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Health-Focused Public–Private Partnerships in the Urban Context

PROCEEDINGS OF A WORKSHOP

Joe Alper, Liza Hamilton, and Claire Moerder, *Rapporteurs*

Forum on Public–Private Partnerships for Global Health and Safety

Board on Global Health

Health and Medicine Division

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This Proceedings of a Workshop was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise. The purpose of this independent review is to provide candid and critical comments that will assist the National Academies of Sciences, Engineering, and Medicine in making each published proceedings as sound as possible and to ensure that it meets the institutional standards for quality, objectivity, evidence, and responsiveness to the charge. The review comments and draft manuscript remain confidential to protect the integrity of the process.

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JOHN T. MONAHAN, McCourt School of Public Policy, Georgetown University
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Although the reviewers listed above provided many constructive comments and suggestions, they were not asked to endorse the content of the proceedings nor did they see the final draft before its release. The review of this proceedings was overseen by **HUGH TILSON,** University of North Carolina Gillings School of Global Public Health. He was responsible for making certain that an independent examination of this proceedings was carried out in accordance with standards of the National Academies and that all review comments were carefully considered. Responsibility for the final content rests entirely with the rapporteurs and the National Academies.

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Acronyms and Abbreviations

AI	artificial intelligence
CBO	community benefit organization
CDC	U.S. Centers for Disease Control and Prevention
DALY	disability-adjusted life year
EHR	electronic health record
GDP	gross domestic product
NGO	nongovernmental organization
PPP	public–private partnership
SDG	Sustainable Development Goal
UN	United Nations
UNDESA	United Nations Department of Economic and Social Affairs, Population Division
USAID	U.S. Agency for International Development
WHO	World Health Organization

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Introduction

Sometime in the latter half of the 2000s, cities around the globe became home to more than half of the human population (UNDESA, 2019). This demographic milestone, driven largely by rapid population growth in so-called secondary cities of 250,000 to 500,000 people in less-developed countries, is important for many reasons. First, cities serve as the primary economic engines of the world—they generate 70 percent of the world's gross domestic product (GDP)—and often drive culture, art, innovation, and business in a given society. At the same time, cities occupy only 2 percent of the planet's surface area, but they account for 70 percent of the world's greenhouse gas emissions and more than 60 percent of global energy consumption. They also generate 70 percent of global solid waste and air pollution. "What happens in cities affects the state of global health and the ability to meet global health goals and the United Nations (UN) Sustainable Development Goals (SDGs)," said Jo Ivey Boufford, clinical professor of global public health at the New York University College of Global Public Health and co-chair of both the Forum on Public–Private Partnerships for Global Health and Safety and the planning committee for this workshop, in her introductory remarks to the Health-Focused Public–Private Partnerships in the Urban Context workshop sponsored by the Forum on Public–Private Partnerships for Global Health and Safety at the National Academies of Sciences, Engineering, and Medicine (the National Academies).

Though more than half of the world's population lives in cities, the international development community has largely concentrated on rural

populations, and UN agencies have remained focused predominately on national-level plans and programs. Recently, however, UN and the international development community have acknowledged the importance of the urban context for policy and planning and for achieving national and global development goals for 2030 and beyond. In fact, Boufford said, cities have become interesting places for the international development community to work, and mayors have become important partners in achieving the SDGs. Mayors, after all, have close relationships with officials who lead government agencies as well as with leaders of civil society organizations and businesses in their cities. In addition, consortia of cities have actively joined climate change discussions and age-friendly and healthy cities networks throughout the world.

Working in the context of the broader urban environment represents a paradigm shift for the health sector, which, traditionally, has focused on the personal health care delivery system and has examined issues such as developing the health care workforce, providing essential medicines, and strengthening local health systems. As Boufford explained, however, "by introducing this broader notion of inter-sectoral engagement and working with other government agencies, we open up the possibility of looking at the role of urban planning, transportation, housing, and economic development as important forces for health, perhaps even more important than the health care sector." Indeed, experts now know that achieving healthier urban communities worldwide requires taking a Health in All Policies approach that works to improve the natural, built, and social environments in which people live (see Figure 1-1). The key point of a Health in All Policies approach, said Boufford, is to recognize that the health and well-being of all citizens is essential for overall social and economic development; that virtually all government policies positively or negatively impact the determinants of health; and that inter-sectoral partnerships across agencies, and across government, civil society, and business, need to align for health in order to improve health.

To draw attention to health determinants and health inequities among populations that live in urban environments and to explore challenges faced in establishing urban population health, the Forum on Public–Private Partnerships for Global Health and Safety hosted a 1.5-day workshop on the role of health-focused public–private partnerships (PPPs) in the urban context. The workshop, held June 13–14, 2019, in Washington, DC, aimed to illuminate some of the intervention strategies that have been designed to attenuate these urban health issues and highlighted the importance of PPPs and urban-level governance in remediation efforts. By facilitating discussion among participants in both the public and private sectors, as well as among policy makers, the workshop served as a platform to share best practices on how to address health challenges through

FIGURE 1-1 Broad determinants of health that could be addressed to make cities healthier.
SOURCES: As presented by Jo Ivey Boufford, June 13, 2019. Used with permission from the International Society for Urban Health.

interventions that target healthier urban populations. Presentations and discussions identified the role of cities in planetary health; the determinants of health and the health inequities found in urban environments; the transitions in global health that focus on the urban context; the evidence and challenges of urban health initiatives; the effects of urbanization and urban planning on health; the effects of food, agriculture, and transportation systems on urban population health; and the roles of digital technology and artificial intelligence (AI) in improving urban health.

The workshop was planned by an ad hoc committee with the following Statement of Task:

> An ad hoc planning committee under the auspices of the National Academies of Sciences, Engineering, and Medicine will plan a 2-day public workshop to explore opportunities to improve the health of communities in urban settings, particularly in low- and middle-income countries. The workshop will apply a broad definition of health to address its multiple determinants and potential for inclusive multi-sectoral engagement. Workshop presentations and discussion topics will include approaches to and examples of multi-sectoral engagement at the city level for health promotion with an examination of governance structures, public- and private-sector participation and contributions, inclusion of stakeholders outside of the health care sector, and evaluation and assessment. Additional workshop presentations and discussion topics may include
>
> - Impacts of urban health threats on the health and safety of employee populations and examples of how the private sector mitigates them;
> - Opportunities for addressing urban inequality through city-level public–private partnerships for health; and
> - Applications of digital and smart cities technology to address urban health and to promote multi-sectoral engagement.
>
> The planning committee will develop the workshop agenda, select and invite speakers and discussants, and moderate the discussions. Experts will be drawn from the public and private sectors as well as from academic institutions to allow for multilateral, evidence-based discussions. A proceedings of the presentations and discussions at the workshop will be prepared by a designated rapporteur in accordance with institutional guidelines.

ORGANIZATION OF THE PROCEEDINGS

The workshop (see Appendix A for the workshop agenda) was organized by an independent planning committee in accordance with the National Academies' procedures. This publication summarizes discussions that occurred throughout the workshop and highlights key lessons, practical strategies, and needs and opportunities that were presented for addressing health outcomes in cities by engaging directly with communities to shape and attend to their health priorities. Chapter 2 provides an overview of the relevance of urban issues in relation to planetary health and lists some of the determinants of urban health and health disparities. Chapter 3 examines evidence and challenges in urban health initiatives in international development, including the effects of urbanization and urban planning on health. Chapter 4 discusses work aimed at identifying

and addressing health inequities in urban settings, and Chapter 5 unpacks the effects of food, agriculture, and transportation systems on the health of urban populations. Chapter 6 explores how digital technologies and AI can contribute to improving urban health. Chapter 7 addresses the topic of political leadership and governance for PPPs in urban health and recounts discussions among a final panel of policy makers and elected officials about the role PPPs can play in improving urban health.

Conforming to the National Academies' policies, the workshop did not attempt to establish conclusions or to develop recommendations about needs and future directions. Instead, it focused on issues the speakers and workshop participants identified and on potential solutions to those issues. In addition, the organizing committee's role was limited to planning the workshop. This Proceedings of a Workshop was prepared by workshop rapporteurs Joe Alper, Liza Hamilton, and Claire Moerder as a factual summary of what occurred at the workshop.

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Cities and Planetary Health: Why Urban Issues Matter

Highlights

- When building cities, greater consideration could be given to the inverse relationship between urban density and transportation-related emissions to prevent cities from becoming carbon-dense urban locations. For existing cities, the challenge is to decarbonize and retrofit them to address the reality of the Anthropocene epoch (Haines).
- Climate change remediation interventions in cities could include establishing early heat-warning systems and interventions; implementing flood protections that use nature-based solutions such as restored coastal ecosystems; decarbonizing the urban economy and expanding sustainable mobility options; and adequately retrofitting urban housing stock to eliminate greenhouse gas emissions (Haines).
- Some cities are now experimenting with urban farming, aquaponics, and other alternative and localized food production systems to reduce agricultural food production and consumption waste, which accounts for approximately 30 percent of the planet's greenhouse gas emissions (Haines).
- Cities and their residents could realize significant health benefits from expanding sustainable mobility options such as public transport systems; car-free zones; and walkability, car-sharing, and bike-sharing schemes and by creating low-emission zones (Haines).
- By making land available at below-market costs, or by making allowances to redevelop land through an incentivized floor-space index that enables higher-density development, governments can encourage the private sector to take on redevelopment projects that improve the livelihoods and environments of disadvantaged urban residents (Vlahov).

- When developing projects to address slum conditions, prudent practices might include involving affected communities in planning processes; developing economic opportunities for current residents while developing physical neighborhoods; and building trust between communities and developers by involving nongovernmental organizations or community benefit organizations in the process (Vlahov).
- Economic and food production policies, social inclusion, mobility, and urban development shape local and proximal determinants of health in urban communities, and each of these drivers offers opportunities for multi-sector interventions (Diez-Roux).
- Research and evaluation opportunities in urban health may include identifying city- and neighborhood-level drivers of health and of health inequalities among and within cities as well as evaluating the health, environment, and equity impacts of policies and interventions. Such evaluations could employ systems thinking, simulation models, and participatory group model building to evaluate urban–health–environment links and plausible policy impacts (Diez-Roux).
- Certain opportunities to compare and share research and evaluation results across cities, such as big data, machine learning/artificial intelligence, multiple methods, and systems approaches, are largely untapped (Diez-Roux).

NOTE: This list is the rapporteurs' summary of the main points made by individual speakers (noted in parentheses), and the statements have not been endorsed or verified by the National Academies of Sciences, Engineering, and Medicine. They are not intended to reflect a consensus among workshop participants.

The opening session provided a foundation for the rest of the workshop by introducing the role of cities in planetary health and the determinants of urban health and health inequities. The three speakers in this session were Sir Andy Haines, professor of environmental change and public health at the London School of Hygiene & Tropical Health; David Vlahov, associate dean for research and professor at the Yale University School of Nursing and professor of epidemiology at the Yale University School of Public Health; and Ana Diez-Roux, dean and distinguished university professor of epidemiology at the Drexel University Dornsife School of Public Health and director of the Drexel University Urban Health Collaborative. After the three presentations, Jo Ivey Boufford moderated an open discussion with workshop participants.

THE ROLE OF CITIES IN PLANETARY HEALTH

Sir Andy Haines (London School of Hygiene & Tropical Health) began his presentation by quoting from The Rockefeller Foundation–Lancet Commission report (Whitmee et al., 2015) and from Pope Francis to call

for a more expansive conversation. This conversation would include a wide range of stakeholders to address human-driven environmental challenges that affect the entire planet and that potentially threaten to undermine recent progress in global health. He noted the term *Anthropocene epoch* was coined to capture the idea that environmental changes driven by humans have been so dramatic that they reflect the start of a new geological period on Earth (Steffen et al., 2007; Whitmee et al., 2015; Zalasiewicz et al., 2010).

Another term used in this context, explained Haines, is the *Great Acceleration*, which refers to rapid advances in human health, economic output, and life expectancy, as well as to accompanying declines in infant, child, and maternal mortality, that have occurred since the middle of the twentieth century. It also refers to the accelerating exploitation of the planet's resources, including fertile land, fresh water, and fisheries, and to the concomitant negative impact on the planet's environment. To further frame the discussion, Haines mentioned *planetary boundaries*, a concept that outlines nine planetary boundaries related to climate change, ocean acidification, stratospheric ozone depletion, atmospheric aerosol loading, biogeochemical flows that interfere with phosphorus and nitrogen cycles, global freshwater use, land-system change, rate of biodiversity loss, and "novel entities" (a term that largely refers to chemical pollution) (Rockström et al., 2009a,b; Steffen et al., 2015). According to Haines, crossing any of these boundaries raises the prospect of deleterious or even catastrophic effects on the planet's environment and, by implication, on human health, particularly when multiple boundaries are crossed. Notably, Haines noted that three boundaries have already been crossed—phosphorus loading, nitrogen loading, and genetic diversity. Abrupt, nonlinear changes can occur in natural systems when they are subject to rapid and extensive change, and such changes may be self-reinforcing.

According to Haines, with increasing urbanization of the human population, the future of planetary health and the interaction between environmental change and human health will depend substantially on policies enacted in cities. Haines explained that "cities are the engines of economic activity, responsible for the bulk of global economic activity and about three-quarters of the global energy-related greenhouse gas emissions." Transportation is one major source of urban emissions, and a strong relationship exists between urban density and transport-related emissions. Haines noted that Atlanta and Barcelona metropolitan areas, for example, both house roughly 5 million people, but Atlanta emits about 10 times more transport-related greenhouse gases than Barcelona does. In large part, this difference arises because Atlanta's metropolitan area covers approximately 4,300 square kilometers while metropolitan Barcelona covers a mere 160 square kilometers. As a result, people from Atlanta spend more

time driving and less time walking, cycling, or using public transport than do residents of Barcelona. They also depend more on private cars.

Haines noted the importance of considering the inverse relationship between urban density and transportation-related emissions when building (e.g., in Africa) or expanding (e.g., in India) new cities to prevent them from becoming carbon-dense locations. For existing cities, Haines said, the challenge is to decarbonize and retrofit them to address realities of the Anthropocene epoch.

Although climate change has begun to affect human health and is likely to have an increasingly negative effect over time, air pollutants such as fine particulate matter and ozone have already had major adverse effects on human health. Indeed, air pollution is one of the most important environmental risk factors for morbidity and mortality. The World Health Organization (WHO) estimates that ambient air pollution kills about 4 million people per year (Gurny and Prüss-Üstün, 2016), but recent estimates suggest the death toll from ambient air pollution could be as high as 9 million per year (Lelieveld et al., 2019b). Haines said climate change can affect health through direct mechanisms, such as increasing exposure to high temperatures and to extreme events (e.g., hurricanes and floods), as well as through indirect mechanisms, such as vector-borne diseases (e.g., dengue and zika), increased exposure to allergens, and undernutrition caused by reduced agricultural productivity. The World Bank has estimated that, in the absence of effective action, climate change could push 100 million people back into poverty by 2030 (Hallegatte et al., 2016) and will likely lead to increased mortality (Preston, 1975).

Haines said that air pollution and climate change can be considered two sides of the same coin; most air pollutants affect the climate directly or indirectly, and most greenhouse gas sources co-emit air pollutants or contribute to their formation. This connection offers a two-for-one opportunity because decarbonizing the economy reduces air pollution. Haines said a general relationship exists between development and greenhouse gas emissions; however, there is no absolute reason why a city could not transition from a low- or middle-income status to a higher-income status along a low air pollution, low greenhouse gas trajectory.

By their very nature, cities are hotter than surrounding rural areas—a phenomenon known as the urban heat island effect (Media in Africa, 2011). The heat island effect can be reduced by planting trees and by having open water and green spaces, but climate trajectories may have the most significant effect on urban heat-loading. For example, a study in 2017 on the challenge of urban heat exposure under climate change projected a much lower urban temperature-loading by the second half of the twenty-first century through a low-emission trajectory than what would

occur through a high-emission trajectory (Milner et al., 2017). This study projected that cities such as Madrid could see temperature increases as high as 7°C by the end of the century. Haines noted that the frequency of heavy precipitation events and extremely intense storms will likely increase with climate change and will likely pose a threat of urban flooding. At the same time, he added, droughts and water shortages will likely become more common.

Given the likelihood that the planet's temperature will continue to rise, Haines said the question becomes one of how to develop sustainable, healthy cities that are resilient in changing climates, reduce emissions to prevent the worst effects of climate change, and protect the health of residents. Regarding resiliency and climate change adaptation, one approach increasingly implemented is establishing early-heat warning systems that identify temperature thresholds over which harm to human health increases dramatically. These heat early warning systems forecast the likelihood of crossing those thresholds, issue high-heat warnings based on risk assessments, and implement interventions to keep people cooler and more hydrated in their homes. He noted that a growing number of cities, including those in lower- and middle-income settings such as Ahmedabad, India, have implemented such systems. After they went live, death rates associated with extreme heat waves dropped (Hess et al., 2018).

Implementing flood protection that uses nature-based solutions, such as restoring wetlands and coastal mangrove ecosystems, poses another possible adaptation. In addition, protecting and restoring watersheds potentially increases supplies of fresh water. Such systems will need to be designed carefully because wetlands, for example, can also host populations of disease-carrying mosquitoes. Haines noted that "we need to think about minimizing the adverse effects on health when designing and implementing these nature-based solutions."

Decarbonizing the energy supply system can dramatically benefit health, he noted (Haines et al., 2009). One study, for example, showed that decarbonizing the world's economy—removing all sources of fossil fuel and transitioning to clean renewables—could prevent 3.5 million premature deaths per year by reducing ambient air pollution (Lelieveld et al., 2019a). Removing all human-related sources of ambient air pollution, including those from households and agriculture, would likely prevent another 2 million premature deaths, Haines added. He also noted that cities and their residents would realize significant health benefits by expanding sustainable mobility options such as public transport systems and car-free zones; increasing walkability, car-sharing, and bike-sharing schemes; and creating low-emission zones.

A range of different innovations in sustainable mobility could reduce air pollution and greenhouse gas emissions and increase physical activity among city residents. In fact, when Haines and his collaborators modeled the effects of increased walking and cycling and of reduced driving on the health of London residents, the residents showed significant improvement in health and reduction in health care costs—even after Haines and his collaborators accounted for a small projected rise in injuries that pedestrians and cyclists might experience from encounters with motorized vehicles (Jarrett et al., 2012; Woodcock et al., 2009). Studies in the United Kingdom and in Canada have also found that urban residents who mostly walk or cycle have the lowest percentages of body fat and have a lower likelihood of diabetes (Creatore et al., 2016; Flint and Cummins, 2016). Though some may be concerned that exposure to air pollution could negate the benefits of cycling and walking, a 2016 study projected that cycling or engaging in other forms of outdoor exercise for as many as 300 minutes per day is beneficial even at particulate matter levels of 50 micrograms per cubic centimeter of air—which is considered heavily polluted (Tainio et al., 2016). Haines said, "In practice, for most cities, cycling and walking is a good solution, and, of course, you get more people out of their cars and that will reduce pollution." The key to realizing these benefits, he added, is to make cities more walkable and bike-friendly. Toward that end, he noted, mobile phone applications can direct people to walking and biking routes that are more pleasurable and that avoid the most polluted streets.

In addition, increasing green spaces can help reduce pollution levels and benefit human physical and mental health. One large study from Canada, for example, found that proximity to urban green spaces reduced mortality from cardiovascular and respiratory disease (Crouse et al., 2017). However, Haines noted that cities that seek to add green spaces need to make them readily accessible to all residents and not just those who are wealthy.

Improving the energy efficiency of a city's housing stock is another route to reducing a city's carbon footprint. However, a caveat exists: sealing houses to increase their energy efficiency would also increase indoor pollutant levels unless homes were equipped with energy-efficient ventilation and with heat recovery. Haines said that adequately retrofitting urban-housing stock would eliminate millions of tons of greenhouse gas emissions and would reduce premature deaths (Wilkinson et al., 2009). Improving housing stock and reducing indoor air pollution would also benefit urban residents in low-income settings (Haines et al., 2013).

Food production and consumption are major drivers of environmental degradation and account for approximately 30 percent of the

planet's greenhouse gas emissions. One way to improve in this realm, said Haines, is to reduce the amount of food produced but not consumed, which currently accounts for about 30 percent of agricultural production (Macdiarmid et al., 2016). A systematic review has shown that promoting healthy, more environmentally sustainable diets—those with increased consumption of fruit and vegetables and decreased consumption of animal products, particularly ruminant meat—would reduce the use of land and water and cut greenhouse gas emissions by 20–30 percent medians for these indicators across all studies (Aleksandrowicz et al., 2016). He noted that some cities are experimenting with urban farming, aquaponics, and other alternative and localized food production systems (Säumel et al., 2019). Haines said, "Whether they will make a large-scale impact on the environmental footprint of the system we do not know yet, but there is certainly a lot of interest in those kinds of innovations at the city level combining sustainable nutrition, low environmental impacts, and job creation." In fact, many cities are becoming more ambitious about tackling their energy consumption and environmental footprints on a variety of fronts.

In closing, Haines reminded workshop participants that only a few decades are left to reduce the risks of dangerous climate change by keeping global average temperature increases to 2 degrees or less above preindustrial measurements. One estimate suggests that, at current rates of emissions, the 2-degree target would be reached after 35 to 41 years (Goodwin et al., 2018). Of great concern is the fact that greenhouse gas emissions reached a record level in 2018 and are still rising (UNEP, 2019). Haines said, "That implies we need to cut emissions very urgently, indeed. We have to keep the pressure up to work toward rapid decarbonization as soon as possible, and, in doing so, the policies enacted in cities will be absolutely crucial toward driving us to a sustainable economy in the Anthropocene epoch."

DETERMINANTS OF URBAN HEALTH AND HEALTH INEQUITIES

David Vlahov (Yale School of Nursing) presented a conceptual framework for urban determinants of health examines various components of urban life—such as physical, built, social, and resource environments—that influence people's behavior and that, in turn, affect individual and community health (see Figure 2-1). The physical environment, which Haines addressed, includes climate, air, water, noise, and nature. In contrast, the built environment considers land tenure, housing, transportation, water sanitation, and drainage. The social environment includes social networks, social supports, social capital, social isolation, violence,

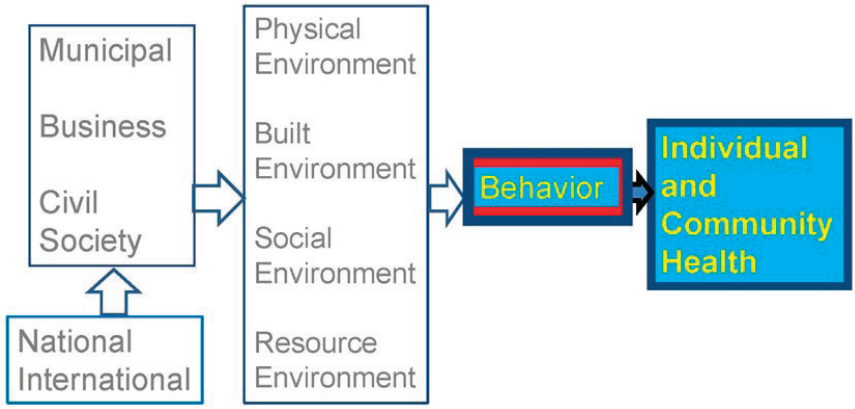

FIGURE 2-1 A conceptual framework for the urban determinants of health.
SOURCE: As presented by David Vlahov, June 13, 2019.

and extreme poverty—all components of how people engage and interact with one another. Finally, the resource environment comprises health services, social services, food availability and access, education, and work. Each of these aspects of the urban environment is influenced by municipal government, business, and civil society, which are, in turn, affected by various national and international influences.

Vlahov said four aspects—size, density, diversity, and complexity—characterize cities, and cities are neither good nor bad. Because of their size, density, and diversity, cities afford opportunities to reach large numbers of people and likely include residents with specialized talents who can play various roles in disseminating information. He added that complexity can be a positive virtue; it can provide an opportunity for inter-sectoral interactions. Cities also have negative aspects such as overcrowding; dispersal or urban sprawl; and social exclusion and culture clashes, which can accompany diversity. In addition, reaching every resident can be challenging in cities that are large. Sectoral divisions that can occur within interlocking systems also represent a potential downside of complexity.

In 1976, the United Nations Conference on Human Settlements held in Vancouver, Canada, declared that adequate shelter and services are basic human rights recognized in international law as part of the right to an adequate standard of living. The conference also declared that governments should help local authorities participate more in national development and that land use and tenure should be subject to public control. The involvement of public–private partnerships (PPPs) in land tenure and

housing creates opportunities for the private sector to contribute capital up front and to deliver products efficiently. In contrast, the public sector controls the regulating environment and, when it has resources (e.g., land), implements projects.

Vlahov noted, however, that there are a number of preconditions that need to be met in order to sufficiently mitigate risks before a PPP that appeals to the private sector may be established. These preconditions may include changes in specific laws that are accompanied by analysis of the partnership's feasibility; social and environmental studies that support the partnership's formation; and willingness to pay the partnership's assessments. In short, the private sector needs to believe that it can make a positive return on its investment in a project. Toward that end, the public sector engages in risk-mitigation measures (e.g., developing strong legal frameworks) to engender more favorable investment conditions.

Urban transportation, discussed later in the workshop, is one model of a PPP. The public sector, Vlahov explained, conducts analyses to ensure feasibility, and the private-sector investor or concessionaire implements the project according to a negotiated structure, such as a building-operate-transfer or building-own-operate arrangement. Typically, such projects are implemented through straightforward deals between individual landowners and the government agency in charge of the project as well as between the agency and the investor or concessionaire. Transportation projects, he added, can benefit from including a separate entity that deals with residents who may be displaced by the projects.

Projects formed to address slum conditions require a more complicated PPP structure because of their potential to displace residents of the area slated for redevelopment. Vlahov noted that early housing projects resembled other infrastructure projects by excluding input from or coordination with affected communities; while those projects may have improved slums, they did not necessarily improve the livelihoods of people who lived in slums. One lesson learned from these early projects was that urban renewal requires both physical infrastructure improvements and opportunities for residents to become integrated citizens of society. In other words, developing economic opportunities for residents may be an advisable complement to physically redeveloping neighborhoods.

Vlahov went on to explain that network partnerships represent another model that extends PPPs by adding a nongovernmental organization (NGO) or a community benefit organization (CBO) to the mix and tasking it with introducing more socially oriented goals, such as facilitating steps to integrate the redeveloped area into its larger community. These three-way partnerships between various actors involve interdependent, adaptable relationships that are based on trust and that, sometimes, may even exist in lieu of contracts. In some instances, private

participation may stem from enlightened self-interest, such as when a project is located in the same city as the private entity's headquarters.

The big question, Vlahov said, is how to incentivize members of the private sector to take on redevelopment projects that would otherwise be unprofitable for them. One answer he suggested is for government to make land available at below-market costs. A second possibility is to redevelop land with what is known as an *incentivized floor space index*—an allowance to engage in higher-density development. Another important question concerns what is required of developers, which can include clearing land, providing temporary shelter and transportation to current residents, and rehousing eligible residents. For example, a slum improvement project in Ahmedabad, India, required developers to rehouse slum dwellers in multistory tenements at no cost to the dwellers—if they could prove they had lived in the slum at a specified cut-off date (Mahadevia et al., 2014).

Developers were required to complete the Ahmedabad project on a 3-year deadline, and completion included obtaining multiple levels of government clearance and convincing residents to consent to the redevelopment. Obtaining this consent proved difficult; many residents thought the free housing was too good to be true and considered it a mere ploy to evict them from the slum. Though they were not required to do so, the developers recruited several NGOs and CBOs to act as intermediaries, negotiate with the residents, and hold the developers responsible for fulfilling their promises.

Vlahov noted several limitations to the Ahmedabad project. First, multiple developers were allowed to work in a particular slum, and this unregulated competition confused residents. Second, no specific quality standards were set for the rehabilitated buildings, which raised concerns about resulting buildings becoming vertical slums. Third, no clear plan existed for slum dwellers who did not meet the eligibility cut-off date or for the 25–30 percent of residents who did not agree to go along with the project. Additionally, while this model provides free housing to slum dwellers, it also allows developers to load the cost of rehabilitation onto saleable units in the development. As a result, developers can sometimes be reluctant to construct saleable units that are sold as anything but luxury homes (see Figure 2-2). Ultimately, that dynamic leads to increased housing prices and excludes the middle class from homeownership.

As cities grow and expand over the next 50 years, PPPs can contribute innovations that include sustainable technologies. The conventional economy of take-make-waste and construction waste generates about 535 million tons of debris each year as well as 60 million tons of food waste. Vlahov said the challenge is to move from a conventional economy to a circular one that recycles as much as possible, throws away as little

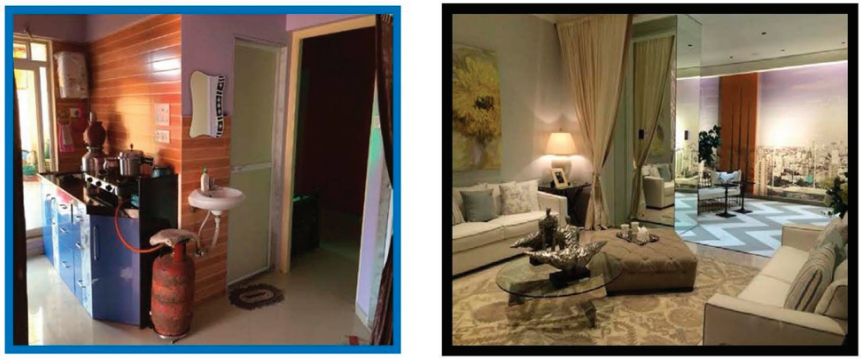

FIGURE 2-2 Free rehabilitated housing and $3–$5 million luxury apartments in the same redevelopment area in Mumbai, India.
SOURCES: As presented by David Vlahov, June 13, 2019; Zhang, 2016.

as possible, and, in the end, uses as few resources as possible. Applying circular economic thinking, he said, could mean less produce in landfills if produce is instead used to make building materials. One company, for example, is using mycelium to convert agricultural waste into a matrix of white fibers that can be turned into a solid material. Another company, in order to create bricks from sand without using clay or heat, is harnessing the natural process coral uses to construct reefs.

Vlahov also noted that a number of NGOs have worked with individual communities and with the private sector to incrementally upgrade informal settlements and slums and to build local enterprise capacity and resilience within the community. The iShack Project in South Africa, for example, is using solar electricity to demonstrate how green technologies can jump-start redevelopment of informal settlements and slums.

Concluding his comments, Vlahov said private markets clearly cannot efficiently provide universal housing for the growing number of people who live in slums around the world. Moreover, governments are often hostile to poorer populations, and collective, grassroots action becomes the only way to provide adequate housing for all (McGuirk, 2015).

OPPORTUNITIES AND CHALLENGES FOR PROMOTING URBAN HEALTH

Ana Diez-Roux (Drexel University) opened her presentation with six reasons for paying attention to urban health. These reasons included the future of humanity rests largely in cities; the health implications of city living are variable and malleable; the health consequences of city living

are not the same for everyone; health in cities is driven by factors at multiple levels; little is known about the effects of urban policies on health or health equity; and urban health and environmental sustainability are linked and reinforcing.

Echoing the previous speakers, her first reason was that the future of humanity rests largely in cities—a consequence of increasing urbanization among the human population (see Figure 2-3). She noted that more than half of the cities in lower- and middle-income countries have fewer than 500,000 residents and pose opportunities for design; these smaller cities could be made healthier and more environmentally sustainable before they become too large to tackle. Diez-Roux said, "Certainly, there is work to be done in big cities, but there is this incredible opportunity in emerging cities all over the world."

The second reason to focus on urban health is that the health implications of city living are variable and malleable. The correlates of city living, Diez-Roux said, are that cities have higher population density; greater diversity in terms of race, ethnicity, national origin, and social class; greater concentration of economic activity; and higher levels of innovation and creativity compared to rural areas. In addition, social interactions in cities are more intense and differ qualitatively from those in rural areas. What this means for health, she said, includes both positives and negatives (see Table 2-1), and the balance is highly context-dependent.

For example, in the United States, the incidence of obesity in both men and women is lower in urban areas (Meit et al., 2014), whereas in most other countries, the incidence of obesity is higher in urban areas (Prasad et al., 2016). Similarly, Diez-Roux noted, data from 15 European cities show an incredible heterogeneity in avoidable mortality across not only cities but also urban neighborhoods (Hoffmann et al., 2014) (see Figure 2-4), but data from the United States show significant variability regarding homicide rates and life expectancy across cities (Chetty et al., 2016). Diez-Roux said, "This is very important because it means there are things that we can do to change the relationship between urban living and health." It also means that potential lessons in this heterogeneity may inform urban design, governance, and management in order to reduce health inequities, she added.

This heterogeneity leads to a third reason to care about urban health: the health consequences of city living are not the same for everyone. Diez-Roux said, "It is important to remember that cities are characterized by large social and health inequalities." In the United States and internationally, for example, income inequality in large cities exceeds that of rural areas, and income inequality is linked to health inequalities and to differences in life expectancy. She explained that these inequalities are partly driven by residential segregation and by resulting differences in resource

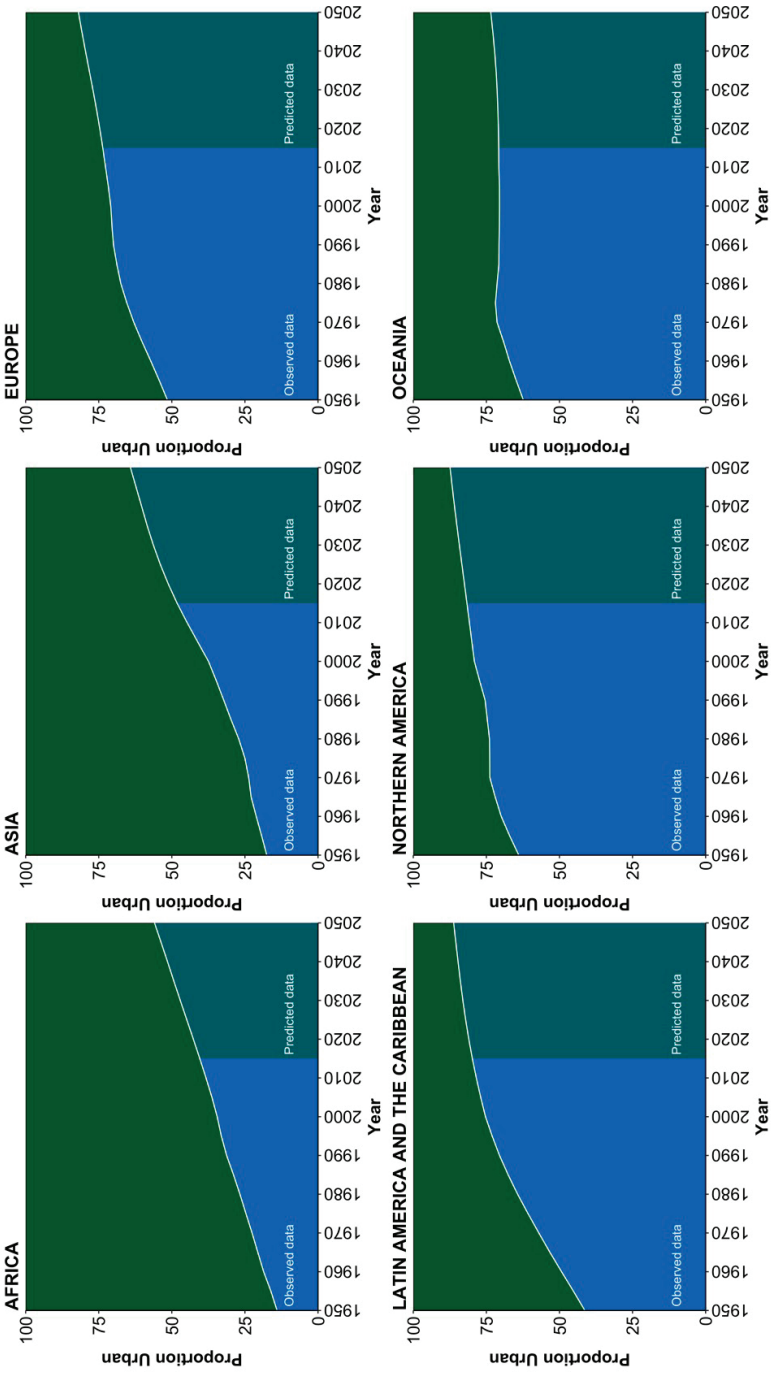

FIGURE 2-3 Historical and projected trajectories for the urbanization of humanity.
SOURCES: As presented by Ana Diez-Roux, June 13, 2019. From 2014 revision of the World Urbanization Prospects, by UNDESA.

TABLE 2-1 Possible Health Consequences of City Living

Minuses	Pluses
Adverse environmental exposures concentrated and magnified—air pollution, industrial exposures, poor housing, heat/climate change	Income and work benefits
Physical environment effects on behaviors—urban design and sedentarism, processed foods	Potential for better access to services as a result of proximity and greater availability
Limited access to services (overcrowding, housing, water and sanitation, health, social)	Positive social interactions, cohesion, support, and advocacy
Social stressors, conflict, violence, discrimination	Creativity, social interaction as health enhancing
	Urban policies can promote health

SOURCE: As presented by Ana Diez-Roux, June 13, 2019.

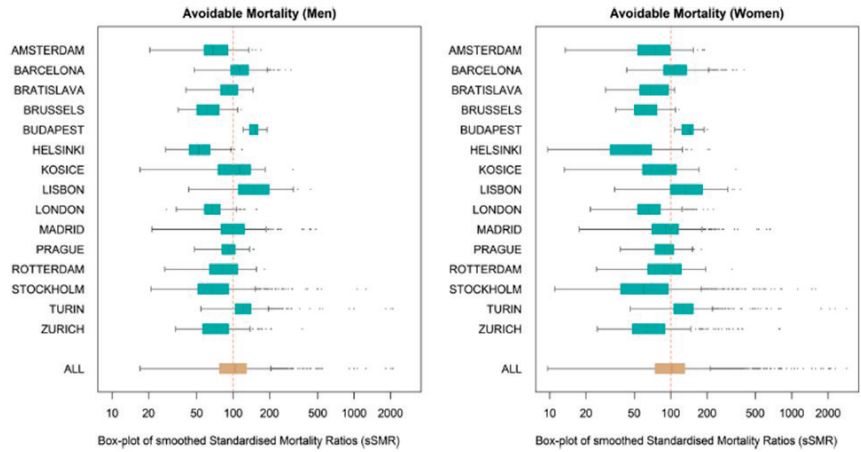

FIGURE 2-4 Avoidable mortalities in small areas of 15 European cities.
NOTES: The box plots show the range of mortality between areas with the lowest and highest mortality. Rectangles denote the range between the 25th and 75th percentiles, and individual dots represent single areas considered outliers with very high mortality.
SOURCES: As presented by Ana Diez-Roux, June 13, 2019; Hoffmann et al., 2014.

distribution across neighborhoods, which, in turn, create differences in physical and built environments, food and recreational resources, services, natural spaces, environmental exposures, and aesthetic and housing quality. Social environments also change and may lead to differences in safety, violence, social connections, and institutional locations. Taken together, these differences reinforce each other and lead to behavioral and stress-related outcomes that also interact to affect health (see Figure 2-5).

The fourth reason urban health matters is that factors at multiple levels drive health in cities and create opportunities for multilevel interventions both inside and outside of the health sector. Diez-Roux noted that economic policies, social inclusion, mobility, food policy, urban development, and other drivers shape local and proximal determinants of health, and each driver offers opportunities for multi-sector interventions.

Diez-Roux also discussed a fifth reason to be concerned about urban health: cities are already enacting policies, but little is known about the effects of urban policies on health or health equity. Opportunity exists, then, to generate evidence of the health and environmental impacts created by policies that cities are currently implementing. For example, one evaluation examining the effect of a new cable-car system on violence in Medellin, Colombia, found lower levels of violence in neighborhoods served by that transit system (Cerda et al., 2012).

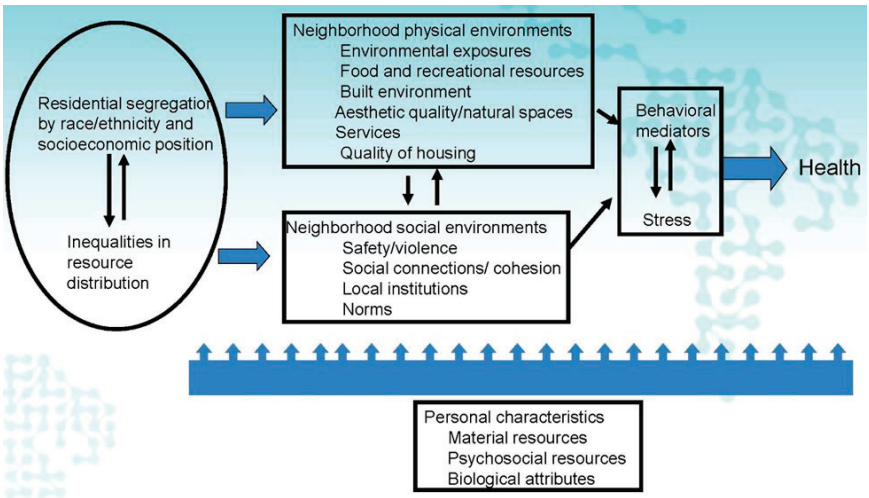

FIGURE 2-5 The factors that contribute to health inequalities across urban neighborhoods.
SOURCES: As presented by Ana Diez-Roux, June 13, 2019; Diez-Roux and Mair, 2010.

Her sixth reason, one that Haines also articulated, is that urban health and environmental sustainability are linked and reinforce each other. Diez-Roux said, "This is about improving urban health and improving environmental sustainability, and the good thing is we can do both at the same time." In her opinion, two options exist for urban development and design. The first features more sprawl, more energy consumption and greenhouse gas emissions, higher levels of air pollution, more dependence on automobiles, increased consumption of processed foods and meat, less physical activity, and increased social consequences such as isolation, violence, and mental health concerns. The alternative option features compact, energy-efficient development with active public transportation, sustainable food, reduced air pollution and greenhouse gas emissions, more physical activity, increased consumption of fruits and vegetables compared to meat, and reduced impact on biodiversity, biomass, and croplands due to a smaller urban footprint. In addition, the latter model would more likely promote inclusion and equity.

Diez-Roux noted that major drivers of differences in health across and within cities remain largely unexplored. She said cities are acting, including actions designed to benefit both health and environment, but they are not rigorously evaluating their actions. She added that opportunities for big data, machine learning/artificial intelligence, multiple methods, and systems approaches to compare and share results across cities are largely untapped, and the Global South provides an unexplored resource for understanding how best to manage, govern, and develop cities so they are healthy and environmentally stable.

As an example of the type of work she would like to see conducted, Diez-Roux described the SALURBAL Project. In the project, she and 14 international partners, primarily in Latin America, collaborated to create the evidence base needed to make Latin American cities, as well as others, healthier, more equitable, and more environmentally stable. This 5-year project, which is funded through March 2022, aims to engage policy makers and the public in new dialogue about urban health and sustainability and about implications for societal action. It also aims to create a platform and a network that will ensure continued learning and subsequent translation of lessons into actions. She said, "We have to change the mindset of how we think about this, and that involves thinking about health as more than health care and also thinking about health and the environment being linked to one another."

Latin America serves as the test site for this project because it is highly urbanized—roughly 80 percent of the 505 million people in the region live in cities—and has diverse urban landscapes and high levels of social inequality. According to Diez-Roux, the project's four goals include the following:

- Identify city and neighborhood drivers of health and health inequalities among and within cities.
- Evaluate the health, environmental, and equity impacts of policies and interventions.
- Employ systems thinking, simulation models, and participatory group model building to evaluate urban–health–environment links and plausible policy impacts.
- Disseminate results and engage policy makers to promote new ways of thinking about the drivers of urban health and the types of policies and interventions that could improve health and sustainability in cities (Diez-Roux et al., 2018).

So far, Diez-Roux and her collaborators have identified nearly 400 cities for which they are working to compile data and have pinpointed four thematic policy areas that have been implemented in Latin America: mobility and emissions control, social inclusion, comprehensive urban development, and health behavior promotion. The project also supports six policy evaluations associated with a housing intervention in Chile, an urban redevelopment project in Brazil, the TransMiCable project in Bogotá, the Vision Zero and bike-share expansion projects in Mexico City, and a menu labeling initiative in Peru. The SALURBAL Project team has conducted participatory works to raise awareness of the project, the complex drivers of health, and the types of policies and interventions that could improve health and sustainability in cities (Diez-Roux et al., 2018). The team has also held several policy and dissemination events that brought together a wide range of nonprofits, private-sector stakeholders, local and national governments, and international organizations.

In closing, Diez-Roux said a tremendous opportunity exists for generating knowledge by creating data linkages, producing new data, mining and processing new and existing data, and using data for cross-city comparisons. Other opportunities include evaluating policies for their health and environmental impacts, building capacity in urban health sustainability research and action, disseminating and translating evidence into programs and policies, and creating partnerships that engage multiple stakeholders.

DISCUSSION

To start the discussion, Jo Ivey Boufford asked panelists to reflect on whether the presence of the private sector has changed over time. Diez-Roux noted the private sector has shown increasing interest in these issues and has started exploring how it can partner in these efforts, but she has not yet seen increased involvement. Vlahov said he has seen more interest

from the private sector in the economic opportunities and health benefits that could result from efforts to improve social and physical built environments. In particular, he saw promise in engaging the private sector in housing-related programs.

Haines said he sees great opportunities for members of the private sector to engage in several ways beyond their traditional roles in public transport and housing. Many businesses, however, still think traditionally. Instead, they could examine how new forms of housing can both reduce environmental footprints and create healthier and more sustainable indoor-household environments. Haines said, "We probably have not capitalized enough on those opportunities." He added that he has seen emerging private-sector interest in bringing renewable energy options and food production options such as hydroponics and aquaponics to urban environments. He suggested mapping emerging areas in the private sector to see how the sector could best be engaged in these efforts.

Rebecca Martin from the U.S. Centers for Disease Control and Prevention asked the panelists for their ideas on how the private sector and others might work with neglected, unincorporated areas that emerge when people move into urban areas but are not included in the governance structures of cities they abut. This problem, Vlahov replied, used to be solved by razing those settlements and hoping the people who lived there would leave, but as cities have become more enlightened about how to accommodate growth, they are considering other, more humane options. In fact, he noted efforts under way in Africa, India, and Latin America that deal successfully with this issue. Diez-Roux said that a similar governance problem is created when former residents of urban cores are displaced into peripheries as cities in the United States and elsewhere gentrify.

One strategy Haines and his colleagues have used in Kenya to address this issue is to support local governments in their bids for sustainable development funds, such as those from the Green Climate Fund.[1] Haines said, "It is often quite difficult for low-income countries and cities to access those funds, so we have been trying to work with them through this work to help them in creating credible bids for funding. It is still too early to say how successful we will be, but if it is successful, then it will leverage new sources of funding into some of these informal settlements."

Scott Ratzan, City University of New York Graduate School of Public Health & Health Policy asked panelists if the urban–rural digital divide plays any role in the differential health outcomes between urban and rural residents. Diez-Roux replied that researchers have not paid as much

[1] Additional information is available at https://www.greenclimate.fund/home (accessed August 27, 2019).

attention as they could to health impacts in this area. Nor have they really studied whether mass media and social media can play roles in reducing disparities. Haines noted that social media use is expanding greatly in low-income countries, where many people have mobile phones before they have settled accommodations, and health communications could make an impact in those areas. For example, he said that countries with a truly free press can more openly debate the pros and cons of different policies proposed to improve population health. He also pointed to the need for positive messages, particularly those directed at young people, about how to achieve development at lower levels of environmental impact than those achieved by richer countries.

John Monahan from Georgetown University commented that local-level authorities in the public sector's formal government will exhibit enormous heterogeneity. He also wondered if that trend would provide an opportunity to learn about which government structures and formal authorities have allowed some places to be more or less successful in their attempts to address some of the cross-sector issues panelists identified in their presentations. Diez-Roux replied that this is, in fact, something that she and her colleagues are trying to characterize in the cities where they work. She noted the challenge is to determine how to measure the features of governance that make a difference. Vlahov noted that he had a chance to speak with about 50 mayors at an International Society for Urban Health meeting in Nairobi and found that some were simply implementers of national policy and had few resources at their disposal while others had more authority and resources to implement local policies. Regarding measurement, he said that disaggregating rural and urban data can be politically unpalatable for national leaders because doing so can highlight troubling differences.

Haines commented that governance at both local and national levels can be influential, particularly when they work together. Some actions, however, are difficult for cities to tackle alone. For example, without adequate national carbon pricing, cities experience difficulty scaling zero-carbon energy policies. At the local level, cities benefit from representational platforms that extend into local communities and into unincorporated or informal communities. Haines said, "Where you see effective city mechanisms for consulting with communities, you get more buy-in and can ensure that policies are attuned to the needs and perceptions of the local community, as well as representing national policy." Another issue that varies across countries is whether cities have any direct responsibilities to local health care sectors.

Charlotte Marchandise-Franquet, deputy mayor of Rennes, France, said that although mayors love smart city technology, she does not see many academics studying smart cities, nor does she see innovators work-

ing with all the data smart cities generate. These data could reflect the complexity of urban health and help policy makers—such as herself—gain insights that would potentially drive more effective health-related policies and activities. Diez-Roux agreed with that assessment and added that even basic data are not being collated, harmonized, and studied. She noted that she and her collaborators are now using remote-sensing information to characterize urban growth, an effort that requires a significant investment of time and money to extract meaning from messy data. Diez-Roux said, "I am convinced that there is meaning there, but I think we have to be careful that we do not use data in ways that can be obfuscating rather than illuminating."

One problem, Vlahov said, is that researchers with backgrounds in medicine and public health do not interact much with engineers and computer scientists who work on smart cities. He said the best work is being done in well-developed, higher-income cities. Haines added that more people like Marchandise-Franquet, who embodies both technical and political expertise, need to be involved in research. He said, "We need people that can bridge that gap between academia and the front-line decision makers at the urban level, and we need to think about how we can strengthen the capacity to envelop more human resources, more people with those mixed experiences."

Haines also said that when he and his collaborators tried to link health and environmental data from 250 randomly selected cities around the world, they found substantial data gaps—particularly from smaller, rapidly growing cities in Africa and Asia. Given that these cities will likely grow most over future decades, investment in data capture needs to occur for at least a range of these cities so that cities can be followed as they develop and expand. He also noted another issue: health and environmental data, when they do exist, are often held by different authorities and encompass different spatial scales. In addition, health data often involve confidentiality concerns with which ethics committees or institutional review boards may take issue. There are, Haines said, approaches for linking health and environmental data that maintain confidentiality, but they require some investment. Singer's concerns about ideology are related to interactions between the public and private sectors, which he considers necessary to facilitate dialogue in order to grow innovation. For example, access to a specific geographic area may be needed to target malaria solutions to the exact location where cases occur. In this instance, the public and private sectors could work together in order to make that area safe and accessible for health interventions. He also emphasized the importance of demonstrating proof of concept and of building partner trust. Parts of WHO's new mission are to promote health and to serve the

vulnerable, but these cannot be accomplished without dialogue. Singer said, "What you see in WHO now, and certainly with Dr. Tedros, is a humility and an openness to engage and to listen, and then to partner under those rules of engagement."

Johnson asked Singer how he sees WHO's role changing as populations shift and people move from the country to cities. Singer responded that this population shift "implicates all kinds of health shifts" and points to the important role of subnational and municipal governments in these transitions. WHO and its partners have some city-level activities, such as the Healthy Cities Network and the Global Network for Age-Friendly Cities and Communities, but Singer noted he has not yet seen an entity pull all of the activities together across schematics and sectors in order to use the platform of cities to deliver health. He saw an opportunity to look more systematically at a health issue, such as aging, noncommunicable diseases, air pollution, or obesity, at the municipal level.

3

Evidence and Challenges for Urban Health Initiatives in International Development

Highlights

- An opportunity forged through consensus around the 2030 Agenda for Sustainable Development is to render new research practices that not only consider local evidence related to a particular intervention's effectiveness but also aggregate such results to identify strategic trends based on new types of global urban health data and data science innovation (Parnell).
- Strengthening research capacity in urban health could include harnessing the private sector to build a credible consortium that drives urban health; focusing on areas where rapid urbanization and health problems will be greatest and where research capacity is least developed; building scientific leadership that can synthesize existing urban knowledge and define gaps; and working globally to identify big lessons through composite and comparative research (Parnell).
- Some areas in which health adaptations could occur in response to increased urbanization may include family planning and reproductive health; air pollution reduction; walkability; transportation and mobility; road traffic safety; access to basics services such as water, sanitation, power, and waste disposal; food security; and improved urban health services (Parnell).
- Creating environments that would enable city residents to increase their physical activity would positively influence a city's health and sustainability. It could also erode silos that prevent public health experts from working with urban and transport planners on common agendas (Nieuwenhuijsen).
- Car-based urban infrastructures lead to cities with heavy car usage, which causes higher air pollution and noise levels, a larger heat island effect, more stress, and reduced social contact and physical activity. Combined, these outcomes increase morbidity and mortality among residents (Nieuwenhuijsen).

- Superblock constructs reclaim public space from cars by changing traffic flows so that cars can drive into but not through multi-block sections of a city. Such constructs could significantly reduce car usage, nitric oxide and noise levels, and surface temperature and increase green spaces (Nieuwenhuijsen).
- Cities that are adding more green spaces are encountering environmental gentrification, a situation which argues strongly for including community organizations in planning processes (Nieuwenhuijsen).

NOTE: This list is the rapporteurs' summary of the main points made by individual speakers (noted in parentheses), and the statements have not been endorsed or verified by the National Academies of Sciences, Engineering, and Medicine. They are not intended to reflect a consensus among workshop participants.

The four speakers featured in the workshop's second session helped participants explore the evidence base from research on the effects of urbanization and urban planning on human health. First, Susan Parnell, global challenges professor in the School of Geography at the University of Bristol and emeritus professor at the University of Cape Town, introduced the United Nations' New Urban Agenda. Next, workshop participants heard three short presentations from Mark J. Nieuwenhuijsen, director of the Urban Planning, Environment and Health Initiative and research professor in environmental epidemiology at the Barcelona Institute for Global Health; Eugénie L. Birch, the Lawrence C. Nussdorf Professor of Urban Research and Education, chair of the Graduate Group in City and Regional Planning, and founding co-director of the Penn Institute for Urban Research at the University of Pennsylvania; and Remy Sietchiping, leader of regional and metropolitan planning at United Nations-Habitat (UN-Habitat). In closing, Ann Aerts, head of the Novartis Foundation, moderated an open discussion.

THE CONTEMPORARY URBAN MOMENT AND ITS IMPLICATIONS FOR GLOBAL HEALTH

Susan Parnell (University of Bristol and University of Cape Town) noted that today is a useful time to stop and think about urban health because cities are primary; the planetary population is increasingly urbanized; and planetary constraints demand a shift in global health ideas, practices, and partnerships. She also explained that the spatial dynamics of development, which arise from increasing geographic population concentration, are changing the burden of disease and opening alternative entry points for disease mitigation. Parnell said, "What I am trying to

point out is that there are a number of reasons for why this is the moment to be rethinking urban health questions, the kinds of ideas we use, the practices we invoke, and the partnerships we bring to bear in restructuring urban health."

Parnell explained that the UN's Sustainable Development Goals (SDGs) 11 and 3 underpin calls for a radical reframing of the urban determinants of health and for a new, commensurate, and integrated approach to global urban science and to global health. She said this underpinning concentrates the minds, efforts, and budgets of nation states as well as those of all other stakeholders engaged in all aspects of public health and health care. She remarked, "We have an opportunity to reconfigure the global agenda so that health becomes the global priority for urban health, and cities become the lens on health." Achieving that reconfiguration, she added, will require thinking differently about the nature of urban health research and, critically, of translational research. She noted that for many urban scientists, the idea of designing systems for change is particularly foreign.

For Parnell, one needed change is not only to look at local evidence that speaks to a particular intervention's effectiveness but also to aggregate results to identify strategic trends based on new types of global urban health data and data science innovation. She said, "Philosophically, we need to be able to shift our understanding of who is important, why they are important, what evidence they need, and how they need to be engaged in this translational research in new and different kinds of ways." She also noted a wonderful opportunity, forged through consensus around the 2030 Agenda for Sustainable Development,[1] to use new forms of research practice and new research partnerships to achieve such a shift.

Parnell then spoke about one big challenge to acting on data to shift the global urban health agenda: the very nature of cities creates complexities around population diversity and entry points for reaching various city populations and constituencies. She said a relatively weak science base, massive geographical gaps in health care availability, and an inadequate understanding of interactions across urban systems combine to obscure central or core messages to deliver to urban populations.

One potential improvement within the New Urban Agenda, compared to the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Action, is its plan to develop a voluntary reporting process that connects better to local core stakeholders in cities. Each of these three initiatives provide mechanisms that may serve as platforms for identifying changes needed to improve health and well-being in cities

[1] More information is available at https://www.undp.org/content/undp/en/home/blog/2018/cities-2030--implementing-the-new-urban-agenda.html (accessed September 23, 3019).

globally. Simultaneously, the urban health caucus may need to organize itself in order to navigate the competing and complex institutional architectures of policy that influenced the often competing and complex aspirations in the 2030 Agenda. Organizing, she said, will create institutional heft and a set of agreed-upon priorities.

At present, Parnell said, there is no urban health equivalent to the mitigation/adaptation strategy pushed by the climate science community via the Intergovernmental Panel on Climate Change. Responding to increased urbanization, health adaptations could occur in areas such as family planning and reproductive health; air pollution reduction; walkability; transportation and mobility; road traffic safety; access to basic services such as water, sanitation, power, and waste disposal; food security; and urban health services.

Each intervention area will engage a vast domain of the private sector, Parnell added. Knowing where and how to make changes in the urban context will require harnessing scientific, medical, and operational expertise and reinvigorating the voice of public health officials in urban development plans. Parnell said, "We have a moment to resurrect the question of health and the relationship between the city and health." Instead of focusing merely on water and sanitation, future discussions will need to focus also on energy, fertility, and pollution. These concerns will have to be embedded in law and will probably be embedded in the codes and practices of institutions and professions that ultimately run a city, she added.

Parnell was certain that big data and data science will play important roles in linking urban development and urban health. New data practices enable new ways to look at patterns and trends. She noted, in fact, that the most important partnerships to be forged around urban health will involve data generation and data access. Parnell said, "I would encourage you to be thinking critically as you engage with the New Urban Agenda about what the nature of health is and what the nature of knowledge is, because that is what will determine the practices that we embed in the city going forward." Her suggestion to the workshop was to strengthen the capacity of urban health research to link to the 2030 Agenda for Sustainable Development and to associated international and national commitments. This will involve

- Harnessing/enrolling the private sector to build a credible and powerful consortium to drive urban health while ensuring public/open access to urban and health data;
- Focusing on areas where rapid urbanization and health problems will be greatest and where research capacity is least developed (i.e., Africa and Asia);

- Building scientific leadership that can synthesize existing urban knowledge and define gaps;
- Working locally in partnership with local governments and local service providers;
- Working nationally with specialists on natural urban policies; and
- Working globally to identify big lessons through composite and comparative research.

EFFECTS OF URBANIZATION AND URBAN PLANNING ON HEALTH

Although cities may be great, said Mark Nieuwenhuijsen (Urban Planning, Environment and Health Initiative; Barcelona Institute for Global Health), the urban planning related to human health that occurred as they grew has been less than optimal: Some cities are densely packed, and others sprawl over many square miles. Neither form, he noted, is good for human health—particularly because of the high levels of air pollution, due largely to heavy reliance on cars for urban transportation, associated with quite a few cities worldwide. Moreover, the negative effect of cars on human health extends beyond the pollutants they emit, Nieuwenhuijsen said. For example, when parked, cars occupy space on streets that could otherwise be used to plant trees.

Today, robust understanding exists on the link between urban design, human urban movement, pollution pathways, and morbidity and mortality (see Figure 3-1). Nieuwenhuijsen said, "The point is that how we design the city determines how we get around and the levels of pollution." For example, designing and investing in car-based urban infrastructure leads to cities with heavy car usage. In turn, such usage leads to higher air pollution and noise levels, a larger heat island effect, more stress, and reduced social contact and physical activity. Taken together, the result is increased morbidity and mortality among urban residents.

In contrast, Nieuwenhuijsen said, designing a city for bicycling and for other forms of active transportation yields a city where many more people cycle. That uptake in cycling leads to reduced air pollution, lower noise levels, less stress, and less space used by heat-absorbing roads—and hence to a smaller heat island effect. It also leads to more green spaces, social contacts, and physical activities. Morbidity and mortality would be expected to be lower as a result. Given the clear link between urban design and human health, Nieuwenhuijsen said, "We cannot put our heads in the sand anymore. We need to look at solutions." His solutions involve land-use changes that reduce car dependency, increase public and active transportation, and create what he called *green cities*.

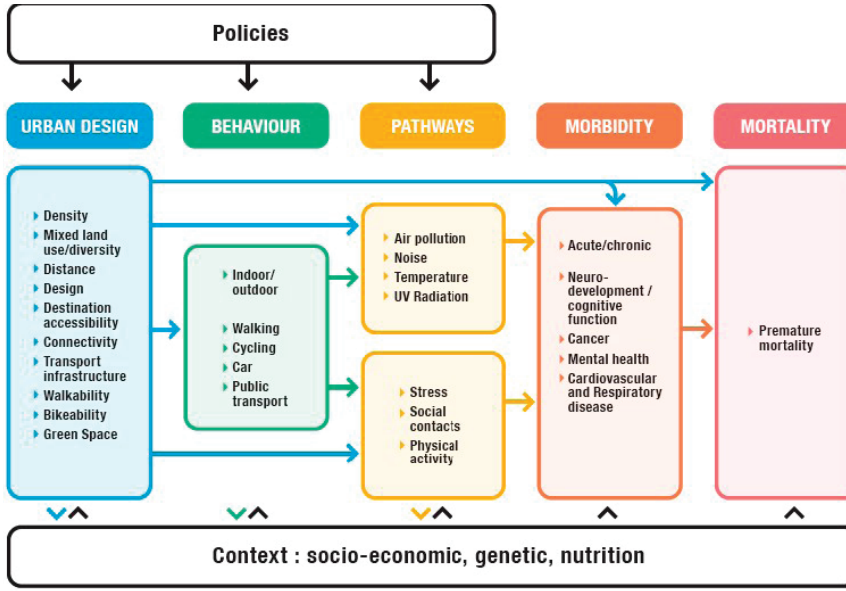

FIGURE 3-1 The link between policies on urban planning and human health. SOURCES: As presented by Mark Nieuwenhuijsen on June 13, 2019; Nieuwenhuijsen, 2016. CC BY 4.0.

In one 2016 study, researchers modeled projected health effects in six quite different cities—Boston, Copenhagen, Delhi, London, Melbourne, and São Paulo—if they were made 30 percent more compact (Stevenson et al., 2016). For all six cities, density increases led to health benefits ranging from 400 to 800 disability-adjusted life years (DALYs) per 100,000 people. However, compactness is not a cure-all: Barcelona, a very compact city, is not a healthy place, and a study Nieuwenhuijsen and his colleagues conducted estimated that the city's heavy dependence on automobiles leads to 3,000 premature deaths each year. Barcelona, he explained, was originally designed in the 1800s with human health in mind, and it relied on wide streets with green spaces in the middle of blocks. Unfortunately, he said, these streets started filling with cars in the 1960s, and the green spaces became garages or other structures.

One solution to this problem is the *superblock* construct (Mueller et al., 2019), which reclaims public space from cars by changing traffic flows so that cars can drive into but not through multi-block sections of a city (see Figure 3-2). Modeling what superblocks would achieve in Barcelona, Nieuwenhuijsen and his colleagues found superblocks would reduce car usage by 19.2 percent, nitric oxide levels by 24.3 percent, noise

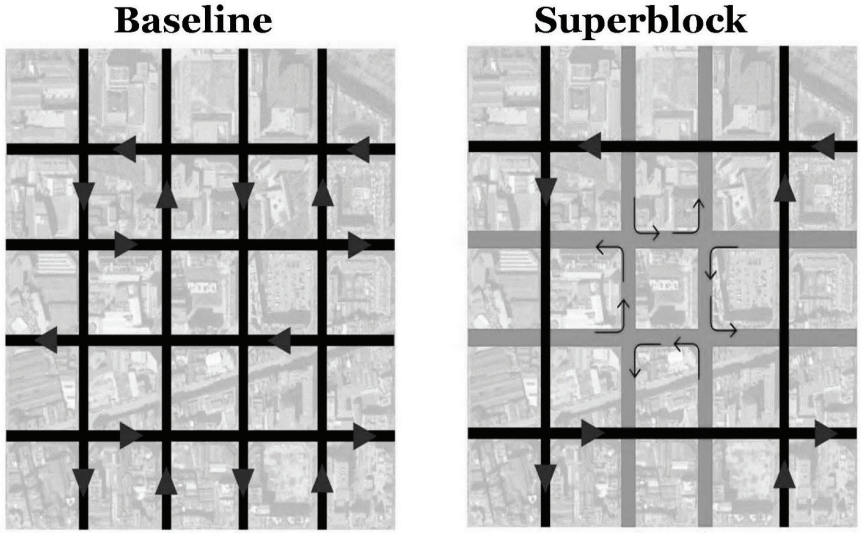

FIGURE 3-2 The superblock construct routes through traffic around a multi-block area and reduces pollution and noise.
SOURCES: As presented by Mark Nieuwenhuijsen on June 13, 2019; Mueller et al., 2019. CC BY 4.0.

levels by 2.9 decibels, and surface temperature by 20 percent. They would also increase green spaces in the city from 6.5 percent to 19.6 percent. Together, these effects would prevent 700 premature deaths per year without accounting for any benefits that would accrue from people walking or riding bikes more.

The United Kingdom's Vision 2030 Walking and Cycling Project,[2] which examined the effect of different street designs on human health, found that redesigning urban transport to rely more on active transportation options—biking and walking—and adding more green spaces would save between 8,000 and 9,000 DALYs per 1 million people (Woodcock et al., 2013). Nieuwenhuijsen said, "By changing the design of what we have in cities, we actually can generate quite large health benefits."

Dedicated cycling lanes can also benefit urban dwellers' health. One study that Nieuwenhuijsen and his colleagues conducted found a direct relationship between the length of cycling lanes per 100,000 people in 167 European cities and the mode share of cycling (i.e., the percentage of

[2] Additional information available at http://www.visions2030.org.uk (accessed September 24, 2019).

urban residents who use bikes regularly)—up to about 25 percent mode share (see Figure 3-3). When they then modeled what would happen if cities could reach 25 percent mode share for cycling, they estimated that doing so would prevent more than 10,000 premature deaths per year. Nieuwenhuijsen said, "Again, you can prevent quite a number of deaths by changing your environment within cities."

Making such changes to a city requires active citizen participation, he noted. For example, the residents of Antwerp, Belgium—a city of 500,000 people with 30,000 vehicles driving each day on a motorway that crosses the heart of the city—worked with scientists and policy makers to generate an idea: put the motorway underground, and create large green spaces over the subterranean road. Public crowdsourcing raised 200,000 euros to support the project's planning stage, and project leaders involved locals by having 2,000 residents collect air samples to determine pollution levels. These residents were also invited to planning sessions devoted to discussing the health effects of air pollution. A health impact assessment esti-

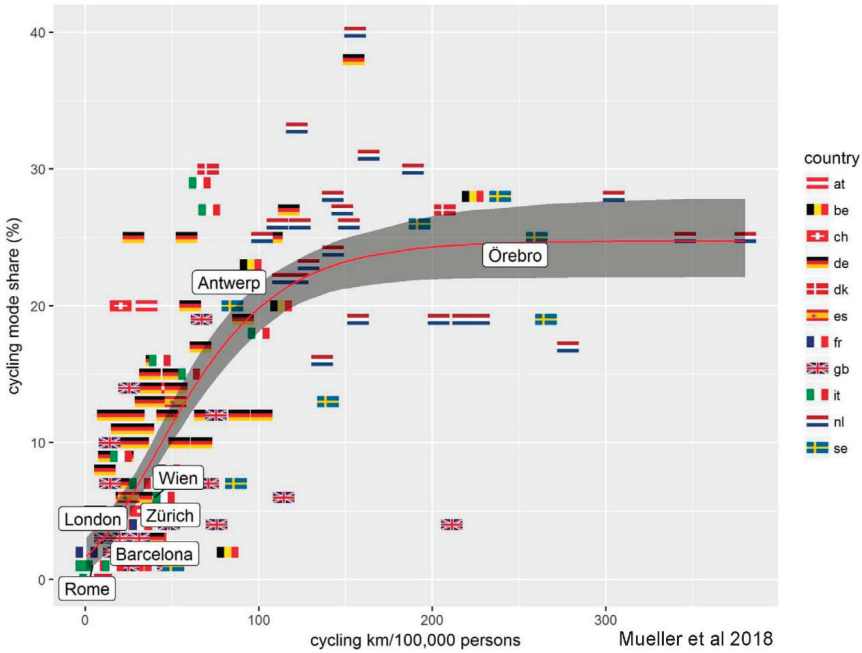

FIGURE 3-3 Bicycle usage versus distance of available cycling lanes for European cities.
SOURCES: As presented by Mark Nieuwenhuijsen on June 13, 2019; Nieuwenhuijsen, 2016. CC BY 4.0.

mated that 21 deaths per year would be prevented within a 1,500-meter radius of the underground road—not accounting for any benefits afforded by green spaces created by the project (Van Brusselen et al., 2016).

Nieuwenhuijsen noted that Antwerp's project is ongoing and that other cities, including Seoul and Barcelona, are moving urban motorways underground. Some cities, such as Hamburg, even aim to be car-free, which he called a pathway to healthy urban living (Nieuwenhuijsen and Khreis, 2016). Though he admitted difficulty imagining a U.S. city going car-free, he noted such action is more likely to happen in Europe. In fact, Freiburg, Germany, has already become car-free.

In his experience as a public health researcher, Nieuwenhuijsen said that urban and transport planners rarely think about health, even though their actions largely impact health. In closing, he said urban and transport planning need more sectoral and systemic approaches that include input from businesses, the housing and health sectors, citizens, educators, architects, and environmental experts and emphasize making cities heathier as the core goal.

DESIGNING PUBLIC SPACES FOR HEALTHIER LIVES

The focus of Eugénie Birch's (University of Pennsylvania) presentation was on designing public space, which she defined as a place accessible to all citizens for their full use and enjoyment. Streets are an obvious public space, one that needs to serve walkers, bicyclists, and drivers, and they should include safe crosswalks, a planting strip, and green spaces. She illustrated the concept of *Complete Streets*, a design philosophy that advocates a comprehensive approach to safely incorporating all users from vehicles to pedestrians. This model considers the entire public space, from active sidewalks and roadways, to dedicated bike lanes, safe crosswalks, planting strips, and green spaces. Other public spaces in a regional context include green spaces to protect water and food supplies as well as wetlands and coastal areas to protect against flooding. She asserted that the Regional Plan Association's *The Future of the New York Metropolitan Area: The Fourth Regional Plan* exemplifies this thinking as its portrait of the region illustrates. It shows population centers (red) and the many green spaces (green) that sustain urban development on the regional scale (see Figure 3-4).

Public spaces, Birch said, can also have ceremonial purposes and can serve as gathering places that encourage socialization. They can even generate opportunities for people to make a living through vending operations. Children need public spaces—a fact recognized in the late nineteenth century when reformers successfully advocated for including playgrounds in urban schools.

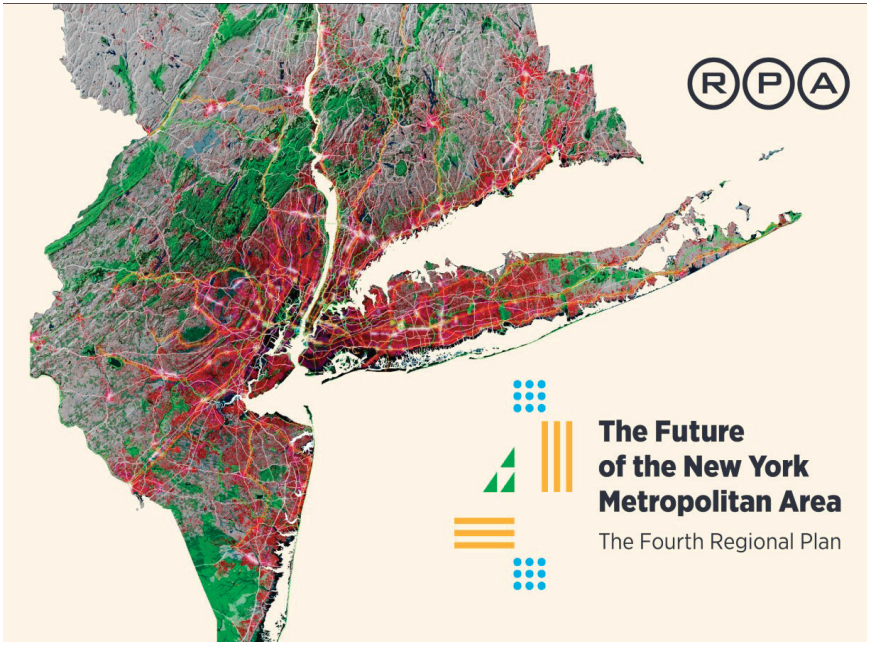

FIGURE 3-4 Population centers and green spaces in metropolitan New York.
SOURCES: As presented by Eugénie Birch, June 13, 2019. Used with permission from the Regional Plan Association.

Birch said it is important to incorporate a variety of voices, including those of community members, into discussions when designing spaces for public use. For example, in New York City, with its high proportion of immigrants, community input has incorporated different visions among new residents about how they would use public spaces. For instance, people have called for soccer fields and cricket pitches in place of football fields. Furthermore, the current New York City Parks Department Commissioner, Mitchell Silver, the first city planner to administer the Parks Department, successfully lobbied for budget increases to prioritize the city's capital expenditures in immigrant and/or low-income communities. The Parks Department labeled the program the Community Parks Initiative, outlined large zones around parks, and targeted other investments in those areas to catalyze broader economic and environmental improvements. Figure 3-5 illustrates the 35 designated zones, all of which are in economically disadvantaged areas.

Other places, especially Legacy Cities in the U.S. Northeast and Midwest where population losses have left cities with acres of abandoned land, have developed public space programs. In Philadelphia, for exam-

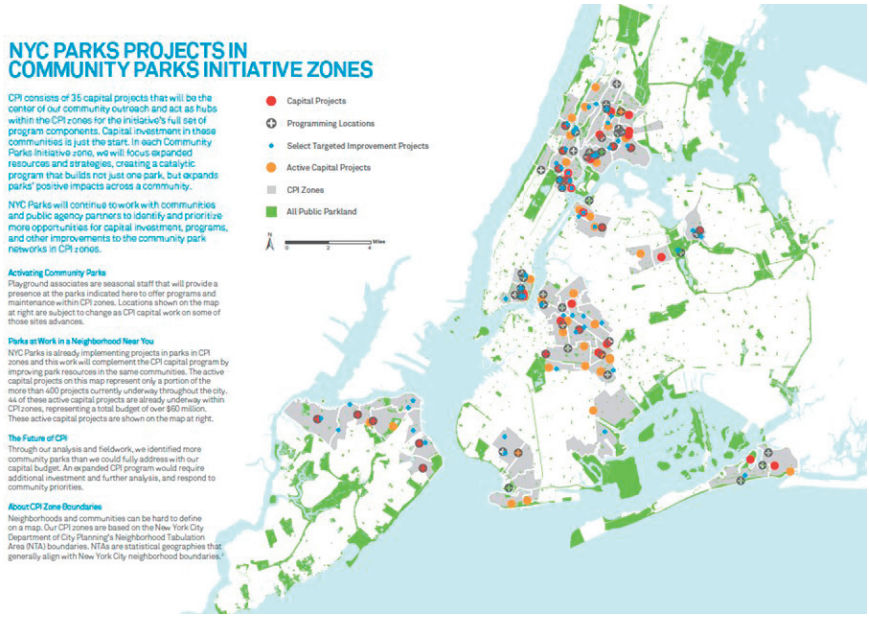

FIGURE 3-5 Map of the Community Parks Initiative, New York City Department of Parks and Recreation.
SOURCES: As presented by Eugénie Birch, June 13, 2019. Used with permission from New York City Parks.

ple, the Pennsylvania Horticultural Society has engaged in a public–private partnership (PPP) to green many of the city's 40,000 vacant lots and to create healthier environments for affected neighborhoods (Kondo et al., 2018). Approximately one-third of the vacant lots have been turned into green spaces, and neighborhoods where conversions have occurred have seen a significant decrease in residents' self-reported feelings of depression and worthlessness (South et al., 2018).

Birch concluded by suggesting more research is needed to firmly establish the key benefits of public space and health. She called on participants to find common questions with which to guide shared research drawn across the many disciplines that are concerned with the built environment and its effects on people.

HEALTH-FOCUSED URBAN AND TERRESTRIAL PLANNING

UN-Habitat, explained Remy Sietchiping (Global Solutions Division, UN-Habitat) is a UN Human Settlements Programme that aims to connect people with the spaces in which they live and, in doing so, to improve

air quality, spatial inclusion and equity, resilience, food security, lifestyle, and nutrition while reducing sprawl and risk exposure. Health, said Sietchiping, is affected by those connections across different scales, from the household to the city and the nation—and even the globe when considering health effects from climate change. Changing how people interact with and benefit from the spaces in which they live requires a multi-stakeholder approach that engages local citizenry and creates public–private–people partnerships. It also requires health actors and urban actors to work together rather than in isolation.

Turning to the subject of the UN's New Urban Agenda, Sietchiping said that health has become a central metric for the agenda (UN Conference on Housing and Sustainable Urban Development, 2016). Sietchiping noted that SDG 3, which focuses on good health and well-being, and SDG 11, which focuses on sustainable cities and communities, are strongly interlinked. He and his colleagues have been working with WHO to prepare a sourcebook on urban territorial planning that will emphasize health. They are also developing an assessment tool that examines the effects of transportation choices on urban health. Going forward, they will emphasize implementing interventions in urban planning that can contribute to well-being. Sietchiping explained that in some regions of the world, such as in Africa, spiritual health is an important component of well-being for many people.

In both Cameroon and Uganda, UN-Habitat has brought together urban planners and health care providers to work on urban planning practices that can benefit health. The challenge has been developing a common language that can bridge gaps between these two communities. However, bridging that gap can produce success—as was seen in a project designed to reduce the incidence of malaria and dengue fever.

DISCUSSION

To start the discussion, moderator Ann Aerts asked panelists to suggest the one action mayors should address first given their limited resources. Nieuwenhuijsen replied that creating environments that would enable city residents to increase their physical activity would have the biggest positive effect on health. Doing so, however, would first require eroding silos that prevent public health experts from working with urban and transport planners on a common agenda. He noted that change is not always expensive. Barcelona, for example, erected plastic barriers on existing roads to create separate cycling lanes, which led to an increase in people riding their bikes rather than driving their cars. Sietchiping agreed that improvements that benefit health do not have to be expensive. However, Birch said that although this type of approach might work in

Barcelona, poverty and unemployment need to be addressed first in many parts of the world.

David Vlahov from the Yale School of Nursing and School of Public Health commented on the importance of input balance in PPPs and on the need for a common language across the many different professions and disciplines integral to improving public health through better urban and transportation planning. He then asked panelists if any of the undergrounding projects include technologies that can capture the carbon dioxide emitted by vehicles traveling through subterranean motorways. None of the panelists were aware of any such efforts. Birch suggested the idea is probably not even considered because, for example, these projects are designed by transportation planners with little input from environmental engineers.

Jo Ivey Boufford remarked that many organizations, and particularly hospitals, have large urban campuses with huge parking lots that would afford opportunities for creating more usable, health-promoting spaces. She then asked panelists to comment on how to address equity in the context of urban planning. Birch replied that conversations about equity are not occurring—particularly not in the developing world where informal settlements with no open spaces or places to congregate account for 40 to 50 percent of a city's land mass. Parnell agreed with Birch that different cities will require different transformations to improve health and equity but added that some of the most important levers of change lie with national governments or even with global corporations. Therefore, creating linkages that extend beyond those of city governments becomes imperative. Nieuwenhuijsen noted that cities that are adding more green spaces are also encountering environmental gentrification, a situation that makes equity worse instead of better and provides strong evidence for including community organizations in planning processes.

Katherine Taylor from the University of Notre Dame commented that making the types of changes panelists addressed requires long-term planning and large investments. Given that the public sector can be quite inconsistent with its commitment to certain values and principles, she asked panelists if they could see the private sector providing a longer-term vision and commitment to change or if the private sector's commitment would be even shorter than that of the public sector. Birch said that depends on the PPP's governance structure, one that includes an active, united civic community that holds partners to their commitments. Nieuwenhuijsen believed the private sector generally has a short-term vision given its emphasis on quarterly and yearly profits, while the public sector has to consider election cycles. The community, he said, has the long-term vision given that most people live in the same community for decades.

One problem Birch encountered when she was a member of the New York City Planning Commission was the "not in my backyard" phenomenon. She said mediating arenas are needed: places where different interests can negotiate with each other given their individual motivations. Nieuwenhuijsen noted that bringing people together from different backgrounds and with differently vested interests is not easy. To address this problem, he and his colleagues have created a knowledge translation group to speak with urban planners and other interested parties about what they have learned as researchers in order to create common ground for future discussions. Also helpful, said Parnell, is identifying ways of incentivizing different constituencies to come to the table to discuss urban health issues.

Charlotte Marchandise-Franquet noted that public opinion can drive the public sector's involvement in a project. In that respect, she believes that mayors can be effective mediators if they are empowered with information from research. Nieuwenhuijsen, sympathizing with the difficult job elected officials have as mediators, acknowledged that large gaps can occur between what academic research finds and what can actually be implemented in a city. The missing component, he said, is knowledge about how to translate and implement research findings in urban environments that have multiple stakeholders with multiple motivations for changing or maintaining the status quo.

4

Identifying and Addressing Health Inequities in Urban Settings

Highlights

- Worldwide, 437 million people live with diabetes, and 65 percent of people with diabetes lived in cities in 2017 (IDF, 2017) (Napier).
- Addressing the growing incidence of diabetes could require a Health in All Policies approach that attends to relevant risk factors, which include housing, water, and sanitation; transportation; occupational factors; health communication; exposure to chemicals and their mixtures; physical activity; food production and distribution; and built, natural, and social environments (Napier).
- Environmental, social, psychological, and cultural risk factors that contribute to diabetes can be mapped using vulnerability assessment tools that evaluate service-use patterns and barriers, including biological, social, geographical, and cultural factors that prevent people from changing their behavior (Napier).
- Data from years of Kaiser Permanente's community health needs assessments indicate that many members have unmet health and social needs; more than 40 percent experience financial strain, 25 percent deal with food insecurity, and 23 percent have issues with housing (Hamity et al., 2018; Sundar, 2018) (Cooke).
- Kaiser Permanente's new program, Thrive Local, attempts to scale lessons learned from their community health programs through developing a resource directory that provides information on social services and public benefits; geographic community partner networks to which providers can refer their patients; and a technology platform that offers two-way, closed-loop referrals and integration into electronic health records and community-based organizations' client-management systems (Cooke).

- The Better Hearts Better Cities program has five pillars: encouraging strong local ownership of multi-stakeholder partnerships that include government agencies, civil society organizations, and implementation agencies; establishing a quality improvement culture for health and care; enhancing the performance of local health systems; delivering health and care closer to where people live, work, and play; and implementing policies that address urban cardiovascular health (So).

NOTE: This list is the rapporteurs' summary of the main points made by individual speakers (noted in parentheses), and the statements have not been endorsed or verified by the National Academies of Sciences, Engineering, and Medicine. They are not intended to reflect a consensus among workshop participants.

The workshop's third panel session featured presentations about urban health inequities. The panelists were David Napier, professor of medical anthropology and director of the Science, Medicine, and Society Network at the University College London and global academic lead for Cities Changing Diabetes; Karin Cooke, director of Kaiser Permanente International and director of technology innovation and the innovation fund for technology at Kaiser Permanente; and Geoffrey So, head of strategy and global health policy at Novartis Foundation. After the three presentations, Rebecca Martin, director of the Center for Global Health at the U.S. Centers for Disease Control and Prevention (CDC), moderated an open discussion with workshop participants.

IDENTIFYING AND ADDRESSING HEALTH INEQUITIES IN THE CITIES CHANGING DIABETES INITIATIVE

Worldwide, 437 million people live with diabetes, and that number is projected to soar to more than 642 million by 2060. To put these numbers into context, David Napier (University College London) remarked that if diabetes were a country, it would be the third most populous one on the planet. What makes this an urban health issue, he added, is that 65 percent of people with diabetes lived in cities in 2017, and that number is expected to increase to 75 percent by 2045 (IDF, 2017). Moreover, because cities are complex, dynamic, and often mutable, diverse drivers can affect illness and lived experience, particularly given that health inequalities are, in general, exaggerated in social environments under stress—which includes most of the world's cities.

Addressing the growing incidence of diabetes will require a Health in All Policies approach, Napier said. In considering the Health in All Policies framework at the World Health Organization (WHO) (see Figure 4-1),

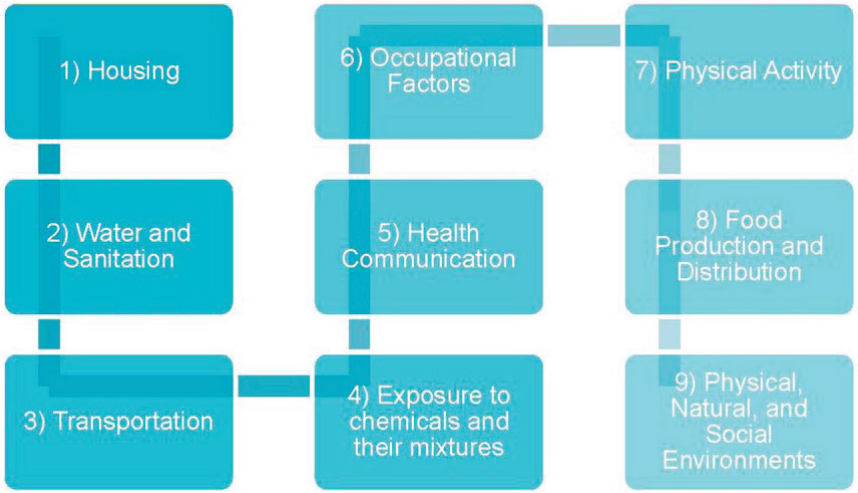

FIGURE 4-1 The World Health Organization's Health in All Policies framework. SOURCES: As presented by David Napier, June 13, 2019. Original author, Anna-Maria Volkmann. Used with permission from David Napier.

he noted that diabetes relevant risk factors are present in each of its policy domains. For example, in the transportation domain, long commutes to work can leave little time to exercise, and crowded, inadequate housing can limit residents' abilities to move and be active. Some domains, he explained, contain significant data upon which to build a research and intervention agenda while others lack data related to health and health impacts. Conducting randomized controlled-type research is not possible in these domains because no single cause of diabetes exists; rather, compounding causes significantly exacerbate each other.

As an aside, Napier briefly mentioned the decision of the United Nations (UN) Global Compact, which monitors ethical and workplace practices at more than 600 businesses worldwide, to develop a taxonomy of public–private partnerships. This taxonomy would allow the Global Compact to see how businesses become vulnerable and to engage the public in promoting good health and well-being to address UN Sustainable Development Goal 3. He mentioned this effort to show room exists to talk about different kinds of businesses and about things they can and cannot do to promote public health.

In that context, Novo Nordisk invited Napier and his colleagues to join one of its new initiatives—Cities Changing Diabetes—in collaboration with Steno, a world-leading institution in diabetes care and prevention. The program seeks to engage different cross-sector partners in address-

ing the diabetes and obesity challenge through discovering actionable insights into health vulnerabilities among at-risk populations, creating opportunities for disseminating those findings through new knowledge networks, and working with local and global advocates to reverse the diabetes and obesity epidemics. Over the past 5 years, 22 cities have partnered with the Cities Changing Diabetes initiative, and Napier expects that number to more than double over the next 5 years. He hopes the data from these partners will produce comparable datasets that the program can analyze to develop and share best practices. Although working across sectors is challenging, he noted, it is also urgent. He presented an example: unchecked diabetes-related mortality and morbidity are projected to bankrupt Mexico's health care system over the next 15 years.

Driving this research effort is what is called the *Rule of Halves* (Hart, 1992; see Figure 4-2)—of the estimated 437 million people living with diabetes, only about half are diagnosed, and of that number, only about half receive care. Moreover, only half of those who receive care achieve their treatment targets, and only half of these individuals achieve desired outcomes. (Cities Changing Diabetes, 2017). This final "half" of people with diabetes live without diabetes-related complications, but that number can vary from less than 40 percent to less than 1 percent depending on the health care system in question. In essence, much of the money funneled into diabetes prevention and treatment is wasted. Napier said, "This really is quite a devastating indictment against what we are doing to halt this epidemic."

In the Rule of Halves, the biomedical domain comprises individuals for whom none of the associated non-biomedical risk factors are very

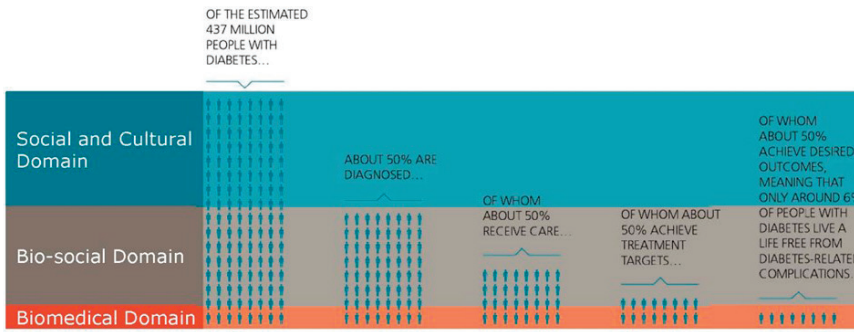

FIGURE 4-2 The Rule of Halves and its role in preventing, managing, and treating diabetes.
SOURCES: As presented by David Napier, June 13, 2019. Original author, Anna-Maria Volkmann. Used with permission from David Napier.

important—because they are doing well, whether they are rich or poor, well educated or not. The bio-social domain comprises what Napier calls the *ground of non-adherence*: people who are diagnosed with diabetes but are not managing it. The social and cultural domain includes individuals who are unaware they have diabetes and for whom, therefore, the illness experience remains entirely non-medical.

To better understand diabetes, Napier argues, we need a new approach that examines and measures the environmental, social, psychological, and cultural risk factors that contribute to diabetes, especially in urban settings; identifies people who are most vulnerable to these risk factors; and determines what can be done to make those individuals and groups less vulnerable. Toward this end, Napier's team has developed a vulnerability assessment tool. This tool examines service-use patterns and barriers, including biological, social, geographical, and cultural factors, that prevent people from changing their behavior. Their goals in using this tool are to understand how vulnerability emerges in a particular city, to identify new and measurable case definitions of diabetes vulnerability, and to find ways of bringing the lived experience to the level of evidence.

In Houston, for example, Napier's research colleagues discovered that groups at the highest risk for diabetes include not only people who are poor but also those who are affluent and professionals who are well educated and live commuter lifestyles. Houston is also a city where faith-based organizations serve as a rich resource for people who are learning to manage their illnesses. In Shanghai, those most at risk are members of middle-class families who consciously conceal early symptoms because of social stigma and fear about losing their jobs or spouses. In Vancouver, Napier's colleagues found that food insecurity causes more than 850,000 Canadians to rely on food banks and eat unhealthy foods. That finding led the city to initiate onsite dietary counseling at its food banks. The research team in Copenhagen found that alienated middle-age men carry a high and unequal diabetes burden even though health care is free and health care registration is mandatory. The city has established community-based social clubs to bring people who live in isolation together to share their diabetes challenges. In each case, locally based research on the social drivers of health vulnerabilities has, with public–private support, led to rapid implementation of specific programs designed to reduce the prevalence of obesity and/or prediabetes and to improve outcomes for people who live with diabetes.

COMMUNITY HEALTH: IMPROVING HEALTH FOR ALL

As a nonprofit health care organization, explained Karin Cooke (Kaiser Permanente, also referred to as Kaiser), takes what it calls a *community*

health approach, which aims to improve the health of its 12.3 million members as well as the health of the 68 million other residents in the communities it services. Toward that end, she noted, Kaiser Permanente has established seven community health priorities: affordability and access, social care, housing and homelessness, wellness in schools, economic opportunity, public policy, and environmental stewardship. The vision for its community health program is to use data to connect people with appropriate resources.

Cooke said Kaiser particularly emphasizes public policy, and its CityHealth initiative, a collaboration with the de Beaumont Foundation, supports the 40 largest U.S. cities in their efforts to develop policies that bolster good health and quality of life. For example, these policies aim to make streets more accessible for physical activity and to provide more affordable housing and stable employment. One exemplar city, Washington, DC, has already implemented five or more policies in many of the emphasized areas. As a result, Cooke said, it has seen some health gains.

Data from years of Kaiser Permanente's community health needs assessments indicate that many members have unmet health and social needs: more than 40 percent experience financial strain, 25 percent deal with food insecurity, and 23 percent have issues with housing (Hamity et al., 2018; Sundar, 2018). Cooke noted that although regions vary, these three social needs consistently rank as most prevalent. She also explained that social needs information is now integrated into Kaiser's electronic health record (EHR). Because social issues are flagged in the same way as health condition alerts, the system's providers are able to link social and medical needs. Cooke said, "What has always been challenging with this is that once the doctors knew there was a social need, then what?"

In 2019, looking beyond its members, Kaiser surveyed more than 1,000 nonmembers to discover their views on social needs, health impacts, and community-resource usage (Kaiser Permanente, 2019). The survey results showed that 55 percent of U.S. residents view social needs as an integral part of overall health and that 97 percent want their medical providers to ask them about social needs and connect them with resources. More than one-third of the survey respondents said they lack confidence in their abilities to access resources and address social needs on their own. Cooke noted, "One-third of all U.S. residents experience some stress related to social needs, so this is clearly an issue that impacts overall community health."

Responding to these findings, Kaiser launched a new program called Thrive Local: Addressing Social Needs for Total Health. This program takes what Kaiser has learned about how to connect its members to social needs and attempts to turn those lessons into a scalable system. Thrive Local comprises a resource directory that provides information on social

services and public benefits, geographic community partner networks to which providers can refer their patients, and a technology platform that allows for two-way, closed-loop referrals and integration into EHRs and community-based organizations' client-management systems. This last component will allow care teams to receive feedback on whether their patients use these resources. Thrive Local, said Cooke, is available for all community-based organizations to use for free. Kaiser is also inviting other health care systems to join the program.

Turning to the subject of affordable housing and homelessness, Cooke noted that Kaiser operates in 6 of the 10 U.S. cities with the largest homeless populations. After examining this immense challenge, the organization identified several ways to address it. Through a partnership with Community-Based Solutions, for example, Kaiser is working in 15 communities to end chronic homelessness by using data analytics to identify solutions that would work best for homeless individuals. Kaiser is also investing $200 million to increase the supply of affordable housing, Cooke added.

BETTER HEARTS BETTER CITIES

The Novartis Foundation's Better Hearts Better Cities initiative aims to improve cardiovascular health in low-income urban populations through a multidisciplinary approach that addresses hypertension and its underlying determinants, explained Geoffrey So (Novartis Foundation). He noted that hypertension kills 10 million people per year worldwide, and 75 percent of those deaths occur in low- and middle-income countries. The program's approach is to build a network of partners in three demonstration cities—Dakar, Senegal; São Paulo, Brazil; and Ulaanbaatar, Mongolia—that reaches beyond the health sector, integrates capacity in existing health systems, and leverages complementary expertise and resources to co-design and implement interventions. In each city, the prevalence of hypertension is 30 percent or more, and cardiovascular mortality affects from 16 percent of the population in Dakar to 40 percent in Ulaanbaatar. In Ulaanbaatar, 60 percent of the 1.4 million residents live in informal settlements with significant health disparities and with high levels of premature cardiovascular mortality.

Better Hearts Better Cities has five pillars: fostering strong local ownership of multi-stakeholder partnerships that include government agencies, civil society organizations, and implementation agencies; establishing a quality-improvement culture for health and care; enhancing the performance of local health systems; delivering health and care closer to where people live, work, and play; and implementing policies aimed at addressing urban cardiovascular health. So noted that the government in

Dakar asked the Novartis Foundation to create a national plan for cardiometabolic diseases and a national digital health strategy. As part of this effort, Novartis successfully advocated for community health workers to assume the task of screening for hypertension and following up on treatment recommendations while also working with community leaders and patient representatives to increase literacy about early diagnosis and healthy behaviors. In addition, the program introduced a standardized algorithm, patient records, a registry for hypertension, and a digital dashboard to facilitate real-time availability of patient and program progress. Senegal also improved access to hypertension medications after the national pharmacy adopted an essential drug list.

In Ulaanbaatar, one finding at the start of Better Hearts Better Cities was that most hypertension patients were unaware of their condition. Two years later, after the implementation of significant health system strengthening activities, more than 80 percent of the population is now screened for hypertension, and more than 30 percent of those screened are diagnosed with hypertension. To address initial gaps related to chronic care in the health system's performance, Better Hearts Better Cities developed a comprehensive digital health platform with patient trackers, clinical decision support, an electronic prescribing function that simplified care coordination, and communication capacity between levels of care. It also made real-time data available to both health managers and policy makers at the Ministry of Health and the National Health Insurance office and engaged pharmacists in hypertension detection and care. Working with local health authorities, the Novartis Foundation and their partners developed solutions for process optimization and systematic hypertension screening in clinics. They also developed digital applications to enhance patient self-management. These efforts, said So, improved the performance of the health care system in Mongolia so that 77 percent of people diagnosed with hypertension now receive treatment, and most patients have their blood pressure under control. He added that Mongolia passed a tobacco tax and used those funds to increase financial support for primary care institutions by 300 percent.

In São Paulo, the program partnered with local champions such as the Corinthians Football Club and the city's many samba schools to increase awareness of hypertension and heart health and to conduct screening campaigns on football match days and during carnival parades. It also facilitated implementing health literacy programs and physical exercise in schools; trained lifestyle advocates at several companies in local communities; and partnered with community leaders to advocate for early diagnosis and treatment and to encourage behavioral change.

On a final note, So commented that when Better Hearts Better Cities started in Ulaanbaatar, it enrolled 25 out of 142 clinics in the city to test

and refine the initiative. The program was rolled out to the entire city 1 year later and began spreading throughout the country in 2019. In the wake of the program's success, the World Bank contributed additional investment to reinforce the country's newly constructed digital health system.

DISCUSSION

Rebecca Martin, moderator, began the discussion by asking panelists to talk about strategies they have developed to address the use of data collected by their partners. Cooke replied that Thrive Local's partners each have their own client management systems, so Kaiser developed a way to integrate data in those systems with its EHRs after years of effort. As a result, all partners now have access to the same data. So noted that putting systems in place to integrate data from different partners and then making that data available to partners has helped the partners understand their prior gaps in knowledge. This has empowered clinics and patients to educate themselves and allowed clinics to provide higher quality of care.

John Monahan from the Georgetown University McCourt School of Public Policy asked Cooke if Kaiser helps under-resourced community organizations implement the technologies they need to participate in the program. Cooke replied that Kaiser is concerned about stressing community systems, so it does invest in community organizations. She hoped that creating an open platform would encourage other systems to join and see the need to support these organizations. She noted that Kaiser is incentivized to invest in the community because it is a nonprofit and because it does better when the entire community is healthier.

So commented that he and his colleagues are working with food and agriculture companies who are trying to leverage technology in a way that will enable farmers to pool their resources and sell their produce as an aggregate for better pricing. Their idea is to link supply information with the demand for healthier food that Better Hearts Better Cities creates in workplaces and schools.

David Vlahov asked So who he first approached in Mongolia to start his program. So replied that he first spoke to national health authorities and to the mayor of Ulaanbaatar to see whether they would be receptive to such a program, and they were. At the same time, he and his team were fortunately introduced to and then worked with an organization that had a history of implementing policies in Mongolia.

5

Effect of Food, Agriculture, and Transportation Systems on Urban Population Health

Highlights

- Increased greenhouse gases produced largely by agricultural systems, which account for 23 percent of the world's greenhouse gas emissions, increase temperature, rainfall variability, and instances of extreme weather. These increases, in turn, affect crop yields, reduce the nutritional content of foods, and trigger price increases, all of which combine to alter nutritional status (Dietz).
- Redirecting subsidies away from corn production and toward production of low-cost, healthy alternatives; restricting marketing of ultra-processed foods; and requiring labels that include both nutritional and sustainability information are ways to provide healthier diets for obesity prevention, more land for sustainable agriculture, and reduced greenhouse gas emissions from agriculture and transport of ultra-processed foods (Dietz).
- Many Latin American cities have embraced transportation innovation as a powerful tool to improve urban health and equity. Such innovations include cable-car systems; bus rapid-transit systems that provide lanes exclusively for buses; open-street programs where streets are closed for biking and leisure activities; and biking infrastructure (Sarmiento).

NOTE: This list is the rapporteurs' summary of the main points made by individual speakers (noted in parentheses), and the statements have not been endorsed or verified by the National Academies of Sciences, Engineering, and Medicine. They are not intended to reflect a consensus among workshop participants.

The fourth workshop panel focused on the role that food, agriculture, and transportation systems play in determining the health of urban populations. The three panelists were William Dietz, professor at the Milken Institute School of Public Health and chair of the Sumner M. Redstone Global Center for Prevention and Wellness at The George Washington University; Allison Goldberg, executive director of the AB InBev Foundation; and Olga Lucia Sarmiento, professor in the Department of Public Health at the School of Medicine at the Universidad de Los Andes. Rebecca Martin moderated an open discussion that followed the three presentations.

THE GLOBAL SYNDEMIC OF OBESITY, UNDERNUTRITION, AND CLIMATE CHANGE

William Dietz (The George Washington University) opened his presentation by defining the word *syndemic*, a new term within medicine but an old one to anthropologists, which refers to the synergistic interactions between epidemics or pandemics. In this case, Dietz used the term to characterize negative interactions over time and place between the pandemics of obesity, undernutrition, and climate change. Such interactions also have common economic, social, political, or environmental drivers that include food, transport, urban design, and land-use systems (Swinburn et al., 2019) (see Figure 5-1). Dietz said, "We consider climate change as a pandemic because of the breadth of its effects on health." Taking this perspective is important, he added, because it creates opportunities for double- and triple-duty solutions.

Dietz explained examples of how this syndemic operates: Increased greenhouse gases produced largely by agricultural systems, which account for 23 percent of the world's greenhouse gas emissions, increase temperature, rainfall variability, and instances of extreme weather, particularly in low- and middle-income countries. These variations, in turn, affect crop yields, reduce the nutritional content of foods, and trigger price increases, all of which combine to alter nutritional status. He said, "If you think about the marginal status of nutritional production in low- and middle-income countries, these are particularly going to be affected and become increasingly reliant on imported food largely in urban centers for their sustenance."

All countries, he noted, are experiencing an increase in obesity, but undernutrition worldwide has somewhat declined over the past 30 years. In his opinion, one of the most important drivers of rising obesity has been the advent of supermarkets and alterations in the food supply. These factors have resulted in increased consumption of ultra-processed foods, heavily marketed worldwide, which leads to increased body weight (Hall

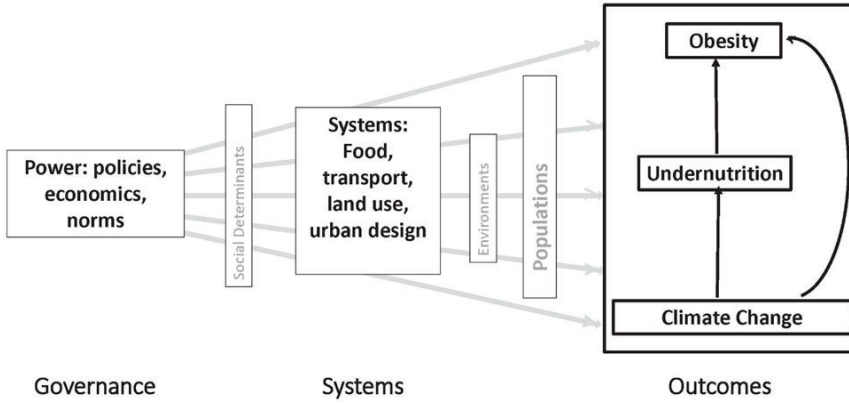

FIGURE 5-1 The systems and drivers of the global syndemic of obesity, undernutrition, and climate change.
SOURCES: As presented by William Dietz, June 13, 2019. Used with permission from William H. Dietz, Redstone Global Center for Prevention and Wellness, The George Washington University; adapted from *The global syndemic of obesity, undernutrition and climate change*; Lancet 2019; 10173:791–846.

et al., 2019; Mozaffarian et al., 2011; PAHO, 2019). Supermarkets were introduced in urban centers some 20 years ago, coincident with increased production of ultra-processed foods, which may be one reason for the higher prevalence of obesity in urban centers compared to the prevalence in rural areas. He said reduced physical activity is also likely to blame, but that is a harder problem to solve; it requires changes in a community's infrastructure, as several workshop speakers had already noted.

Ultra-processed foods, particularly those produced from corn, have a major adverse effect on the environment, Dietz said. Corn production is heavily dependent on fertilizer and pesticide applications, and, as flooding in the U.S. Midwest in 2019 demonstrated, these chemicals can run off into waterways and harm ecosystems distant from farm fields. Ultra-processed foods are also convenient, tasty, and inexpensive and have long shelf lives, all of which make them particularly appealing in low-income communities that lack easy access to fruits and vegetables. He also noted that fast food sales increase as countries increase their wealth.

According to the NOVA classification of foods (Monteiro et al., 2017, 2019), ultra-processed foods are those made from industrial substances with little or no whole foods, and they include sugary drinks, cookies, and packaged soups, noodles, or snacks. Again, corn production is a factor because of the amount of high-fructose corn syrup found in sugary drinks. Ultra-processed foods, he noted, are associated with decreased

satiety—the feeling of having eaten enough—compared to unprocessed foods, and lower satiety likely leads to increased calorie consumption.

To conclude his presentation, Dietz listed possible approaches to reducing consumption of ultra-processed foods. These included redirecting subsidies away from supporting corn production and toward supporting production of low-cost, healthy alternatives. Shifting subsidies in this manner would increase the cost of ultra-processed foods, reduce demand for them, and better reflect their true costs. Restricting the marketing of ultra-processed foods is another approach, one that a few countries such as Colombia and Mexico have used in the face of industry resistance. Another strategy would be to implement food labels with both nutritional and sustainability information. Dietz said taking these actions would result in triple-duty consequences such as healthier diets for obesity prevention, more land for sustainable agriculture, and reduced greenhouse gas emissions from agriculture and transport of ultra-processed foods.

In closing, he also noted that changes in urban design, land use, and transport systems could also have triple-duty consequences for reducing obesity, undernutrition, and greenhouse gas emissions. Steps in that direction include redesigning infrastructure to support physical and public transport systems, reducing subsidies for fossil fuel production, increasing gasoline taxes, and engaging in social marketing.

POTENTIAL TRANSPORTATION SOLUTIONS

The harmful use of alcohol is a global problem, began Allison Goldberg (AB InBev Foundation) and both the United Nations (UN) and the World Health Organization (WHO) have recognized that alcohol use is a leading risk factor for noncommunicable diseases worldwide. The contribution of alcohol to noncommunicable diseases may be even more acute in urban areas than in rural regions, she added. Germane to this workshop, the UN has proposed that public–private partnerships (PPPs) are needed to reduce the adverse effects of harmful drinking.

In response to this call for PPPs, AB InBev launched its Global Smart Drinking Goals in December 2015 and aimed to create a new norm around smart drinking as well as a culture in which harmful drinking is deemed socially unacceptable. Two of the goals are designed to empower consumers through choice by ensuring that no- or lower-alcohol beer products represent at least 20 percent of AB InBev's global beer volume by the end of 2025 and by placing a guidance label on all of its beer products by the end of 2020 as a way to increase alcohol health literacy by 2025. Two other goals seek to influence social norms and individual behaviors in order to reduce harmful alcohol use. To achieve this, AB InBev is investing at least $1 billion worldwide by 2025 in dedicated social marketing cam-

paigns and related programs. It will also conduct pilot programs to reduce the harmful use of alcohol by at least 10 percent in each of six cities as a way to develop best practices globally by 2025 (Georgetown University and AB InBev Foundation, 2020).

In addition, with an initial commitment of $150 million over 10 years, AB InBev created the AB InBev Foundation in 2017 to oversee the pilot programs in each of the six cities. Currently, the foundation spearheads pilot programs in Brasilia, Brazil; Columbus, Ohio; Jiangshan, China; Johannesburg, South Africa; Leuven, Belgium; and Zacatecas City, Mexico, where it tests a model of PPP with multiple stakeholders and sectors that include the alcohol industry. The foundation, Goldberg noted, is committed to supporting evaluation and to sharing all lessons that emerge from programs in these six cities.

Goldberg discussed the pilot in Columbus, Ohio, in some detail. This pilot was launched at the end of 2016 with a steering committee representing the mayor's office, The Ohio State University's College of Public Health, AB InBev's corporate social responsibility division, the Columbus Distributing Company, the city's epidemiology office, and the city's family health administrator. The steering committee first committed to a safe-ride program to address impaired driving in the community. This intervention, which ran from mid-September 2017 through December 31, 2017, combined $30 coupons for round-trip, ride-sharing arrangements with increased enforcement in high-risk areas and at high-risk times, such as after an Ohio State football game. The coupons were available online as well as at high-risk drinking areas. In addition, the program was promoted significantly on television and radio. External program evaluation included two waves of an intercept survey that would identify the type of people who would usually spend time in hospitality zones; a survey of safe-ride users over five weekends; and usage data from Lyft, one of the ride-sharing participants. The evaluation also included some cost–benefit analyses.

The following are preliminary findings from this intervention: Coupon redeemers said they were less likely to drive while intoxicated but were also likely to have one additional drink before they used the coupon. The analysis suggested that the benefit-to-cost ratio was low. Goldberg noted that although the results were mixed, they created an opportunity for the community to reflect on what the findings mean. To facilitate such reflection, the foundation is convening a community gathering to explore lessons from the program. The gathering will also provide a platform to discuss potentially redesigning the safe-rides program to better address both short-term injury prevention associated with impaired driving and long-term health promotion through reducing heavy drinking. In closing, Goldberg noted that the six pilot cities are testing a diverse set of inter-

ventions that include screening, enforcement, and policy changes. The foundation looks forward to sharing what works—and what does not—to inform best practices in public health.

THE EFFECT OF TRANSPORTATION SYSTEMS ON THE HEALTH OF URBAN POPULATIONS: EVIDENCE FROM LATIN AMERICA

Latin America, Olga Sarmiento (University of Los Andes, Bogotá) said, is highly urbanized: more than 80 percent of the population lives in urban areas, and the region includes 19 of the 30 most unequal cities in the world. About 36 percent of the region's large cities exceed WHO air-quality guidelines, and 5 of the 20 most congested cities in the world are in Latin America, she noted. At the same time, she said, many cities in Latin America have developed and embraced innovative transportation policies and interventions that move beyond those of traditional systems.

For example, 55 cities in 13 Latin American countries have bus rapid-transit systems that provide lanes exclusively for buses, and they account for 32 percent of the 171 cities in 42 countries worldwide that have bus rapid-transit systems. In addition, 8 cities in 4 countries have cable-car systems. Nearly 250 cities have *ciclovias recreativas*, which are open-street programs in which streets are closed to cars at least twice monthly to provide space for biking and other leisure activities. In addition, 51 cities in 10 countries have established nearly 3,500 kilometers of infrastructure for cycling—largely through PPPs and with support from local communities.

Bogotá, Colombia, hosts one of the largest bus rapid-transit systems. TransMilenio SA, which accounts for 18 percent of all trips taken in the city on any given day, is run by a public entity, but the bus operators and fare collection company are all private. All told, Sarmiento said, 45 percent of individual trips in the city are made by public transport and account for 2.4 million passengers per day. Despite the city's congestion, the average speed of the TransMilenio buses is 26 kilometers per hour, which makes it the fastest mode of transportation in Bogotá. A survey of 1,000 adults found that TransMilenio users were more likely to meet physical activity recommendations and were more likely to engage in moderate to vigorous activities compared to those who were not users of the system (Lemoine et al., 2016b). However, TransMilenio users have noted that the system is very congested, and air quality on the buses could be better.

Currently, Bogotá is working on expanding TransMilenio, and Sarmiento and her colleagues have used an agent-based model to assess how system expansion would affect walking behavior. This model suggests that walking minutes will increase to a threshold but will decrease thereafter (Lemoine et al., 2016a). The threshold, she said, depends on what other modes of transportation are available and how far apart the

boarding stations are located. In Bogotá, stations are about 680 meters apart. She explained, "Our recommendation for the city of Bogotá is to keep having those stations at least 600 meters apart if one of the effects for TransMilenio is related to healthy behaviors, which, in this case, is walking."

Sarmiento and her collaborators have also evaluated connections between mental health and the availability of good public transportation systems. In one study of 11 Latin American cities, her team found that longer, more delayed commutes were associated with more depressive symptoms. However, there was an exception: individuals who had a transit stop within a 10-minute walk were less likely to have depressive symptoms. In addition, users of urban transit systems were nearly 5 percent less likely than drivers to screen positively for depression (Wang et al., 2019).

In 2018, Bogotá opened a new transportation system, the TransMiCable cable-car operation, that is also a PPP. Currently, 21,000 people use the 3.43 kilometer system daily to commute from some of the poorest areas in the city. The system has reduced travel time from 62 minutes to 13 minutes from the informal settlements it serves into the city. It has also stimulated 16 different projects that are bringing parks, a library, an administrative office, a museum, and other improvements to this part of the city. Sarmiento's team is now evaluating how TransMiCable has affected the amount of exercise cable-system riders get and the levels of air pollution to which they are exposed during commutes.

DISCUSSION

Rebecca Martin, moderator, started the discussion by asking panelists how they share their evaluation results. Goldberg said her program has an evaluation team that attends steering committee meetings to explain the results of their evaluations and to provide context for how those results fit into a larger knowledge base. Her program is also preparing to launch a website where data will be available for research purposes. Sarmiento said her team shares its results with city administrators and transit-system operators.

Dietz then responded to a question about whether to start addressing obesity by reducing consumption of ultra-processed foods in countries that have only recently been exposed to them. Dietz replied that more working experience is needed in low- and middle-income countries and that data need to be shared with policy makers there. In his opinion, most health systems in these countries are clearly not prepared for the consequences of increasing obesity—particularly type 2 diabetes and its medical complications. He said Latin America is an exception, and it is

"probably the most progressive place in the world where governments are addressing the epidemic of obesity." He also noted that obesity is not necessarily considered negative; in some countries, such as South Africa, increased body size is considered an indication that a person is HIV negative.

Responding to a question about what communication tactics the panelists use to reach their target audiences, Goldberg said her organization's programs use social marketing approaches, community ambassadors, and broader communication channels to create a culture where harmful drinking is unacceptable. She noted that the alcohol industry can be a valuable partner because of its expertise in reaching specific audiences with various communication and marketing strategies.

6

How Digital Technology and Artificial Intelligence Can Help Improve Urban Health

Highlights

- Existing networks of environmental sensors that sense factors such as air quality can be connected to a graphical user database to provide real-time information on health impact (e.g., to determine whether biking will positively or negatively impact health given the level of air pollution on certain days) (Feller).
- Determining how to converge various metrics of success within a partnership may be important since different stakeholders have different ways of measuring success (Feller).
- Transportation services provided to disabled and older adults through driverless cars could generate between $91 billion and $251 billion in annual revenues for market penetration ranging from 10 percent to 90 percent (Rouse).
- The international development sector has underestimated the amount of work entailed in digitization and the need to help communities transition from paper to digitized data. Capacity building will be essential to enable the world's growing cities to use real-time data to make real-time decisions (Waugaman).
- Developing a virtual health assistant for front-line health workers could be important in low- and middle-income countries where dedicated community health workers, many of whom work without regular pay or extensive training, provide a majority of care (Waugaman).
- Several common challenges to scaling artificial intelligence (AI) in low- and middle-income countries exist, including limited data availability and quality; low levels of adopting electronic health records; business model sustainability; integration of AI into the health system; lack of required evidence that using AI affects health outcomes positively; gaps in AI building blocks and required infrastructure; and regulatory and policy issues (Waugaman).

NOTE: This list is the rapporteurs' summary of the main points made by individual speakers (noted in parentheses), and the statements have not been endorsed or verified by the National Academies of Sciences, Engineering, and Medicine. They are not intended to reflect a consensus among workshop participants.

The final session of the first day of the workshop examined how data, digital technologies, and artificial intelligence (AI) can transform urban health. The three speakers were Gordon Feller, founder of Meeting of the Minds; William B. Rouse, the Alexander Crombie Humphreys Professor and director of the Center for Complex Systems & Enterprises at the Stevens Institute of Technology; and Adele Waugaman, senior advisor for digital health at the U.S. Agency for International Development (USAID). Ann Aerts moderated an open discussion after the three presentations.

CAN SMART CITIES DELIVER MEANINGFUL HEALTH BENEFITS?

Urbanova[1] is a nonprofit public–private partnership (PPP) in Spokane, Washington, that aims to address urban health and community development challenges using the power of data and digital technology, explained Gordon Feller (Meeting of the Minds). Partners in Urbanova include companies such as Verizon, Itrón, Avista, and McKinstry; Meeting of the Minds, a nonprofit organization; the Schools of Medicine, Nursing, and Engineering at Washington State University; and the city of Spokane, which Feller noted is an economically distressed city that experiences significant air-quality problems related to seasonal wildfires. In fact, he added, it was a wildfire-triggered, 4-day, air-quality catastrophe in August 2017 that led Urbanova to move from being someone's good idea to becoming a mission-driven organization working on solutions.

Given that regional wildfires are beyond Spokane's control, Urbanova focuses some of its efforts on transportation, another important contributor to air quality. In this domain, it first used the city's existing network of air-quality sensors to generate accurate readings of air pollution levels and to build a graphical user interface or dashboard that could deliver insights from sensor data to the public. For example, individuals might consult the dashboard to see if riding their bikes to work might be unhealthy given current levels of air pollution. Similarly, an employer might consult the dashboard to see if employees could safely work outdoors. Feller reflected

[1] More information is available at https://urbanova.org (accessed October 1, 2019).

on research published by Meeting of the Minds and noted the importance of creating a system that could provide real-time, actionable insights. He said, "Historical data are interesting for academics and policy makers, but it is not necessarily great for the bus driver or the bus passenger to know anything except real-time information."

When it was time to expand the sensor network, several practical issues needed to be addressed, such as who owned the street lights and poles on which the sensors would be installed, who owned the wireless network over which data would be transmitted, and who was able to do the engineering analysis in real time to produce actionable insights. Feller noted that hard work and fundraising were involved in answering these questions in the context of a PPP philanthropies had trouble deciding how to work with an entity that was not solely for-profit, nonprofit, or government. In addition, different stakeholders had different ways of measuring success, which, Feller said, increased the importance of figuring out how to converge various success metrics.

A particular problem for information technology companies that want to get involved in this type of PPP, Feller said, is that the price of connectivity, data storage, and computation are moving rapidly toward zero. He noted, "That is not a very good thing if you are running a business that is providing connectivity, computation, and storage, but it is great for the rest of us who are not running those businesses and want to take advantage of it." In closing, he noted that technology companies therefore need to develop new business models for a world where silicon chips or sensors are moving toward pennies per unit.

INTELLIGENT TECHNOLOGIES FOR URBAN DISABLED AND OLDER ADULTS

William Rouse (Stevens Institute of Technology) started his presentation on how technology can help the 100 million disabled and older U.S. adults remain mobile by citing the three rules for a successful old age that are proposed in the book *Being Mortal*: retain a sense of purpose, maintain social connections, and stay mobile (Gawande, 2014). Assistive technologies (e.g., transportation, work coaches, and counseling coaches) can help disabled and older adults travel to work or help them age in place and remain in their homes, Rouse said. He added that new combinations of competencies, such as people qualified to serve as consumer-facing technology assistants, will be needed to realize the potential of assistive technologies.

One of the biggest needs among disabled adults is transportation to and from the workplace, and both disabled and older adults need to be able to engage in daily activities. Rouse said assistance for these two

groups includes complementary support in physical, sensory, and cognitive domains. Cognitive assistance, powered at least partially by AI, could include smart phones, tablets, and driverless cars, but such technologies need to interact together seamlessly to provide the best assistance. He explained that work coaches, available via users' smartphones, can use AI, positional data, and knowledge about individuals and work environments to tell users what tasks to perform, where to perform them, and how to carry them out. His team, in fact, has deployed a work-coach app at 19 military commissaries and grocery stores to help workers restock shelves most efficiently.

Given that some disabled and older adults may have mental or cognitive challenges, a smartphone app-based counseling coach may help individuals overcome frustration and manage anxiety. A counseling coach could also provide messages to help individuals overcome fears about making mistakes on the job, for example, or manage anger when tasks do not go as planned (Hoffman et al., 2019; Jorge, 2001; Rouse and McBride, 2019). Rouse noted that his team's work-coach app is already deployed, and the counseling-coach app has progressed far in the development process. So far, he added, the work-coach app has improved performance ratings and job retention among individuals who have used it. Rouse explained that an important consideration regarding the role that AI can play in creating and operating these cognitive assistants will be how much users trust the results of AI (see Figure 6-1).

One of the PPPs with which Rouse and his colleagues work involves automobile companies, small AI companies, and advocacy groups that collaborate on developing driverless cars that could serve disabled and older adults. Revenues for such a system would come from a service-type model rather than from cars sold to individuals—each car is projected to cost more than $100,000 and to be too technologically sophisticated for most individuals to maintain. In fact, a modeling exercise showed that selling services would generate more revenue than selling cars would (see Figure 6-2).

Existing programs might also accrue savings given that adopting driverless cars as a mobility option might enable more disabled individuals, for example, to work instead of relying on social security disability checks. This model could also keep older adults out of assisted living or skilled nursing facilities (see Figure 6-3). Rouse noted that 41 percent of disabled adults receive support from Supplemental Security Income or from Social Security Disability Insurance programs at an average of $1,234 per month. While only 2 percent of older adults are in assisted-living facilities and only 5 percent are in nursing facilities, these facilities cost an average of $4,000 and $7,000 per month, respectively. Pro-

	Cognitive Advisor Performance (Relative to Expectations)			
Human's Level of Trust	Demonstrated Long-Term Good Performance	Demonstrated Near-Term Good Performance	Low Frequency of Poor Performance	High Frequency of Poor Performance
Human Allows Advisor to Perform Its Chosen Actions	Yes	Maybe	No	No
Human Performs Actions Advisor Recommends	Yes	Yes	Maybe	No
Human Takes into Account Advisor's Recommendations	Yes	Yes	Maybe	No
Human Ignores Advisor, Perhaps Turning It Off	No	No	Maybe	Yes

FIGURE 6-1 Performance versus trust of artificial intelligence.
SOURCE: As presented by William Rouse, June 13, 2019.

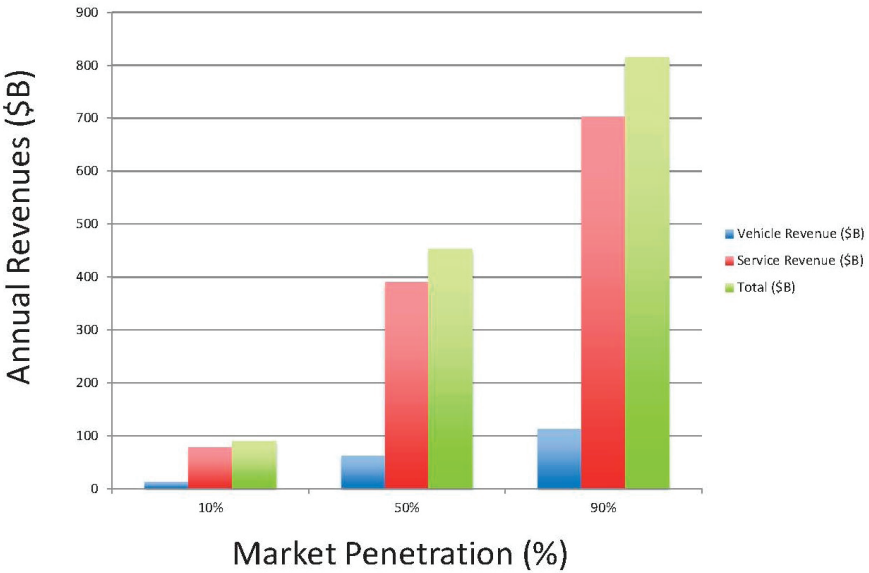

FIGURE 6-2 Projected annual revenues from selling self-driving cars and selling services that use self-driving cars.
SOURCE: As presented by William Rouse, June 13, 2019.

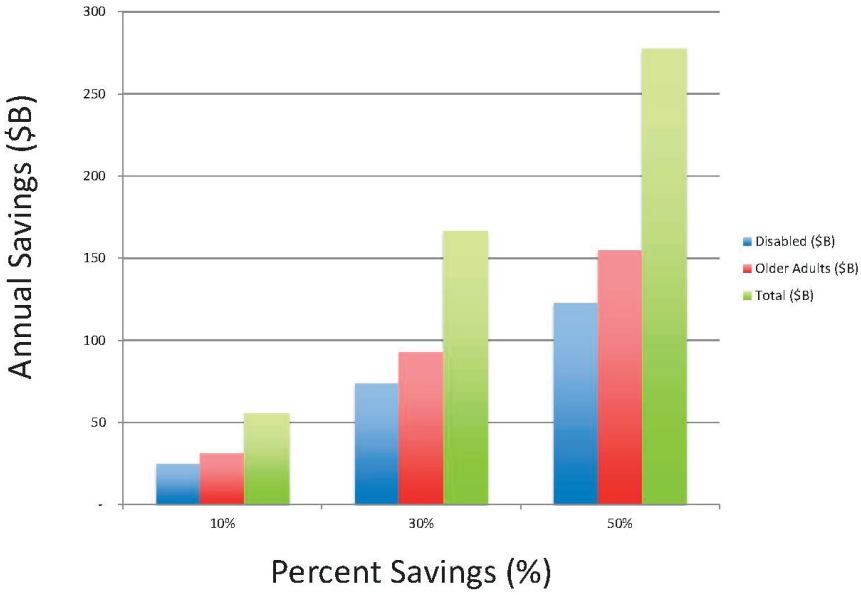

FIGURE 6-3 Projected annual savings from deploying self-driving cars to assist disabled and older adults.
SOURCE: As presented by William Rouse, June 13, 2019.

jections suggest that transportation services provided by driverless cars could generate between $91 billion and $251 billion in annual revenues for market penetration ranging from 10 percent to 90 percent, and services for disabled and older adults could generate savings that range from $56 billion to $278 billion annually. Rouse said that "this is a trillion-dollar opportunity" that has made getting partners involved in this effort easy.

With so much money on the line, automakers and transportation service providers can justify substantial investments in this market—even given significant uncertainty about which players will realize the biggest pieces of the market. In addition, Rouse said, the federal government (e.g., via the National Institutes of Health and the National Science Foundation) can justify investing substantially in pursuing knowledge and technologies that will enable this market and afford various agencies substantial savings. He added that advocacy groups have successfully articulated and communicated the needs of disabled and older adults, as well as how to provide support for those needs; driverless cars can potentially enhance quality of life for this population of U.S. residents.

Rouse talked about a future of innovations in which well-developed transportation infrastructures will roll out in urban areas that are large

enough to justify required investments. He suspected that innovators will seek growth in suburban and rural regions as offerings mature. He predicted that these two trends together will create millions of new jobs, including those needed to perform nightly maintenance on fleets of driverless cars.

ARTIFICIAL INTELLIGENCE IN GLOBAL, URBAN HEALTH

By 2030, said Adele Waugaman, USAID, 60 percent of the world's population will live in urban areas—up from 30 percent in 1950. Africa and Asia, currently home to 90 percent of the world's rural population, are the fastest-urbanizing regions on the planet; by 2050, Africa is projected to reach 54 percent urbanization, and Asia is projected to reach 64 percent urbanization.[2] She noted that nearly half of the world's urban dwellers live in relatively small settlements of fewer than 500,000 inhabitants and that the fastest growing urban regions are medium-sized cities as well as cities in Asia and Africa with fewer than 1 million inhabitants. (UNDESA, 2015).

These figures are relevant to USAID, she explained, because every country with USAID presence experiences urban population growth. This type of growth exacerbates problems associated historically with urban areas: extreme poverty, food insecurity, poor health, and vulnerability to risky events such as crime, forced eviction, or disaster. In addition, urban areas account for 70 percent of greenhouse gas emissions and consume two-thirds of the world's energy. Waugaman noted that by 2040, cities will house the majority of people who live on less than $1 per day. In addition, food accounts for a significant portion of the urban poor's household expenses, which makes them vulnerable to food insecurity during spikes in food price. From a health perspective, she added, nearly half of city dwellers in Africa, Asia, and Latin America suffer from a minimum of one disease caused by poor sanitation and lack of access to safe water.

Waugaman said the USAID urban team has been thinking about the confluence of these factors and about how sustainable urbanization will be central to meeting many global development commitments, including the 2030 Agenda for Sustainable Development, the Paris Agreement on Climate Action, the Addis Action Agenda on financing for development, and the New Urban Agenda.[3] To meet these commitments, USAID is looking increasingly to partnerships that will provide access to financing, local

[2] For more information about USAID's Sustainable Urbanization for Global Progress and Security, see https://www.usaid.gov/urban (accessed July 30, 2020).

[3] For more information, see https://www.usaid.gov/sites/default/files/documents/1865/USAID_Urbanization.pdf (accessed July 30, 2020).

capacity building, big data, AI, and various other digital technologies to generate actionable insights. She cautioned, though, that the international development sector has underestimated the amount of work that digitization entails, and she underscored the need to help communities transition from paper to digitized data. She noted that capacity building will be essential to enable the world's growing cities to use real-time data to make real-time decisions.

Changing topics slightly, Waugaman explained that the Center for Innovation and Impact in USAID's Bureau for Global Health recently completed a report on the role that AI can play in global health (USAID et al., 2019). This report highlights opportunities for AI to increase access to care, improve equity, ensure higher-quality health outcomes, increase efficiency, and reduce the cost of care. Constraints identified in this report include limited availability of digitized data from which to draw inferences, equity issues around the suitability of using AI with specific local populations, and nascent policy and regulatory environments. The report also included a landscape analysis of existing AI building blocks most relevant to global health. It used a broad definition for AI that included machine learning and other technologies commonly lumped under the AI umbrella (see Figure 6-4).

Following this landscape analysis, the report team identified 27 different use cases covering discrete areas in which AI could be applied in global health and selected four priority areas to explore further with potential partners: AI-enabled population health, virtual health assistants for patients, virtual health assistants for frontline health workers, and decision support tools that can provide more specialized expertise for generalist physicians. Waugaman said that developing a virtual health assistant for frontline health workers is particularly important in low- and middle-income countries where dedicated community health workers, many of whom work without regular pay or extensive training, provide most care. She noted, "This is a really critical opportunity to be empowering those frontline and community health workers with decision support tools that enable them to best be able to provide care to those who are seeking it."

However, she noted, several common challenges to scaling AI in low- and middle-income countries exist: limited data availability and quality, low levels of adopting electronic health records, business model sustainability, integration of AI into the health system, lack of required evidence that using AI affects health outcomes positively, gaps in AI building blocks and required infrastructure, and regulatory and policy issues. In addition, concerns about privacy, data ownership, and data-collection ethics will need to be addressed. For example, if AI-enabled tools only benefit people who have smart phones and 4G connectivity,

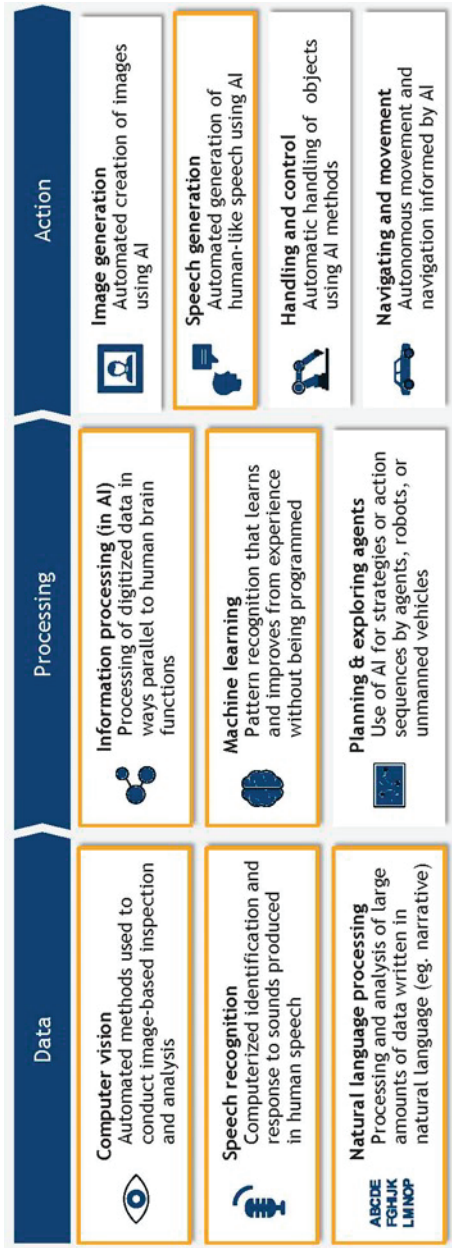

FIGURE 6-4 Artificial intelligence building blocks, with those of greatest relevance to global health outlined in gold.
SOURCES: As presented by Adele Waugaman, June 13, 2019; USAID et al., 2019.

achieving health equity will be difficult. She also noted concerns about foreign, private companies monopolizing or inappropriately profiting from health data and about patient diagnoses potentially being delivered without counseling and support.

A major challenge, also encountered in the developed world, involves how to integrate AI tools into existing health systems. Waugaman said the tools' impact will likely be muted if the health system's capacity to integrate and use the insights produced by these tools is insufficient. She said avoiding past mistakes will be critically important—particularly those related to inadequate interoperability and to fragmented digital health information systems that resulted from investments in prior generations of digital technologies.

Regarding actions needed to chart a collective path forward, Waugaman and her colleagues identified a range of possibilities, including providing technical assistance to innovators to help them navigate complex and sometimes contradictory regulatory environments and to enhance their business model sustainability. The report also identified various ecosystem supports that need to be in place, such as opportunities to work with partner country governments to develop enabling policies and regulations. In closing, Waugaman said people are optimistic and hopeful about this space, but the space has some significant challenges ahead.

DISCUSSION

Aerts opened the discussion by asking Feller how he decided to focus on air quality in Spokane. Feller replied that his organization hired Gallup to conduct a rigorous scientific survey of what the city's residents felt the highest priority should be. Rouse noted that his team's decision to work on a job coach originated with a request from Source America, which employs 50,000 disabled adults and has a stretch goal of creating technology that will enable 1 million disabled adults to be employed. Source America, explained Rouse, knew the number of employable individuals would be constrained unless employees had technical assistance to meet job requirements.

Robert Clay from Save the Children asked Feller how his team overcame a problem that can negatively affect how well a PPP operates if it is not addressed: how to decide on specific roles and responsibilities for each partner. Feller replied that one important step was to extract the partnership's executive director from her home organization, provide her with a distinct budget, and have her report directly to the partnership's board rather than to her home organization. His team also designated in advance what tasks were assigned to each partner—with clear lines of responsibility. He said some gray areas (e.g., cost control and data quality) existed,

and everyone had to play a role in them. However, each partner had a clear, definitive idea from the start about what its responsibilities were.

Andrew Wilson from PATH asked Waugaman how she engages the private sector to fill funding and resource gaps given that sustained business models have not yet been established. Waugaman replied that the key is to first identify and prioritize needs by bringing together stakeholders. Once a clear picture of needs is established, it becomes easier to identify where government can play a role, where international actors can provide expertise and resources, and what the private sector's role in a project should be. She said, "I think there is a tremendous role for the private sector in almost every context. If you want to look at scalable and sustainable solutions, I think that business-sector engagement is critical." Speaking from his experiences, Rouse added that defining a market opportunity is important to get companies interested in participating in a partnership.

Responding to a question about where to look for examples of good government partners, Waugaman noted that United Nations (UN) and World Health Organization (WHO) member states passed a digital health resolution within the past 2 years that calls for WHO to play a more active role in the digital health space. This resolution also called for member countries to build coherent national health strategies that shift investments away from digital health systems that increase fragmentation and lack interoperability. On the donor side, a set of principles for donor alignment on digital health[4] now exists and should create a more coherent digital health investment strategy that leads to enhanced interoperability and reduced fragmentation. Feller commented on an understanding in the technology world: any new technology innovation in the public sphere, such as ride-share and city streets, will have regulatory constraints from the beginning—not after the fact, as was the case with ride-sharing apps and scooters.

Jo Ivey Boufford asked panelists for their ideas on how to create a market outside of clinical services to develop technologies that examine community conditions and broader determinants of health beyond those that affect individuals. Waugaman replied with two examples where this happens. The first started with work in Haiti after the devastating earthquake in 2010 and a subsequent outbreak of cholera. In that instance, some Haitian mobile network operators were willing to provide aggregated anonymous datasets about population movement that health responders then used to predict where cholera might spread and to pre-position supplies to enable rapid response. As a second example, Waugaman cited

[4] Additional information is available at https://digitalinvestmentprinciples.org (accessed October 2, 2019).

work by UN on trends in mobile phone SIM-card top-ups as indicators of when food prices spike: a drop in top-ups implies that consumers had to spend more money on food than on phones.

KEY POINTS FROM THE DAY'S DISCUSSIONS

To conclude the workshop's first day, Aerts listed what she believed were the day's key points. They include the following:

- The future of planetary health will depend on cities.
- Cities have characteristics that can be positive or negative for urban health depending on the political and public will to act to improve urban health.
- The tools of systems thinking can facilitate greater reflection by encouraging people to see cities as real ecosystems with different elements that may influence urban health.
- Success depends on engaging the interests of the citizenry, giving local communities ownership over interventions, and promoting good local governance.
- A key to reaching common goals is breaking down silos between two professional communities: health and urban planning.
- Vulnerability assessment can deliver surprising results and can identify urban subpopulations that have the highest risk of developing a health issue.
- Real-time data can improve the quality of care, enable better decision making, and influence health policy.
- The global syndemic of obesity, undernutrition, and climate change introduces a new sense of urgency to tackle urban health issues in low-income settings.
- Innovative transportation models developed in Latin America could prove useful in other parts of the world.
- Big data, digital technologies, and AI can influence how researchers look at aging, how aging individuals can enjoy a better quality of life, and how cites warn their citizens of potential health hazards.
- In low- and middle-income countries, AI will potentially increase access to and equity of health care and to increase quality and efficiency while reducing health care costs.
- A lack of quality digital data currently prevents full realization of the promise of big data and AI to improve urban health.
- Equity issues can be exacerbated by AI—particularly given the nascent policy and regulatory environments.

7

Political Leadership and Governance of Public–Private Partnerships for Urban Health

Highlights

- The partnership composition for the Cities Changing Diabetes initiative has depended on context (e.g., in Houston, more than 75 organizations belong to this coalition, but government is the major partner in China). Partnering with a local research institution is important because the institution usually knows the main local issues (Lund).
- Policy change can be most successful when it is evidence-based, data-driven, and action-oriented (Baptista Leite).
- Policy makers, planners, and other stakeholders can geo-reference where different interventions are most needed by collecting data on a wide variety of health indicators (Baptista Leite).
- Corporations can do more than provide a technology or product; rather, they can provide a solution that matches a particular community's context (Baptista Leite).
- The World Health Organization's Healthy Cities Network can mitigate the complexities of policy development (which involves substantial legwork, data, and education and diverse stakeholder interest) by empowering city mayors to use their convening abilities to gather people to communicate and to develop win–win strategies and partnerships (Marchandise-Franquet).
- Areas of a city that need attention, as well as possible intervention to attenuate issues, may be pinpointed through mapping health inequalities by neighborhood and by soliciting ideas and solutions from these communities (Marchandise-Franquet).

NOTE: This list is the rapporteurs' summary of the main points made by individual speakers (noted in parentheses), and the statements have not been endorsed or verified by the National Academies of Sciences, Engineering, and Medicine. They are not intended to reflect a consensus among workshop participants.

The workshop's second day focused on political leadership, policies, and governance issues as they relate to public–private partnerships (PPPs) in urban health. The morning started with a presentation by Niels Lund, vice president for health advocacy at Novo Nordisk, and was followed by a discussion that included Lund; Clarion Johnson, private consultant to ExxonMobil; and Ann Aerts, head of the Novartis Foundation. Clarion Johnson moderated as well as participated in the discussion. Next, two elected officials made presentations: The first was Ricardo Baptista Leite, member of the Health Committee and the Foreign Affairs Committee in the Portuguese National Parliament, national health spokesperson for the Social Democratic Party, and head of public health at the Universidade Católica Portuguesa's Institute of Health Sciences. The second was Charlotte Marchandise-Franquet, deputy mayor for health for Rennes, France; president of the French Health Cities Network at the World Health Organization (WHO); chair of WHO's Health Cities European Network Political Vision Group; and co-chair of the Global Urban Air Pollution Observatory. Jo Ivey Boufford moderated the workshop's final discussion after Baptista Leite and Marchandise-Franquet presented.

CORPORATE GOVERNANCE AND PARTNERSHIPS: THE CITIES CHANGING DIABETES INITIATIVE

Niels Lund (Novo Nordisk) explained that one of the more unusual features of some European countries, such as Denmark, is that their laws allow foundations to own for-profit companies; this creates foundations that drive and control a for-profit business but have a philanthropic mission. The result is an entity obligated by law to reinvest the dividends it receives via the corporate shares it owns or to disburse them as grants. Novo Nordisk's philanthropic arm, for example, awards grants totaling $900 million to $1 billion per year.

Lund said Novo Nordisk's three-tier approach to working sustainably calls for the company to act responsibly, integrate social and environmental priorities with financial responsibilities in its business strategy, and help address global issues—including those that go beyond self-interest. As a pharmaceutical company, said Lund, Novo Nordisk has to take a

long-term outlook for any of its investments; over the long term, social and environmental concerns also become financial ones. In that respect, the company sees opportunities in addressing global issues such as the United Nations (UN) Sustainable Development Goals (SDGs) and the growing burden of noncommunicable diseases (e.g., diabetes) recognized by the UN.

Lund then turned to the Cities Changing Diabetes initiative and noted that, as Napier explained earlier, diabetes is rising at an alarming rate around the world (see Figure 7-1). Without action, 11.7 percent of the world's population, or more than 700 million people, will have diabetes by 2045 if the current trajectory holds. Lund said, "That is a lot, but that is actually what it will require to bend the curve, and it says something about the level of ambition we need to have." He then added that bend-

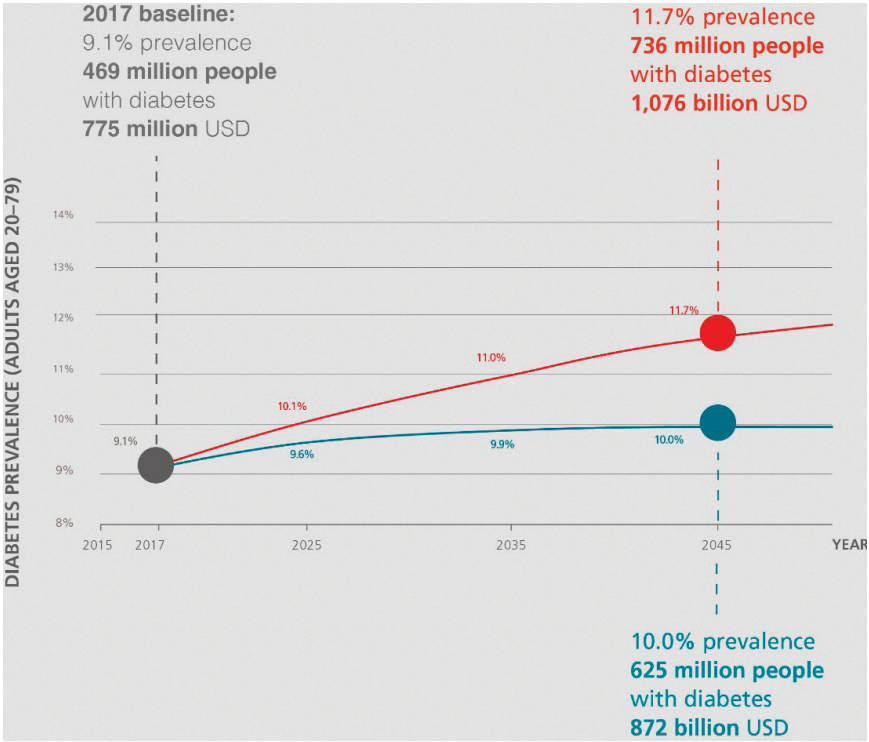

FIGURE 7-1 Bending the curve on diabetes.
NOTE: USD = U.S. dollars.
SOURCES: As presented by Niels Lund, June 14, 2019; Cities Changing Diabetes, 2017.

ing the curve for diabetes can serve as a model for altering the trajectory of other chronic diseases.

Lund noted that an urban focus for interventions makes sense given that two-thirds of people with diabetes live in cities (IDF, 2017) and that cities are where inequities are highest. He added that cities influence how people live, work, and eat, all of which affect obesity and diabetes (Tellnes, 2005). He noted that although there are great opportunities to intervene given the relationship between diabetes, obesity, and city planning, no organization can solve this problem alone—not even the health sector. Reflecting that, Cities Changing Diabetes has been collaborating with climate leadership group C40 Cities to map the health benefits that would accrue through action to mitigate climate change and vice versa. It has also collaborated with the Eat Foundation to develop advice on food and nutrition for cities. As of July 2019, 22 cities and more than 150 civil society and academic institutions are partners in the Cities Changing Diabetes initiative, and more cities are expected to join over the coming years.

Lund noted the importance of all partners realizing some value in any partnership, and that holds true for Cities Changing Diabetes. For people with diabetes, the program will foreground their voices, improve their access to resources, and improve their quality of life. For cities, the partnership offers access to new insights about risk factors for diabetes; a platform for action to reduce morbidity, raise productivity, and cut spending; and a PPP that aims to improve the city environment. For Novo Nordisk, the program provides sustained access to stakeholders, a platform to improve the company's reputation, and a platform to put diabetes on the political agenda.

Bending the diabetes curve will be an iterative process driven by knowledge acquisition and experience. This process has started with the development of a diabetes projection model that can estimate the effect of a specific intervention on the curve. The program also maps future challenges by identifying social and cultural dynamics that affect diabetes vulnerability and by then developing hypotheses about what is needed to address those dynamics. The program will share solutions it develops through knowledge networks, publications, exchange visits, and summits, and it plans to translate global research insights and best practices into local policy and action. Lund said a key lesson so far has been that Novo Nordisk, as a pharmaceutical company, has to ensure it builds trust among its partners and the cities in which it works.

Based on work completed so far, the program has identified four action areas: places, community, food, and health care. Places shape the way people move and interact, and they affect health on several levels, Lund said. City planning, he explained, can transform cities from relying predominantly on cars to being more bicycle friendly and can benefit

both health and climate. Community can engage people outside of the formal health care system. In particular, faith-based communities can reach broad groups of people, target prevention efforts in a safe environment, and overcome mistrust and loneliness. Lund said food, of course, is vital to health, and being able to access healthy foods—through establishing sustainable food systems—needs to be an essential part of any effort to bend the curve. Access to affordable, quality health care, in terms of both prevention and treatment, is also vital to health. Along with increasing access to care, it is important to train doctors to ensure they understand the benefits of addressing diabetes with their patients. Lund then noted the importance of raising the profile of public health among policy makers at city and national levels. To reach policy makers, the program is assessing the economics of diabetes and obesity prevention, including the economics of designing and piloting social investment programs.

A program review conducted from 2014 to 2016 found that Cities Changing Diabetes has contributed value to its partners. The participating cities reported that the program acts as a catalyst for change by facilitating a process that builds new relationships around shared insights and common goals. The program has built relationships as a foundation for action by convening stakeholders who do not normally collaborate on shared goals. It is also building a new evidence base and developing new research tools that change perspectives and practice. Through such actions, it contributes to generating a more holistic and multidisciplinary approach to tackling diabetes in cities. Finally, the review found that the program is playing an important role in facilitating change by promoting existing agendas and goals or by facilitating or accelerating changes that were not already planned.

In the future, Cities Changing Diabetes will take a long-term approach to bending the diabetes curve and improving population health by 2045. Between today and 2025, the initiative aims to implement health actions and policy changes in cities that will create new social norms, behaviors, and health-promoting environments over subsequent decades. Lund noted that the initiative's goal over the next 5 years is to start delivering on key objectives: implementing more health actions in more cities; building a stronger evidence base on challenges and solutions and then disseminating that knowledge; establishing a greater focus on health policy at the city, national, and global levels; and engaging in advocacy on city, national, and global agendas to show that action on urban health is necessary, desirable, and achievable.

DISCUSSION

Clarion Johnson began the discussion by noting the importance of Lund's emphasis on long-term views. He said, "If you are going to intro-

duce anything that has a preventive component, those three words are essential." Ann Aerts added that long-term engagement is missing from the Better Hearts Better Cities urban hypertension initiative she and her colleagues are driving. The initiative, she said, only received approval to work in three cities because, unlike Cities Changing Diabetes at Novo Nordisk, Better Hearts Better Cities is not run by a corporate; it is run by the Novartis Foundation, which is separate from corporate Novartis. Lund commented on the importance of selecting cities that are able to engage in a partnership and for which the program has sufficient resources to invest. He noted, "Many cities will not have that human resource to drive a collaboration."

Johnson then asked who could be at the initial table and whether that initial group needs to be involved throughout the project. Aerts replied that the Novartis Foundation initiative chose cities by evaluating disease burden and likelihood of program success, both of which are based on a country's stability and on a city's willingness to engage. Better Hearts Better Cities gathered local stakeholders only after the mayor of a city agreed to participate and clarified what the city wanted from the program and which sectors it wanted involved. Typically, the list of stakeholders includes city health authorities, national finance ministers, information technology companies, insurance organizations, patient associations, sport associations, school officials or the education minister, and employee associations. She noted that one difference between Better Hearts Better Cities and Cities Changing Diabetes seemed to be that Better Hearts Better Cities relies mostly on local resources, but the Novartis Foundation provides seed funding for the "risky" or most innovative parts of Cities Changing Diabetes—parts for which governments do not necessarily have the budget. Lund said that the composition of the partnership for Cities Changing Diabetes depends on context. For example, more than 75 organizations belong to the coalition in Houston, but because civil society organizations are less prominent in China, government is the major partner there. He added that including a local research institution is important because such institutions usually know the major local issues and ensure an unbiased analysis of local situations and potential challenges.

Recounting his experience with ExxonMobil's malaria program, Johnson explained how the company approached him after a series of employee deaths from malaria and wanted him to start a program to cure the disease. Johnson knew this was impossible but found a way to explain that although curing malaria was beyond his capabilities, developing a program to better manage the disease and prevent deaths would be feasible. Eight years later, no deaths from malaria have occurred, and between 4,000 and 5,000 cases of malaria have been prevented. He also noted that

testing whether people were compliant with their antimalarials cost $200 when the program started because samples had to be sent to Scotland on dry ice for analysis. Later, working with the French Army, the program developed a simple urine dipstick test that immediately determined whether employees were compliant with their antimalarials—for pennies per sample. Taking antimalarials was not a condition of employment, but it was a condition for being deployed in certain regions.

Responding to a question about program financing, Lund stressed the importance of developing a cost–benefit analysis for obesity and diabetes programs that parallels those developed to curtail smoking and alcohol abuse. His team is doing this in Europe. Lund said

> If we work with interventions that address both the social aspect as well as the health aspect [of diabetes prevention and treatment], I am quite confident that we can show a return on investment through reduced cost as well as improved tax collection and productivity gain. We can then either de-risk outside investments or simply have the program funded through long-term commitments by the municipality.

Sir George Alleyne from the Pan American Health Organization noted that getting long-term commitments from politicians is difficult because their reelection cycles occur every few years. He asked how programs can work with civil society to ensure continuity of interest. Lund replied that although working with elected officials is difficult, sustaining programs that are not anchored in local political processes and local decision making is also difficult. That said, Lund noted that the collaborations his program helps form do engage local civil society because those are the organizations that produce change on the ground.

LEADERSHIP TO TRANSFORM GLOBAL GOALS INTO LOCAL ACTION AND PARTNERSHIPS

In the 1970s and 1980s, said Ricardo Baptista Leite (Assembleia da República, Portugal), business schools began looking at new management models, particularly those deployed in the Japanese auto industry, as a guide for reforming the health care sector (which physicians considered to be poorly managed). This transformation led to what Baptista Leite referred to as the *industrialization* of health care: a process motivated by the belief that health outcomes will improve when the health sector becomes more productive and produces more efficiently. Baptista Leite said, "We all know what happened there. We ended up with a rise of the burden of disease and a rise in costs, which leads to risk and unsustainability, and compromises our universal aim—through the SDGs—of

achieving universal health coverage." Poorer health outcomes, he noted, affect everyone but mainly affect the most vulnerable populations, and that dynamic creates a vicious cycle of inequalities, inequities, and poverty that, in turn, increases the burden of disease and raises the cost of health care even further.

The main problem, Baptista Leite said, is that hospitals have become factories of health production and are incentivized to produce more in order to be paid more. An alternative to incentivizing higher volume of treatment, he said, is to incentivize good health outcomes and good experiences for patients. He then discussed Portugal, where half of the country's primary care physicians are paid based on performance, and half are paid a salary regardless of their patients' outcomes. The system in Portugal, he noted, demonstrated that paying for performance based on an audited set of outcome measures, rather than on volume, improves health outcomes for patients with arterial hypertension and type 2 diabetes by roughly 24–26 percent and 21–28 percent (Alves et al., 2016).

Baptista Leite noted that increased spending on health care, particularly in low- and middle-income countries, produces better health outcomes. However, this holds true only to the point at which outcomes plateau or even dip slightly, as they do in the United States (see Figure 7-2).

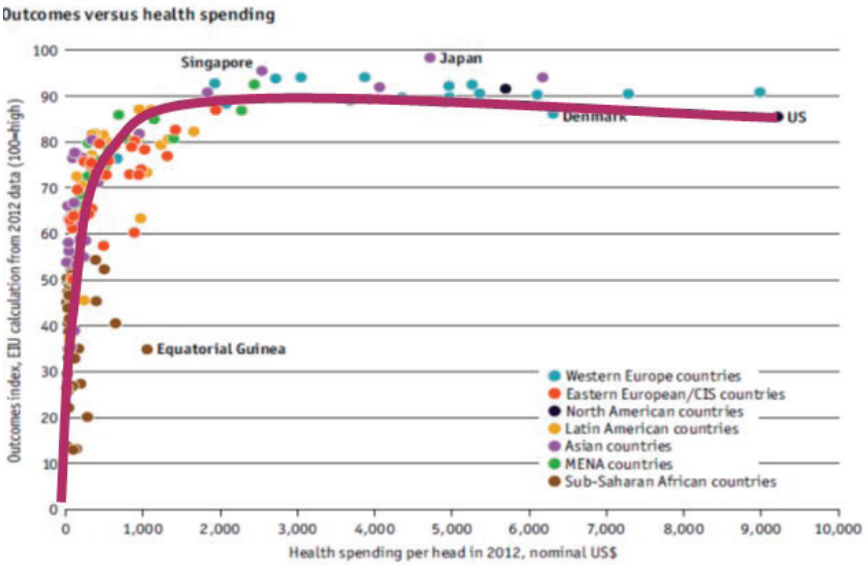

FIGURE 7-2 Health outcomes versus health spending per head.
SOURCES: As presented by Ricardo Baptista Leite, June 14, 2019. Original author, Vivek Muthu. Used with permission from Ricardo Baptista Leite.

A major question prompted by the data is how to generate even better outcomes in the future without compromising the sustainability of the world's health systems. Baptista Leite said, "To deal with that, we need to understand what comprises our health status."

Based on his experience as a physician, Baptista Leite said he probably sees only 10 percent of what affects a particular patient's health; the remainder includes 30 percent from biological factors and 60 percent from economic, environmental, social, and behavioral influences. He said, "The truth is, we are only normally dealing with the 10 percent, and that is why looking at the social determinants of health is so important." For this reason, he believed that applying the value principle not only to the health care system but also to the community will improve health without bankrupting national health care systems. Creating such a community-based, value-based system requires partnerships that include local government, education systems, private and public sectors, and nongovernmental organizations and that establish what he called *community-based outcome measures*. Baptista Leite explained, "Instead of just focusing on controlling diabetes or hypertension, we can actually create incentives toward lowering the incidence and prevalence of hypertension and diabetes."

Baptista Leite firmly believed that public health will not enter mainstream discussions in either politics or health care if it fails to be integrated into larger financing systems for health care. Otherwise, he said, public health will continue to be seen as a side endeavor and will receive less than 3 percent of national health budgets.

When Baptista Leite was elected deputy mayor of Cascais, Portugal, a city of 200,000 people located 20 kilometers from Lisbon, he began working on a project he called Cascais 2030. This project translates the 169 global indicators included in the 17 UN-approved SDGs to the local level. For example, one indicator for SDG 3 calls for universal health coverage; at the city level, this translates into every citizen having access to a family doctor. Today, city council members submit proposals through a digital portal that requires them to indicate which of the 17 SDGs the proposal will address. The city's residents gather annually to review what the city has done to meet the SDGs. Baptista Leite noted the most relevant part of this activity: it influences the city's budget. When data show the city lagging on certain goals, the city can alter its budget to move those areas forward. As an aside, he noted that although Cascais has won many awards for its work on climate change and adaptation, data from the portal suggest the city has actually performed worst on that goal. Baptista Leite said, "It goes to show that if you do not measure, you just believe whatever the awards tell you."

A second project he discussed was Smart Health Cascais, which aims to monitor key health and social indicators among city residents. The

genesis of this project, Baptista Leite explained, was his interest in understanding what the city received for the millions of euros it spent on nongovernmental organizations and other contractors that delivered a wide range of services. By geo-referencing all of the indicators the project had developed in the health, education, and social sectors, he and his colleagues could generate data down to the neighborhood level. The resulting analysis showed, for example, that the percentage of residents who lacked a family physician varied significantly across the city (see Figure 7-3). Similarly, data on the number of prescriptions written for antidepressants and antianxiety drugs identified parts of the city that may benefit from more mental health services (see Figure 7-4), and data on obesity and diabetes allowed the city to redesign its bike lanes to traverse the most critical areas.

He noted in closing that the data collected by Smart Health Cascais are available to the public. This transparency helps with accountability and creates an incentive to push people in the right direction. The availability of real-time data also allows city governments to adapt their policies and programs in a timelier manner. He said that achieving universal health care will be impossible without the participation of nongovernmental and community-based organizations and of the private sector. Baptista Leite commented, "If we do not work with civil society, we will leave people behind, and we will not have true universal coverage."

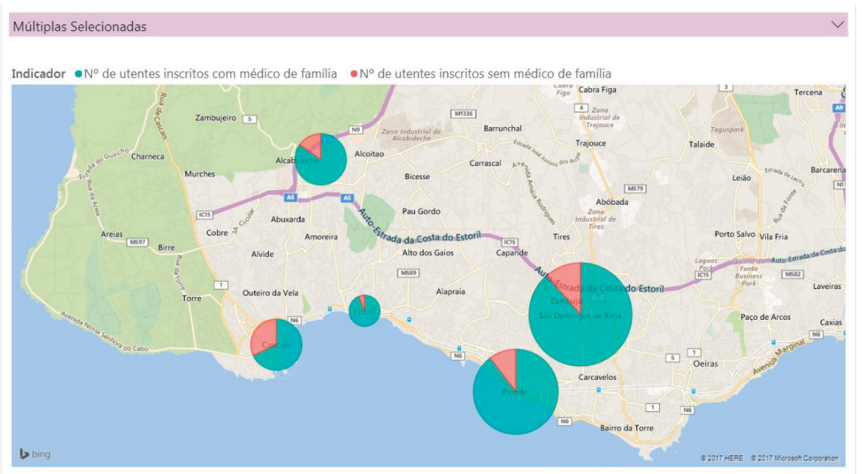

FIGURE 7-3 The proportion of people who have a family physician (green) and of those who do not (orange).
SOURCES: As presented by Ricardo Baptista Leite, June 14, 2019. Used with permission from Cascais City Hall.

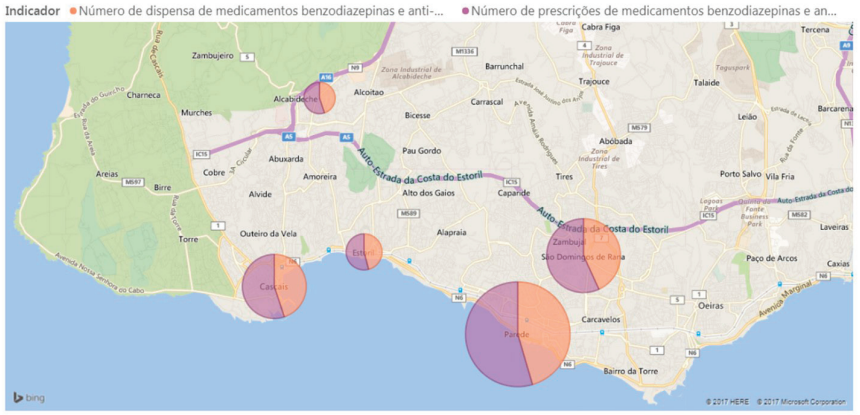

FIGURE 7-4 The number of prescriptions written (purple) and dispensed (orange) for antidepressants and antianxiety drugs.
SOURCES: As presented by Ricardo Baptista Leite, June 14, 2019. Used with permission from Cascais City Hall.

IS HEALTH A POLITICAL CHOICE?

The WHO European Healthy Cities Network, which has existed for more than 30 years, includes 1,500 cities in 29 national networks, explained Charlotte Marchandise-Franquet (city of Rennes, France). In France, nearly 100 member cities had a budget of more than 200,000 euros in 2018, a 50 percent increase from 2014, and she expected the number of participating cities to reach 200 by the end of 2019. The vision of the WHO Healthy Cities program, she added, is to address inequities in health care and leave no one behind.

In her view, health is a political choice. In theory, Health in All Policies frameworks include all necessary stakeholders at the table to discuss a given problem and develop policies to address it. In reality, though, developing policy involves substantial legwork, data, and education to address complex dynamics among different stakeholders (Lacouture et al., 2015). It also involves appeasing various constituencies and social movements, which can require overlooking particular data or acting without data.

This is where the WHO Healthy Cities Network enters. It empowers city mayors to use their convening abilities to get people to the table; their positions and communication skills, as well as the best research available, to influence public opinion; and their clout to develop win–win strategies and partnerships. Equally important, Marchandise-Franquet said, is the fact that mayors in the network speak with one clear message on health and well-being.

Her city, which includes 450,000 people in western France, conducted a project to integrate health into the renovation of a deprived neighborhood. The first step was to map health inequalities by neighborhood to identify areas that needed attention The project team then used the data to enter particular communities and speak with people who lived there to solicit actionable ideas about how to address specific problems that affect morbidity and mortality in those neighborhoods. Then, they mapped every actor involved in a particular neighborhood's renovation to determine which actors could enact which solutions. For example, the city wanted to build a new school in the neighborhood. However, because it would be located on a major road, some people worried that students and teachers would be exposed to high levels of air pollution. Working with school officials and architects, the city designed the school to minimize exposure to automobile exhaust.

In closing, Marchandise-Franquet said that creating healthy cities requires a global vision, not a mere sprinkling of a little of this and a little of that onto existing problems. The Healthy Cities movement represents an ecosystem that addresses the complexity of cities and the issues that adversely affect their residents.

DISCUSSION

Jo Ivey Boufford began the discussion by asking panelists how they started conversations about change with their colleagues, people in power, and the public. Baptista Leite said he pushes for policy change by using the acronym EDA—evidence-based, data-driven, and action-oriented. He noted, "Coming from an academic field, evidence should be our bread and butter." Many change conversations fail because they are not oriented toward action. Being oriented to act means raising awareness among the public first; any program not in line with public concern will never be approved by politicians. What is needed, he said, is for the public at large and for policy makers specifically to understand that health is more than a social policy issue. It is also an economic tool to drive social justice, inclusive wealth, and growth. Accomplishing those goals requires data both to inform policy makers and the public and to adjust projects when needed.

Data, said Baptista Leite, can also generate tools. For example, his university has created an app called Let's End Hepatitis C. The app, which uses mathematical models to predict outcomes based on various policies and implementation plans, transformed Romania's plan to eliminate hepatitis C in the country. Baptista Leite said the country is now on track to eliminate this disease by 2029.

Marchandise-Franquet recounted how her city changed alcohol consumption practices by changing its messaging about binge drinking.

Instead of saying alcohol was bad, the new messaging encouraged people to drink water along with their alcoholic beverage of choice. Moreover, the message was delivered not by the city government but by peers who were put on the street at night. The result was a precipitous drop in emergencies on Thursday nights—party nights—and an increase in healthy behaviors.

Boufford then asked the panelists to discuss any successful or unsuccessful experiences they have had as elected officials when they work with the private sector. Baptista Leite replied with one of his findings: corporations are starting to understand that they need to provide a solution that fits into context rather than a technology or product alone. Corporations have also realized they need to think of government as an equal, essential partner in order to be most successful. Portugal, he noted, was able to negotiate payment for hepatitis C treatments based on patients cured rather than on pills dispensed. In return, the involved companies became active partners in the coalition assembled to attack hepatitis C and helped design a protocol for early diagnosis and treatment.

Marchandise-Franquet spoke about an issue she has seen: corporations often propose programs that will work in more affluent neighborhoods rather than in those that most need the program, or they develop programs without considering the real needs of people who live in less affluent neighborhoods. Such outcomes tend to occur because representatives from those corporations do not work or live in less affluent neighborhoods. This is where the knowledge and connections of city leaders can become helpful.

Robert Clay from Save the Children remarked that many of the workshop attendees, including himself, are comfortable working at the national or the state level on health-related programs but have little experience working with municipalities on urban health. He asked the panelists for suggestions about how to work more productively with cities and city officials. The major difference between working at national and city levels, Baptista Leite responded, is that "you actually get something done at the local level, and that translates into people's lives in a much more direct way." Moreover, he added, when a program does not work, city officials hear about it from residents, and that can motivate officials to find new solutions. He also noted, from his experience, that multinational organizations in particular often fail to gain an understanding of local culture and key opinion leaders before they approach the mayor.

Lund noted that PPPs were very transactional in the past—if a city needed its schools cleaned, it hired a company to clean them. While transactional relationships still occur, today's PPPs are likely to based on shared, purpose-driven values and goals. Companies, foundations, and civil society organizations join municipalities to solve societal challenges.

Baptista Leite noted this transformation enables the development of more sustainable solutions.

Marchandise-Franquet was then asked whether funds to support city-based programs come from national government or local taxes, whether receiving national money then limits what cities can do, and if partnerships with private companies could help cities advocate for more national money. She replied that her city receives funds from the French government as well as from local taxes for its health-related programs, and this money has allowed the city to innovate and improve its residents' lives. That, in turn, has made the city more attractive for business and investment—people want to live in a healthy city, she said—which makes for good politics at both local and national levels. In fact, France has doubled the amount of money it provides to its healthy cities because the national government has seen the benefits of these programs.

Baptista Leite said it is in the national government's interest in Portugal to decentralize and to give local governments the authority to provide services and accountability. The problem is that funding does not always follow. What helps cities in Portugal is that money raised from corporate taxes largely stays in the cities where companies are based and that, as Marchandise-Franquet noted, people—and therefore businesses—want to be in healthy cities. The key in Portugal is to lobby at the national level to ensure that decentralization is done well and comes with appropriate resources and that mechanisms for accountability are created at the local level.

As an aside, Baptista Leite noted that his city dedicates 5 percent of its total budget for citizen-nominated projects on which city residents vote. One project, a skate park developed by the city's youth and approved by city voters, was built on land in one of the city's most expensive neighborhoods. Baptista Leite noted that what happened next was extraordinary. He said, "Not only did it become the most fashionable skate park in the country, it is a source of revenue for that whole area, and it has actually generated a whole set of social initiatives and movements around it."

Responding to a question about the extent to which ideology hinders developing effective programs at the local level, Baptista Leite said ideology impedes local progress less; people are more concerned about how a program affects their own lives and about what it means for their children and their neighborhood than they are about ideology. Baptista Leite noted, "If we were to reinforce the role of local governance, then there would be a potential to move away from the ideological stance and go toward what it impacts in the real world, on real people's lives." Aerts agreed that local work with a range of stakeholders and with civil society often rises above ideology.

FINAL THOUGHTS

In her closing remarks, Boufford stated that the workshop's discussions clearly made the case that cities are key actors in driving the global health agenda and that achieving urban health requires work across government, private, and community-based sectors. She said, "None of this happens unless those partnerships are there and those relationships are there, and this requires patience and trust." The workshop also highlighted several advantages of working with local governments, including gaining critical insights into communities, acquiring data to inform projects, and creating relationships with key local organizations. Decentralizing national authority and resources to local government varies by country, and understanding the real political power of local officials is important.

Another major point raised over the preceding one and a half days was that health not only equals health care but also depends on urban planning, housing, transportation, food systems, energy, and other sectors and on government ability and willingness to work with civil society and the private sector. Boufford noted that, in general, the private sector is relatively absent from broader discussion on the determinants of health. However, interest is increasing within the business community, and there are opportunities to better engage the private sector, particularly at the city level where results can be seen directly by the public and by customers. Boufford stated that it seems clear that incentives will need to be developed to address the relative lack of market forces supporting sustainable PPPs that create long-term shared value for all partners. Some examples have been explored in this workshop, but more are needed to align the expertise, financial resources, and political forces important for improving urban health and reducing urban health inequities—both of which are critical factors in achieving global health.

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Appendix A

Workshop Agenda

Day 1 – June 13, 2019

Lecture Room, National Academies,
2101 Constitution Avenue, NW, Washington, DC 20418

9:00 AM **Welcome and Introduction from the Workshop Co-Chairs**

- **Ann Aerts,** Head, Novartis Foundation
- **Jo Ivey Boufford,** Clinical Professor, College of Global Public Health, New York University

SESSION 1: CITIES AND PLANETARY HEALTH: WHY URBAN ISSUES MATTER

9:15 AM **The Role of Cities in Planetary Health**

Speaker:

- **Sir Andy Haines,** Professor, Environmental Change and Public Health, London School of Hygiene & Tropical Health

9:45 AM **Determinants of Urban Health and Health Inequities**

Moderated by: **Jo Ivey Boufford,** Clinical Professor, College of Global Public Health, New York University

Speakers:
- **David Vlahov,** Associate Dean for Research, Yale University School of Nursing; Professor, Yale University School of Nursing
- **Ana Diez-Roux,** Dean, Dornsife School of Public Health, Drexel University; Distinguished University Professor of Epidemiology, Dornsife School of Public Health, Drexel University

10:30 AM **Facilitated Discussion/Question-and-Answer Session**

Moderated by: **Jo Ivey Boufford,** Clinical Professor, College of Global Public Health, New York University

11:00 AM **BREAK**

SESSION 2: EVIDENCE AND CHALLENGES IN URBAN HEALTH INITIATIVES IN INTERNATIONAL DEVELOPMENT

11:30 AM **Session Chairs:**
- **Ann Aerts,** Head, Novartis Foundation
- **Rebecca Martin,** Director, Center for Global Health, U.S. Centers for Disease Control and Prevention

Introductory Speaker:
- **Sue Parnell,** Urban Geographer, Department of Environmental and Geographical Sciences, University of Cape Town (UCT); Executive, African Centre for Cities, UCT

11:45 AM **Part 1—Effects of Urbanization and Urban Planning on Health**

Moderated by: **Ann Aerts,** Head, Novartis Foundation

Speakers:
- **Mark J. Nieuwenhuijsen,** Director, Urban Planning, Environment and Health Initiative, Barcelona Institute for Global Health (ISGlobal); Research Professor, Environmental Epidemiology, ISGlobal

- **Eugénie L. Birch,** Lawrence C. Nussdorf Professor of Urban Research and Education, University of Pennsylvania; Chair, Graduate Group in City and Regional Planning, University of Pennsylvania; Co-Director, Penn Institute for Urban Research, University of Pennsylvania
- **Remy Sietchiping,** Leader, Regional and Metropolitan Planning, United Nations Human Settlements Programme (UN-Habitat)

12:45 PM **Facilitated Discussions and Question-and-Answer Session**

Moderated by: **Ann Aerts,** Head, Novartis Foundation

1:00 PM **LUNCH**

2:00 PM **Part 2—Identifying and Addressing Health Inequities in Urban Settings**

Moderated by: **Rebecca Martin,** Director, Center for Global Health, U.S. Centers for Disease Control and Prevention

Speakers:
- **David Napier,** Professor, Medical Anthropology, University College; Director, Centre for Applied Global Citizenship, University College; Director, Science, Medicine, and Society Network, University College London
- **Karin Cooke,** Director, Kaiser Permanente International; Director, Technology Innovation and Innovation Fund for Technology, Kaiser Permanente
- **Geoffrey So,** Head, Strategy and Global Health Policy, Novartis Foundation

2:45 PM **Facilitated Discussions/Question-and-Answer Session**

Moderated by: **Rebecca Martin,** Director, Center for Global Health, U.S. Centers for Disease Control and Prevention

3:00 PM **Part 3—Effect of Food, Agriculture, and Transportation Systems on the Health of Urban Populations**

Moderated by: **Rebecca Martin,** Director, Center for Global Health, U.S. Centers for Disease Control and Prevention

Speakers:

- **William Dietz,** Professor, Milken Institute School of Public Health, The George Washington University; Director, Sumner M. Redstone Global Center for Prevention and Wellness, The George Washington University
- **Allison Goldberg,** Executive Director, AB InBev Foundation
- **Olga Lucia Sarmiento Dueñas,** Professor, Department of Public Health, School of Medicine, Universidad de Los Andes

3:45 PM **Facilitated Discussions and Question-and-Answer Session**

Moderated by: **Rebecca Martin,** Director, Center for Global Health, U.S. Centers for Disease Control and Prevention

4:00 PM **BREAK**

4:15 PM **Part 4—How Can Digital Technology and Artificial Intelligence Contribute to Improving Urban Health?**

Moderated by: **Ann Aerts,** Head, Novartis Foundation

Speakers:

- **Gordon Feller,** Founder, Meeting of the Minds
- **William B. Rouse,** Alexander Crombie Humphreys Professor, Stevens Institute of Technology; Director, Center for Complex Systems and Enterprises, Stevens Institute of Technology
- **Adele Waugaman,** Senior Advisor, Digital Health, U.S. Agency for International Development

4:45 PM **Facilitated Discussions and Question-and-Answer Session**

Moderated by: **Ann Aerts,** Head, Novartis Foundation

5:15 PM **Closing Comments**

- **Ann Aerts,** Head, Novartis Foundation
- **Jo Ivey Boufford,** Clinical Professor, College of Global Public Health, New York University

5:30 PM **ADJOURN TO INFORMAL RECEPTION**
East Court of the NAS Building

Day 2 – June 14, 2019

Lecture Room, National Academies,
2101 Constitution Avenue, NW, Washington, DC 20418

SESSION 3: POLITICAL LEADERSHIP AND GOVERNANCE FOR PUBLIC–PRIVATE PARTNERSHIPS IN URBAN HEALTH

9:00 AM **Welcome and Opening Session**

Moderated by: **Clarion Johnson,** Private Consultant, ExxonMobil, and **Ann Aerts,** Head, Novartis Foundation

Speaker:
- **Niels Lund,** Vice President, Health Advocacy, Novo Nordisk

Discussion:
- **Niels Lund,** Vice President, Health Advocacy, Novo Nordisk
- **Clarion Johnson,** Private Consultant, ExxonMobil
- **Ann Aerts,** Head, Novartis Foundation

9:45 AM **Panel of Policy Makers/Elected Representatives**

Moderated by: **Jo Ivey Boufford,** Clinical Professor, College of Global Public Health, New York University

Speakers:
- **Ricardo Baptista Leite,** Member, Health Committee and Foreign Affairs Committee, Portuguese National Parliament; National Spokesperson for Health, Social Democratic Party (PSD); Head, Public Health, Institute of Health Sciences, Universidade Católica Portuguesa
- **Charlotte Marchandise-Franquet,** Deputy Mayor for Health, City of Rennes, France; President, World Health Organization (WHO) French Healthy Cities Network; Chair, Political Vision Group, WHO Healthy Cities European Network; Co-Chair, Global Urban Air Pollution Observatory (GUAPO)

10:45 AM **Facilitated Discussions/Question-and-Answer Session**

Moderated by: **Jo Ivey Boufford,** Clinical Professor, College of Global Public Health, New York University

11:00 AM **Closing Comments**

- **Ann Aerts,** Head, Novartis Foundation
- **Jo Ivey Boufford,** Clinical Professor, College of Global Public Health, New York University

11:15 AM **ADJOURN**

Appendix B

Biographical Sketches of Workshop Speakers

Ann Aerts, M.D., M.P.H., D.T.M., has been the head of the Novartis Foundation since January 2013. The Novartis Foundation has the challenging goals of expanding access to quality health care and eliminating diseases such as leprosy and malaria. Before her current role, Dr. Aerts was the franchise medical director of critical care for Novartis Pharma in Basel and the therapeutic area head of cardiovascular and metabolism in Novartis Pharma Belgium. Prior to joining Novartis, she served as the director of the Lung and Tuberculosis Association in Belgium, as the head of the Health Services Department of the International Committee of the Red Cross (ICRC) in Geneva, and as the health coordinator for the ICRC in several countries. Dr. Aerts holds a degree in medicine and a master in public health from the University of Leuven, Belgium, as well as a degree in tropical medicine from the Institute of Tropical Medicine in Antwerp, Belgium. Dr. Aerts is a member of the advisory boards of the Global Health Group of the University of California, San Francisco (UCSF); the Organisation for Economic Co-operation and Development (OECD) Network of Foundations Working for Development (netFWD); the ITU/United Nations Educational, Scientific and Cultural Organization Broadband Commission for Digital Development; and the Governing Council of the United Nations Technology Bank for Least Developed Countries.

Ricardo Baptista Leite, M.D., M.P., is a member of the Portuguese Parliament and serves on its Health Committee and its Foreign Affairs

Committee. He is also the national spokesperson for health in the Social Democratic Party (PSD) and the head of public health at Católica University of Portugal. He is the founding president of Unite–Global Parliamentarians Network to End HIV / AIDS, Viral Hepatitis, and Other Infectious Diseases and the vice chair of the Parliamentary Network on the World Bank and International Monetary Fund. One of six people globally nominated by the Economist Intelligence Unit in 2016 as an "HCV Change Maker" in recognition of leadership in the field of hepatitis C, Dr. Baptista Leite is also a guest lecturer at the NOVA Information Management School and the NOVA Medical School. He is the former deputy mayor and city councilor of Cascais and was responsible for health, economic diplomacy, and international relations. Prior to being elected to the Portuguese Parliament, Dr. Baptista Leite worked as a practicing physician, including a 5-year infectious diseases residency program at the Western Lisbon Hospital Centre and an internship at the World Health Organization (WHO) in Copenhagen. Among other publications, he is the main author of the book *Citizenship for Health*. He was a Ph.D. candidate at Maastricht University and completed postgraduate studies at multiple universities, including Johns Hopkins University, the Harvard Kennedy School of Government, and the Harvard Medical School. Dr. Baptista Leite is the founder of the initiative Creating Health–Research and Innovation Funding and the co-founder of the Estoril Conferences.

Jo Ivey Boufford, M.D., is the co-chair of the Forum on Public–Private Partnerships for Global Health and Safety and the immediate past president of The New York Academy of Medicine. She is now a clinical professor of global public health at the College of Global Public Health at New York University, where she is also a professor of public service, health policy, and management at the Robert F. Wagner Graduate School of Public Service. In addition, she is a clinical professor of pediatrics at the New York University School of Medicine. She served as the dean of the Robert F. Wagner Graduate School of Public Service at New York University from June 1997 to November 2002. Prior to that, she served as the principal deputy assistant secretary for health in the U.S. Department of Health and Human Services (HHS) from November 1993 to January 1997 and as acting assistant secretary from January 1997 to May 1997. While at HHS, she was the U.S. representative on the Executive Board of the World Health Organization (WHO) from 1994 to 1997. She served in a variety of senior positions in and as president of the New York City Health and Hospitals Corporation (HHC), the largest municipal system in the United States, from December 1985 until October 1989. Dr. Boufford was awarded a Robert Wood Johnson Foundation Health Policy Fellowship at the National Academy of Medicine (NAM) in Washington, DC,

for 1979–1980. She currently serves on the boards of the United Hospital Fund and the Health Effects Institute. She was elected to membership in the NAM in 1992 and served on the National Academies of Sciences, Engineering, and Medicine's Board on Global Health and Board on African Science Academy Development. She served two 4-year terms as the foreign secretary of the NAM between 2010 and 2014 and was elected to membership in the National Academy of Public Administration in 2015. She received honorary doctorate of science degrees from State University of New York, Brooklyn (1992); New York Medical College (2007); Pace University (2011); and Toledo University (2012). She has been a fellow of The New York Academy of Medicine since 1988 and a trustee since 2004. Dr. Boufford attended Wellesley College for 2 years and received her B.A. in psychology magna cum laude from the University of Michigan and her M.D., with distinction, from the University of Michigan Medical School. She is board certified in pediatrics.

Eugénie L. Birch, Ph.D., M.S., FAICP, RTPI (hon), holds the Nussdorf Chair for Urban Research in the School of Design at the University of Pennsylvania. She is the founding co-director at the Penn Institute for Urban Research and is also the co-editor of Penn Press's *The City in the Twenty-First Century* series and the co-editor of SSRN's *Urban Research eJournal*. Her recent publications include *Slums: How the Informal Real Estate Markets Work* (University of Pennsylvania Press, 2016) and *More Than Window Dressing?: Stakeholders and Partnerships in the New Urban Agenda* in *URBANET* (January 2018). Dr. Birch has served as a member of the New York City Planning Commission and on the jury for the World Trade Center site design. She served on the Barcelona Smart City and Expo awards jury for several years. She has also served as the chair of the United Nations Human Settlements Programme's (UN-Habitat's) World Urban Campaign (2014–2016) and as the president of the General Assembly of Partners (2015 to present) and was a member of the U.S. delegation to Habitat III. She is a member of the Global Council on the Future of Urbanization at the World Economic Forum (WEF) and of the WEF Future of Urban Development and Services Advisory Board. Dr. Birch holds a doctorate of philosophy and a master of science in urban planning from Columbia University.

Karin Cooke, M.B.A., is the director of Kaiser Permanente (KP) International, where she designs educational programs and presentations for international health care leaders to share KP's leading practices and success with its integrated health care model. These programs highlight KP's focus on community health, innovation, and patient-centered care. Prior to joining KP International in 2018, Ms. Cooke was a director with KP's

Technology Innovation, a group that identifies emerging technologies that are relevant for KP. KP Technology Innovation partners with KP leaders and frontline innovators to test solutions that can transform how care is delivered. Ms. Cooke led a cross-functional team that fostered innovation projects from across the organization through funding, design coaching, designing pilot projects, navigating legal and intellectual property issues, and fostering stakeholder engagement. Prior to working at KP, Ms. Cooke worked in venture philanthropy, corporate social responsibility, health care, and education and focused on capacity building and leveraging technology to support the different communities served. Ms. Cooke has a bachelor's degree in communications from the University of California, Berkeley, and an M.B.A. from the Anderson School at the University of California, Los Angeles.

William H. Dietz, M.D., Ph.D., is the chair of the Sumner M. Redstone Global Center for Prevention and Wellness at the Milken Institute School of Public Health at The George Washington University. From 1997 to 2012, he was the director of the Division of Nutrition, Physical Activity, and Obesity in the Center for Chronic Disease Prevention and Health Promotion at the U.S. Centers for Disease Control and Prevention (CDC). Prior to his appointment to CDC, he was a professor of pediatrics at the Tufts University School of Medicine and the director of clinical nutrition at the Floating Hospital for Children within the Tufts Medical Center (formerly the New England Medical Center). At the Floating Hospital, he was the director of the pediatric weight control program and a clinic for children with failure to thrive. He has been a councilor and a past president of the American Society for Clinical Nutrition and a past president of the North American Association for the Study of Obesity. From 2001 to 2003, he served as a member of the Advisory Board to the Institute of Nutrition, Metabolism, and Diabetes of the Canadian Institutes for Health Research. In 1995, he received the John Stalker Award from the American School Food Service Association for his efforts to improve school lunches. Dr. Dietz served on the 1995 Dietary Guidelines Advisory Committee. In 1997, Dr. Dietz received the Brock Medal of Excellence in Pediatrics from The New York Academy of Medicine. In 1998, Dr. Dietz was elected to the National Academy of Medicine. In 2000, he received the William G. Anderson Award from the American Alliance for Health, Physical Education, Recreation, and Dance and was recognized for excellence in his work and advocacy by the Association of State and Territorial Public Health Nutrition Directors. In 2002, he was made an honorary member of the American Dietetic Association, and he received the Holroyd-Sherry Award for his outstanding contributions to the field of children, adolescents, and the media. In 2005, he received the George Bray Founders Award from the

North American Association for the Study of Obesity. In 2006, he received the Nutrition Award from the American Academy of Pediatrics (AAP) for outstanding research related to nutrition of infants and children. In 2008, he received the Oded Bar-Or Award from The Obesity Society for excellence in pediatric obesity research. In 2012, Dr. Dietz received a Special Recognition Award from the AAP Provisional Section on Obesity as well as the Outstanding Achievement Award from the Georgia Chapter of AAP. He was the co-chair of the commission that produced *The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission Report* in 2019. He is the author of more than 200 publications in scientific literature and the editor of 5 books, including *Clinical Obesity in Adults and Children* and AAP's *Nutrition: What Every Parent Needs to Know*. He received his B.A. from Wesleyan University in 1966 and his M.D. from the University of Pennsylvania in 1970. After completing his residency at Upstate Medical Center, he received a Ph.D. in nutritional biochemistry from the Massachusetts Institute of Technology.

Ana V. Diez-Roux, M.D., Ph.D., M.P.H., is the dean of the Dornsife School of Public Health and directs the Urban Health Collaborative at Drexel University. She is internationally known for her research on the social determinants of population health and for her study of how neighborhoods, particularly urban ones, affect health. Her work on neighborhood health effects has been highly influential in policy debates on population health and its determinants. The related programs she has led have spanned physical environments (including air pollution and built environment factors), social environments, and policy effects. She is particularly interested in methodological aspects of special relevance to urban health research, including multi-level analysis and the application of the tools of complex systems methodologies to urban health problems. She has led large National Institutes of Health and foundation-funded research and training programs in the United States and in collaboration with international partners. Most recently, she convened the Network for Urban Health in Latin America and the Caribbean, which focuses on promoting research, training, and policies to promote urban health throughout the region. She is the principal investigator of the SALURBAL (Salud Urbana en America Latina/Urban Health in Latin America) study, funded by the Wellcome Trust. Dr. Diez-Roux has served on numerous editorial boards, review panels, and advisory committees relevant to urban health, including the Clean Air Scientific Advisory Committee (CASAC) of the U.S. Environmental Protection Agency (as chair), the Committee on Health and Wellbeing in the Changing Urban Environment of the International Council for Science (ISCUS), and the Environmental Health Matters Initiative of the National Academies of Sciences, Engineering, and Medicine. She was

awarded the Wade Hampton Frost Award for her contributions to public health by the American Public Health Association. She is an elected member of the American Epidemiological Society, the Academy of Behavioral Medicine Research, and the National Academy of Medicine.

Gordon Feller is the founder of Meeting of the Minds, a nonprofit that brings together urban sustainability and technology leaders to share knowledge and build lasting alliances. Mr. Feller is also a retired member of the U.S. Federal Electricity Advisory Committee (retired 2018) and a former member of the executive office at Cisco Systems HQ (retired 2017). In addition, Mr. Feller acts as a consultant to chief executive officers in numerous organizations, including nonprofits, for-profits, and government. He is a Wilson Center Global Fellow at the Smithsonian Institution in the United States.

Allison Goldberg, Ph.D., is the executive director of AB InBev Foundation, where she oversees the execution of the foundation's strategic vision according to its guiding principles: promoting transparency, supporting local leadership, and maintaining academic integrity. Dr. Goldberg leads the Foundation's mission to reduce harm from alcohol worldwide and tests new models for cross-sector collaboration. A recognized expert in private-sector-led public health initiatives, Dr. Goldberg earned an interdisciplinary Ph.D. in public health and political science from Columbia University and a B.A. in political science from the University of Michigan. She is a 2015 Aspen Ideas Festival Scholar and holds an academic appointment as a lecturer at Columbia University where she teaches a course titled "Global Intractable Challenges: Innovations, Frameworks, and Change." Dr. Goldberg has more than 30 publications across outlets such as the United Nations Foundation's *Global Daily* and other journals such as the *Journal of Health Communication–International Perspectives*, *Global Public Health*, *Journal of Acquired Immune Deficiency Syndromes* (*JAIDS*), and *Sexually Transmitted Infections*.

Sir Andy Haines, M.D., M.B.B.S., was the dean (subsequently the director) of the London School of Hygiene & Tropical Medicine for nearly 10 years, until October 2010, and is currently a professor of environmental change and public health at the same institution. He was a family doctor in inner London for many years and is a former professor of primary health care at the University College London (UCL). His international experience includes a secondment at the World Health Organization (WHO) in Geneva and work in Jamaica, Nepal, and the United States. He has participated in many national and international bodies, including the United Nations Intergovernmental Panel on Climate Change (on three

occasions), the United Kingdom's Department for International Development Research Advisory Group (latterly chair), and the WHO Advisory Committee on Health Research. He was the chair of The Rockefeller Foundation/Lancet Commission on Planetary Health and led several Lancet series including *Public Health Benefits of Strategies to Reduce Greenhouse Gas Emissions* (2009). He is currently a member of the Sustainable Development Solutions Network Leadership Council, the Scientific Advisory Panel of the Climate and Clean Air Coalition, and the Rockefeller Council on the Economics of Planetary Health. His research interests focus on the linkages between health and natural systems and the health (co-)benefits of "low carbon" policies, sustainable healthy cities, and food systems.

Clarion Johnson, M.D., the co-chair of the Forum on Public–Private Partnerships for Global Health and Safety, served as global medical director of ExxonMobil until his retirement in 2013. Currently, Dr. Johnson is a consultant to ExxonMobil, the immediate past chair of the Joint Commission's International and Resource Boards, and a member of the Yale School of Public Health Leadership Council. He serves on several boards including those at the Bon Secours Hospital System; the Yale School of Public Health; and the Milbank Memorial Fund. Dr. Johnson previously served on the Board on Global Health at the National Academies of Sciences, Engineering, and Medicine. He also holds a secretary appointment from the U.S. Department of Health and Human Services to the Advisory Board of the National Institute for Occupational Safety and Health (NIOSH). In addition, he was a member of the Governor's Task Force on Health Reform and was the co-chair of the Governor's Insurance Reform Task Force in Virginia. He is the past chair of the Virginia Health Care Foundation and of the Board of City Lights Charter School in Washington, DC. He served as an advisor and a lecturer in the Harvard Medical School's Department of Continuing Education Global Clinic Course from 2005 to 2008. In 2013, he received the President's Award from the Oil and International Petroleum Industry Environment Conservation Association (IPIECA) and from the Oil and Gas Producers (OGP) for contributions to health. In 2012, he received the Society of Petroleum Engineers (SPE) Award for Health, Safety, Security, Environment, and Social Responsibility. In 2011, he received a medal from the French Armed Forces Institute De Recherché Biomedical for "Project Tetrapole," a public–private partnership in malaria research. Dr. Johnson is a graduate of Sarah Lawrence College and a member of its board of trustees as well as a graduate of the Yale School of Medicine. While on active duty in the U.S. Army, he also trained as a microwave researcher at the Walter Reed Army Institute of Research. He is board certified in internal medicine, cardiology, and occupational medicine.

Niels Lund, M.Sc., M.B.A., is the vice president for health advocacy at Novo Nordisk, a global health care company with more than 90 years of innovation and leadership in diabetes care. Mr. Lund is responsible for managing Changing Diabetes flagship programmes (including Cities Changing Diabetes) and the Access to Insulin Commitment, which includes Changing Diabetes in Children and Partnering for Change with the International Committee for the Red Cross. Additionally, his responsibilities include partnerships with patient organizations and patient advocates globally. Mr. Lund acts as the co-chair of the Health and Healthcare Strategy Officers' Council in the World Economic Forum (WEF) and contributes to WEF's agenda blog platform. Mr. Lund has a master of science in economics from the University of Copenhagen and a master of business administration in health services management from The George Washington University. He joined Novo Nordisk in 2007 as a health economist and worked in various roles before being appointed the vice president in 2012. Before joining Novo Nordisk, Mr. Lund worked in international development with assignments from UNICEF in India and the World Bank in Washington, DC.

Charlotte Marchandise-Franquet has worked as a coordinator, communications officer, and project manager in the corporate world and in nongovernmental organizations (NGOs). In 2014, Ms. Marchandise-Franquet was elected the deputy mayor for health for Rennes, France; the president of the World Health Organization's Healthy Cities French Network; and the chair of the political vision group of European Healthy Cities. Ms. Marchandise-Franquet is an international expert in Health in All Policies and urban health approaches. She defends whole-of-government and whole-of-society approaches. Ms. Marchandise-Franquet also developed a local policy of health promotion, health equity, and environmental health using a systematic, democratic point of view in order to empower inhabitants. Ms. Marchandise-Franquet advocates for city diplomacy and Health in All Policies and works to organize cooperation between cities as well as among city networks, ministries, and university-based grassroots movements. Ms. Marchandise-Franquet believes cities are global actors and advocates to include them systematically in high-level conferences and especially in pursuits to achieve the Sustainable Development Goals.

Rebecca Martin, Ph.D., is the director of the Center for Global Health (CGH) at the U.S. Centers for Disease Control and Prevention (CDC). Dr. Martin has worked both domestically and internationally in immunization, HIV, and health system strengthening and now leads CDC's global efforts to protect and improve health globally through science,

policy, partnership, and evidence-based public health action. Dr. Martin has more than 18 years of experience working in international health. Since 1991, Dr. Martin has worked in the global health arena and has had CDC assignments in Kenya, Tanzania, and Denmark (2002–2011). She was detailed to the World Health Organization (WHO) African Regional Office from 2002–2006 and was based in Kenya as a senior epidemiologist in the inter-country immunization program office for eight East African countries. From 2006–2008, Dr. Martin served as the program director for strategic information and human resources for health within the CDC country office in Tanzania. Partnering with the Ministry of Health, she led and implemented studies to measure and evaluate the HIV/AIDS epidemic and to strengthen the national capacity to respond. Between 2008 and 2011, Dr. Martin was detailed to the WHO European Regional Office as the regional advisor for immunization, and she spearheaded regional efforts to strengthen immunization and surveillance systems, provide evidence for the introduction of new vaccines, achieve the goal of measles and rubella elimination, and maintain the region's polio-free status. Most recently, from 2012–2016, Dr. Martin served as the director of the CGH Global Immunization Division, which leads CDC's global polio eradication efforts, accelerates disease control for vaccine-preventable diseases, introduces new and underused vaccines, and strengthens immunization systems. Dr. Martin began her career with CDC in 1997 in the Epidemiology and Surveillance Division of the National Immunization Program. Prior to joining CDC, she worked at the Maryland Department of Hygiene and Mental Health in Baltimore, Maryland, as the immunization program epidemiologist. There, she led efforts to increase vaccination coverage, conduct outbreak investigations, coordinate the development and introduction of Maryland's immunization registry, and support the state's Vaccines for Children program. Dr. Martin received her doctorate of philosophy from the Johns Hopkins Bloomberg School of Public Health in international health with a focus on infectious disease epidemiology. Over the past 15 years, she has collaborated with multi-lateral organizations and development partners and has worked closely with ministries of health and nongovernmental organizations. She has co-authored manuscripts and has developed strategic plans and normative guidance and guidelines on immunization strategies, vaccine-preventable diseases, and surveillance methods for both immunization and HIV.

A. David Napier, Ph.D., is a professor of medical anthropology at the University College London (UCL) and the director of its Science, Medicine, and Society Network. Dr. Napier has been involved in three Lancet commissions and led the 2014 *Lancet Commission on Culture and Health.* He regularly writes for the press (e.g., *Le Monde*) and his work has been

widely featured in publications such as *The New York Times*, *The Financial Times*, and *The Guardian*. For his activities with more than 100 charities, the government and research councils in the United Kingdom (UK) awarded him the first Beacon Fellowship in Public Engagement. He also received the Burma Coalition's Human Rights Award. Dr. Napier has consulted on vulnerable populations in the aftermath of natural and human disasters for, among others, the World Health Organization, CRISIS UK, the United Nations, and the International Organization for Migration. Currently, he is global academic lead for the Cities Changing Diabetes public–private partnership, which works in 19 countries with city governments that represent more than 120 million people.

Mark J. Nieuwenhuijsen, Ph.D., is a world expert in environmental exposure assessment, epidemiology, and health risk and impact assessment and focuses on healthy urban living. His experience and expertise are in all-cause mortality; respiratory and cardiovascular disease; mental health and cognitive function; cancer and reproductive health; exposure measurement and modeling of indoor and outdoor air pollution; green spaces; ultraviolet (UV) exposure; noise; temperature and physical activity; and new technology such as geographic information systems, smartphones, personal sensors, and remote sensing. Dr. Nieuwenhuijsen leads the international TAPAS study (http://www.tapas-program.org), which examines the health impacts of active transport in six European cities; the European Commission (EC)-funded PHENOTYPE (www.phenotype.eu) study, which examines the relations between green spaces and health; and the SUMA HIA project, funded by ISGlobal, on health impact assessment in low- and middle-income countries. He has been a co-investigator in many projects, including ICEPURE (www.icepure.eu), which examines exposure to and health effects of solar UV; ESCAPE (www.escapeproject.eu) (and related VE3SPA), which examines the long-term health effects of air pollution; CAVA, funded by the National Institutes of Health, which aims to validate smartphone-based data-collection methods; EC-funded CITISENSE (http://citi-sense.eu), which aims to empower citizens using smartphone technology; EC-funded HELIX (http://www.projecthelix.eu), which examines the early life exposome and childhood diseases; EC-funded EXPOsOMICs (http://www.exposomicsproject.eu), which examines air pollution, water exposome, and health; the EC-funded PASTA study (http://www.pastaproject.eu), which promotes active transportation through sustainable transport; the EC-funded BlueHealth project (www.bluehealth2020.eu), which evaluates the relationship between blue space and health; and the EC-funded LifeCycle project (http://lifecycle-project.eu) on birth cohort coordination in Europe. Dr. Nieuwenhuijsen edited three books: one on exposure assessment, one on environmental

epidemiology, and one on the integration of human health into urban and transport planning. He has also co-authored 400 papers that have been published in peer-reviewed journals and 30 book chapters. In 2018, he was awarded the ISEE John Goldsmith Award for Outstanding Contributions to Environmental Epidemiology.

Susan Parnell, Ph.D., is a global challenges professor in the School of Geography at the University of Bristol and an emeritus professor at the University of Cape Town, where she co-founded the African Centre for Cities. She has recently been a visiting professor at LSE Cities, a Leverhulme Visiting Professor at the University College London (UCL), and the Emeka Anyaoku Visiting Chair at UCL. She has been actively involved in local, national, and global urban policy debates around the 2030 Sustainable Development Goals and advocates for better science policy engagement on cities. She has authored numerous peer-reviewed publications, historical and contemporary, that document how cities respond to policy change. Recent books include *Building a Capable State: Post Apartheid Service Delivery* (Zed, 2017) and *The Urban Planet* (Cambridge, 2017).

William B. Rouse, S.M., Ph.D., is a researcher, educator, author, and entrepreneur. His current positions include principal at Curis Meditor, professor in the School of Systems and Enterprises at Stevens Institute of Technology, and professor emeritus in the School of Industrial and Systems Engineering at the Georgia Institute of Technology (Georgia Tech). His earlier positions include the executive director of the university-wide Tennenbaum Institute and the chair of the School of Industrial and Systems Engineering at Georgia Tech. He was the chief executive officer of two innovative software companies—Enterprise Support Systems and Search Technology—and held earlier faculty positions at Georgia Tech, the University of Illinois, the Delft University of Technology, and Tufts University. His expertise includes individual and organizational decision making and problem solving, as well as design of organizations and information systems. In these areas, he has consulted with more than 100 large and small enterprises in the private, public, and nonprofit sectors, where he has worked with several thousand executives and senior managers. His current research focuses on understanding and managing complex public–private systems such as health care delivery, urban systems, and defense and emphasizes mathematical and computational modeling of these systems for policy design and analysis. Dr. Rouse received his B.S. from the University of Rhode Island and his S.M. and Ph.D. from the Massachusetts Institute of Technology.

Olga L. Sarmiento, M.D., Ph.D., M.P.H., is a professor in the Department of Public Health at the School of Medicine at the Universidad de Los Andes (Bogotá, Colombia). Currently, she is the director of the Group of Epidemiology at the Universidad de Los Andes. Dr. Sarmiento's research interests include urban health, healthy behaviors, and the built environment in relation to children and adults in Latin America. She has been a board member of the International Society of Physical Activity and Health and of the Global Advocacy for Physical Activity (GAPA) council, the Urban Health Network for Latin America and the Caribbean, and the International Society of Urban Health. Her current research focuses on international studies and includes the Urban Health in Latin America project (SALURBAL); the International Physical Activity and Environment Network (IPEN); the International Study of Childhood Obesity, Lifestyle, and the Environment (ISCOLE); the Stanford-Colombia Collaboratory on Chronic Disease (S-C3); and the Our Voice in the City project in Bogotá. She holds an M.D. from the Universidad Javeriana (Bogotá) and an M.P.H. and a Ph.D. from the Department of Epidemiology in the School of Public Health at the University of North Carolina at Chapel Hill.

Remy Sietchiping, Ph.D., leads the Regional and Metropolitan Planning Unit at UN-Habitat. He oversees the development of strategic programmes within UN-Habitat, including national urban policy, urban–rural linkages, smart cities, metropolitan development, and the application of the International Guidelines on Urban and Territorial Planning to the health sector. He manages an active global portfolio in more than 40 countries. Prior to joining UN-Habitat, Dr. Sietchiping was project leader of the Global Land Tool Network where he coordinated work on tool development processes—particularly on access to land, tenure security, land management and planning, land information, land policy and legislation, and land-based financing. His working experience spans more than 25 years across the United Nations systems, academia, the private sector, the public sector, and nongovernmental organizations in Australia, Cameroon, Ethiopia, Jamaica, and other parts of the world. Dr. Sietchiping has more than 40 publications, including books, peer-reviewed articles, papers in proceedings, and reports. He speaks French and English and holds a Ph.D. in geography from the University of Melbourne in Australia.

Geoffrey So, M.S., is the head of partnerships at Novartis Foundation. He leads the foundation's global health policy discussions and works across the portfolio of foundation initiatives to identify strategic partnership needs. He also actively cultivates collaborations with partners across sectors to materialize opportunities that leverage comparative strengths for health impact and sustainability. Prior to joining the Novartis Foundation

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David Vlahov, R.N., Ph.D., is an associate dean for research and a professor at the Yale School of Nursing. He is also a professor of epidemiology at the Yale School of Public Health. His primary area of focus has been urban health. His studies in Baltimore, Harlem, and the Bronx have served as a platform for subsequent individual, community-level, and policy-level intervention studies. This work has contributed new knowledge to efforts to promote health equity. Dr. Vlahov was the director of the Center for Urban Epidemiologic Studies at The New York Academy of Medicine and was the founding president of the International Society for Urban Health (www.isuh.org). He has been a visiting professor at the medical school in Belo Horizonte, Brazil, and has served as an expert consultant to the World Health Organization's (WHO's) Urban Health Center in Kobe, Japan. He is the editor in chief of the *Journal of Urban Health*, has edited 4 books on urban health, and has published more than 666 scholarly papers. He was the principal investigator of The Rockefeller Foundation's Roundtable for Urban Living Environment Research (RULER) project on urban health metrics. He was also a member of the WHO Knowledge Network for Urban Settlements, which was part of the WHO Commission on the Social Determinants of Health. He served on the New York City Board of Health. Currently, he is a member of the National Academy of Medicine and serves on the National Academies of Sciences, Engineering, and Medicine's Board on Global Health.

Adele Waugaman, M.A., is a senior advisor in digital health at the U.S. Agency for International Development (USAID), where she leads the development of a new strategy to guide the agency's investments in digital technologies to support global health programs and outcomes. She co-chairs the 200-member Digital Health and Interoperability Working

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