Safer Cycling Through Improved Infrastructure

It is crucial to improve cycling safety in the United States. The Centers for Disease Control and Prevention's injury statistics Web site (WISQARS) reports that in 2014, there were 902 cyclist fatalities and 35 206 serious cyclist injuries (requiring hospitalization). The United States has much higher fatality and serious injury rates per kilometer cycled than comparable high-income countries. Controlling for exposure levels, cyclist fatalities in 2010 per 100 million kilometers cycled were 4.7 in the United States versus 1.0 in the Netherlands, 1.1 in Denmark, and 1.3 in Germany.[1] Serious injury rates in 2010 were also much higher in the United States: 207 serious injuries per 100 million kilometers cycled versus 44 in Germany.[1]

Clearly, the United States has a long way to go to achieve the Vision Zero goal described by Cushing et al.[2] As emphasized in that article, traffic fatalities and serious injuries are not inevitable, and they can be reduced to low levels by implementing the right policies, especially improved infrastructure and technology. Traffic safety experts now use the term "crashes" instead of "accidents" to emphasize that the design of the transportation system contributes to most traffic fatalities and injuries. Although Cushing et al. focus on Sweden, all Scandinavian countries—as well as the United Kingdom, the Netherlands, Germany, Switzerland, and Austria—for decades have been implementing the sorts of policies advocated by Vision Zero, which applies to all means of travel. The new perspective of Vision Zero is that traffic fatalities and injuries can and should be reduced far below current levels and should not be accepted as an inevitable risk of travel.

Cushing et al. apply Vision Zero to the case of cycling and pose the question of whether improved cycling infrastructure can make cycling safer in the United States.[2] The article by Pedroso et al. shows that the large growth in bicycle infrastructure in Boston from 2007 to 2014 was associated with a reduction in the cyclist injury rate and a large increase in cycling levels.[3]

Except for some college towns and a few large cities, most roads in the United States have no cycling infrastructure, and what exists is often dangerously designed, poorly maintained, and not connected to form a useful network. Bicycle infrastructure with physical separation from motor vehicles is especially important on high-speed, high-volume arterials with large vehicles such as trucks and buses.[4] In addition, intersections are dangerous for cyclists because of turning motor vehicles. Yet only a few American cities have been redesigning intersections to reduce that danger.

LESSONS FROM EUROPE

The Netherlands, Germany, and Denmark offer decades of experience on how to improve the safety, convenience, and comfort of cycling facilities.[4–6] Many Dutch, German, and Danish cities have an extensive system of on-road bicycle lanes and off-road bicycle paths, often including priority traffic signals and advance stop lines for cyclists at intersections. Some large cities have recently been building "cycle superhighways," which increase the speed and safety of long-distance bicycle commuting to work. These express routes are usually separate bicycle paths parallel to major roads with minimal road crossings and with a green wave of synchronized traffic signals at intersections timed for faster cycling.

The bicycle networks in Dutch, German, and Danish cities also include special bicycling streets: narrow streets on which cyclists legally have the right of way over motorists for the entire width of the street.[6] Most local neighborhood streets are traffic calmed with speed limits of 30 kilometers per hour (20 mph) or less and with infrastructure modifications that force motor vehicles to slow down: speed humps, raised intersections, chicanes (curves added by design), parked cars on alternating sides, and road narrowing.[6]

Many such neighborhood streets feature dead ends for motor vehicles—via bollards or other barriers—but convenient passageways for cyclists. Providing deliberately circuitous routing for cars and direct routing for cyclists discourages through traffic from using neighborhood streets while encouraging cycling. It also improves cycling safety by reducing both the volume and speed of motor vehicle traffic in residential neighborhoods.

In addition to better infrastructure, many European cities provide mandatory traffic safety education in their schools—to teach safe walking and cycling skills—and require far stricter motorist training and licensing than those in the United States.[6] Further promoting traffic safety, police enforcement of traffic regulations is much stricter in the Netherlands, Germany, and Denmark, both for motorists and nonmotorists.[6] Confirming the Vision Zero recommendations of Cushing

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et al., improving cyclist safety in Europe has required a multifaceted approach that includes infrastructure, supportive programs, and car-restrictive policies—as is also shown in a recent literature review on this issue.[5]

LESSONS FROM THE UNITED STATES AND CANADA

Recent implementation of improved cycling infrastructure in some American and Canadian cities has led to significant improvements in cycling safety. Table 1 summarizes key statistics for 10 American cities that have been especially successful at improving cycling safety and increasing cycling levels by greatly expanding their cycling infrastructure. All 10 cities have reduced the number of cyclist crashes and serious injuries (including fatalities) relative to the total number of bicycle trips, confirming the same relationship as found for Boston, Massachusetts, in the article by Pedroso et al.[3]

It is not simply a matter of expanding bicycle infrastructure, however. The specific type of bicycle infrastructure matters. Several studies show the crucial importance of physical separation of cycling facilities from motor vehicle traffic on heavily traveled roads. A study of different kinds of cycling facilities in Vancouver and Toronto, Canada, found that the safest kind of facility, by far, were cycle tracks, which are on-street bicycle lanes that are physically separated from motor vehicles by raised curbs, bollards, or concrete barriers.[7] Compared with major streets with parked cars and no bicycle facilities, cycle tracks on roads without parked cars were 89% safer; regular, unprotected bicycle lanes on major roads without parked cars were 53% safer; and lightly trafficked residential streets without any bicycle facilities were 56% safer. Thus, removing car parking and replacing it with cycle tracks is an ideal way to improve cycling safety on major streets. Traffic calming—discouraging through traffic and reducing speed limits—is key to improving safety on local neighborhood streets.

TABLE 1—Better Bicycle Infrastructure, Improved Cyclist Safety, and Increased Cycling

City	Years	Growth in Bikeway Network,[a] %	Growth in Bicycle Trips, %	Change in Crashes per 100 000 Trips, %	Change in Fatalities and Severe Injuries per 100 000 Trips,%
Portland, OR	2000–2015	53	391	−62	−72
Washington, DC	2000–2015	101	384	−46	−50
New York, NY	2000–2015	381	207	NA	−72
Minneapolis, MN	2000–2015	113	203	−75	−79
San Francisco, CA	2000–2015	172	167	−36	NA
Cambridge, MA	2000–2015	27	134	−57	NA
Chicago, IL	2005–2015	135	167	−54	−60
Seattle, WA	2005–2015	236	123	−25	−53
Los Angeles, CA	2005–2015	130	114	NA	−43
Philadelphia, PA	2008–2015	17	51	NA	−49

Note. NA = not available. We extrapolated the numbers of daily bicycle trips following the methodology used by the New York City Department of Transportation. The extrapolation assumes that each daily bicycle commuter makes two trips per day, and that work trips account for one fifth of all urban bicycle trips, roughly corresponding to the 17% of all urban bicycle trips for the commute to work reported by the 2008–2009 National Household Travel Survey. The percentage growth in extrapolated bicycle trips is exactly the same as the percentage growth in daily bicycle commuters, which is the only nationally comparable source of data on cycling levels in individual American cities.

Source. Data on bikeway mileage and serious injuries and fatalities were provided by departments of transportation, departments of public health, and metropolitan planning organizations in each of the 10 cities. We obtained the number of daily bicycle commuters in each city from the 2000 US Census and the American Community Survey, 2005 (Chicago, Los Angeles, and Seattle), 2008 (Philadelphia), and 2015 (all cities).

[a]Bikeways included in the statistics for the table comprise on-road bike lanes (including buffered bike lanes and cycle tracks), off-road bike paths, paved multiuse trails such as greenways, and bike boulevards and neighborhood greenways. All 10 of these cities increasingly have been building cycle tracks, buffered bike lanes, and off-road greenways, which provide physical separation from motor vehicles and thus greater safety.

Similarly, a study of cycle tracks in Montreal, Canada—with the most extensive system of cycle tracks in North America—found that cycle tracks had an injury rate 28% lower than that on parallel roads without bicycle facilities and attracted 2.5 times more bicycle trips than did roads without cycle tracks.[8]

CONCLUSIONS

The answer to the question posed in the article by Cushing et al. is that bicycle infrastructure can indeed help improve cycling safety and increase cycling levels. That is clearly demonstrated by decades of evidence from Europe, by the 10 US cities listed in Table 1, and by the article on Boston by Pedroso et al. However, the type and quality of bicycle infrastructure matter as well. It is crucial to provide physical separation from fast-moving, high-volume motor vehicle traffic and better intersection design to avoid conflicts between cyclists and motor vehicles. More and better bicycle infrastructure and safer cycling would encourage Americans to make more of their daily trips by bicycle and, thus, help raise the currently low physical activity levels of the US population. AJPH

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J. Pucher took the lead in conceptualizing the editorial and writing the text. R. Buehler was responsible for the collection and analysis of the Table 1 data. Both authors were involved in improving successive versions of the text and table.

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A Public Health of Consequence: Review of the December 2016 Issue of *AJPH*

A recent effort by the US Department of Health and Human Services (HHS) Office of the Assistant Secretary for Health (OASH) articulated Public Health 3.0 as an effort that emphasize[s] cross-sectoral environmental, policy, and systems-level actions that directly affect the social determinants of health and advance health equity. This approach correctly notes that where we live remains a more important determinant of our health than do our genes, despite substantially more effort in recent years in understanding the latter rather than the former. As described in *AJPH* a few months ago, Public Health 3.0 represents a next-phase approach in public health, moving beyond the core functions of disease surveillance and environmental approaches to promote healthier communities, to an effort that incorporates health into all aspects of governance, at multiple jurisdictional levels.[1] This approach echoes the "health in all policies" approach that has long been embraced by the American Public Health Association, bringing to this effort the weight of the federal department that ultimately is responsible for promoting the health of Americans. These approaches clearly aspire to tackle the foundational drivers of population health, the ubiquitous factors that we have urged public health scholarship to grapple with, in these pages, over the past year.

SCHOLARSHIP TO INFORM PUBLIC HEALTH ACTION

It seems to us that it falls to public health scholarship to provide the data that can inform Public Health 3.0, or a "health in all policies" approach. Several articles in this issue of *AJPH* do just that, starting with the essay by Ahern,[2] who focuses on the utility of population intervention parameters that can help bridge the gap between research findings and policy. This editorial provides a compelling argument for the provision of measures in our work that are readily interpretable for those who are in a position to shift policy. Ahern suggests that such measures "would make a substantial contribution to the effort to translate between research and policy."[2(pXX)] We could not agree more and look forward to more articles in *AJPH* that adopt this approach. We would see this as entirely consistent with the agenda we are proposing here, one that engages population health scholarship with the conditions that foundationally make people healthy. While a methodological approach may not, at first blush, seem to portend a substantially new focus for public health scholarship, it may well provide a lens through which we present our findings that makes them more relevant, more immediately accessible, and more forward looking as public health transitions to a new era. Four empiric articles in this issue of *AJPH* contribute data that can also bolster this approach.

CREATING BETTER PLACES

Two articles focus directly on the influence of place on the health of populations. Branas et al.[3] wonder if remediation of abandoned buildings and vacant lots can be a cost-beneficial approach to mitigating firearm harms in the United States. Informed by broken windows thinking,[4] the authors conducted a quasi-experimental study assessing the link between abandoned building remediation and firearm violence, finding a 40% reduction in the latter while finding no change in nonfirearm violence. The authors speculate that blighted structures may create physical opportunities for violence, and ample work in the field suggests that blighted urban neighborhoods may also result in an erosion of collective efficacy, also contributing to more violence.[4] Importantly, Branas et al. show that taxpayer and societal returns on investment for the prevention of firearm violence were $5 and $79 for every dollar spent on abandoned building remediation. Given the scope of the firearm epidemic in the United States today, this seems indeed like money well spent.

Barber et al. tackle the issue of adverse neighborhood conditions and risk of cardiovascular disease among African Americans.[5] The authors show that each standard deviation increase in neighborhood disadvantage was associated with a 25%

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