapopan, 2020b). As the work progressed, definitive segregation elements were implemented, including trapezoidal concrete bollards, known as “quesadillas” (Figure 1) (Government of Zapopan, 2020b). The bike lane also includes horizontal and vertical markings, tap painting, folding bollards, and vialotons (raised pavement markers) (Government of Zapopan, 2020b). The final design of the bike lane set the width at 2.80 meters with 1.80 meters for transit and 1 meter for the buffer. Intersections were marked with colored thermoplastic paint and damaged surfaces were re-paved to increase cyclist comfort and safety.

The emerging bikeway on Av. Guadalupe connects to the cycling infrastructure of downtown Guadalajara (Government of Zapopan, 2020b) and will connect to a new BRT line at Periférico beginning 2022. The portion of the cycle lane built between Niño Obrero Street and the Chapalita roundabout was paid for through Jalisco State funds, whereas the lane built between Niño Obrero Street and Periférico was paid for by the city. When the city allocated its budget, the funds initially allowed for the bike lane to only be built between Niño Obrero Street and Rafael Sanzio Avenue. However, the Mobility and Transport Directorate moved to invest in nearly doubling the length of the emergent cycle lane due to the needs of the pandemic, leading the Directorate to restructure its MXN\$16 million annual budget. The city chose to pause several other projects that were not feasible in the pandemic for a year to do so (Government of Zapopan, 2021).

During the planning of the bike lane, the city also consulted several external actors, including the World Resources Institute (WRI) and other partners of the Bloomberg Initiative for Global Road Safety. The WRI México team carried out a crash study using data from SETRANS (2020), reviewed the proposed design of the cycle lane, and offered design recommendations. The crash study showed a total of 143 conflict events, of which 10% resulted

in injury between 2014 and 2019. The study also found that 88% of all crashes occurred at intersections, with the intersection at Periférico being the most dangerous with 40% of all crashes. The study was used to better understand the traffic dynamics along the corridor and to identify intersections for redesign.

Community Engagement and Opposition

On May 19th, 2020, the municipality of Zapopan began constructing the emergent cycle lane on Av. Guadalupe (Government of Zapopan, 2020b). The Government of Zapopan, via the Mobility and Transport Directorate, organized a dialogue with residents, neighborhood representatives, and businesses in the area, as well as publicized the project prior to its launch through virtual meetings, telephone assistance, social networks, and WhatsApp (Government of Zapopan, 2020b).

On June 3rd, the Mobility and Transport directorate held a virtual meeting with 50 residents to provide a detailed explanation of the project (Government of Zapopan, 2020b). The studies and technical justifications of the project were also provided during this meeting (Government of Zapopan, 2020b).

Several weeks later, residents from gated condominiums near Av. Guadalupe protested the cycle lane’s construction, citing increased traffic and claiming this congestion will endanger the cyclists (Hernandez, 2020; Ríos, 2020). This complaint largely arose from reduction in car lanes along the avenue (Ríos, 2020). The opposing residents proposed that the cycle lane be placed in the median, however the city did not agree to this due to safety, cost, and logistical concerns (Ríos, 2020). The residents protested by flying banners, gathering *en masse*, and parking private vehicles on the street to prevent construction (Chávez, 2020). Occasionally, confrontations would occur between residents and the personnel building the bike lane and police were frequently called to attend to the protests.

After weeks of protest and obstruction, an agreement was reached between neighborhood representatives and public servants to continue work on the cycle lane starting on July 11 (Government of Zapopan, 2020d). As part of this agreement, 17 requests from the neighborhood residents were accepted, most of which take aim at improving vehicular flow along the avenue (Government of Zapopan, 2020d). Included in the residents’ list of demands was a 30% reduction in waiting times at three

TABLE 1 | Comparison of 2016 and 2020 cyclist capacity on Av. Guadalupe.

Capacity 2016				Capacity 2020			
Concentrated capacity over 6 total hours							
Morning total	671	PCPS*	1 every 32 sec	Morning total	1,039	PCPS	1 every 21 sec
Evening total	716	PCPS	1 every 30 sec	Evening total	988	PCPS	1 every 22 sec
Total			1,387	Total			2,027
Increase in cyclist circulation				31.6%			

*Presence of cyclists per second.

TABLE 2 | Cyclist counts taken at the Av. Guadalupe/Periférico intersection and the Av. Guadalupe/Niño Obrero intersection prior to construction (May 2020), after completion (August 2020), and in May 2021.

Cyclist counts	May 2020		August 2020		May 2021*	
	Men	Women	Men	Women	Men	Women
Guadalupe and periférico/naranjos						
Cyclists	363	8	319	14	425	14
Percentage	98%	2%	96%	4%	97%	3%
Total		371		333		439
	% general variation		10.24% –		32% +	
Guadalupe and niño obrero						
Cyclists	46	4	90	18	145	15
Percentage	92%	8%	83%	17%	91%	9%
Total		50		108		160
	% general variation		116%+		48.15%+	

*May 2021 counts were only taken between 18:00 and 20:00.

specified traffic lights as well as several intersection redesigns to provide for protected left turns. In addition, the residents also requested the median along Av. Guadalupe be reforested, which the city has since completed.

Impact

The city initially projected that the emergent bike lane would increase daily capacity from 2,000 riders to 10,000 based on an estimation of potential cyclists in the area. However, reaching the bike lane's projected capacity could be a long-term process as new riders take up cycling, which may contribute to the lower cyclist counts seen soon after implementation. Actual cyclist counts reveal that in August 2020, 2,875 cyclists were registered, that is, 26% more than in May 2020 and 31.6% more than in April 2016 (Table 1) (Government of Zapopan, 2021). The counts also show that 10% of the total cyclist trips were made by women. For the 2020 counts, this capacity was measured from 6:45 to 9:45 in the morning and from 6 in the evening to 9 at night.

Cyclist counts taken prior to construction in May 2020 and counts taken in August 2020 just after completion of the first phase of the bike lane saw significant increases at the Niño Obrero intersection, but a fall at the beginning of the corridor where Av. Guadalupe joins with Periférico. A comparison of cyclist counts from May 2020 to May 2021 show sizeable increases at both ends of the corridor, especially at the intersection of Niño Obrero.

Regarding Zapopan's goal of connecting its southwestern neighborhoods with opportunities and services in central Guadalajara, cyclist counts demonstrate that more cyclists are using the corridor than before (Tables 1, 2). In addition, the increase in cyclists at the eastern end may indicate that more cyclists are riding the full length of the corridor and connecting to the downtown Guadalajara cycle network than previously.

DISCUSSION

Many cities have developed bicycle infrastructure planning and design guidelines, however there are also generic guides that offer design recommendations to suit a range of communities. Yet, these guidelines often neglect the preferences and behaviors of cyclists, which play a crucial role in building effective and efficient cycling infrastructure (Broach et al., 2012; Madsen and Lahrmann, 2017).

The Dutch CROW Design Manual for Bicycle Traffic offers a set of generic guidelines that have been cultivated and refined for nearly three decades, having first been published in 1993. Given the Design Manual's longevity and success in the Netherlands with its high rates of cycling, principles found in the CROW Design Manual arguably demonstrate a comprehensive understanding of cyclist behaviors and preferences (Zhao et al., 2018).

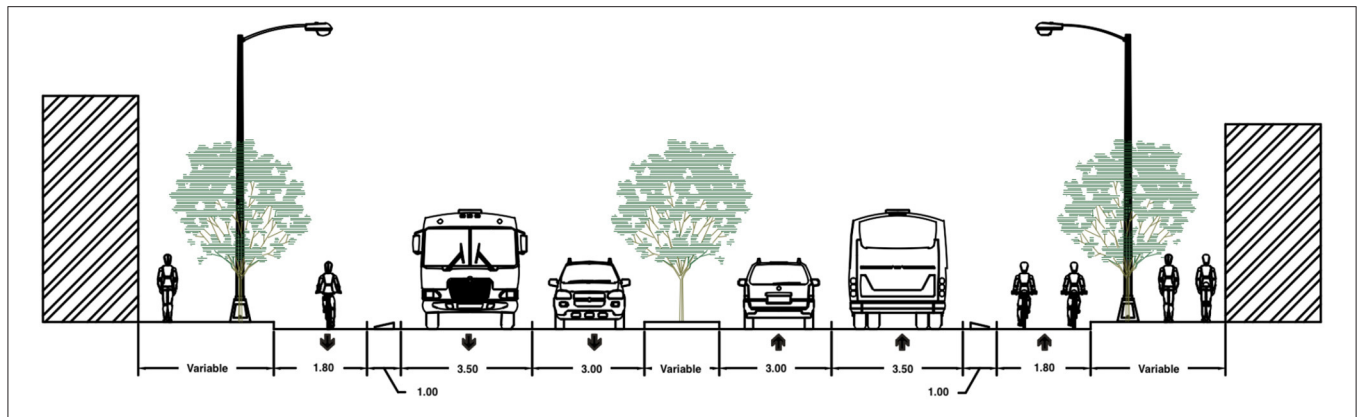


FIGURE 2 | General schematic of the Av. Guadalupe bike lane design.

In 2007, when an updated version of the CROW Design Manual was published, it included five general principles for designing bicycle infrastructure, derived from the Design Manual's previous iterations (Groot, 2007). These principles are safety, directness, cohesion, comfort, and attractiveness (Groot, 2007), and for utility-oriented cycle routes, this is also the order of priority (European Commission, n.d.). When conflicts arise between principles, safety should be prioritized, such as avoiding dangerous stretches at the expense of directness or cohesion (European Commission, n.d.).

Because the CROW principles are broad enough to be transferable and adaptable to diverse contexts, we can use them to analyze bicycle planning practices and identify strengths, weaknesses, and gaps in planning processes and design (Hull and O'Holleran, 2014). This case study examines the emergent bike lane on Av. Guadalupe through the five CROW principles as the benchmark for high-quality cycling infrastructure.

Safety

Protecting cyclists and other road users from harm is the top priority for cycling infrastructure according to the CROW Design Manual (Groot, 2016), and safety is best ensured through design that limits conflict between cyclists and other road users. Safety is not only important for preventing fatalities and injuries, but also for promoting cycling, as safety concerns are often a major obstacle to ridership (Golub et al., 2016; Ravensbergen et al., 2020).

Achieving high levels of cyclist safety requires segregating the cycle lane and ensuring cyclists have adequate space to maneuver (Groot, 2016). Av. Guadalupe has adhered to this principle well, even including separators in the initial stage by using cones and mesh rather than painting a temporary line. The subsequent implementation of plastic bollards and concrete quesadillas will also continue to protect cyclists. In addition, the width of the cycle lane exceeds the minimum recommendations from WRI by 0.3 meters, whereas WRI recommended a minimum total width of 2.50 meters (1.50 meters for the lane and 0.6–0.9 meters for the buffer), the city implemented a lane totaling

2.80 meters (1.80 meters for lane and 1 meter for buffer) (Figure 2).

Outside of design, safety, whether actual or perceived, can also be affected by factors such as crime and lighting, which can impact travel mode choice (Garrard et al., 2012; Singleton and Wang, 2014). Although an analysis of these other factors lies outside the scope of this paper, the city has recognized this issue and taken steps to holistically further the safety of the bike lane. For example, the city conducted an exploratory night ride on Av. Guadalupe with a group of five women in September 2020 to identify each of the factors that contribute to the perception of safety on the journey, as well as those elements that are identified as unsafe to improve the quality of both the infrastructure and the environment. The findings of the night ride were then integrated into the planning methodologies for both the present project and future strategies.

Directness

Directness of a cycle route refers to optimizing travel time and distance. The most direct routes minimize travel time and travel distance to better compete with other transportation alternatives, such as passenger cars (Groot, 2016). However, directness does not always mean selecting the shortest distance. Factors like grade and number of intersections should also be considered (European Commission, n.d.).

Av. Guadalupe was primarily selected to provide a direct route from lower income residential areas to employment in central Guadalajara (Government of Zapopan, 2020b). The route is also almost entirely at a level grade, but Av. Guadalupe also has 27 intersections, only 12 of which are signalized. The WRI crash study found most traffic crashes occurred at intersections prior to implementation of the bike lane. Data on crashes post-implementation is not yet available, however the volume of crashes seen in the study indicates a need for more intensive intersection redesign, especially at the Av. Guadalupe/Periférico intersection. Four intersections have already been redesigned along the corridor to improve directness and safety. These redesigns include safety zones at the crossings, corners with universal accessibility, tactile guides, and bollards.

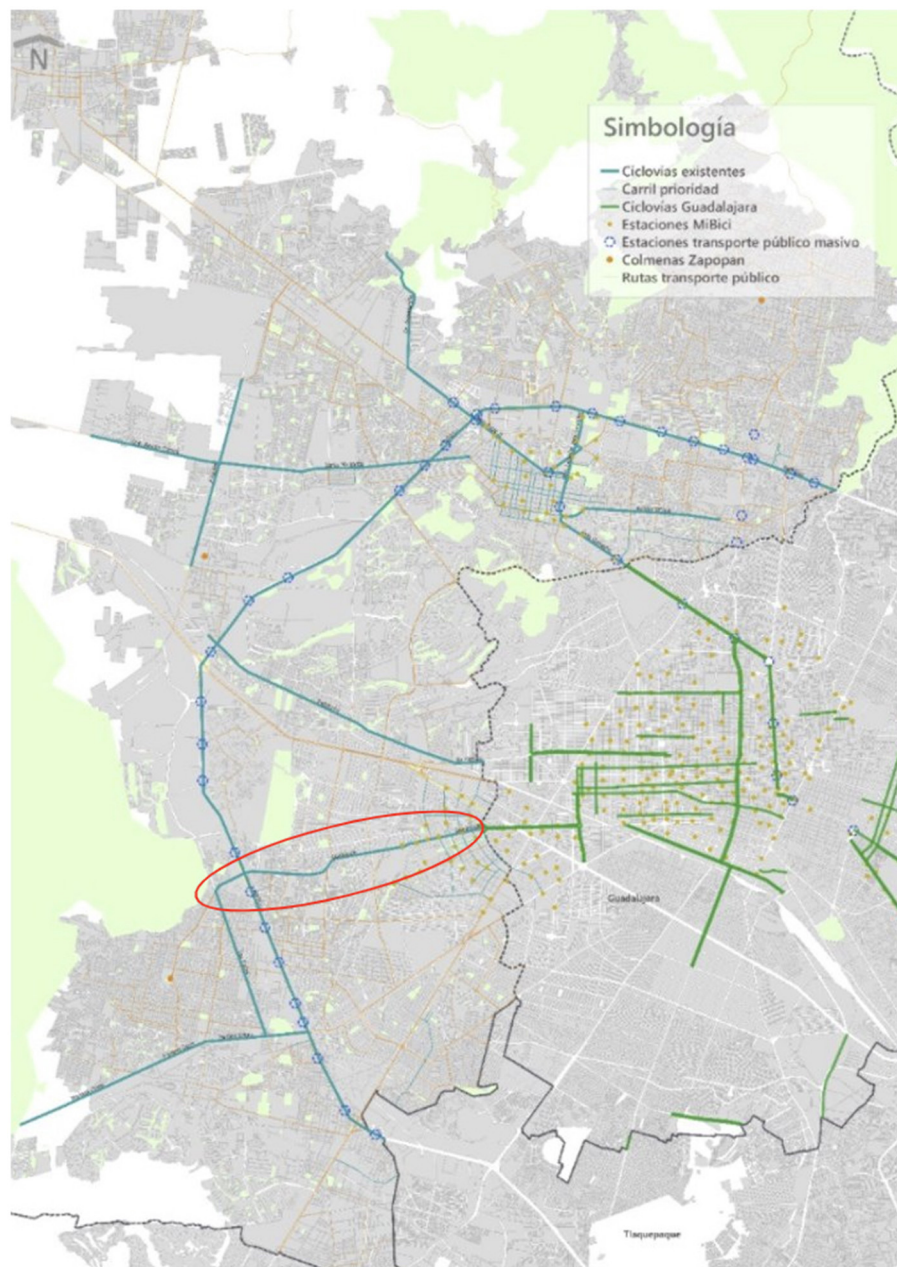


FIGURE 3 | Location of cycle lanes in Zapopan (blue lines) and Guadalajara (green lines). Av. Guadalupe is shown encircled in red.

Intersection improvement is important because it reduces the travel time for cyclists by simplifying the navigation required, while increasing safety.

Cohesion

The cohesion of a cycle route, or a cycle network, hinges on the ability of cyclists to move from origin to destination with relative ease (Groot, 2016). As such, cycle lanes should include connections to public transport as well as strive to be continuous, well-signed, and recognizable. High-level cohesion also entails

cyclists are consistently protected by segregated infrastructure with as few lapses as possible.

Although the emergent cycle lane at Av. Guadalupe does connect to pre-existing cycling infrastructure that enters Guadalajara (Figure 3), the map shows a disparate and widely separated cycling network in Zapopan. Many of these lanes connect to Guadalajara's downtown cycle network. In this way, Zapopan's network serves primarily as a feeder system to the services and opportunities found in Guadalajara rather than as a link between places and neighborhoods in Zapopan itself. The

creation of the emergent cycle lane is to an extent bridging this gap, as the emergent cycle lane connects to neighborhoods in the west.

Comfort

For cycle infrastructure to provide comfort, i.e. a smooth and stress-free ride, the cycling surface should be level, have an appropriate width, and reduce vibrations and obstacles (Groot, 2016). Comfort is further enhanced when the other principles are adhered to, such as safety and cohesion.

Given the bike lane's rapid construction the final two CROW principles had less priority during implementation. This is evidenced by the city's later maintenance to remove dangerous gratings and ensure an even surface after concerns were raised by the community (Avelar, 2021). The later construction also included constructing floating bus platforms (Vega, 2021) to minimize conflicts between pedestrians and cyclists, as well as increase comfort for both users. Much of this later construction was informed by feedback from cyclists and residents.

Attractiveness

When cycling infrastructure is aesthetically pleasing and interesting, more people are likely to take up cycling or cycle more (Groot, 2016). To ensure attractiveness, the infrastructure should be well-maintained and well-integrated into its environment.

Attractiveness is frequently subjective; however, efforts show that the city took care to build an appealing and well-constructed bike lane as evidenced in the design of the buffer and use of colored paint, which also improves safety and visibility. Av. Guadalupe is a complex corridor, passing through diverse land use and income areas. There are high-density neighborhoods, gated communities, schools, and a tourist area with restaurants as well as large surrounding areas with populations living in poverty. This diversity poses a challenge on implementation and integration of the bike lane (Stehlin, 2019), which can be partially seen in the opposition of some resident groups.

LESSONS LEARNED AND PRACTICAL IMPLICATIONS

Emergency transport planning can be a double-edged sword. Although crises like the COVID-19 pandemic give a political mandate for implementing cycling, or other active travel, projects that may have previously lacked political or public support, the speed of such actions brings its own obstacles, which if not taken into consideration can lead to negative effects.

From Zapopan's case, several issues can be distilled, including community opposition and feelings of disenfranchisement, limited funding resources, and a lack of speed management. These obstacles are not uncommon when projects are rapidly implemented regardless of global location, however in the Global South, these obstacles existed prior to the COVID-19 pandemic and will persist beyond it. By identifying these process gaps and offering methods to bridge them, this paper contributes to the advancement of cycling infrastructure and design in México, Latin America, and the Global South more broadly.

Community Opposition

For Zapopan, the greatest obstacle was opposition from residents living near the cycle lane. A phenomenon occasionally termed "bikelash" in the literature (Wild et al., 2017; Field et al., 2018). Although the pandemic required emergency active travel measures be implemented around the world, opposition to these initiatives from urban residents or local officials was not uncommon, especially when motorists lost access to road space (Cantrill, 2020; McIntyre, 2021; Smith, 2021). In the context of the pandemic, municipalities may underestimate the scale of bikelash because emergent cycle lanes appear to be a clear method for limiting harm to the municipal population. Even outside of the pandemic, there is evidence that cities often underestimate the scale and intensity of bikelash (Lubitow and Miller, 2013; Vreugdenhil and Williams, 2013; Duarte et al., 2014).

Bikelash is largely thought to arise out of motorist irritation over reductions in car lanes or parking to accommodate bicycle infrastructure (Vivanco, 2013; Spotswood et al., 2015). In some cases, such as that of Zapopan, this annoyance grows into organized opposition in the form of protests against the implementation of a cycle lane. What bikelash reveals about transport planning is that the traditional technocentric paradigm is unsuited to understanding and incorporating the social, political, and cultural aspects of mobility (Field et al., 2018).

Techno-centric policymaking that presents projects, such as cycling infrastructure, as neutral solutions runs the risk of creating power imbalances in the governance process when decisions are made through a strictly top-down approach (Timms et al., 2014; Ralph and Delbosc, 2017). In the Global South, greater levels of poverty and variation in socioeconomic status also likely exacerbate the power imbalances created through techno-centric policies because low-income populations have historically not been well-represented in the political process (Bayat, 2000; Devas, 2004).

Coupled with opposition from motorists, this lack of representation for low-income populations—who would benefit most from improved cycling facilities—adversely impacts the likelihood of cycling policies coming to fruition. For bikelash, this means the hostility arising in the Global South may largely stem from higher income populations that drive private vehicles as their primary mode of transportation. However, like other cycling literature, bikelash is not as well studied in the Global South and requires further investigation (Duran et al., 2018).

Steps can be taken to reduce bikelash and should be considered for future cycling initiatives, such as *shifting to expecting and preparing for bikelash, rather than responding reactively* (Field et al., 2018). Bikelash can also be mitigated by *involving the community, especially disadvantaged groups, in the long-term education and consultation processes of transportation planning*. Early involvement in the process can furnish the community with a sense of ownership over the project and surface any deep-seated concerns (Wild et al., 2017).

Funding Resources

Funding for infrastructure projects reflects the policy priorities of governments, whether at the local or national level. In Latin America, car-oriented planning continues to take the lead

in most cities, indicated by the large investments in roads and infrastructure catering to motorized vehicles. According to the Anatomy of Mobility in Government of México (2018) report, between 2013 and 2017, 74% of spending on mobility projects in México went to roads or infrastructure for cars, whereas cycling only received 1.54%. Jalisco makes up the vast majority of this spending. The report revealed that Jalisco invested MXN\$375 million in non-motorized transport, which is 22% more than the combined spending of the other 31 states.

Underlying Jalisco's, and more specifically, the AMG's large spending on cycling is a strong policy foundation that was gradually created through the institutionalization of cycling planning. This is exemplified by the inclusion of rights and protections for cyclists in the 2017 Mobility Law passed by the state, which also mandates that governments implement bike lanes and bike parking facilities (Government of Jalisco, 2017). Several years before this law, Zapopan itself had created a Strategic Projects Office to address long-term urban issues, including cycling. When the pandemic struck, Zapopan was able to reallocate funds from paused projects to the Av. Guadalupe bike lane. Although renegotiation of the budget was largely possible due to the pandemic context, the policy foundation present in Zapopan enabled the city to develop and implement a viable emerging cycle lane strategy.

Notably, in the Global South, shifting away from car-centered transport planning is immensely important as the climate crisis worsens, and urbanization and motorization rates rapidly grow. For governments looking to do so, *establishing strong policies that prioritize cyclists, and other active travelers, over car users can unlock the funds needed for related infrastructure projects, especially for developing cities with limited transport budgets* (Adriazola-Steil et al., 2021a). By placing greater emphasis on cycling, cities in the Global South can also create greater accessibility to opportunities and services for residents, though this also lacks study (Rosas-Satizábal et al., 2020), while also working to mitigate the negative environmental impacts of car use.

Speed Management

The COVID-19 pandemic acted as a catalyst for quickly constructing a lane that has long been in the works. To overcome the challenge of time, the city started with pop-up temporary material then moved to focusing on permanence. Yet, a major gap in Zapopan's emerging bikeway strategy is the lack of speed management. Speed plays a role in nearly every traffic crash around the world and is the leading factor in 30–50% of crashes (WHO, 2018). If not taken into consideration, speed can compromise the quality of a cycle lane and put cyclists at risk (Isaksson-Hellman and Töreki, 2019; Ruiz-Padillo et al., 2021; Ugan et al., 2021).

Reducing speeds is an important first step to protecting cyclists and promoting cycling. On mixed use roads, speeds are recommended to be set at 30 km/h (Adriazola-Steil et al., 2021b). Av. Guadalupe maintains a speed limit of 50 km/h,

posing a danger to cyclists and other vulnerable users. At these speeds, it was necessary for the city to segregate the cycle lane and include safety basics such as adequate width. Though these are major steps to creating safe movement for users, the city could also aim to reduce speed limits on its mixed mode corridors.

Despite the importance of speed management, it is often neglected by governments and transport planning offices, sometimes due to national legislation that sets urban speed limits or prohibits local speed limit changes. In many parts of Latin America and the Global South, reforming speed limit legislation can be a difficult political process due to public opposition or political hostility, regardless of the evidence that reducing speeds correlates with reductions in traffic injuries and fatalities (Ang et al., 2020).

Governments at the local and national level in the Global South can take steps to better protect cyclists and all road users by *enacting legislation that reduces speed limits to appropriate levels and effectively enforcing these limits*. México has taken this step recently with the passing of the General Law on Mobility and Road Safety in 2021, which has set a maximum urban speed limit of 50 km/h and lowered speed limits on secondary and tertiary streets to 30 km/h.

CONCLUSION

The emergent cycle lane along Av. Guadalupe has created a much-needed connection for many in southwest Zapopan during the pandemic. However, a coherent and well-connected cycling network will require further development, but the success of this project can be one of the boosts to overcoming the remaining constraints by gaining community support, attracting more users to cycling and shifting budgets towards cycling projects.

Further research on cycling in the Global South is needed to better understand the technical and cultural factors that affect cycling infrastructure and ridership. By examining the case of Av. Guadalupe and its successes and shortcomings, three challenges were identified that could have ramifications for future cycling projects: community opposition, limited funding, and a lack of speed management. Through deep community engagement and strong policy foundations, these difficulties can be lessened.

Going forward, a greater understanding of the impacts of emergent cycle lanes, like that of Av. Guadalupe, would benefit from data collection across variables beyond cyclist count alone, such as cyclist demographics. This analysis of Av. Guadalupe was particularly limited by the lack of post-implementation data available on ridership, traffic crashes, and accessibility that would provide insight into the efficacy and efficiency of the lane. However, the bike lane has also not been fully implemented for an extended period to adequately measure its impact, and Zapopan also has little pre-implementation data by which to compare. The analysis presented here is also limited as some secondary sources have been used to inform conclusions made about the design of the Av. Guadalupe bike lane and its surrounding environment.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: The raw data (cyclist counts) supporting the conclusions of this article will be made available by the authors, without undue reservation. Requests to access these datasets should be directed to Carlos López Zaragoza, carlos.lopez@zapopan.gob.mx.

AUTHOR CONTRIBUTIONS

HO and SE-S conceived, developed, and structured the community case study. HO researched and wrote the first draft of the manuscript and revised the manuscript. SE-S supervised, reviewed, and wrote partial sections of the manuscript. DA and SA provided information, data, and some images on the planning, design, construction, and implementation of the emergent bike lane. JS and CL provided the cyclist count data, some images, and wrote some background information on the

bike lane's planning and implementation process. DA, JS, CL, and SA also contributed to manuscript revision. All authors contributed to the article and approved the submitted version.

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