Roundtable on Urban Living Environment Research (RULER)

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ABSTRACT *For 18 months in 2009–2010, the Rockefeller Foundation provided support to establish the Roundtable on Urban Living Environment Research (RULER). Composed of leading experts in population health measurement from a variety of disciplines, sectors, and continents, RULER met for the purpose of reviewing existing methods of measurement for urban health in the context of recent reports from UN agencies on health inequities in urban settings. The audience for this report was identified as international, national, and local governing bodies; civil society; and donor agencies. The goal of the report was to identify gaps in measurement that must be filled in order to assess and evaluate population health in urban settings, especially in informal settlements (or slums) in low- and middle-income countries. Care must be taken to integrate recommendations with existing platforms (e.g., Health Metrics Network, the Institute for Health Metrics and Evaluation) that could incorporate, mature, and sustain efforts to address these gaps and promote effective data for healthy urban management. RULER noted that these existing platforms focus primarily on health outcomes and systems, mainly at the national level. Although substantial reviews of health outcomes and health service measures had been conducted elsewhere, such reviews covered these in an aggregate and perhaps misleading way. For example, some spatial aspects of health inequities, such as those pointed to in the 2008 report from the WHO's Commission on the Social Determinants*

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of Health, received limited attention. If RULER were to focus on health inequities in the urban environment, access to disaggregated data was a priority. RULER observed that some urban health metrics were already available, if not always appreciated and utilized in ongoing efforts (e.g., census data with granular data on households, water, and sanitation but with little attention paid to the spatial dimensions of these data). Other less obvious elements had not exploited the gains realized in spatial measurement technology and techniques (e.g., defining geographic and social urban informal settlement boundaries, classification of population-based amenities and hazards, and innovative spatial measurement of local governance for health). In summary, the RULER team identified three major areas for enhancing measurement to motivate action for urban health—namely, disaggregation of geographic areas for intra-urban risk assessment and action, measures for both social environment and governance, and measures for a better understanding of the implications of the physical (e.g., climate) and built environment for health. The challenge of addressing these elements in resource-poor settings was acknowledged, as was the intensely political nature of urban health metrics. The RULER team went further to identify existing global health metrics structures that could serve as platforms for more granular metrics specific for urban settings.

EXECUTIVE SUMMARY

In 2008, for the first time in history, half of the world's population lived in urban areas. While this milestone includes both developed and developing countries, by 2020, urban will become the predominant mode of living in the developing world. Although considerable attention has been, and should be, focused on addressing poverty and health in rural settings, cities are increasingly where people live, where economic livelihood supports rural counterparts, and where density can make population health efforts more efficient. Especially as poverty—which is inextricably linked with poorer health outcomes—becomes more urbanized, the complex array of forces and challenges that impact population health needs to be recognized, acknowledged, and addressed to make urban settings livable. Facilitating this effort requires comprehensive, effective, efficient, and affordable metrics and data systems to guide urban management.

For 18 months in 2009–2010, the Rockefeller Foundation provided support to establish the Roundtable on Urban Living Environment Research (RULER). Composed of leading experts in population health measurement from a variety of disciplines, sectors, and continents, RULER met for the purpose of reviewing existing methods of measurement for local area health in the context of recent reports from UN agencies on health inequities in urban settings. The audience for this report was identified as international, national, and local governing bodies; civil society; and donor agencies. The goal of the report was to identify gaps in measurement that must be filled in order to assess and evaluate population health in urban settings, especially informal settlements (or slums) in low- and middle-income countries. Care must be taken to integrate recommendations with existing platforms (e.g., the Health Metrics Network and the Institute for Health Metrics and Evaluation) that could incorporate, mature, and sustain efforts to address these gaps and promote effective data for healthy urban management. The key points are summarized below:

1. Urban settings are a priority area of focus as they are the platform on which the 21st-century megatrends are played out. These megatrends include demographic shifts, globalization, climate change, proximal inequities, and decentralization. The urban infrastructure can buckle under the increasing weight of population and spatial growth. Urban areas are subject to increasing and more rapid transportation, which affects

global transmission of infectious disease. Similar increases in the volume and speed of communication have positive and negative health consequences, as well. Urban areas can become more dense and diverse; if unaddressed, spatially proximate socioeconomic inequities can create cultural clashes and violence. In addition, many urban areas are subject to the effects of climate change, with weather disturbances affecting coastal cities and temperature-related effects heightened in these "heat islands." Finally, there is a global trend toward decentralization, in word if not deed, which puts the onus of responsibility to respond to these challenges on local governments, without always providing the necessary resources. These impacts are greatest in the urban settings of low- and middle-income countries.

2. The urban setting is a determinant of health. The discussion of urban health metrics in this report focuses on determinants of health; that is, the physical, social, and resource environments and how they are managed. This perspective arises from, and is consistent with, the messages conveyed in recent major reports from UN agencies (e.g., the WHO's CSDH report on *Closing the Gap in a Generation*, the WHO/UN-HABITAT's *Hidden Cities*, and UN-HABITAT's *Harmonious Cities*).

3. Disaggregation of local data is absolutely necessary to uncover and address health inequities. Although it is generally understood that city dwellers, on average, enjoy better health than their rural counterparts, this may reflect the practice of aggregating data that provide an average of all urban residents—rich and poor—rather than disaggregating data by people (e.g., population groups defined by socioeconomic status, race or ethnicity, gender, migration status, etc.) or place (e.g., slum vs. non-slum or neighborhoods). In developing countries, for example, slums without legal status are often overlooked in official reports used for planning services within cities; they are therefore frequently uncounted or undercounted, distorting the urban average. As a result, the different worlds of city dwellers and the substantial health challenges of the urban poor go overlooked. These differences in health outcomes within urban areas disaggregated by absolute or relative poverty are seen worldwide and for a wide variety of health outcomes. Likewise, differences in health outcomes are seen by geographic-area-specific levels of infrastructure and services within cities. A child who lives in a slum in Kenya is far more likely to die before the age of five than is his or her compatriot in another part of the city or in rural Kenya.[1,2] One notable study reported that life expectancy of black men in Harlem, an area of concentrated disadvantage in New York City, was lower than that among men in Bangladesh.[3,4] An oft-quoted study from Glasgow showed dramatic differences in life expectancy by neighborhood.[5]

4. Some data are already available in low-resource settings to generate disaggregated data at the intra-urban level, but obstacles to their use exist. Except during periods of conflict, most countries conduct a population census every 10 years. While the number of variables is limited and the interval between censuses is long, the major advantage is that such data are highly granular and include variables, however limited, on the urban environment. Simple indices based on these data have been developed and used in practice (e.g., Unsatisfied Basic Needs). Likewise, remote sensing data, which are a rich source of spatial data, are now more accessible and affordable, making local area analyses more feasible. In addition, cities typically have multiple other data sources as yet uncatalogued. There are, however, technological and political obstacles to allowing municipal governments adequate access to data, and resources to process data are not consistently available.

5. Affordable innovative technologies are becoming available to supplement existing efforts at disaggregating data. Drawing together censuses with remote sensing techniques requires several steps, including geocoding of addresses from the census

(where addresses exist) and collecting information that falls outside the scope of the census, e.g., amenities and hazards. Recent work using low-cost GPS devices, including cell phones with cameras, shows that generation of coordinates to connect data to place in real time is now feasible. Geographic information systems (GIS) is an established technology that takes coordinates and is used to generate maps. GIS is especially attractive for urban management as it permits simultaneous depiction of variables that can incorporate data from multiple sectors (e.g., health, transportation, housing, and criminal justice) for urban managers to visualize topical and spatial areas of need by types and to more intelligently plan comprehensive policies and programs.

6. Analytic strategies that make more variables interpretable at a disaggregated level continue to be developed. The census is appealing because it provides the most refined data on populations, but the range of variables is severely limited. Regional and national surveys are richer in the detail that they measure, but the sampling is typically too sparse to depict small areas. Analytic methods have been under development in the past decade to join data through an imputation procedure in order to provide more granular estimates of variables collected on surveys, as well as analysis of data at multiple levels (e.g., individuals nested in neighborhoods nested in counties or districts).

7. Missing indicators: Unrepresented or underdeveloped variables require attention to more completely depict the *urban environment*. This report focuses on the determinants of urban health and explicitly does not attempt to review measures of health status or health-related behavior. However, we note that comparisons of rural and urban disease burdens (as measured by disability-adjusted life years lost [DALYs]) do not exist, nor do comparisons of DALYs by disease within urban areas. In terms of the urban environment, there are unrepresented or underdeveloped variables that need to be incorporated into existing and emerging platforms, e.g., the social environment, climate, and urban governance. As noted above, innovative technologies are coming through the pipeline that can make some of these measures feasible and accessible. For other variables, work has been developed at various levels of refinement, but (despite recommendations from earlier reports) has not been incorporated into existing platforms. Therefore, feasibility, let alone accessibility and impact, remains an issue.

     At the same time, improving urban health metrics requires going beyond technological innovation to facilitate interdisciplinary and multi-sectoral teams. For example, physical scientists have a long head start on capturing and analyzing data on geography and climate, mostly at regional levels. Producing more complete data on how urban environments impact individual health will require interdisciplinary collaboration, in this case between physical and social scientists. Another opportunity is through mining data from other governmental and nongovernmental sectors. In low-resource settings, this will likely involve more than just a data merge. As the e-health movement evolves, urban measures might be woven in. It is also important to recognize that the group that pays for the data defines the data (in terms of sample, data elements, collection methods, and analytic strategies—typically to evaluate programs under-written), and many funders operate in the same space. This piecemeal approach can and should be considered the source of elements that are organizable into a more integrated whole, going beyond individual project goals to better articulate an urban management guide for assessment, to motivate and monitor action.

8. Improving urban health metrics requires acknowledging and addressing the politi-cization of data. While concepts and technologies for measurement have advanced, decision making on data from urban, and especially intra-urban, settings is highly politicized. National and local/municipal leaders have a stake in maintaining

aggregated data that can reduce transparency and accountability for resource allocation and mask differences that could potentially affect political stability. How boundaries are drawn, who is counted, what data are collected, what types of information are accessible at what level—these are all politically determined. The calls for good urban health governance compellingly echoed in the recent round of reports from international agencies, as well as the global trend toward decentralization of government, require that these issues be addressed head-on. Making local data available and actionable requires navigating these issues.

9. Fortunately, there exist internationally recognized platforms that can address these technical and political challenges and build on these opportunities. Two are discussed in this report: the Health Metrics Network and the Global Institute for Health Metrics and Evaluation. The first is positioned to work with countries to develop health informatics infrastructure and systems with technological support and political sensitivity. The second has made great strides in developing and expressing confidence in health metrics at global, national, and regional levels. Both are examples of platforms that can create data and systems that are responsive to the situation on the ground, contributing to the improvement of population health. UN organizations such as the WHO Kobe Center and the UN-HABITAT Global Urban Observatory program provide context, experience, and commitment, as well as technological expertise that should be enhanced and incorporated into the global effort to create state-of-the-art urban health metrics. This combination of organizations should commit to interacting and integrating their efforts. Also, they need to advocate for other international efforts, such as the Demographic and Health Surveys, to contribute more completely to, and coordinate efforts toward, achieving metrics that can underpin empirically based good urban management. The potential for these international agencies should be developed with foundation support to formalize a consortium of six cities in low- and middle-income countries that can develop, test, and validate model urban health metrics with sufficiently disaggregated data and key variables that are valid and not cost prohibitive for planning and managing urban health at the local level.

As the world has passed the demographic milestone of becoming predominantly urban, shaping and incorporating metrics that depict the urban environment, with a highlight on disaggregated data, is an important step toward responding to the health challenge of expanding population. International agencies and nation-states have been ignorant of, or in denial about, the increasing vulnerability and consequent impact of urban environments. At the same time, they are in a position to catch up, heightening the importance of good metrics if we are to recognize, acknowledge, plan, and respond to this unrelenting challenge of our times.

STATEMENT OF PURPOSE

The purpose of this report was to urge responsiveness to the growing health inequities in resource-poor urban settings. The audience includes international agencies, national and local governments, donor agencies, and developers and users of existing health metric platforms. The background for the report is the acknowledgement that urban has become the predominant mode of living and that 21st-century megatrends of globalization, climate change, inequity, and decentralization are all affecting urban settings. The context for the report is the publication of a number of reports by the UN and other agencies over the past decade, which drew attention to health inequities within urban settings and highlighted the need for improved metrics to uncover and in turn address the inequities. This report

emphasizes the need for individual data, and in particular the spatial disaggregation of the data, on factors that affect health. It summarizes technical, political, and donor issues that affect efforts to improve access to disaggregated data for urban settings. The report also reviews indicators for urban health and notes shortfalls in adaptation and utilization within the urban context of such aspects as geography and climate. It also addresses gaps in measurement for social environment and governance. As most reports conclude that "more (in this case, some) data are needed," this report also discusses issues of affordability of data. Finally, it discusses specific organizational structures that have the intellectual and political resources to build "urban" into their ongoing work.

LIST OF ACRONYMS

CSDH	Commission on Social Determinants of Health
DHS	Demographic and Health Surveys
GRNUHE	Global Research Network on Urban Health Equity
GUO	Global Urban Observatory
HEART	Health Equity Assessment and Response Tool
HMN	Health Metrics Network
IHME	Institute for Health Metrics and Evaluation
KNUS	Knowledge Network on Urban Settlements
LMIC	Low- and Middle-Income Countries
LSMS	Living Standard and Measurement Survey
MICS	Multiple Indicator Cluster Survey
UHRC	Urban Health Resource Centre
WHO	The World Health Organization

PART 1: BACKGROUND AND CONTEXT FOR URBAN HEALTH METRICS

Background

Urban settings are a priority area of focus as they are the platform on which the 21st-century megatrends are played out.

Urban is the predominant mode of living for the 21st century, and urban settings are the platform on which a number of megatrends are playing out. The first trend is demographics, with cities expanding in population size, diversity, and space. The second trend is globalization, with cities as the hubs of commerce, communications, infectious diseases, and violent crime. The third is climate change, the effects of which can be magnified in urban settings as a result of their physical layout and construction materials. The fourth is inequities, as poverty becomes urbanized; within cities there is both individual- and area-specific poverty. Fifth is the global movement toward decentralization of governance, with decision making and resources shifting toward the local level. Each of these trends has implications for, and differential effects within, urban populations.

The increase of urban dwellers and growth of urban areas: In 2008, for the first time in human history, the majority of the world's population was living in urban centers. Virtually all population growth during the next 30 years is likely to occur in urban areas, as well. Projections indicate that by 2030, about 60% of humans will be urban dwellers, rising to about 75% by 2050.[6]

Megacities are a highly visible example of this trend. In 1975, only five cities worldwide had 10 million or more inhabitants; three were in low- and middle-income countries (LMICs; or "developing" countries). The number will increase to 23 by 2015,

and all but four will be in developing countries. The growth rate within megacities in the developing world will be much higher than in the developed world (e.g., anticipated growth, 2000–2015: Calcutta, 1.9% vs. New York City, 0.7%). UN-HABITAT estimates that by 2050, 86% of the population in more developed regions and 67% in less developed regions will live in urban areas.[7]

Although megacities are the most visible sites of urban concern and are concentrated in the world's largest economies, they represent only about 6% of the world's urban population. In the coming decades, urban growth is expected to take place more slowly in most megacities and faster in successful midsized cities.[6] While large cities in developing countries will account for 20% of the increase in the world's population between 2000 and 2015, small cities (fewer than 5 million residents) will account for 45% of this increase.[8] By 2015, an estimated 564 cities around the world will contain 1 million or more residents. Of these, 425 will be in developing countries. These projections highlight the importance of viewing urban health as an international and global issue.

As a result of the need to accommodate population growth, most new city growth is through horizontal expansion of small and midsized urban centers. At first glance, this trend might seem to mitigate risks associated with overcrowding, but in fact it brings its own health challenges. For example, horizontal growth may mean longer commutes, which present health risks related to sedentary lifestyles and increased traffic. It can threaten land needed for food and water supplies, with implications for sustainability. Such growth also generally calls for the spatial expansion of urban amenities and services, which may not be provided for economic and political reasons, thereby compounding poor health outcomes and health inequities within urban centers. Supporting the growth of healthy and sustainable cities represents a complex challenge.

To clarify, any discussion of urbanization needs to acknowledge that the practice of dichotomizing the world as "urban" and "rural" is problematic. While much of the discussion and policy making around urban health has been framed as aggregated urban vs. rural, this is misleading. In fact, people are tied together in many ways that ultimately undermine that distinction. In terms of migration patterns, while those living in rural areas usually migrate to urban areas, the reverse also occurs (as do rural–rural and urban–urban migrations). Loss of jobs in urban areas can be followed by migration to rural areas where living costs are lower. Circular, temporary migration also occurs, as well as border straddling (one foot in each area) and commuting. Migration can be stepwise for a family or kinship group. Reciprocal links between urban and rural can be maintained over time to maintain economic security. Rural demand for non-agricultural goods may further develop rural towns as marketplaces where half or more of rural income is from non-agricultural activities. In terms of monetary flows, remittances from urban to rural areas may significantly supplement food, consumer goods, health, and education, as well as enhance investment in local productive activities, although the literature is mixed on quantifying these relationships. In sum, the distinction between urban and rural can be fuzzy. As cities grow spatially, absorbing outlying areas, it will become more important to speak of urban zones or catchment areas. At its most basic level, "urban" is represented as a function of population size and density, and although precise definitions vary among countries, boundaries are more often defined politically than empirically.[9] As such, the more appropriate statement is not that more than half of the world's population is urban but that given the wide influence of urbanization, more than half of the world is urban.

Five Key Megatrends   Demographic shifts, globalization, climate change, inequities, and decentralization—all of these tend to originate in, proceed through, and generate effects on cities. They create environments that are complex both to understand and to

govern. A prominent feature of urban settings is that the disparities themselves are intensely local, with the rich living in penthouses and the poor on the street below. These megatrends operate differentially on the poor.

Demographic Shifts The growth of urban areas LMICs, where most of the growth is occurring, is the result of two factors: natural increase in population (excess of births over deaths) and migration to urban areas. The ratio of the two factors has been estimated at 60:40. The greater effect of natural growth reflects high birth rates and lower mortality in cities within LMICs. Despite the fact that urban settings provide more opportunity for female literacy and income-earning activities that can change the basis for valuation of women from childbearing and raising to contributing to family income, and despite the wider availability of contraception and family planning in cities, high birth rates persist in many cities within LMICs.

The growth of urban areas is typically attributed to rural–urban migration. Indeed, migration involves "push–pull" factors that can be economic, cultural, political, or environmentally based. Examples of factors that "push" people from rural areas include lack of economic opportunities, discrimination, political fears, natural disasters, and desertification. Examples of factors that "pull" people toward cities include economic opportunity, better educational prospects, and sometimes better living conditions. These movements occur between and within countries, predominantly within short distances. Migration can even take place in the form of daily commuting, which also has environmental and health implications. However, it is probably incorrect to say that urbanization is moving faster today or that migration is the primary cause of urbanization.

Two demographic trends have implications for urban health. First, the persistence of high birth rates raises concerns about the availability of, and access to, family planning services. Second, lower mortality rates lead to an aging population, with the number of people over 65 years old living in urban areas of LMICs estimated at over 1 billion, pointing to the importance of planning for age-friendly cities.

Globalization Globalization refers to processes that increase interdependence across borders. Although the phenomenon is not new, the pace and extent are. They are driven by advances in, and the spread of, technology; unprecedented flows of information; increased ability to travel; the migration of people, goods, and services; and the creation or destruction of jobs and economic opportunities. All of these are first apparent in cities and can result in conditions that are positive or negative for health.

On the positive side, globalization can make accessible new information and services that may enhance health. It can also create conditions in cities, whereby individuals and families can take advantage of economic development opportunities to increase their income, meet other entrepreneurs, or gain competitive advantage.

On the negative side, *violence* may become global. In cities with large poor populations, including immigrants, those who lack employment, appropriate housing, education, or health services might join the formal city if the rules were designed to include and benefit them. But where this is not the case, they build an informal economy with its own forms of advantage. If the informal economy is based on crime, violence may result. If cultural alienation is also significant, terrorism may arise, with violent results. "MS-13," a highly violent criminal gang with roots in El Salvador, matured in Los Angeles and has now spread to 42 states within the USA—an example of a criminal gang that has gone global.

Cities with dense populations and transportation hubs may also be vulnerable to emerging infectious diseases. An important example is SARS, a novel organism

that entered Hong Kong and not only caused an epidemic there but also traveled to Toronto, initiating a subsequent epidemic.

Climate Change A third 21st-century megatrend is human-induced climate change.[10] The consequences of climate change are already evident across the globe. Extreme weather incidents will cause droughts that can lead to more limited water and food supplies.[11] Alternatively, extreme weather events can also manifest as floods, typhoons, or hurricanes. Cities are frequently situated on coasts and rivers, where they are vulnerable to climate-related changes in the form of rising sea levels, storm surges, and flooding. Damaging health impacts of floods include drowning, injuries, and disruptions of health services.[12] Floods, along with ground saturation, erosion, and deforestation, can lead to landslides, which block roads and damage houses, as well as electricity and water supplies. The most vulnerable will be poor people and people with preexisting chronic diseases or disabilities. In New Orleans, the effects of flooding on poor people who lacked transport for evacuation showed what may occur in affected urban areas.[13] Changes in temperature and humidity can also affect the distribution of infectious diseases. Mental health stress is another consequence of climate-related events, especially those that force population displacement.

The effects of climate change go beyond deaths due to drought, floods, and windy typhoons, to include temperature-related deaths. The impact of a global temperature increase is magnified in cities as the densely built urban environment often creates and sustains a "heat island" effect, where temperatures can be 3–4°C higher than in adjacent rural areas. As noted by Kjellstrom and Monge,[14] increased mortality during heat waves has been reported by many cities in the USA,[15] in Europe, and in developing countries. In France, 15,000 people died during the 2-week heat wave of 2003,[16] and a similar number died in other countries of central and southern Europe. Extreme heat mortality is primarily an effect of overload on the cardiovascular system due to physiologic reactions to heat exposure.[17] In addition, acute hospital admissions and emergency ambulance transport for heart disease, asthma, and acute kidney diseases increased;[18–20] One effect of increasing temperatures in cities is an increasing level of ground-level ozone due to motor vehicle emission interactions with solar ultraviolet radiation;[21] furthermore, ozone formation is both faster and greater when air temperature increases. Ozone increases the incidence and mortality of heart and lung diseases and causes respiratory distress symptoms.[22]

Health Inequalities and Inequities in Cities Health inequalities refers to differences or disparities between groups. The related term health inequities refers to inequalities that can be corrected but are allowed to stand because of distorted power and decision-making arrangements. The current approach to prioritization of public health actions has been away from targeting those at highest risk toward improving the health of all residents, i.e., the Rose hypothesis.[23] More recently, however, this "lift all boats" approach has been viewed as possibly widening disparities where greater access and utilization of innovations can be, or is, accessed earlier among the wealthy than among the poor. Additional efforts are needed to address the inequities that preserve inequalities in environment and health status.

Although it is generally understood that city dwellers, on average, enjoy better health than their rural counterparts, this may reflect the practice of aggregating data that provide an average of all urban residents—rich and poor—rather than disaggregating data by people (e.g., population groups defined by socioeconomic status, race or ethnicity, gender, or migration status) or place (e.g., slum vs. non-slum neighborhoods). In developing

countries, for example, slums without legal status are often overlooked in official reports used for projecting services within cities; therefore, the slum populations are frequently undercounted and often uncounted, distorting the urban average. As a result, the different worlds of city dwellers and the substantial health challenges of the urban poor go overlooked. These differences in health outcomes within urban areas, disaggregated by absolute or relative poverty, are seen worldwide and for a wide variety of health outcomes. Likewise, differences in health outcomes are seen by geographic-area-specific levels of infrastructure and services within cities. A child who lives in a slum in Kenya is far more likely to die before the age of five than is his or her compatriot in another part of the city or in rural Kenya.[1,2] One notable study reported that the life expectancy of black men in Harlem, an urban area of concentrated disadvantage in New York City, was lower than that among men in Bangladesh.[3,4] An oft-quoted study from Glasgow showed dramatic differences in life expectancy by neighborhood.[5]

Some articles suggest that inequalities in cities are rising. The UN-HABITAT Report *Harmonious Cities* (2009) provided comparisons over time of the Gini coefficient (a measure of income inequality expressed as a ratio where a value above 0.4 indicates high inequality) from 120 large cities across the globe, derived from Global Urban Observatory (GUO) data. While trends of inequalities across regions and over time were variable and difficult to generalize, Gini coefficient values indicating extreme inequality (>0.4) were not uncommon. The argument that inequalities are increasing might be based on the projections that much of the population growth by 2030 is expected to be slum dwellers in LMICs, resulting in "poverty becoming urbanized."

Further complicating the measurement of inequities is the spatial distribution of the poor. As Montgomery notes, although individual and spatial data may overlap, there are poor people who do not live in areas of concentrated disadvantage (i.e., slums or informal settlements) and slums contain not only poor people. This tends to muddy what might be categorizations, complicating efforts to uncover urban health inequities. In Belo Horizonte, Brazil, the municipal government attempted to define Planning Units so as to be homogenous with respect to poverty indicators,[24,25] but over time, the composition of these units may change as a result of development and migration. All of this is to say that subsequent discussion of urban or intra-urban spatial distinctions are a shorthand about clustering environment when in fact, municipal leaders and civil society need to take a more nuanced approach to refine local assessment and on-the-ground action.

Decentralization Decentralization is the devolution by central (i.e., national) governments of specific functions, with all of the administrative, political, and economic attributes they entail, to local (i.e., municipal) governments that are independent of the center within a legally delimited geographic and functional domain. The trade-off is between local government's knowledge of local needs and central government's technical and organizational advantage in providing public services to districts with heterogeneous preferences.[26]

The argument for decentralization is that democracy is important for economic growth. Local governance is increasingly recognized as the basic unit of democratic governance as it provides an environment in which decision making and service delivery are brought closer to the people, in line with local preferences and conditions. Decentralization tends to enhance transparency and accountability, which addresses concerns about opaque and corrupt national governments. Decentralization has been tied to increases in effectiveness of service delivery, early warnings of potential disasters, encouraging communities to find their own solutions that are tied to local conditions, and increasing participation in health care processes, particularly among marginalized groups. It can make development projects more sustainable and cost-effective as local

populations are involved at all levels, from design and implementation to monitoring and evaluation.

Several conditions are important if decentralization is to occur.[27] First, decentralization must be understood not as a complete transfer of national to local authorities, but as a greater coordination and regulation between levels of government, with adequate financial resources to support process. Second, appropriateness of functions to be decentralized, adequacy of fiscal resources to be transferred to local governments, adequate legal frameworks, and sufficiency of technical and skilled staff at all levels of government are needed for decentralization to work. Likewise, to prevent decentralization efforts from being hijacked by local elites, there need to be broad-based participation at the state level and a mobilized civil society.

A major impediment has been those politicians who show a lack of willingness to relinquish or share power. While legislative changes are crucial to the process of decentralization, the inability to make the transition to people-centered governance, with its implications for participation and empowerment, is perhaps a bigger problem. As national governments become financially strapped, they may transfer responsibilities to local settings without the requisite financial and technical resources; this can undermine the benefits of decentralization. The absence of public awareness and of a culture of participation, as well as the weak "voice" of poor and marginalized sections of the population, inhibit the development of effective decentralization. This sets up a decision-making process dominated by local elites and government officials.

One issue is how to measure the impact of decentralization. At its most basic, it is evaluated by observing the quantity and quality of public services and how they relate to socioeconomic development.[28]

Health Issues in Cities   Much of the above discussion of urban health issues could be viewed as relevant to rural settings: the impact of globalization, climate change, inequities, and decentralization. With urban as the predominant mode of living, are there in fact health issues that are unique to, or predominant in, urban settings? First, no uniquely urban diseases come to mind, so any attempt to detail the extensive literature on health metrics for specific disease outcomes would be unsatisfying and distract from the point of this report, namely, to acknowledge and measure the urban environment. Second, although a number of outcomes, such as violence and pedestrian injuries, are more frequently found in urban environments (though they are by no means unique to cities), the measure of, and action on, environments that contribute to these outcomes are underdeveloped and barely analyzed. Perhaps as important is the recognition that poverty, which is becoming urbanized, is associated with worse health outcomes and that how poverty plays out in urban areas differs in many respects from how it plays out in rural counterparts. As Baharoglu and Kessides noted in their analysis of poverty, there is a subset of characteristics that are more pronounced for the poor in urban areas and may require specific analysis: commoditization (reliance on the cash economy); overcrowded living conditions (slums); environmental hazards (stemming from density and hazardous location of settlements, as well as exposure to multiple pollutants); social fragmentation (lack of community and inter-household mechanisms for health security); crime and violence; traffic accidents; and natural disasters.[29] These factors have been presented in different ways, including academic conceptual frameworks for urban health, and are consistent with recent reports from international agencies on addressing the urban setting, especially among the poor in developing countries, to promote good urban management and population health.

The Context of the Report: Reports from the United Nations and Other Bodies Point to the Need to Address Inequities Through the Determinants of Health and to Recognize Urban Settings as a Determinant of Health

In the past five years, reports issued through prominent international agencies and organizations have drawn attention to health inequalities and indicated the importance of addressing inequities in urban settings. These include *Century of the City* (2007) from the Rockefeller Foundation and *Closing the Gap in a Generation* (2008) from the World Health Organization's (WHO's) Commission on Social Determinants of Health (CSDH), which included input from the Knowledge Network on Urban Settings (KNUS). The reports highlighted the statistic that in 2008, for the first time in history, half of the world had become urban. They also underlined the importance of both health and environmental inequities in urban settings.

These two reports were precursors to other reports that delved deeper into the importance of considering the urban environment in addressing health inequities. Examples of the latter include the Global Research Network for Urban Health Equity's (GRNUHE's) *Improving Urban Health Equity through Action on the Social and Environmental Determinants of Health (*2010) and the WHO and UN-HABITAT joint report *Hidden Cities: Unmasking and Overcoming Health Inequities in Urban Settings* (2010), which included the WHO Health Equity Assessment and Response Tool (HEART).

In parallel to these reports, other UN agencies spoke to the impact of urbanization in the 21st century. These included UN-HABITAT's *State of the World's Cities 2008/2009—Harmonious Cities* and the United Nations Population Fund's *State of the World Population 2007: Unleashing the Potential of Urban Growth* (2007).

In passing, we also note earlier reports from the National Research Council (*Cities Transformed* in 2003) and the World Bank (*Analyzing Urban Poverty: A Summary of Methods and Approaches* in 2004), both of which provide summaries and recommendations about urban health methods and metrics that are particularly relevant here.

The message in these reports is that the urban setting is becoming increasingly relevant in public health; that health inequities need to be uncovered and addressed, requiring disaggregation of data at the intra-urban level; and that entire domains of measurement are underdeveloped to accomplish this.

The reports are discussed briefly below; the reader is encouraged to examine them in full.

Closing the Gap in a Generation,[30] *the WHO CSDH, 2008*   Taking the language of the report, social determinants of health (SDH) are defined as the conditions, including the health system, in which people are born, grow, live, work, and age. These circumstances are shaped by the distribution of money, power, and resources at global, national, and local levels. These in turn are influenced by policy choices. SDH are mostly responsible for health inequities—the unfair and avoidable differences in health status seen within and between countries.

Responding to increasing concern about these persisting and widening inequities, the WHO established the CSDH in 2005 to provide advice on how to reduce them. The commission's final report, released in August 2008, contained three overarching recommendations: (1) improve daily living conditions; (2) tackle the inequitable distribution of power, money, and resources; and (3) measure and understand the problem and assess the impact of action. Rather than summarize the full range of recommendations, we highlight several.

Under the recommendation to improve daily living conditions, the topics call for improving lives from the start, creating healthy places, fair employment and decent work, social protection throughout life, and universal health coverage. Under the rubric of "Healthy Places, Healthy People" (the title and content draw heavily from the work of the KNUS), the report states,

> Where people live affects their health and chances of leading flourishing lives. The year 2007 saw, for the first time, the majority of human beings living in urban settings. Almost 1 billion live in slums....The daily conditions in which people live have a strong influence on health equity. Access to quality housing and shelter and clean water and sanitation are human rights and basic needs for healthy living. The Commission calls for: greater availability of affordable housing by investing in urban slum upgrading including, as a priority, provision of water, sanitation and electricity; healthy and safe behaviors to be promoted equitably, including promotion of physical activity, encouraging healthy eating and reducing violence and crime through good environmental design and regulatory controls, including control of alcohol outlets; sustained investment in rural development; and economic and social policy responses to climate change and other environmental degradation that take into account health equity.[30(p4)]

The commission's second recommendation calls for "health equity to become a marker of government performance."[30(p11)] and for the UN "to adopt health equity as a core global development goal and use a social determinants of health indicators framework to monitor progress."[30(p19)]

The third recommendation notes that "Action on the social determinants of health will be more effective if basic data systems, including vital registration and routine monitoring of health inequity and the social determinants of health, are put in place so that more effective policies, systems and programs can be developed. Education and training for relevant professionals is vital."[30(p20)]

These recommendations are framed as needing support and action across the board—from global institutions and agencies, governments themselves (national and local), civil society, research and academic communities, and the private sector. The recommendations to national and local governments include "policy coherence across government; strengthening action for equity and finance; and measurement, evaluation, and training" for civil society, including participation in policy, planning, and programs, as well as evaluation and monitoring of performance. Recommended actions for research institutions include generating and disseminating evidence on SDH.

Although not explicit, the report calls for the generation, availability, and analysis of data at a sufficiently granular level to address the health inequities raised.

Improving Urban Health Equity through Action on the Social and Environmental Determinants of Health,[31] *GRNUHE, Rockefeller Foundation, 2010* The Rockefeller Foundation funded the establishment of GRNUHE in 2009 to build on the WHO CSDH report by further articulating and developing the third recommendation, on building the research base through summarizing the evidence for action on SDH, particularly in LMICs. The network comprised researchers predominantly from LMICs, but also key urban health researchers from high-income countries, urban

planning departments nongovernment organizations (NGOs), and international development agencies.

The aims of GRNUHE were fivefold: (1) to provide an opportunity to utilize the existing global evidence in countries too often under-resourced in terms of evidence and capacity; (2) to develop both a suitable intellectual framework and a methodological approach to undertake urban health equity research in LMICs; (3) to support the expansion of evidence in key areas relevant to the emerging health and social issues in contextually different corners of the world; (4) to provide global leadership in urban health equity that combines research, training, and policy expertise within a multi-sectoral, interdisciplinary, collaborative framework; and (5) to develop a practical suite of collaborative action-oriented research projects in urban health equity.

GRNUHE framed four areas for investigation and in the process sought to answer the questions of: (1) how to put health equity at the heart of urban planning and design; (2) how to ensure urban social conditions that promote health equity; (3) how to consider the added pressure of climate change on urban health inequities; and (4) how to put health equity at the heart of urban governance. GRNUHE identified five overarching research areas: (1) the social epidemiology of urban health inequities; (2) retrospective health equity evaluation; (3) prospective action-oriented applied research—designing healthy and inclusive urban settings; (4) understanding the role of external pressures on urban health inequity; and (5) knowledge translation, i.e., knowledge to action.

The GRNUHE report noted that "this type of research is partly dependent on the quality of existing information systems and should interact with ongoing initiatives in this area, such as Urban HEART, RULER, and UN-HABITAT's monitoring program, otherwise population surveys will be needed."[31(p72)] In summary, this report was framed as a review of the existing literature, formulation of a conceptual framework, and a proposed set of research topic areas. In summary, the report extended the concepts and recommendations of the WHO CSDH report, with a thrust to further articulate the factors that generate and maintain health equities.

Hidden Cities,[32] *the WHO and UN-HABITAT, 2010*   The WHO proclaimed 2010 as the "Year of Urban Health," marked on April 7th—World Health Day—and culminating in the release of the *Hidden Cities* report, jointly authored with UN-HABITAT, at the Global Forum on Urbanization and Health held in Kobe, Japan. The report extended the work of the WHO CSDH and the KNUS, articulating the health inequalities within urban areas. It emphatically states that "No city—large or small, rich or poor, east or west, north or south—has been shown to be immune to the problem of health inequity." The report notes that systematic differences in health are not distributed randomly but show a consistent pattern across the population. One of the most striking examples is the systematic differences in health between different socioeconomic groups, a difference that is not biologically determined but produced largely by social circumstances. If existing social and economic policies maintain these gaps, they must be recognized as inequitable and changed to reduce inequities.

Most relevant is the extension of the inequity discourse into content related to urban health metrics. The report notes:

> Understanding urban health begins with knowing which city dwellers are affected by which health issues, and why. To achieve this understanding, available information must be disaggregated according to defining character-istics of city dwellers, such as their socioeconomic status or place of residence.

Turning the spotlight on the information in this way will provide a better understanding of what the problems are, where they lie and how best to address them. Disaggregated data invariably reveal urban health inequities, which are defined as health inequalities that are systematic, socially produced (and therefore modifiable) and unfair. Health inequities are the result of the circumstances in which people grow, live, work and age, and the health systems they can access, which in turn are shaped by broader political, social and economic forces. They are not distributed randomly, but rather show a consistent pattern across the population, often by socioeconomic status or geographical location. No city—large or small, rich or poor, east or west, north or south—has been shown to be immune to the problem of health inequity.[32(pxii)]

The *Hidden Cities* report extends the WHO CSDH and GRNUHE reports to make the connection that uncovering health inequities within cities requires disaggregated data.

It states,

The starting point is a clear picture of the health issues and their determinants within the city. Disaggregated data should be used; depending on the specific context, data can be disaggregated into male versus female, age groups, geographic areas or locale with the city, and socioeconomic groups. Once information is assembled, it can be organized to identify the population subgroups and health issues that reveal the greatest urban health inequities.[32(pxv)]

While the report raises the importance of disaggregated data, it limits discussion to demographics and "geographical areas or locale in the city,"[32(p83)] leaving the reader to recognize its importance, without much guidance on measuring place.

At the core of the *Hidden Cities* report is the section on the development and testing of indicators for measuring health inequity that were assembled as Urban HEART. This instrument provides a set of indicators that cover important content areas including health; physical, social, economic, and service environments; and governance. These content areas with their indicators are shown in Figure 1.

The Urban HEART team selected these indicator measures carefully. Although the indicators are arguable (as with any tool or index), the developers make a point of having used explicit criteria. Five key criteria were used to identify core indicators: availability of data, strength of indicator to measure inequalities, coverage of a broad spectrum of issues, comparability and universality of indicator, and availability of indicator in other key urban and health tools. The first and last points are noteworthy in that Urban HEART was not conceived as involving fresh data collection, but as analyzing available data. As the report notes, the goal of implementing Urban HEART is to equip policymakers with the necessary evidence and strategies to reduce inter- and intra-city health inequities. Urban HEART has four characteristics desirable in such a tool: (1) it is easy to use; (2) it is comprehensive and inclusive; (3) it is operationally feasible and sustainable; and (4) it links evidence to actions.

Likewise, it notes key issues to consider while abstracting data, namely, disaggregation ("stratified by sex, age, socioeconomic status, major geographical or administrative region and ethnicity, as appropriate");[32(p83)] validation using standard reliable sources and vetted by national authorities and experts; consistency of data across time; and

#	DOMAIN / INDICATOR	DEFINITION
HEALTH OUTCOMES		
1.	Infant mortality	The number of infant deaths between birth and exactly one year of age, expressed as a rate per 1,000 live births
2.	Diabetes prevalence and death	Diabetes prevalence and death rates per 100,000 population (age-standardized)
3.	A. Tuberculosis treatment success B. Tuberculosis prevalence and death	A. Proportion of tuberculosis cases detected and cured under directly observed treatment, short course (DOTS) B. Prevalence and death rates associated with tuberculosis
4.	Road traffic injuries	Road traffic death rate per 100,000 population
PHYSICAL ENVIRONMENT AND INFRASTRUCTURE		
5.	Access to safe water	Percentage of population with sustainable access to an improved water source
6.	Access to improved sanitation	Percentage of population with access to improved sanitation
SOCIAL AND HUMAN DEVELOPMENT		
7.	Completion of primary education	Percentage of population having completed primary education
8.	Skilled birth attendance	Proportion of births attended by skilled health personnel
9.	Fully immunized children	Percentage of fully immunized children
10.	Prevalence of tobacco smoking	Percentage of population who currently smoke cigarettes and other tobacco products
ECONOMICS		
11.	Unemployment	Percentage of population who are currently unemployed
GOVERNANCE		
12.	Government spending on health	Percentage of local government spending allocated to health

FIGURE 1.   Content indicators for HEART Instrument, the WHO, 2010.

representativeness of the population and subpopulations. Related issues include confidentiality, data security, and data accessibility.

An intriguing feature of Urban HEART is the extension of the data into a visual matrix, with indicators listed in vertical rows by calendar time or by geographical area using traffic light colors (i.e., green, yellow, and red) to indicate performance level. This striking visual is designed to provide urban managers with an overview of areas where priorities might be set, as well as where goals have been achieved.

In terms of feasibility and refinement of the instrument, although the report does not explicitly address the "how to" for resource-poor settings, it does note that since the 2008

launch of the pilot program, Urban HEART has been pilot tested in cities in Brazil, Indonesia, the Islamic Republic of Iran, Kenya, Malaysia, Mexico, Mongolia, Philippines, Sri Lanka, and Vietnam.

In summary, the *Hidden Cities* report and the Urban HEART instrument extend the work of the WHO CSDH and GRNUHE in articulating the importance of disaggregation at the level of the individual (e.g., demographics) and of place to uncover health inequities along the lines of SDH. The Urban HEART tool provides a feasible and accessible tool that incorporates a range of actionable determinants. The report uses broad brush strokes in encouraging disaggregation by place, referring to some places as major geographical or administrative regions,[32(p14)] others as "locales," and yet others as "intra-urban." However, the main contribution of Urban HEART is the presentation of a limited range of indicators selected for their salience to SDH, as well as the pilot testing to demonstrate feasibility.

Harmonious Cities 2008/2009 UN-HABITAT[7] An important claim for turning our attention to urban settings is the growth of inequities. Some existing data show wide intra-urban disparities, with health outcomes in slums worse than in rural areas (the piece on health inequities in the previous section). As noted above, the UN-HABITAT State of the *State of the World's Cities 2008/2009—Harmonious Cities*, provided a narrative summary of their 120-city survey from existing data in countries worldwide. The report noted considerable variation in the degree of inequity between cities, as measured using the Gini coefficient. For cities that provide data over time, the report notes examples of increasing inequality, although the trends are neither linear nor consistent between cities or regions, suggesting considerable variation over time and place.[7(pp72–74)] The use of the Gini coefficient does not indicate whether the inequality is due to the rich getting richer, the poor getting poorer, or both; the latter is typically assumed to be the case. Most relevant here is the presence of data at the local level, although limited to large cities with available data. However, spatial data at an intra-urban level are not presented in this report. The data come from the UN Global Urban Observatory and the Monitoring Urban Inequities programs.

State of the World Population 2007: Unleashing the Potential of Urban Growth, 2007 UNFPA[33] Although this report is elegantly constructed and expressive on the challenges of, and responses to, increasing urbanization, the attention to metrics is summed up in the conclusion with "international organizations can help policymakers and the different segments of civil society make better decisions regarding the urban future by encouraging them to generate and use solid sociodemographic information."[33(p69)] Therefore, it is noted here only in passing.

Analyzing Urban Poverty: A Summary of Methods and Approaches, 2004 World Bank Report[34] This report provides a state-of-the-art summary of methods for analyzing urban poverty. It summarizes urban issues; definitions and indicators of poverty; the location of the poor using mapping and GIS; measures of access and accessibility using existing data sources; strategies for urban poverty analysis, including statement of purpose, service delivery, and city budgeting; and policy and project monitoring. The report also summarizes data sources for urban poverty analysis, including the population census, administrative data across sectors, household surveys, and participatory assessments. It concludes with a rich array of

case studies that illustrate urban poverty analysis in practice. Although the report refers to the importance of spatial disaggregation through mapping, its presentation on such tools as GIS is cursory.

Cities Transformed, 2003 NRC[35] The *Cities Transformed: Demographic Change and Its Implications in the Developing World* report of the National Research Council (NRC), National Academy of Sciences (US) provides a comprehensive summary and new interpretation of the data and analyses of urban demography. The panel concentrated on six areas: urban population dynamics and city growth, social and economic differentiation within and across cities, fertility and reproductive health in urban areas, mortality and morbidity in urban areas, labor force implications of a changing urban economy, and the challenge of urban governance.

Of particular relevance to this report was the need for granular data. It notes, "What is needed now is a new emphasis on inter- and intra-urban differentials, and these are topics to which demographers have paid remarkably little attention. The neglect of intra-urban research on developing countries is all the more surprising in view of the close attention given to neighborhood effects and other intra-urban issues in research on cities in the United States."[35(p2)] The panel recommended that "governments focus attention on inter- and intra-urban differences when designing health services for cities (recognizing that this will require better data and research) and adapt existing services and programs to address emerging health threats."[35(p6)]

In terms of spatially disaggregated data, the report notes that "remotely sensed and geocoded data hold some promise for measuring the spatial extent of cities and certain aspects of urban change, but these are costly and difficult technologies."[35(p8)] These technologies have become more accessible since this landmark study was published. Likewise, the report also notes that in a number of LMICs, census data, while available, were rarely processed at the level of a local areal unit, further limiting the ability to examine intra-urban social and economic differentials that can support local policy, planning, and investment decisions.

In summary, addressing health inequities in urban settings is a global priority. To detect, address, and monitor inequities, the reports discussed above raise, if not emphasize, the importance of disaggregated data at the intra-urban level. They also raise key concepts to measure, including geography, climate, physical (including food) security, social, and service environments, and governance. This report builds upon and extends these views
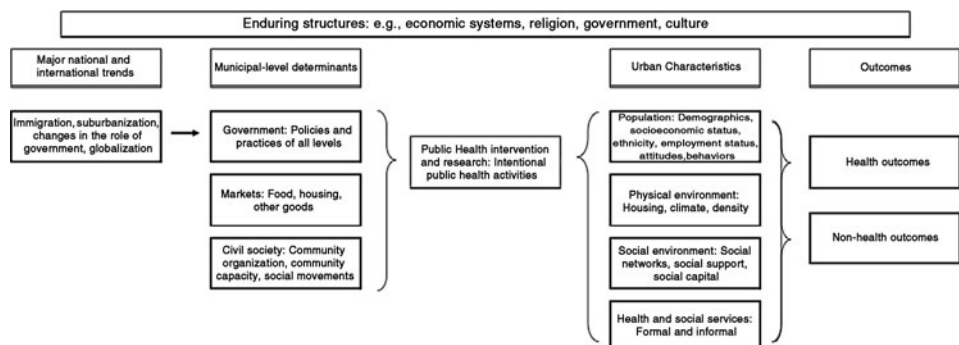

FIGURE 2. Conceptual framework for urban health.

and findings to articulate recommendations for stakeholders committed to public health in the international, national, local, civil society, and donor sectors.

Academic Models   In addition to the presentations from international agencies and nonprofit organizations, there has been a long tradition of conceptualizing in the academic community. Conceptual frameworks for urban health abound. As the published frameworks overlap, for simplicity, we start with the model proposed by Galea, Freudenberg, and Vlahov (see Figure 2).[36]

Briefly, the framework shows that health (and non-health) outcomes are influenced by "living conditions," which include the physical, social, and natural environments, as well as health and social services. These in turn are influenced by local factors, i.e., municipal-level determinants, which include features of the local government, markets, and civil society. Finally, these in turn are influenced by national and international trends. Enduring structures capture the essence that cities exist in different contextual settings, which shape the dynamics of these other influences. Taken together, urban settings can be a determinant of health. However, while the above framework suggests what to measure, it does not explicitly lead us toward generating and accessing disaggregated data to depict and address inequities within this group of concepts. In fact, few reports other than the current one have disaggregation as their raison d'être. Disaggregation is addressed in the next section.

PART II: DISAGGREGATION TO UNCOVER AND ADDRESS HEALTH INEQUITIES IN URBAN SETTINGS

Disaggregation of Local Data is Absolutely Necessary to Uncover and Address Health Inequities

Although it is generally understood that city dwellers, on average, enjoy better health than their rural counterparts, this may reflect the practice of aggregating data that provide an average of all urban residents—rich and poor—rather than disaggregating data by people (e.g., by population groups defined by socioeconomic status, race or ethnicity, gender, and migration status) or place (e.g., by slum vs. non-slum or by neighborhood). Disaggregation by individual characteristics includes measures of poverty. The extensive literature on measuring poverty is well beyond the scope of this report and is described elsewhere.[37] More attention is now being directed toward capturing spatial data that can then be disaggregated for policy and program planning. In developing countries, for example, slums without legal status are often overlooked in official reports used for projecting services within cities; slum populations are therefore frequently uncounted, distorting the urban average. As a result, the different worlds of city dwellers and the substantial health challenges of the urban poor go overlooked. These differences in health outcomes within urban areas disaggregated by absolute or relative poverty are seen worldwide, and for a wide variety of health outcomes. Likewise, differences in health outcomes are seen by geographic area—at specific levels of infrastructure and services within cities. A child who lives in a slum in Kenya is far more likely to die before the age of five than is his or her compatriot in another part of city or in rural Kenya.[1,2] One notable study reported that the life expectancy of black men in Harlem, an area of concentrated disadvantage in New York City, was lower than that among men in

Bangladesh.[3,4] An oft-quoted study from Glasgow showed dramatic differences in life expectancy by neighborhood.[5]

Individual and Spatial Data are Already Available in Low-Resource Settings to Generate Disaggregated Data at the Intra-urban Level

As noted above, although health outcomes on average are better in urban than in rural settings, socioeconomic, and especially spatial, data, where available, have determined that areas of concentrated disadvantage have poor health outcomes, sometimes worse than those in rural areas. Disaggregated data serve to identify inequities and to provide the basis for informed decision making. They are necessary in the context of decentralization, where decision making and resources operate at the local level. Data from low-resource settings can be used to generate disaggregated data at the intra-urban level. Although such data may be inaccessible for a variety of technical and political reasons, there are examples of low-resource settings where such obstacles have been overcome.

Individual-Level Data from the Census, Administrative Data Sources, Surveys, and Other Sources   Excepting periods of conflict, most countries conduct a population census every 10 years. In addition, cities typically have multiple other, frequently uncatalogued, data sources.

Census The population census contains basic information about all citizens in a country. Although usually conducted only once a decade, the census may provide valuable information about housing and basic service access, education levels, and employment. While the number of variables is limited and the interval between collections is long, the major advantage is that such data are highly granular and include variables, however limited, on the urban environment. Since the census is by definition a counting of everyone, the data can be disaggregated to city, municipal, and neighborhood levels. Simple indices based on these data have been developed and used in practice (e.g., Unsatisfied Basic Needs).[38]

A repository of census instruments can be obtained from the Integrated Public Use Microdata Series (IPUMS) International at the University of Minnesota Population Center.[135] That site also includes "microdata" (subsamples) of information from the censuses of 44 countries, representing 130 individual censuses with 279 million person records, which were obtained and organized by IPUMS. In 2010, 11 countries were added, and after 2010, at least 23 countries will be added. Of the 44 countries so far available, Appendix 1 (http://rfruler.org) shows the variables from the latest available census (mostly from 1999 to 2001) of 12 countries representing the various continents: Argentina, Brazil, Canada, China, Egypt, India, Kenya, Mexico, South Africa, UK, USA, and Vietnam. Appendix 2 (http://rfruler.org) provides copies of the instruments used in the respective most recent country censuses. They include information on a broad range of population characteristics, including ethnicity, migration, labor force participation, occupational structure, education, life course transitions, nuptiality, fertility, and household composition. Household data include migration status, economics, geography, group quarters, dwelling characteristics, household construction, utilities, and appliances. The information available in each sample varies according to the questions asked that year and by differences in post-enumeration processing.

The census is appealing for a number of reasons. Simply told, census data are widely used, can generally be disaggregated to levels that allow for analysis of intra-urban disparities, and can serve as an important check on how representative other surveys are.

Census data do not come without limitations. To offset expense and flagging interest of residents, they are performed infrequently and are limited in the number of variables that can be collected. These make the data less informative, especially in rapidly changing areas. Also, it can be difficult for a census to identify, reach, and interview a mobile population that may include pavement dwellers, street children, internally displaced populations, and people living in and adjacent to slums. Methods such as ethnographic mapping and respondent-driven sampling (for more detail, see http://www.respondentdrivensampling.org), which have been used efficiently in hidden and mobile populations, can complement census activities. All told, the census is one of the most powerful policy tools available for tracking shifts in population demographics and health status and for facilitating the planning of services and resource allocation.

Institution-Based Administrative Data Institution-based administrative sources can provide a wealth of data relevant to urban health.[39,40] Not confined to the health sector, these include data such as tax revenue by source, services delivered, resources allocated and spent, commodities provided, the quality and accessibility of services, details about the existence and quality of infrastructure, human resources and work force information, civil registrations (e.g., births and marriages), and vital statistics. However, these data can be difficult to access and integrate horizontally. Many local authorities collect significant amounts of information about their cities, but often that information is gathered and stored in ways that make them difficult to access or use. Even if accessible, a person from the health sector may have problems getting those working in sanitation or environmental protection to share their records. In addition to issues of proprietorship, different sectors often operate under different regulations and mandates, making them reluctant to share data. Moreover, some sectors may feel that contributing data that will be used to measure urban health will make them responsible for a problem over which they do not want ownership. Finally, because these data are not generally collected with urban health in mind, they are often collected in administrative units of the governing agency, making them impossible to correlate with health outcomes. They also contain built-in biases, such as eligibility criteria and how outcomes are defined. Generally, the chief elected official with authority over multiple agencies needs to facilitate access to data by multiple sectors and to make clear that urban health is a multi-sectoral priority and responsibility. Vertical integration raises many of the same problems, with the additional complication of double counting. Administrative responsibility for urban health often falls in the gaps between the municipal, regional, and federal government.[41] Finally, changes in political power often mean sweeping changes in government programs, posing further difficulties with data continuity.

Cross-national surveys include such instruments as the Demographic and Health Survey (DHS), the Multiple Indicator Cluster Survey (MICS) and the Living Standard and Measurement Survey (LSMS) (Appendix 3; http://rfruler.org). These large-scale, population-based surveys capture information on individuals and households, including data on infrastructure and amenities that are more detailed than those provided by the census. They are a primary source of information where the census is either unavailable or not done (e.g., in post-conflict states). Some countries also conduct national surveys (examples from 12 countries appear in Appendix 3). There are also city-level data (e.g., the New York City Housing and Vacancy Survey, done every 3 years); those identified are in Appendix 4 (http://

rfruler.org). Typically, these are insufficiently granular to uncover and address intra-urban inequities. However, in wealthier countries, some cities do perform local or city-level household surveys.

The Urban Inequities Survey In 2003, UN-HABITAT initiated Urban Inequities Surveys (UIS) that address urban-specific issues. UIS is a sample survey consisting of three instruments: household, women, and community questionnaires. It is carried out within cities where the sample size varies between 1,000 and 4,000 households, selected according to the principles of probability sampling, which implies the enlisting and mapping of the total universe within the city. Since the initiation of the UIS goes back to the monitoring needs for the Habitat Agenda, and the other Millennium Development Goals (MDG) indicators, the survey questionnaire covers related thematic areas such as secure of tenure, water, sanitation, transportation, energy, crime and violence, accident, employment, climate change, municipal finances, housing rights, and gender, as well as health and social and economic variables. UISs have been conducted in large cities, Addis Ababa, Lagos, Casablanca, Cairo, and São Paolo, as well as in 17 secondary cities of Lake Victoria. UN-HABITAT is presently conducting UIS in two cities: Mwanza (Tanzania) and Kisumu (Kenya).

Spatial Data in the Form of Mapping, Remote Sensing, Geographic Information Systems Spatial information can be gathered with traditional mapping, GIS, and remote sensing techniques (e.g., Landsat satellite imagery) using both daytime and nighttime visualization. Most of these techniques have become more widely available and affordable. Such data need to be joined with census data, which can provide information at a finely granular level. This section reviews remote GIS, sensing techniques, and data sources such as the census, which can provide highly disaggregated data for uncovering health inequities.

Maps and Other Visual Tools The effectiveness of all data collection, processing, analysis, and use for policy recommendations lies in how the results are communicated to policymakers. Maps, GIS, and other visual tools are especially potent tools in documenting, understanding, and advocating for urban health. They compel attention, and their implications are easily grasped by politicians, policymakers, and journalists. They also invite criticism and spark debate, helping to develop local knowledge.

   Visual tools, such as maps that meaningfully present data, have supported action in public health, including urban health, for more than 150 years. One of the earliest uses of mapping for public health action (in fact, in the area of urban health) is John Snow's depiction of a cholera outbreak in London in 1854. By plotting the distribution of cholera deaths in London, Snow was able to identify the heart of the outbreak—the Broad Street Pump. The outbreak was famously terminated by the act of Snow's disconnecting the pump handle.

Geographic Information Systems GIS is an established technology that enables the user to assign spatial coordinates to data that can then be mapped. One of the most important features of GIS is its ability to integrate spatial with non-spatial information. GIS allows the user to capture, process, analyze, understand, and interpret geographical information—in the form of maps, data, charts, and reports—so as to expose relationships, patterns, and trends.[42] It is used to conduct analyses ranging from simple data plotting (a la John Snow's placing of dots on a map to indicate residences of cholera cases) to sophisticated spatial correlation analyses. In public health, GIS can be used to determine the catchment

area of health facilities not only by using distance as a parameter but also by considering multiple geographical variables, such as available public transport. GIS is especially attractive for urban management as it permits simultaneous depiction of variables that can incorporate data from multiple sectors (e.g., health, transportation, housing, and law enforcement), enabling urban managers to visualize urban systems and more intelligently plan policies and programs.

Remote Sensing Technology Remote sensing technology entails the use of satellite-based information. Satellite imagery enhances accuracy in spatial data collection, making it particularly effective in health policy planning at smaller geographical levels, such as the local community;[43,44] Although the global positioning system (GPS) is commonly used in surveying, tracking, and other data collection processes, it is important to keep in mind its 5- to 12-m spatial distortion. Such spatial distortion is acceptable for regional analysis, but not at the local or community level. Currently, 0.4-m resolution satellite imagery is commercially available. This allows detection of urban health facilities, pollution sources, and so on and can be useful to monitor such phenomena as disease outbreaks.

Remote sensing and GIS enable deeper analysis than does simple digital cartography. Indeed, geospatial analysis could potentially be used for early problem detection and comparison of possible solutions. For example, UN-HABITAT has recognized the value of using remote sensing for synoptic overviews of settlements and cities in order to locate slum areas by identifying hazardous areas (e.g., flood plains) and characterizing roofing materials, road networks, and built-up density (e.g., vegetation).[7] Additionally, remote sensing of nighttime light has been used to explore poverty in Africa[45] and to create a global poverty map.[46]

Until recently, remote sensing and GIS were typically used by physical scientists to study environmental conditions. Now they are being used to delineate urban areas.[47] A combination of daytime and nighttime visualization has been used to mark boundaries of urban areas and slums.[44] For example, visualization of buildings during the day can frame boundaries of urban areas, and patterns of greenery can help identify and mark boundaries of slums (since slums typically have high-density roofing and little greenery). Visualization at night shows lights, which provide another estimate of boundaries and density that can be matched with daytime visualization. UN-HABITAT incorporated high-resolution satellite imagery into the community profiling of the UIS by using the data for secondary cities in Africa and Asia to disaggregate data at the smaller level of the enumeration area. The introduction of Google Earth in 2005, however, enabled the use of high-resolution satellite imagery for data collection and planning by a broad range of users.

To date, there has been limited integration of physical and social scientists to examine and analyze remote sensing data on environmental conditions and their possible effects on human and especially urban populations. When this has been done (e.g., the work of AM Noor and similar), the integration has been productive. Increasing opportunities for this type of collaboration are important to address population responses to climate change at the international, national, and local levels.

A caveat is in order. While technology and tools are available for the creation of highly disaggregated spatial data, national and local governments in LMICs typically operate with only rudimentary data that lack spatial content. Census data are not typically processed to yield data at municipal or intra-urban levels; nor are they geocoded. There are a growing number of examples of spatial research in LMICs (e.g., in Kenya, Somalia, and Sierra Leone),[44,43,48] suggesting that this issue

is not insurmountable. But it must be overcome if we are to take better advantage of these technologies and generate metrics for local action.

Individual and Spatial Data with Community-Driven Enumeration in Slums and Informal Settlements Segments of the population may be overlooked in official statistics such as the census, administrative data sets, and surveys because they are not legally recognized. The absence of such data precludes comprehensive analyses and actions to address intra-urban inequities. A powerful, and increasingly common, response by residents of informal settlements to the lack of attention they receive from government and international agencies is to generate their own documentation and maps. The residents then use this material to negotiate with local government for infrastructure and services that can transform their health (e.g., water, electricity, sanitation, drainage, health care, emergency services, and rule of law). The enumerations can also be used to negotiate land tenure, which in turn encourages households to invest in better quality housing. In some instances, local governments have not only accepted the legitimacy of this process but actually incorporated the data generated into their policies and plans.

In cities in sub-Saharan Africa and much of Asia and Africa, 30–60% of the population commonly lives in informal settlements. Because these settlements are illegal and often not shown on official maps, the residents often have no legal address (in fact, the streets are often unnamed). The inhabitants may not be included in government surveys because of the lack of maps and official addresses to guide those conducting the surveys (or the reluctance of data gatherers to work in these settlements).

The idea of low-income communities undertaking enumerations originated as a defense strategy against eviction. In the early 1970s, for example, when the 70,000 inhabitants of Janata colony in Mumbai were threatened with eviction, community organizations counted the number of businesses, telephones, and electricity poles. They then used this information in court to demonstrate the legitimacy and economic importance of the settlement that the authorities wanted to bulldoze.[49]

In the mid-1980s, women pavement dwellers in Mumbai, working with the Society for the Promotion of Area Resource Centres, a local NGO, undertook their own census, titled *We, the Invisible*.[50] The census helped disprove two common myths about pavement dwellers that politicians used as reasons to evict them: that they were "recent migrants" (most had been in the city for years or decades) and that they were unemployed (almost all had jobs).

Of course, furnishing government agencies with detailed data about all of the households in a settlement, along with maps including plot boundaries, roads, paths, and existing infrastructure, does more than provide the information needed for upgrading. It also facilitates plans for infrastructure improvements that could involve evicting large numbers of people from their homes. It is important that those using the enumerations in negotiations propose alternative plans—both to reduce evictions and to support the resettlement of those residents who must move.[51,52]

Community-driven enumerations have become a standard tool of a growing number of national and city federations of slum/shack dwellers (there are now national federations in more than 25 countries).[53] They are able to produce detailed data for each household living in an informal settlement at scale—see, for example, the enumeration of 70,000 households in informal settlements in Kisumu, Kenya's third largest city, undertaken by the Kenyan Homeless People's Federation.[54] Federations in India have undertaken slum enumerations in more than 40 cities. Many of these enumerations now use GIS tools and techniques, in part so that the maps produced can be used to negotiate for tenure. This also helps in the planning and management of upgrading, especially where government

agencies come to accept and use these maps. GIS can also provide the spatial framework for the residents to negotiate tenure, although to do so often requires local surveys to achieve the necessary precision on plot boundaries.

City and national slum/shack dweller federations have also increasingly undertaken citywide surveys to document the number and location of informal settlements in and around cities. This also provides valuable information for negotiations with city governments and for developing programs to improve conditions in all such settlements.[55–57]

"Slum" enumerations are also a means of mobilizing the population as the enumerators (who are residents, not outsiders) explain to every household why they are collecting the information. They help residents to better understand their settlement and capabilities. For example, they may encourage the formation of savings groups. Often they provide a household with the first written evidence that it lives there, as each house structure is numbered and each household receives a document showing the information collected about it during the enumeration. These are often useful for residents of informal settlements in seeking government entitlements. Enumerations can also document local income flows, giving residents an indication of what they can afford to invest in themselves and often leading to community-identified initiatives.

The example of community enumerations and assessments coordinated by Urban Health Resource Centre in India: Table 1 shows data from five Indian cities— the proportion of slums that are unlisted and therefore without recognition is staggering, representing about 40% of all slums and 36% of all slum residents.

While slum enumerations are important, they are not enough. The urban poor are not homogeneous, even within a country or state. The National Sample Survey Organization (NSSO) Survey (NSSO-2002), for example, showed that in the states of Andhra Pradesh, Delhi, Gujarat, Maharashtra, and West Bengal, the proportion of slums with a majority of its houses built with pucca (i.e., solid and permanent) materials was much higher than in other Indian states. As the face of urban poverty changes at the state level, differences are stark among cities, as well as within individual cities. Surveys in seven slum settlements in Karachi found that infant mortality rates varied from 33 to 209 per 1,000 live births.[58] Malnutrition in children under six years of age was 33% vs. 55% in different groups of slums of Bangalore city.[59] Urban vulnerability is multidimensional and slum communities can help determine the factors for differential vulnerability.[60]

Slums that have had prior program inputs usually have greater awareness on health and other issues. Thus, the same slums reap the benefits of various programs year after year. This is mainly because slum lists are not updated regularly and because there is greater political awareness and negotiation capacity in the relatively better-off slums. "The people whose needs justify the whole development industry are the people with the least

TABLE 1   Number of listed and unlisted slums in five Indian cities

City	No. of listed slums	No. of unlisted slums
Agra	215	178
Bally	75	45
Dehradun	78	28
Jamshedpur	84	77
Meerut	102	85
Total	554	413
Aggregate slum population	1,276,062	727,332

power to influence development and to whom there is least accountability in terms of what is funded and who gets funded."[61]

Process for Slum Enumeration and Assessment in India: UHRC Example   Discussions held by the Urban Health Resource Centre (UHRC; New Dehli, Agra, Indore, and Meerut, India) program teams with slum-based community groups and NGOs active in Indore city (the first city where this assessment was undertaken), as well as visits to slums, showed wide disparities in health conditions, including access to health care, across slums. Hence, a health vulnerability assessment was undertaken to identify and geographically map slums and urban poor clusters that were more vulnerable than the others.

Process for Qualitative Assessment of Vulnerability of Slums Unlisted slums are often identified with the help of community stakeholders and others knowledgeable about the city's slums. Pilot visits are made to slums, and discussions with the community and other primary stakeholders are held to identify relevant determinants of vulnerability. These determinants are then collated to form a set of critical vulnerability criteria (see table below). Data are collected from slum community representatives or community-based

Text Box: Factors and Criteria for Assessing Health Vulnerability in Slums

Factors	Situations affecting health vulnerability in slums
Economic conditions	Irregular employment, poor access to fair credit
Social conditions	Widespread alcoholism, gender inequity, poor educational
Living environment	Poor access to safe water supply and sanitation facilities, overcrowding, poor housing, and insecure land tenure
Proximity/use of public	Lack of access to ICDS and to primary and other health care services, health facility poor quality of health care
Hidden/unlisted slums	Slums not in official records or hidden, remain outside the purview of civic and health services and are more vulnerable
Slum location	Slums located in unauthorized areas such as roadsides, private land, or in high-risk areas such as those adjacent to drains or in riverbeds
Rapid mobility	Temporary migrants, denied access to health services and other development programs; difficulty in tracking and providing follow-up health services to recent migrants
NGO/CBO activities	Presence of NGO/CBO activities/programs help slums to cope better with challenges; lack of organized community/collective efforts, however, makes slums more vulnerable
Prior program input	Slums where government or nongovernment programs have been implemented in the past or are being implemented have greater access to services

organizations (CBOs), with the assistance of teams of trained surveyors, where available. The slums are assigned a score on the basis of all the indicators. Three categories are created by distributing the minimum to maximum scores. The cumulative score of each slum is then used to categorize the slum as highly vulnerable, moderately vulnerable, or less vulnerable.

The vulnerability status of the slums are then validated and triangulated through meetings between government departments and nongovernment agencies on the one hand, and community-based organizations, community leaders, and residents on the other. The groups involved, as well as the vulnerability criteria, vary slightly from city to city, depending on the context and local conditions. Factors and criteria are noted in the text box.[129]

Case Study: Pune, India   In Pune, a social entrepreneur NGO, Ashoka, has been mobilizing slum youth to collect data. Using GIS technology, they are systematically generating and analyzing information on slum demographics and creating a spatially organized slum database to guide urban planning and public infrastructure to serve the slums. These data are also being used to advocate for the slum residents, to put pressure on public officials to resettle slum communities living within flood-prone areas, and to work with local governments to lobby the national government for additional funding.[62] Community-driven surveys, such as those conducted in Pune, India, or by federations of urban poor, can be powerful tools for forcing official recognition, creating legitimacy for a group of people or an issue and lobbying leaders for services and resources.

The work in Pune is not an isolated example. In fact, the international movement of federations of urban poor has provided a vehicle for the poorest groups in many urban areas to become active participants in documenting and resolving problems in their communities. Using the power of collectives, the federations work to make government more effective. D'Cruz and Satterthwaite describe the role that community-directed surveys can play in this work of the federations:

> Community-directed surveys are important in helping low-income people to examine their own situations individually and collectively, in order to more effectively consider their priorities and plan their actions more strategically. In addition, survey results can provide government and other donor agencies with the maps and the detailed data needed for supporting projects. Government agencies usually have little or no detailed data about informal settlements. Community-directed surveys have indicated how to obtain and analyze necessary information about each household, each house, each piece of land, and each settlement.[63(p10)]

Affordable Innovative Technologies are Becoming Available *and Accessible* to Supplement Existing Efforts to Disaggregate Data

Combining the census with remote sensing techniques requires several steps, including the geocoding of locations from the census using addresses or GPS, collecting information to supplement or validate the census (e.g., roofing material), and information missed by the census (e.g., amenities and hazards). Several advances, such as wider accessibility to remote sensing data through Google Earth and recent work using low-cost GPS devices, have made this work more accessible to low-resource settings. They demonstrate the feasibility of capturing coordinates that connect data to places in real time. Also, recent work using GPS coordinates of images taken with cell phones demonstrates the feasibility of capturing information on community amenities and hazards missed by the census. Technology providing standardized data collection instruments through handheld devices, including cell phones (computer- and telephone-assisted structured interviews), has also proven helpful.

Expansion of Low-Cost Options for Data Collection—The Role of Cell Phones with Geocoding   The use of handheld computers with geocoding to perform mapping in low-resource settings is a relatively recent development.[64] Even more recent is the use of cell phones to capture images with GPS coordinates that are then geocoded (e.g., http://geocode4pros.com/demos.htm).

There are two causes for concern about moving to cell phone technology for data collection in developing countries. One is cell phone coverage. While national coverage in developing countries is described as an "emerging market," what cellular coverage exists in developing countries is predominantly in urban and peri-urban areas. Currently, cell phone coverage is expanding in Africa. By 2008, over 65% of the African population had access to cell phone coverage.[136] In Kenya alone, 19 million inhabitants have cell phones, with service provided at a cost of Ksh 5.66 (approximately US $0.07) per minute. Most relevant to data collection using cell phones (with geocoding software), 34% of Kenya's geographic area (mostly urban areas) has cell phone coverage.[137]

Another concern is the availability and cost of cell phones with the desired features. Fortunately, cell phone availability has become widespread in low-resource settings. In the recent election in Kenya, for example, 80% of election tallies by precinct were transmitted by cell phones that had been bought at a subsidized cost of Ksh 2,600 (approximately US $32.29) each.[138]

Several features make the new GPS-activated cell phones appealing for rigorous data collection. First, while photographs with GPS by themselves are attractive for mapping amenities and hazards, they do not replace survey responses as in a census; thus, there is an additional step in data collection. Technology has advanced to where adding text within computer- or telephone-assisted structured interviews can be done with the advantage of direct data entry and real-time logic edits. Second, the quality of the information can be monitored. Geocoding software available for mobile devices and smart phones has the advantageous ability to obtain the position of the data collector and thus to identify placement throughout the data collection phase. Also, the software is becoming increasingly affordable.

Example of Application in Kibera, Kenya   In November 2009, an NGO called Map Kibera (www.mapkibera.org) began work on an ambitious project to digitally map Africa's largest slum, Kibera, in Nairobi. The Map Kibera project uses an open-source software program, OpenStreetMap (http://www.open streetmap.org), to allow users to add and edit information as it is gathered. This information is then free for use by anybody wanting to grasp what is actually happening in Kibera: residents, NGOs, private companies, and government officials. Workshops communicate with local residents and show them the findings available from the map. Paper maps are distributed to residents and updated as new information comes in. This technology and approach comes with caveats. Engaging the local population from the outset is critical to build trust and avoid conflict, as people generally do not like to be mapped without their consent.

Example of Application in a Favela in Rio de Janerio   In Brazil, an NGO called Rede Jovem (http://www.redejovem.org.br) has been deploying youths armed with GPS cell phones to map public interest spots (e.g., schools, hospitals, and restaurants) as a form of asset mapping in five favelas of Rio de Janerio. The mappers physically travel around the favela, logging information about landmark of interest with their phones, which interface with Google Maps. Reporters then perform data entry with the information from the maps displayed on the phones; a video or photograph can be added to provide more

detail. The information is logged using Wikimapa (www.wikimapa.org.br) and Twitter (http://twitter.com/RedeJovemIPRAF).

Analytic Strategies That Make More Variables Interpretable at a Disaggregated Level Continue To Be Developed

Examples using methods that combine census and survey data have included the generation of poverty maps using small-area analytic techniques.[65] These are useful for advancing knowledge and informing public policy and business decision making. Although much of the work has been developed and used in developed countries, the techniques are gaining traction in developing countries.

In one case study in Ecuador, sample survey data on income and consumption from small surveys were combined with the larger sample size from the census to provide poverty rates for populations covered by the census. The results found poverty rates to be precisely measured even at fairly disaggregated levels; however, beyond a certain level of spatial disaggregation, standard errors rose rapidly.[66]

In another example from Albania, census and survey data were used to assess the impact of internal and external migration on local poverty at the disaggregated level of commune (comparable to a district) and municipality. While the commune-level analysis showed concentrated areas of poverty in the northern region of Albania, the analysis at the municipal level showed pockets of poverty throughout the country.[67]

PART III: INDICATORS FOR URBAN HEALTH METRICS

Unrepresented or Underdeveloped Variables Require Attention to more Completely Depict the Urban Environment and Uncover Inequities: the Case for Geography, Climate, Social Environment, Governance, and Other Variables

Measures of health (or disease) itself and behavior that affects health have received more attention than measures of the urban environment that affect health. While important, detailed discussion of health metrics is not included in this report. That said, several aspects of health metrics are worth mentioning. Although vital records systems, especially at a local level, are recognized as a priority and are key to the assessment and analysis of the impact of environment on health outcomes, this topic is very broad and discussed in detail elsewhere. Similarly, the impressively efficient metric Burden of Disease has gained wide currency, but it has not been without criticism, the details and discussion of which can be found elsewhere. The goal of the current report was not to provide a DALYS-like accounting of urban or intra-urban health burdens and risks on a disease-by-disease basis. No one else is yet in a position to attempt that either, and rural–urban DALYS comparisons are not yet available for many countries. The influence of health behavior on disease prevention (e.g., hand washing and infectious disease transmission) has been addressed in detail elsewhere.[68]

In addition to more complete discussions already underway elsewhere, there are two other reasons for the severely truncated presentation of health and health behavior in this report. First, no uniquely urban diseases come to mind, so any attempt to detail the extensive literature on health metrics would distract from our primary goal, namely, acknowledging and measuring the urban environment. Second, while a number of outcomes, such as violence and pedestrian injuries, are found more frequently in urban environments, the actions on environments, as well as their measure, that contribute to these outcomes are underdeveloped and barely

analyzed. To take a simple example, population health is being advanced by the availability of affordable medications for diagnoses made by trained health care providers in newly constructed clinical facilities. Equally necessary, however, are transportation to get people to the clinics, safe environments that encourage movement of residents and providers toward locations where services and amenities are placed, and—more rudimentary—clean water to take medications. All these are examples of variables that must be included in the equation to improve population health, and they are only magnified in urban settings.

More to the point, following the lead of the various recent UN reports noted above and presented in a conceptual framework[69] (see Figure 2), new work needs to be undertaken to further develop and, more importantly, to implement in an efficient and affordable way the variables that cover the following domains: geography, climate, physical environment, social environment, and governance. As noted above, innovative technologies coming through the pipeline make the measurement of some of these variables feasible and accessible. For other variables, work has been developed at various levels of refinement, but (despite recommendations from earlier reports) has not been incorporated into existing platforms; therefore, feasibility, much less accessibility and impact, remains problematic.

Climate Change   Climate change is recognized as a new type of risk factor for health. Although the phenomenon is global, its impacts are felt at the local level. Climate change can impact health directly, as in the case of heat waves and extreme weather events, but it also impacts other environmental risk factors, such as water quality and quantity, food and nutrition, ecosystems, desertification, and air pollution. The only attempt so far to measure the health impact of climate change was as part of the Global Burden of Disease of selected risk factors, which concluded that more than 150,000 deaths in 2000 could be attributed to climate change.[70] That report focused on a few health impacts, where evidence for the association between climate variables and health was stronger. It included the climate change-related impacts of floods, malnutrition, diarrhea, and malaria. Since then, the WHO has updated these figures, showing a small decline to just over 140,000 deaths.[71]

One problem with such estimates is that they were done at the global level. We can separate at the level of large regions, or clusters of countries, but not at the individual country level, let alone at the sub-regional, city, or intra-urban level. Moreover, it is difficult with current information to determine, say, how much extra dengue or malaria or flooding can be attributed to climate change at the local level. This makes the monitoring of climate change impacts and inequalities at the intra-urban level nearly impossible with the currently available data.

The key areas of concern for which intra-urban indicators are needed include climate-sensitive communicable diseases, storms, floods, water scarcity, air pollution, and heat waves. For this, raw data are available (e.g., from FEMA and UNITAR)[139,140] but indicators are underdeveloped. Methods and indicators are also needed to accurately identify and count those in the main vulnerable groups, which include children and the elderly, as well as poor and marginalized populations. Disaggregation of census data provides a starting point to address this need.

One way to measure these changes would be to look at borderline situations. For example, rather than attempting to determine what fraction of cases of dengue can be attributed to climate change at the city level, surveillance systems could monitor new cases in areas where there is normally no transmission, but where conditions are likely to change or have changed based on climatic models. Similarly,

health systems could measure the unequal impacts of climatic events based on assessments of a population's vulnerability to such impacts. Thus, in the case of heat waves, the focus would be on identifying which population groups are most affected (e.g., the elderly or those living in heat islands) so as to better focus interventions.

A high proportion of city dwellers in lower-income countries are already exposed to a variety of climate-related risks that threaten their lives, health, and well-being. Different groups and individuals experience and respond to these risks in different ways, with some groups exhibiting greater resilience and proving to be less vulnerable than others. Climate-related risks can be daunting for the urban poor, who, unable to afford housing in well-protected neighborhoods, often must live in marginal sites that are periodically ravaged by floods or beset by scarcities of water and other essentials; they also lack the resources for timely evacuation in a crisis. Among the poor, it has been shown that women, children, and the elderly often suffer most from the effects of environmental hazards.[72] In short, the health consequences of climate risks have important equity, gender, and age dimensions.[73]

Climate-related risks produced by extreme weather events—especially the coastal floods that result from hurricanes and typhoons, the landslides and inland floods brought on by heavy precipitation, heat waves whose health effects in cities are exacerbated by air pollution and the features of the urban built environment that tend to concentrate heat in urban "hot spots," and the serious droughts that cause drinking water to become scarce or altogether inaccessible in poorly served city neighborhoods—are already very much in evidence, with the larger disasters chronicled even in the international press. Table 2 lists the ten largest natural disasters that have occurred in Mexico and Pakistan, as recorded in EM-DAT, the international disaster database. More recently, in 2010, Pakistan underwent the worst flooding in its history. As Satterthwaite et al. discuss,[74] the disasters recorded in such international databases omit the many smaller events that, when taken together, paint an even grimmer picture of the magnitude of health hazards (see http://www.desinventar.org for Latin America). In short, a compelling rationale for action to meet these climatic threats can be based wholly upon events in the recent record. There is therefore no need to engage with the complexities of climate forecasts to appreciate the need for action.

TABLE 2   Ten largest natural disasters in Mexico and Pakistan[24]

Mexico			Pakistan		
Disaster	Date	Homeless or needing immediate assistance	Disaster	Date	Homeless or needing immediate assistance
Earthquake	Sept. 1985	2,130,204	Flood	Feb. 2005	7,000,450
Storm	Oct. 2005	1,954,571	Flood	Oct. 1992	6,655,450
Flood	Oct. 2007	1,600,000	Flood	July 1992	6,184,418
Storm	Oct. 2005	1,000,000	Flood	Aug. 1976	5,566,000
Storm	Oct. 1997	800,200	Earthquake	Oct. 2005	5,128,000
Flood	Sept. 1999	616,060	Flood	Aug. 1973	4,800,000
Storm	Sept. 2002	500,030	Flood	July 1978	2,246,000
Storm	July 2008	500,000	Drought	Nov. 1999	2,200,000
Storm	July 1976	300,000	Storm	June 2007	1,650,000
Storm	Oct. 1976	276,400	Flood	Aug. 1996	1,300,000

Disasters due to flooding cause massive population displacement, injuries, and loss of life on a regular basis. As noted by Douglas and colleagues,

> Many of the urban poor in Africa face growing problems of severe flooding. Increased storm frequency and intensity related to climate change are exacerbated by such local factors as the growing occupation of floodplains, increased runoff from hard surfaces, inadequate waste management and silted-up drainage. One can distinguish four types of flooding in urban areas: localized flooding due to inadequate drainage; flooding from small streams within the built-up area; flooding from major rivers; and coastal flooding.[75(p187)]

Many informal settlements in Lagos, for example, are at risk of flooding; Lagos's location on a narrow lowland coastal stretch on the Atlantic Ocean puts it at risk from sea level rise and storm surges. But it is mainly the lack of attention by state and local governments to the need for storm and surface drains and other infrastructure, as well as to the need for effective land use management, that has created most of the flooding risks. Interviews with the inhabitants of four informal settlements close to the coast showed that flooding was the most serious problem they faced. Flood waters usually entered homes and remained for several days. Over 80% of respondents reported that they had been flooded three or four times during 2008.[76]

Policymakers who appreciate these already evident climate-related health threats, however, will find compelling reasons for acting with a heightened sense of urgency in climate forecasts. Forecasts indicate that extreme weather events are likely to increase in severity and frequency in the coming years. Even if the total number of urban dwellers exposed to such events were to hold constant, the greater anticipated frequency and severity of these extreme events would by itself multiply the expected health consequences relative to today's totals. When forecasts of demographic trends are considered in conjunction with the climate forecasts—demographers foresee an increase of nearly 3 billion urban dwellers in LMICs by 2050—the costs of further inaction are striking. Unless action is taken to safeguard the neighborhoods of the poor and to protect other vulnerable groups from such climate-related risks, the future health consequences for vulnerable urban dwellers will be severe.

Which Health Risks Need Attention? Seaward hazards in low-elevation coastal zones Because seaward hazards are forecast to increase in number and intensity as a result of climate change, and coastal areas are disproportionately urban, it is especially important to quantify the exposure of urban residents in low-elevation coastal zones and to understand the likely implications for health. Many of Asia's largest cities are located in coastal areas that have long been cyclone-prone. Mumbai saw massive floods in 2005, as did Karachi in 2007.[77,78] Storm surges and flooding also present a threat in coastal African cities, e.g., Port Harcourt, Nigeria, and Mombasa, Kenya,[75,79] as well as in Latin America, e.g., Caracas, Venezuela, and Florianopolis, Brazil.[80] Urban flooding risks in developing countries stem from a number of factors: impermeable surfaces that prevent water from being absorbed and cause rapid runoff; the scarcity of parks and other green spaces to absorb such flows; rudimentary drainage systems that do not cover large areas of the city, are often clogged by waste, and, in any case, are quickly overloaded with water; and the ill-advised development of marshlands and other natural buffers. When flooding occurs, fecal matter and other hazardous materials contaminate flood waters and

spill into open wells, elevating the risks of water-borne, respiratory, and skin diseases.[81]

Cities in dryland areas: Globally, dryland areas, which are characterized by low and erratic precipitation, contain far larger populations and more urban residents than do low-elevation coastal zones. Dryland areas are home to an estimated 2 billion people worldwide, about 45% of whom live in cities and towns.[83] Developing countries account for about 72% of the dryland land area and 87–93% of its population. Water shortages are already apparent in dryland ecosystems, with an estimated 1,300 m^3 of water available per person per year—well below the 2,000-m^3 threshold considered sufficient for human well-being and sustainable development.[84]

The effects of water stress in dryland ecosystems reach beyond access to drinking water. Especially in sub-Saharan Africa, a number of cities have become dependent on hydropower for much of their electricity.[85,86] Water stress can also induce complex rural–urban interactions. Lower agricultural productivity can increase the costs of agricultural production, which in turn can cause agricultural prices to rise, reduce employment and earnings, and possibly encourage both circular and longer-term migration to urban areas.[86,87]

Heat waves: A growing literature focuses on the health problems arising from heat waves in urban areas, with recent work considering the implications in low-income urban settings.[82,88–91] One study examined the history of heat wave-related deaths in three cites of contrasting wealth (gross national income per capita)—Delhi, India; London, England; and São Paulo, Brazil—based on daily counts of all-cause mortality (excluding violent deaths) using counts of deaths by age and cause derived from mortality registries for the four-year period of January 1991 to December 1994. Setting these data against time series data of daily ambient temperature, they found that for each of these cities, an increase in all-cause mortality was observed for same day and previous day temperatures >20°C, with the excess mortality being greatest in Delhi and smallest in London. They conclude that "populations in low-income countries where life-threatening infections are still common may have the greatest vulnerability to the effects of heat," adding that "those most susceptible to heat are likely to remain susceptible if there is not due attention paid to infectious disease, diarrheal illness, and other major causes of early mortality in these poor populations."[89] The implications of heat-related health threats for policy have also been spelled out by the WHO.[92]

Spread of malaria and dengue fever: Climate change influences habitats, including those of disease vectors. This has been summarized in Gage et al.,[93] as well as in similar reviews by Kovats and Hajat.[82]

The urban poor are often more exposed than others to these environmental hazards. Because the housing they can afford tends to be located in environmentally riskier areas, it affords them less protection. Housing quality is also poor, especially when the urban poor rent or live on land sites with insecure tenure. In addition, their mobility is more constrained. The poor are likely to experience further indirect damage as a result of the loss of their homes, population displacement, and disruption of livelihoods and networks of social support.[80] For further discussion of urban exposure and vulnerabilities, see Campbell-Lendrum and Woodruff[94] and UNDP.[95]

What more do we need to know? Exposure to climate-related risks is being documented by biogeophysicists. But vulnerability varies greatly across cities and neighborhoods. And despite the everyday nature of some of the health threats

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Text Box: Measuring environmental risk, NIPORT Survey, Bangladesh
•In the rainy season, is there standing water in or around the households more than 8 h in this
  community?
•Are the water drainage facilities open or partially blocked or almost blocked in this community?
•Has this community flooded in the last 3 years? 5 years?
•Have the residents of this community ever had to flee their dwellings due to flooding?
•How long did the last flood waters remain (i.e., take to recede)?

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mentioned above, social and health scientists have neither systematically documented vulnerability nor explored in sufficient detail the aftermath of climate-related disasters, both large and small, to understand why some communities and individuals are resilient and recover quickly while others are fragile and experience long-term damaging consequences. Sample surveys are ubiquitous in demography, yet few have included the basic questions by which measures of exposure to risk and vulnerability can be derived. Designing such questions would seem straightforward enough, as demonstrated in the neighborhood survey module of the National Institute of Population Research and Training (NIPORT),[96] one of the rare attempts to gain a comprehensive, quantitative understanding of the risks facing urban populations in Dhaka and other cities in Bangladesh. The Text Box shows a few elementary questions from this survey, and Table 3 shows responses by slum and non-slum areas and municipalities.

What do We Need to do Differently? In a few words, it is necessary to bring social science expertise to bear on adaptation. This means supporting more research to link social scientists with biogeophysical scientists and international with local researchers, disaggregating national census data to political jurisdictions—municipal and below—where urban adaptation decisions need to be made. This is an essential step in documenting vulnerability to climate-related risks; using national sample surveys and other accessible data to forecast city population growth by risk zone; and ensuring that national adaptation programs of action are evidence-based, making full use of existing research and data. Thus, the issue for climate change in urban settings is a combination of not having complete metrics (but having the data to create them) and not having disaggregated data, coupled with few studies that have applied such data to health outcomes.

Social Environment   Despite long-standing interest in the relationship between the social environment and health, there is little consensus on how to define and measure social environment. For example, a recent systematic review of 2,396

TABLE 3   Responses (%) to environment questions, NIPORT, Bangladesh[96]

Question	Urban slum areas	Urban non-slum areas	District municipalities
Standing water around household during rainy season	31.9	13.5	14.1
Community flooded during rainy season.	29.9	17.7	21.9
Residents ever had to flee due to flooding	69.7	38.2	64.3

abstracts on social capital (i.e., the degree of connectedness and the quality and quantity of social relations in a given population) and its effects on health found a lack of congruence in how social capital was measured and inconsistency in findings.[97] Few cross-national surveys include meaningful measures of the social environment, no doubt in part because of its complexity and multidimensionality.

The social environment describes the structure and characteristics of relationships among people within a community. Components of the social environment include social networks, social capital, segregation, isolation, and the social support that interpersonal interactions provide. Comprehensive definitions of many of these factors are given elsewhere.[98] A city's social environment can both support and damage health through a variety of pathways.[1,3,99] For example, social norms in densely populated urban areas can support individual or group behaviors that affect health, e.g., smoking, diet, exercise, and sexual behavior.[5] Social supports can buffer the impact of daily stressors and provide access to goods and services that influence health, e.g., housing, food, and informal health care.[100] The racial/ethnic diversity characteristic of many cities also has the potential both to enhance health (e.g., social support) and to damage it (e.g., segregation and racism). Measures of social inclusion and exclusion, social connectedness, social support, and social networks have all been used to explore the relationship between health and the social environment in urban settings,[101] but the concept of social capital has received the most attention in the peer-reviewed literature. Social networks in the form of slum-level groups or CBOs have proven to be a potent institutional mechanism for implementing slum health and development programs. Members of these slum CBOs, with motivation and training, function as role models, empower slum families to adopt behaviors, avail themselves of services, and negotiate for other slum development programs.[129]

Social capital refers to the degree of connectedness and the quality and quantity of social relations in a given population. A number of dimensions of social capital have been developed, including cognitive, structural, bonding, and bridging social capital. The cognitive refers to perceptions of support, reciprocity, sharing, and trust. The structural refers to the extent and intensity of associational links or activities. Bonding refers to social cohesion within a group structure. It may be vertical (top-down) or horizontal (between individuals in the same context). Bridging refers to links across groups. In passing, these concepts are relevant to the measurement of governance discussed below. One way these concepts have been operationalized is through Ralph Sampson's work on "collective efficacy," which develops five items about people in the same community (sense of trust, close knit, "get along," help others, shared values) and about informal social control (likelihood of intervening in a set of five circumstances). Another approach, by Ichiro Kawachi, includes three items (membership in voluntary groups, interpersonal trust, and perceived norms of reciprocity). Others have extended social capital to concepts such as "neighboring" or neighborhood cohesion, community competence, psychological sense of community,[102] neighborhood perceptions,[103] and neighborhood quality indices.[104]

Community-level measures: Nearly all studies that have examined social capital as a community-level variable aggregate individual behaviors or attitudes rather than use community-level measures.[105] In general, measures of the social environment are based on lengthy surveys of individuals, while those based on administrative data (which are rare) are by necessity focused more on the service environment than on the social environment per se; see, for example, Witten

et al.,[106] who developed a community resources accessibility index, and Yen and Kaplan,[107] who created a neighborhood environment measure. Lochner et al.[102] suggest that community improvements and community trust are measures of community-level social capital that can be captured through observation, but these types of measurements remain largely undeveloped.[97] In addition, to parse out the effect of other factors, such as socioeconomic status, from that of social capital would be difficult.

Measurement of social environment by existing urban indicator projects: Given the reliance on long, individual-level surveys and the debate over how to measure various aspects of the social environment, it is perhaps not surprising that large-scale urban indicator projects have generally neglected this domain. Some—such as the World Bank City Indicators, WHO Healthy Cities, and the UN-HABITAT Urban Indicators program—include percentage of the population living in poverty as a measure of social inequity and of the social environment. This is based, no doubt, on the theory that a large gap between the rich and poor leads to a breakdown of social cohesion.[108] However, Kawachi[109] has also noted increasing evidence that social capital matters less for the health of residents in comparatively egalitarian countries than it does for those in highly unequal societies with inadequate safety nets. Therefore, using inequality as a measure of the social environment may be inadequate.

Other urban indicators programs have included measures of social inclusion or exclusion. UN-HABITAT, for example, includes as a domain of the social environment gender inclusion, which is measured by the number of women in leadership positions and by literacy rates among women. Similarly, the WHO Urban HEART, discussed above, looks at literacy, violence against women, unemployment among women, and the proportion of woman earning and controlling income. The United Nations Educational, Scientific, and Cultural Organization Indicators of Racial and Ethnic Discrimination include a number of city-level measures of racial and ethnic inclusion and exclusion, but they are still in their pilot phase. Perhaps the most in-depth population-based effort to measure the social environment is the New Zealand Quality of Life Project. This national survey has an entire section devoted to social connectedness; it includes measures of overall quality of life, diversity and identity, local community strength and spirit, electronic communication, and arts and culture. Individual responses are aggregated to form community-level measures.

Gaps in social measures: When measuring a population, practicality often necessitates identifying and selecting a few items to add to an existing effort such as a census or survey. Unfortunately, these can be superficial and of questionable value. The census and cross-national surveys rarely reflect constructs of the social environment beyond basic family and household composition. Other key measures such as social networks, social support, and social capital are not captured. Considerable effort has been expended on smaller-scale studies that address the various forms of social capital (e.g., cognitive and structural). How to incorporate these into existing population-based efforts is worth further attention (e.g., subsample within intra-urban areas during larger population-based surveys). In addition, most work to date on measuring social capital has been done in the higher-income countries; development of measures for use in developing countries is at an early stage. Harpham et al.[105] have developed the Adapted Social Capital Assessment Tool, which has seven items for structural social capital (connectedness) and 11 for cognitive social capital (reciprocity, sharing, and trust). Psychometric

properties of measures for social capital are still in conceptual and operational development.

Urban Governance "Urban governance" refers to the sum of the many ways that individuals and institutions, both public and private, plan and manage the common affairs of the city. It is an ongoing process, through which conflicting or diverse interests are accommodated, and cooperative action is taken. It includes formal institutions, as well as informal arrangements and the social capital of citizens. According to the Global Campaign on Urban,[141] a program of UN-HABITAT, good urban governance is characterized by a series of interdependent and mutually reinforcing principles that include sustainability, subsidiarity, equity, efficiency, transparency and accountability, civic engagement and citizenship, and security.

   The state, civil society, and private sector (the three main players in urban governance) all have significant influence over the physical and social environment, as well as health care and social services. Research increasingly supports the idea that aspects of governance can affect population health.[101] Considerable work has been devoted to conceptualizing "governance," though much of it has been with nation-states as the unit of analysis. As Harpham and Boateng point out, scholars have conceptualized governance using a range of dimensions; some overlap, but many do not.[82] In general, the focus has been on government—public sector management, accountability, legal frameworks, transparency, resource allocation, participatory approaches, provision of basic services, development and maintenance of infrastructure, and human rights. Government, though important, should not be conflated with governance. As Harpham and Boateng explain, "The crucial distinction between government and governance is the notion of civil society, which can be defined as the public life of individuals and institutions outside the control of the state."[110]

Measurement Challenges for Governance In his article on designing governance indicators, Stewart[111] suggests four major challenges for researchers: concept definition, measure choice, sample choice, and indicator evaluation. Indicator evaluation refers to normative considerations about what constitutes "good" urban governance and the standards by which indicators should be judged. These issues are discussed more fully in the section on policy and political considerations. Unfortunately, concerns about concept definition and measure choice persist. For example, Bouckaert and Van de Walle[112] examined measures for urban governance, extending points made by Harpham and Boateng.[110] They note that governance measures were viewed largely in terms of monitoring performance of public administration. They also note that the link between "hard" measures of inputs, activities, and outputs and "hard" outcomes and impact over time was difficult to determine. They observed the emergence of a greater emphasis on accountability. This stimulated the development and introduction of "soft" indicators, e.g., trust and satisfaction, as measures of "good governance." The starting point is the assumption that low trust in government reflects poor performance and that trust can therefore be restored by improving service quality. They note that measures of trust are culturally determined and that it can be difficult to discern what influences trust in government and what demonstrates that the trust is related to a government action. Likewise, measuring satisfaction is complicated as satisfaction may reflect a mood as much as a clear evaluation of the quality of the service. They state that

although trust and good governance overlap, measures of trust are not a full proxy for good government.

Stewart, in discussing the Worldwide Governance Indicators developed by the World Bank (described below), found similar problems in measuring the underlying concepts of governance. He suggests that they demonstrated no clear evidence of validity.[111] Others have suggested soft measures based on citizens' perceptions of their lives, such as the National Well-Being Index, quality of life measures, or measures closely related to some of the social environment indicators discussed above (e.g., community resources index). The proliferation of proposed measures, along with the lack of clarity about what should be measured and how, suggests persistent problems in measuring governance. In addition to problems with concept definition and measure choice, sampling presents difficulties. Most local areas are influenced by multiple levels of government, often with different administrative boundaries. Moreover, many (perhaps most) social communities and affiliations transgress administrative boundaries. The policy and political implications of these sampling issues pose technical challenges for researchers hoping to understand the relationship between governance and health. Thomas concludes that "Despite the evident demand for global measures of the quality of governance, the work is still in its infancy and usage is premature."[113]

Measurement of Governance by Existing Urban Indicator Programs Our review of urban health indicators suggests that the challenges in measuring urban governance outlined by Stewart[111] have not been resolved. Most of the urban indicators we reviewed contained few, if any, indicators of governance. In general, if governance was included, it was limited to measures of citizen participation, such as voter turnout. Notable exceptions include select projects from the World Bank, UN-HABITAT, and the WHO's Urban HEART.

The World Bank's Worldwide Governance Indicator, developed in the 1990s, brought to the forefront concepts of governance. While historically important, it reflects a national perspective on governance and has limited relevance to measurement within urban settings. It covered the following five dimensions: (1) voice and accountability: the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and free media; (2) political stability and absence of violence: perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including political violence or terrorism; (3) government effectiveness: the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies; (4) regulatory quality: the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development; and (5) rule of law: the extent to which agents have confidence in and abide by the rules of society, in particular, the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence.[113]

UN-HABITAT's Urban Indicators include governance as one of five major domains. They identified three goals for good urban governance (and indicators to measure progress toward those goals): (1) promote decentralization and strengthen local authorities; (2) encourage and support participation and civic engagement; and (3) ensure transparent, accountable, and efficient governance of towns, cities, and metropolitan areas.

In addition, UN-HABITAT is developing a parallel Urban Governance Index (UGI) to demonstrate the importance of good urban governance in achieving broad development objectives, such as the MDGs and those of the Habitat Agenda. The index measures the quality of urban governance across five domains: effectiveness, equity, participation, accountability, and security. It relies on 26 indicators that are based primarily on qualitative measures of government practice (e.g., government regulations, codes, and processes) and quantitative measures of government performance and equity (e.g., percentage of women in government). The hope is that the index will facilitate regional and global comparison of cities and catalyze local action to improve the quality of urban governance. The UGI was developed jointly by the GUO and the Global Campaign on Urban Governance, supported by select cities as well as key members of the campaign's Global Steering Group. Field testing was carried out in two stages, with a group comprising first 12, and then 24 large- and medium-sized cities from various regions. The participant cities were: Amman, Bayamo, Colombo, Dakar, Douala, Enugu, Guadalajara, Ibadan, Ismailia, Kandy, Kano, Louga, Matale, Montevideo, Montreal, Moratuwa, Naga City, Negombo, Pristina, Quito, Santo Andre, Tanta, Vancouver, and Yaounde.

UN-HABITAT provides guidance on how cities can design their own governance indicator systems. The following steps provide a guideline for designing a local governance indicator system for a city or group of cities: (1) Sensitize local leaders to the importance of measuring progress in urban governance; (2) Develop locally appropriate indicators: definition, selection criteria, linkages with other indicators; (3) Define benchmarks and targets; (4) Assign scoring and weighting to the indicators, sub-indices, and formulae for local adaptation of the UGI; (5) Field test in cities; (6) Collect data on a periodic basis; (7) Incorporate findings into urban policy development.

The WHO's Urban HEART, introduced in "Disaggregation to Uncover and Address Health Inequities in Urban Settings," while less extensive than UN-HABITAT's UGI, is one of the few heath-specific measurement projects to include multiple indicators of urban governance. The Urban HEART measures: (1) government spending on health and education; (2) voter participation; (3) completion of primary education; and (4) proportion of the population covered by health and other insurance.[142]

Metrics for Governance: A Way Forward? Harpham and Boateng[110] suggested a series of questions that may offer a way to measure participatory urban governance. Framing the issue as one of creating an inclusive action space, they asked: "(1) How are other actors or groups outside the public sector (government) involved in the governance system? (2) How are decisions made? Are decisions within the framework of any explicit policy?"[110(p76)] They also proposed that the following questions be used to measure the "action space" for good governance:

> What are the priorities of good governance in any given society? What specific actions are needed, considering ongoing policies, programmes, and priorities? Who should carry out these key actions? Who are the appropriate actors? How can these actors be mobilised? How can their capacity to perform be strengthened? How can the required resources be mobilised? How can the necessary political support be obtained? How can the progress of actions be monitored? How can the sense of responsibility for good governance be strengthened?[110(p77)]

These questions may provide a way to analyze governance in any city regardless of the level of development. At a minimum, such questions point to the importance of clarifying the dimensions, goals, definitions, and sampling frame of urban governance before meaningful indicators can be developed. In the context of urban health specifically, much more thought must be paid to which aspects of urban governance are most salient to the urban health conceptual frame and how they can most easily be measured, given the range of settings and limitations of data availability. Until these connections and concepts are more clearly articulated, analyses will be incomplete.

Other Variables   RULER reviewed the reports and used the conceptual framework presented in Figure 2 under the section on "Disaggregation to Uncover and Address Health Inequities in Urban Settings." The group acknowledged a number of important measures that had been addressed extensively elsewhere, such as measures of poverty, land tenure, and health services. Two others of particular relevance to the urban population are noted here: physical hazards within households and food security.

Physical Hazards Within Households One puzzling question is why censuses and household surveys collect so few data on certain health hazards common in housing (particularly in housing occupied by low-income groups) when we know that they are significant for low-income populations. This may be because of a tradition of documenting visible, easily assessed physical aspects (e.g., permanent construction materials, earth or non-earth floors, provision for water and sanitation, main cooking fuel used) rather than health hazards or the occupants' experience of them and their impacts. Thus, there are few data about household and neighborhood health hazards that are known to have a significant health impact on large sections of the urban population in low- and in many middle-income nations. For example, we have never seen a conventional survey (including those on health) that questions households about accidental fires or injuries from burns or scalds (and who gets burnt and scalded). Nor do conventional household surveys include questions about households' experiences of flooding or extreme weather events, even though many studies have revealed how common it is for those in certain informal settlements to get flooded or be impacted in other ways by weather. These are events whose frequency and/or intensity are likely to increase in many urban locations with climate change. It might also be useful to include questions about other common hazards, for which other sources offer inadequate reporting, or none at all.

Food Insecurity and Hunger Food insecurity and hunger are examples of individual-level and population-level concepts that can be part of the measures for poverty but are not routinely collected in censuses and health surveys. This is an important urban health issue. From a quarter to a third of urban children in low-income nations are commonly found to be stunted. A study of ten nations in sub-Saharan Africa showed that the proportion of the urban population with energy deficiencies was above 40% in all but one nation and above 60% in three—Ethiopia, Malawi, and Zambia.[114] And, as noted above in the discussion of slum dweller-initiated surveys, there can be significant variation within and between poor communities.

Food insecurity refers to an individual's or family's anxiety about the possibility of depleting its food supply before it can afford to buy more and of experiencing severe food restriction (including weight loss due to insufficient resources). It is

measured directly, based on information gathered from interviewees. Usually, a unidimensional scale of the perception of food insecurity captures the progressive worsening of the situation through the intermediate levels where families rely on the distribution of decreasing amounts of food for its members, worsening nutritional quality and diversification of diet to reduce costs, and the deletion of some meals, with children spared in situations of lesser gravity. The questionnaire is derived from the scale proposed by Radimer et al.[115] which has been used worldwide to study food insecurity.

The Brazilian Food Insecurity Scale (EBIA), validated by Segall-Corrêa et al.,[116] consists of 15 questions requesting yes or no answers on the experience over the last three months of insufficient food at various levels of intensity, ranging from concern over food to spending an entire day without eating. Of the 15 questions, seven concern family members under the age of 18. Each affirmative response represents one point; thus, the totals range from zero to 15 points, with Safety as zero.

During an exploratory citywide survey named Project Health in Belo Horizonte, Southeast Brazil—"Projeto Saúde em Beagá (BH)"—which focused on particular aspects of food insecurity, 4,408 interviewees were asked whether "the food was ever gone before someone had money to buy more." The affirmative response, as conveyed in personal communication with Waleska Caiaffa (December 2010), was 24.4%. Of those ($n=1,077$), 45.4% decreased the amount of food in the meals, 23.1% were hungry but had nothing to eat, and 16% had lost weight because of insufficient food.

As noted in the Brazilian survey, items for measuring food insecurity include a measure of "hunger," which has long been considered a rural phenomenon, related mostly to food availability and to agricultural production. But hunger exists in urban areas, too. The relatively low reported prevalence of underweight in urban areas, for example, masks differences within cities across social groups and wealth quintiles, a strong indicator of socioeconomic status.[117,118]

In market economies, cities are characterized by "relative inequality," where poverty is measured by the opportunity and resource difference between the poor and the rich living in a clustered environment. Disposable income and food prices largely determine the amount and types of foods consumed by poor urban families. For the urban poor, hunger is manifested by the lack of money to purchase adequate food in terms of both quantity and quality.[116–118] Hunger is an intermediary between food availability (amount and cost) and malnutrition. As noted, it reflects the degree to which resources are distributed. Standard measures for hunger remain to be developed and tested to determine whether they can be useful in documenting resource distribution and projecting health in intra-urban settings.

PART IV: INDICATORS FOR URBAN HEALTH METRICS

Improving Urban Health Metrics Requires Acknowledging and Addressing the Politicalization of Data

As discussed in the first chapter, decentralization of government authority is viewed as an increasingly prevalent, as well as potentially promising, trend. Indeed, from a policy perspective, local decision making has clear advantages over centralized forms of governance. In many places, however, local leaders and planners are responsible for jurisdictions for which they do not have the appropriate level of data. More and more responsibility for health programs and services is being placed in the hands of

municipal or even smaller units of government, but without the experience, technical expertise, and spatially disaggregated data, they face a near impossible task.[37] To be truly effective, decentralized forms of government must match authority with the appropriate data and resources.

The lack of good intra-urban data creates significant problems for policymakers and community groups intent on addressing disparities. As Montgomery[37] explains, "When a disaggregated approach is applied to urban health, it brings to light gross inadequacies in the basic population and health information that ought to provide much of the evidence base for policy." Without good neighborhood-level data, decisions are more likely to be driven by political influence than by evidence of need. It is also true, however, that many policymakers would prefer that disparities remain obscure because, once disparities are identified, they face pressures to resolve them without always having the resources or political capacity to do so. Resolving disparities has both political and resource allocation implications that can be difficult for leaders to face in the zero-sum world of politics and budgeting.

As noted above, concepts and technologies for measurement are advancing capabilities for data collection and analysis in urban and especially intra-urban settings. But how boundaries are drawn, which people are counted, what data are collected, what types of information is accessible at what level—these decisions are all politically determined. National and district or municipal leaders have a stake in maintaining aggregated data that can reduce transparency and accountability for resource allocation and mask differences that could potentially affect political stability. Calls for good urban health governance called for in the recent round of reports from international agencies, as well as the global trend toward decentralization of government, require that these issues be addressed head-on.

Although this report focuses on metrics for developing countries, the examples provided here include New York City because it provides a rich array of information that illustrates the complexities in politicizing data.

Administrative Boundaries   Drawing geographic boundaries is technically challenging; it is also highly politicized. Most areas, particularly those with well-developed data systems, have multiple administrative boundaries that are used for a variety of purposes, many of which link data to these boundaries. In New York City, for example, we identified more than 18 different geographic units used by various levels of government to measure need, monitor progress, and allocate resources. Each boundary has its own administrative, technical, and political rationale, as well as history, and most have some interest group that lobbied for their construction and is invested in their continuation. These boundaries can be extremely useful tools for tracking change through time and exploring intra-urban differences. However, each also has different strengths and weaknesses and provides a slightly different slice of data. How boundaries are drawn, and which boundary is used for which analysis, can be used to either highlight or obscure disparities. For example, boundaries can be drawn to include wealthy (and healthier) neighborhoods along with poorer ones so that, on average, heath status appears fine, even though a different analysis might show disparities between the two areas. Furthermore, different boundaries each developed legitimately for different purposes ends up complicating the ability to the document relationships between conditions and health determinants.

Understanding how and why a particular geographic unit is used is of critical importance. Boundaries are often tied either to political representation or to resource allocation, making them enormously important in the distribution of

power. The level of contention over where, how, and by whom boundaries are drawn makes clear their significance. Elected officials in representative democracies, for example, have a strong vested interest in making sure that everyone in their district is counted and/or that the lines of their district are redrawn to include additional people or people likely to support them in an election. In New York State, for example, politicians argue over whether the 60,000 individuals incarcerated in prisons in upstate, rural New York are counted as residents in the county where the prison is located or in the cities in which they lived prior to incarceration. When they are counted upstate, these prison populations often skew the demographics, health indicators, and resource allocations in those regions. More important is that the loss of these populations from urban centers contributes to the defunding of those areas of extreme poverty that are disproportionately affected by high incarceration rates.

Politicians not only argue over who is to be included in a particular bounded space but they also go to extraordinary lengths to draw political boundaries so as to consolidate their power and diminish that of their rivals. Former New York Republican State Senator Guy Velella customized his own district so as to exclude the home of his former challenger. His district also includes the jail at Rikers Island—adding about 13,000 people. When Mr. Velella was convicted of bribery in 2004, he served his jail time there, in his home district. As the outline of his district suggests, the boundary was carefully drawn block by block to include ethnic whites who were his power base while excluding more recent immigrants to the neighborhood (see Figure 3).

Text Box: Boundaries abound in New York City

In New York City, crime data collected by police precincts are unrelated to educational attainment (analyzed by school districts), income (analyzed primarily by census tract and community districts), and health outcomes (generally analyzed by community health districts). Turning to political representatives to rationalize these systems only begets more confusion, as each level—city, state, and federal—has yet another set of administrative boundaries, each without a structured relationship to the others or to any of the other administrative units.

Although much health-relevant data are collected and analyzed in administrative boundary units, health phenomena and their determinants often do not fit easily into these boundaries, which are typically drawn for reasons other than resolving urban health issues. Infectious diseases cross boundaries; people cross boundaries. As Messer[119] notes, the geographic units in which researchers report findings are often based on data availability rather than on a conceptual framework. Administrative boundaries often artificially subdivide regionally based communities.[111] Moreover, neighborhoods can be defined both spatially and socially, and people's perceptions of "neighborhood" may or may not correspond to administrative boundaries.[120] Harpham[41] notes that, particularly in the North, researchers are

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Text Box: Vertical challenge or financial advantage?

In the USA, cities such as New York, with the highest HIV/AIDS case counts, are awarded funds directly from the federal government, but those same cases are counted again to calculate additional federal funds for states. Thus, states without large cities have less than half of the per capita funds for AIDS care than states with large cities.
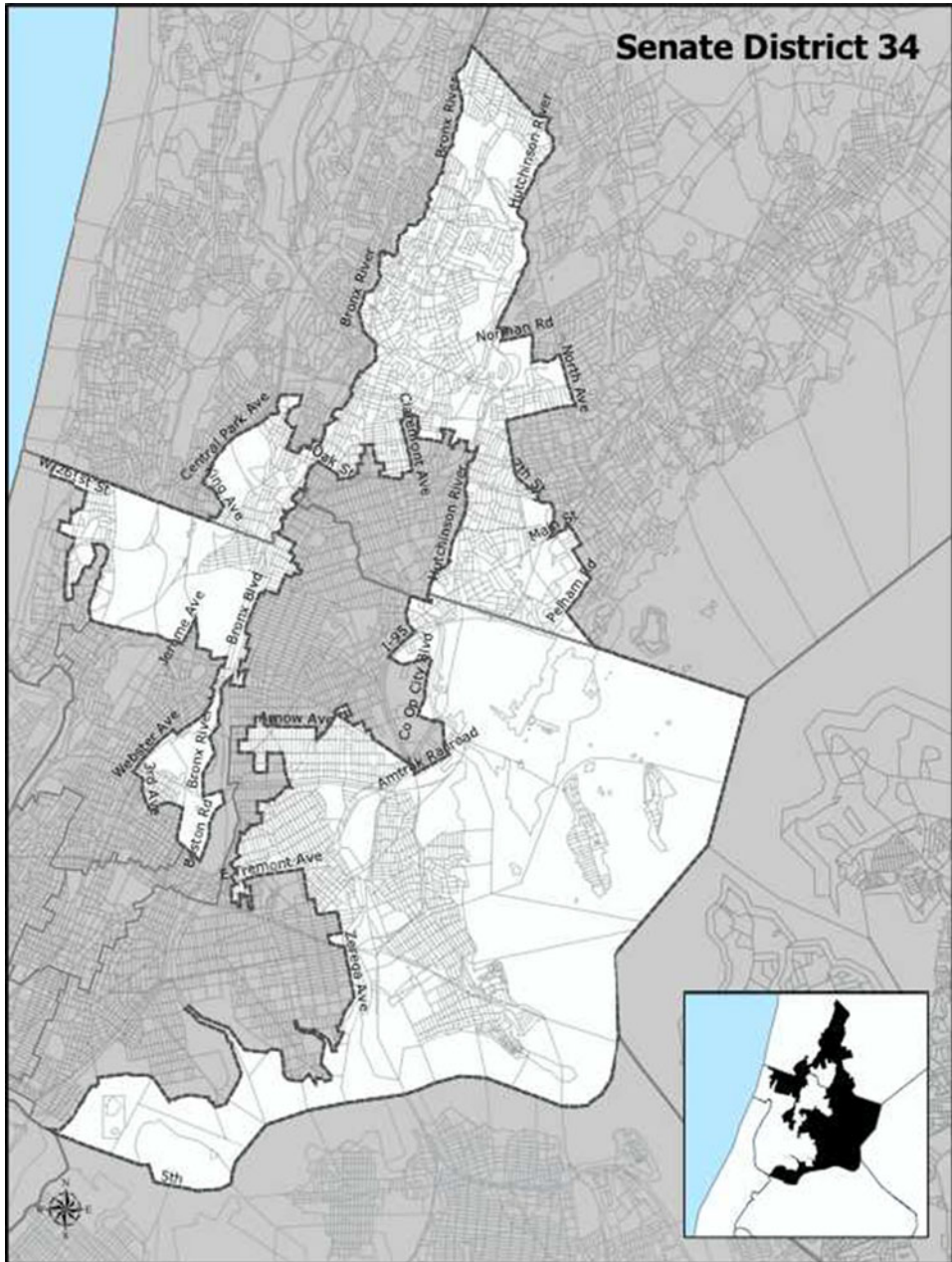
FIGURE 3.   New York State Senate District 34.

paying increasing attention to communities defined by social factors—such as religion, race, age, sex, sexual orientation, or type of work—rather than by geographic proximity. This gap between administrative boundaries and the health issue explored can deliberately or inadvertently skew findings. For example, as Mansfield and Wilson[121] explain, mortality data in the USA are coded by county and are unavailable at the congressional district level, creating a disconnect between public health and representative democracy. Mortality data can and have been calculated for congressional districts through weighting and aggregation of data and

could be used for both political and advocacy purposes, but to do so would require extra effort.

Besides being tied to political representation, administrative boundaries often have significant implications for the allocation of services and resources. Calculation of national, regional, and local aid is often based on population counts and other population-based measures of need within a given administrative boundary. In addition to direct funding based on counts, resources are often also allocated indirectly, based on the political power of elected officials from a particular region. In the USA, for example, lucrative government contracts and military bases often go to those areas with the most powerful elected officials. There, as elsewhere, city and county services—including education, publicly funded health care, sanitation, and police—are funded principally through property taxes and, in some jurisdictions, also through income and sales tax. This system of tying services to the tax base is a key mechanism for gross disparities between neighboring school districts in per capita spending per student. The same taxation and spending system has driven deep divisions between large urban centers and their separately incorporated suburbs.

In addition to the horizontal challenges involved in where and how boundaries are drawn at the municipal or intra-urban level, there are also vertical challenges in reconciling boundaries at the national, regional, and local levels. When more than one level of government is responsible for decision making over a particular geographic region, unless activities are well coordinated, conflicts and problems can easily occur.[111] Moreover, in political systems with multiple layers, deliberate and accidental double counting occurs, especially when tied to resource allocations (see text box).

Who Is Counted   Administrative data, in general, and census data, in particular, can be problematic because they are highly politicized. Because census data are generally tied to political representation and/or resource allocation decisions, many individuals and groups have a vested interest in being counted and/or in excluding others from the count.

The 2007 UN World Population Report[33] noted that the formation and growth of slums is still influenced by government leaders and planners who, unprepared for the flow of migrants into cities, left the areas unappealing and without services so as to discourage or reverse migration and growth.

Underlying this exclusion is the issue of how urban planning systems are developed and implemented and the extent to which data collected by these systems reflect or reinforce repressive systems. As Watson explains:

> …[I]n many parts of the world planning systems are in place that have been imposed or borrowed from elsewhere and in some cases these "foreign" ideas have not changed significantly since the time they were imported. Planning systems and urban forms are inevitably based on particular assumptions about the time and place for which they were designed, but these assumptions often do not hold in other parts of the world and thus these systems and ideas are often inappropriate (and now often dated, too) in the context into which they have been transplanted. Frequently, as well, these imported ideas have been drawn on for reasons of political, ethnic, or racial domination and exclusion rather than in the interests of good planning.… Planning therefore was, and still is, used as a tool of social segregation and exclusion.[122](p214)

To the extent that data systems mirror these interests, they can be a tool for exclusion and segregation. A classic example is censuses or health surveys that exclude slum dwellers who are then left out of planning and/or are ineligible for government services and resources. In developed countries, as well, government data are often used to reinforce systems of oppression. Daniels and Schultz describe how the US census, which is often used in health research, has historically reflected racist ideologies:

> In 1790, the U.S. Census included three categories: Free Persons (White, and all other free persons except Indians not taxed); slaves (counted as 3/5 of a person); and Indians living on reservations (not taxed). By 1850, categories had shifted to more explicitly racial language, denoting simply "white" and "free person of color." By 1890, an expanded range of racial categories included "white"; "black" (persons with ¾ or more Black ancestry); "mulatto" (1/2 Black ancestry); "quadroon" (1/4 Black ancestry); and "octoroon" (1/8 Black ancestry). By 1910, these categories had contracted to aggregate the previous distinctions in percent ancestry into just "white," "black," and "mulatto" categories.…And, of course, the U.S. racial paradigm of hypodescent means that a small amount of African ancestry overrides a much larger amount of European ancestry.[123(p89)]

Technical Challenges in Who Gets Counted Some populations, particularly slum dwellers, are undercounted because existing census methodologies could not be adapted to slum conditions.[124] The dearth of data about those most negatively affected by urban living conditions is especially problematic. By not counting slum dwellers, government officials can more easily deny the scope of the problem and direct resources to people they deem more desirable or deserving (Figure 4). In describing the Pune, India, slum census, Sen and Hobson explain what is at stake in being counted:

> Creating a census immediately provides the data to support the estimate that over 40% of Pune's population lives in slums. The census also serves to validate the existence of slum dwellers in the city, by providing concrete information about their residence in and contribution to the city. The second objective is raise awareness about slums and slum dwellers. It increases the visibility of the urban poor, not just as settlements, but as visible viable communities to work with. The role of the poor in the city as contributors to Pune's vibrant economy has to be accepted by municipal authorities. A change in attitude toward slum dwellers is a first stage toward recognition that poor women and men cannot be excluded from urban resources to which other residents have access, such as allocation of land, security of tenure and credit for housing.[125]

Many other "invisible" groups are eager to gain legitimacy, representation, and resources by being counted (see Text Box).

While the text thus far has focused on government exclusion of individuals or groups, in fact, some individuals may want to avoid the census for a number of reasons. For example, fear of privacy and linkage to other governmental agencies
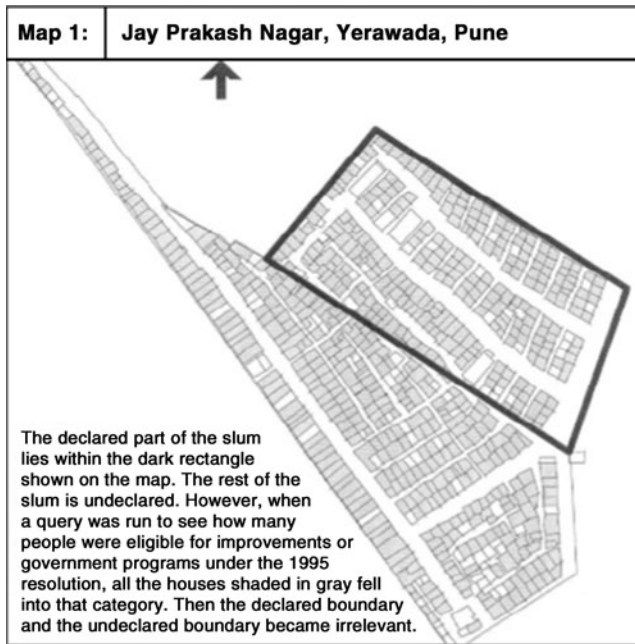
Map 1: Jay Prakash Nagar, Yerawada, Pune

The declared part of the slum lies within the dark rectangle shown on the map. The rest of the slum is undeclared. However, when a query was run to see how many people were eligible for improvements or government programs under the 1995 resolution, all the houses shaded in gray fell into that category. Then the declared boundary and the undeclared boundary became irrelevant.

FIGURE 4.   Consequences of declared slums.

cause those who are not legally documented or who are living in illegal housing situations to avoid the census. In addition, a number of stigmatized identities, conditions, or family structures may cause people to avoid the census. In some parts of the world, such as the Czech Republic, fears about breach of privacy and government corruption have led to open calls to refuse participation in the census.[126]

Text Box: Counting stigmatized groups

For the first time in the centuries-long history of the United States census, the number of same-sex couples who self-identify as married—license or no license—were collected in the US 2010 census. This change was heralded by gay, lesbian, and bisexual rights activists as a positive step in official recognition of same-sex relationships, and they urged their constituencies to participate in the census and identify their relationships. However, as with other stigmatized groups, privacy of census data was a concern and the government launched an outreach campaign to assure people that the census information cannot be shared with law enforcement, the military, or immigration officials.

Demand for Data and Transparency   Another issue, besides that of who is being counted, is that of the demand for data ownership as well as the transparency of, and access to, data. This entails the articulation of a local government need for data to motivate and monitor action. This has technical and political components. At one level, it is a matter of a local government's obtaining data from the national level. There may be technical issues such as system capability at either end, i.e., at the national and/or local levels. To address the technical barriers to the demand for the data, the WHO National Statistical Strength program was developed. It provides assistance using sub-regional workshops to shape nations' upcoming census and information technology systems. The Research and Policy in Development of the UK

Overseas Development Institute provides training in translating knowledge into policy in LMIC settings. International pressure is needed to support these efforts to embrace a "Health Tracer" approach that demonstrates benefits for the entire urban population of the access and use of local data.

Data may be invisible for a number of reasons. One is limited budgetary and technical resources. As governments decentralize, they can pass along responsibility to the local setting both to reduce the cost of central government and to provide data that are responsive to local circumstances. A key question, however, is what resources go to the local setting to carry out this information gathering, management, and analysis? What resources does the national government have for itself?

Another reason for invisibility of data is "ownership of the data." Governments collect data under the condition of public trust, where it is taken as a given that individuals cannot be identified. Individual data that are finely grained can challenge this public trust. National and local governments need to be sensitive to this concern, balancing it with the need to generate data to drive and monitor local action.

At a more basic level, data is power and larger political aggregations preserve the status quo, stifling potential tensions by disempowering a segment of the population. A finer-grain resolution could expose disparities that would be the basis for the reallocation of resources.

From Urban Health Metrics to Action   Translating metrics of urban health into action is a process that is not well described in literature. Indeed, change happens at multiple levels and is driven by a range of different actors, including academia, the disadvantaged community, civil society and advocacy organizations, and policymakers. Those using metrics to influence change need to be cognizant of these different audiences and realize that different arguments are persuasive to different groups, just as some metrics will resonate more powerfully than others depending on the audience. In general, however, most meaningful change happens both from the bottom up and from the top down. Urban health researchers and advocates must, therefore, be prepared to translate their work into language understood by multiple audiences. One central strategy underlying effective efforts to translate metrics into action is the early and consistent involvement of stakeholders. This builds consensus and support for the long journey.

The following steps were learned from the experience of the UHRC, an Indian nonprofit organization that aims to bring sustainable improvements in maternal and child health among the urban poor, through a consultative and knowledge-sharing approach in partnership with the government and civil society.[128,129]

1. Bring trustworthy and credible evidence to describe the challenge of urban health to administrators and policymakers.

   Evidence of the numbers of urban poor and the problems they face (e.g., health outcomes) can be persuasive to public officials. However, researchers and advocates must carefully evaluate what kind of data will be viewed as trustworthy and credible. For example, in India, data from and supported by Indian stakeholders are not likely to be appreciated because they are viewed as the perspectives of academia and civil society within the country. However, in some parts of the world, data generated or endorsed by the United Nations are seen as much more valid and acceptable than data generated in-country officials or groups. Understanding the local context is critical to assessing what kinds of data to use. In India, disaggregated DHS data were used to bring attention to

the health and living conditions of the urban poor and help administrators and other stakeholders appreciate the disparities within urban India. The other form of data which was found to be powerful was spatial data (or maps), depicting the poverty habitations within a city and including those which were not part of official slum lists. The process of generating the city maps was done along with city administrators to get their buy-in right from the start.

2. Review existing government documents to identify policies helpful to the cause which served as leverage points

A review is important to understand the point from which one starts and will also identify points of leverage. For example, in India, the National Population Policy published by the Ministry of Health and Family Welfare stated that there were a 100 million urban poor in India. This estimate in an official policy document was useful in getting policymakers' attention. In addition, in many countries, it is important to align any new programs or policies with existing policy frameworks. This may be especially true in countries with strong and well-developed bureaucracies that are resistant to change. However, in other countries, a new administration may be looking for a break from the past and want radically new programmatic or policy ideas. In addition, the level of control the politicians have over bureaucracies and civil service varies by country and sometimes by jurisdiction. Again, knowing the local political context is important.

3. Use few, simple, compelling messages to policymakers and media.

Bureaucrats and policymakers are not likely to absorb complex data or information, nor are the media likely to be interested in such presentations. Rather, they are more likely compelled by simple figures that demonstrate the scope of the current problem, increases in urban poor populations, and what will happen if no action is taken. Intra-urban disparities are also compelling using simple messages such as an urban poor child is twice as likely to suffer from chronic undernutrition as compared with a child from a rich urban segment.

4. Express the metrics in a catchy or dramatic way.

Images such as maps or graphs are often more effective than words for expressing the problem in a striking way. For instance, nearly half of all child births in slums take place at home, one in every two urban poor children under five years of age is stunted, only two out of every ten urban poor households have piped water access.

5. Bring together diverse stakeholders to support the agenda.

Researchers talking to politicians are generally much less effective than a diverse group of key stakeholders engaging in such an interaction. The more one can demonstrate wide support for one's cause, the more likely officials are to appreciate and be responsive. One way to start is by identifying active voices, e.g., academia, retired civil servants, or advisors to major federal government ministries, to help host a series of consultations where there is exchange of information, views, and building of consensus around the cause, issues, problems, and priorities.

6. Documentation within the government system

Since government systems work on written documents, it is critical to document as many steps documented as possible. This also ensures continuity in event of transfer of the concerned bureaucrats and can be done unobstructively

by way of minutes/proceedings of meetings or letters from city/state/national official to call a meeting for the discussion of a crucial subject.

7. Study tours of officers to model programs

    When officers at national and/or state levels observe a program and understand it directly during a study tour, it helps propel the agenda more forcefully. Also, it provides an opportunity to get community action and voices heard directly during such a study tour.

8. Create opportunities for community stakeholders to speak directly to civil servants and political leaders.

    Some of the most powerful voices are those directly affected. It is important to create opportunities and platforms where community representatives from slums interact directly with officers at city, state, and national levels. Having a panel discussion where officers act as chair, co-chair, and moderator, and civil society actors and slum community representatives are panelists has been proven to be a useful approach toward this end.

9. Get the message out widely to build stronger agenda across different sectors.

    If political leaders and government officials begin to hear about the same issue from multiple sources, they are more likely to respond. Getting the word out through conferences, seminars, and professional associations can give added credence to the importance of an issue. In addition, multiple mentions in the media can lead to questions in the legislature that are part of official record and require an official response from lawmakers. However, to be effective, one needs to vary the messengers so that people hear about the issue from different quarters. Using the media can be particularly effective.

10. Plan for a persistent, long-term effort with key policymakers.

    Facilitating policy change or substantial improvement can be a time-consuming and slow process, making it especially critical to have a multistep process that creates opportunities for small successes. In India, for example, community groups worked toward getting officials to certify the community maps. This involved holding three to five consultations and trying to get the chief administrators involved (e.g., City Health Officers and Deputy Health Officers). Several national and state-level consultations involving stakeholders mentioned above, as well as key officials of concerned Ministries, helped maintain the momentum and served as reminders for the cause. Intermediate successes included facilitating constitution of a task force to suggest guidelines for the cause (urban health); having a circular issued to states to prepare maps of all cities with listed and unlisted poverty clusters plotted is vital to build on each next step.

11. Remain flexible and responsive to the policy formulation system.

    All through this process where urban health metrics are being utilized through different approaches to propel real action in terms of policy, it is crucial that facilitators remain flexible yet fairly assertive on causes, and also that they learn the skills to be responsive to bureaucracies so that trust is built and cemented brick by brick.

    These approaches resulted in increased attention to Urban Health evidenced through: recommendations of a national government task force;[130] increased budgetary allocation for Urban Health, the Indian Government's National Slum Health Project Guidelines; publication of India-DHS official urban health report based on data for eight large cities;[131] and the drafting of a dedicated National Urban Health Mission.[132,133] The efforts on

enumeration and mapping of the uncounted led to the Ministries of Health and Housing and Urban Poverty Alleviation mandating all state governments to prepare city maps with listed slums, unlisted slums, and hidden poverty clusters marked on city maps along with resources.[134] This brought the hitherto 50% of the slums not part of official lists on the policy and program radar bringing justice to this very large segment of urban India's less fortunate population.

Fortunately, There Exist Internationally Recognized Platforms that Can Address These Technical and Political Challenges and Build on These Opportunities

There are a number of existing platforms to optimize opportunities, address challenges, and make development sustainable for urban health metrics. The Health Metrics Network (HMN) and the Institute for Health Metrics and Evaluation (IHME) are two networks that are organized around large-scale metrics for health. Each has enormous strengths in terms of technical expertise and political buy-in. Neither has put a major focus on measuring and considering the urban environment and its impact on health, but the potential is there. This chapter reviews these two platforms in terms of their strengths and potential for incorporating urban environment measures to stimulate further action for health beyond health care, especially in informal settlements (slums). In addition, it describes major resources for standardizing measures and methods for health metrics, the WHO Indicator and Metadata Registry and the Statistical Data and Metadata Exchange Health Domain (SDMX-HD). Finally, this chapter concludes with an ongoing international resource for urban health metrics: the UN-HABITAT GUO.

Health Metrics Network   Health information systems are woefully inadequate in many developing countries. Some of the most basic information, such as vital records, is not in place or is poorly documented, much less accessible, at the national level. HMN is an international project housed at the WHO with support from multiple donor agencies to achieve a single strategic goal: to increase the availability and use of timely and accurate health information. To achieve this goal, HMN identifies strategies for health information systems (HIS) development and strengthening; supports countries in implementing HIS reform; and increases knowledge about global public goods through research, technical innovation, and sharing lessons learned. To achieve this, HMN has three objectives: (1) Create a harmonized framework for country HIS development (the HMN Framework), which describes standards for country health information systems; (2) Strengthen country HIS by providing technical and catalytic financial support to apply the HMN Framework; and (3) Ensure access and use of information by local, regional, and global constituencies. Now in its second edition, the HMN Framework and Standards for Country Health Information Systems (HMN Framework) defines the systems and standards needed at both national and global levels for HIS strengthening. The HMN Framework serves as the foundation of HIS, describing the rationale and methodology needed to assess and implement strategies to ensure that accurate, reliable information is collected and used.

To meet its objectives, the HMN has developed and implemented the HMN Assessment Tool which facilitates the process by which countries compare performance with objective standards for health information and provides the basis for the

evaluation of country health information systems. The tool consists of a stand-ardized questionnaire of specific criteria, against which the current health information system is evaluated. The tool provides a baseline assessment and diagnosis of critical gaps in health information results, processes, context, and resources; it also serves as an ongoing monitoring tool to gauge performance and achievement. An assessment using the HMN tool is a requirement for all countries receiving HMN support. Based on the results of the assessment, key performance gaps and problems are given priority attention to guide strategy to strengthen HIS. HMN provides technical and financial support to countries to strengthen their health information systems. While HMN's role is not to be a primary source of funding, HMN financial support enables countries and partners to convene stakeholders, develop plans, mobilize resources, and ensure assessment and monitoring of progress.

HMN supports a range of activities that address the health information system as a whole, including its various subcomponents. Country plans for strengthening health information system can include activities to enhance the legal and contextual underpinnings of the health information system, the performance of critical data collection methods, and the availability and quality of data for essential health indicators, including those associated with the MDGs. HMN funding will lead to increased networking among in-country, regional, and global partners, which will enable information sharing and dissemination, standardization, and harmonization. HMN funding will also support enhanced data use, including synthesis and analysis of information and linkages to prioritization, planning, and budgeting as part of evidence-based decision making for health. Financial support is provided to LMICs with the greatest need in terms of health information systems development, the strongest national commit-ment to change, and the most supportive partners.

In 2007, Resolution 60.27 of the 60th World Health Assembly urged stakeholders, including international bodies, the public and private sectors, and health information and statistical communities, to use the standardized norms and guiding principles of the HMN Framework to strengthen their health information systems. Today, more than 80 countries use the HMN Framework. Figure 5, below, shows the main components of the framework.

One of the great challenges of this integrated approach to health information systems is aligning donor and agency demands on information. In January 2010, the eight most relevant agencies working in global health—the Bill & Melinda Gates Foundation; GAVI; the Global Fund to Fight AIDS, Tuberculosis & Malaria; UNAIDS; UNFPA; UNICEF; the World Bank; and the WHO (HMN)—agreed to strengthen at the local level the five key data sources of information: surveys, birth and death registration, census, health facility reporting systems, and surveillance and administrative systems.[143]

HMN and Urban Health Two points are noteworthy when the HMN is viewed in the context of urban health metrics. Neither should be viewed as a criticism of HMN, which is focused on addressing the large and important problem of building and sustaining competent health information systems, especially in LMICs.

First, despite the appropriate emphasis on health metrics such as vital status, disease prevalence and incidence, workforce, and resources for curative and preventive service, reference to urban environment variables that influence health
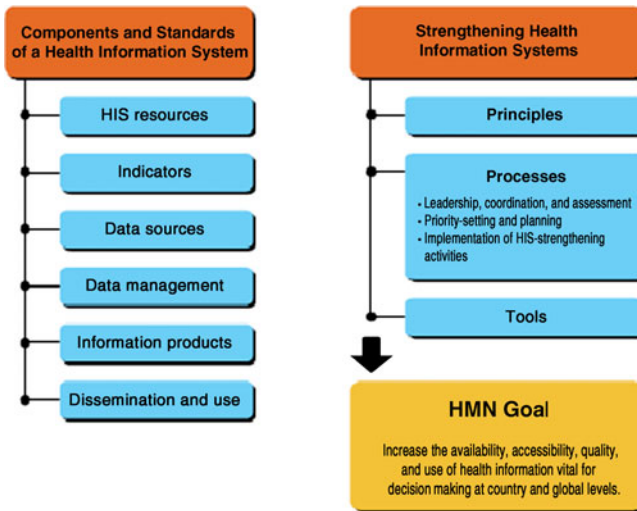
FIGURE 5. HMN framework components. Source: http://www.who.int/entity/healthmetrics/documents/framework/en/index.html.

is lacking. The centerpiece of the 2010–2011 Biennial Strategy adopted by the HMN Board was presented as "MOVE-IT for the MDGs," a new initiative that will harness information technology to improve systems to manage pregnancies, record births, deaths, and causes of death, and enhance measurement of progress toward the health-related MDGs. Civil and vital events registration systems lie at the heart of a sound and viable national health information system, but have received little global and national attention and investment in recent decades. While the HMN document refers to sources of data, such as the census and national surveys, that can provide information on environmental factors, acknowledgement of the need to nudge partners to incorporate such data when addressing determinants of health is nowhere explicit. Measures of environmental risks and non-health amenities that affect health also receive scant attention.

Second, HMN is framed around countries, with attention paid to enumeration units that are expressed as national-, regional-, and district-based; no explicit mention is made of urban or intra-urban units of analysis. This was expressed at the July 2010 HMN meeting where the Board adopted its 2010–2011 Biennial Strategy. Dr. Jaime Sepulveda, Director of Integrated Health Solutions Development at the Bill & Melinda Gates Foundation, who sits on the HMN Board, said, "HMN's new strategy reflects the shared vision of global and country players investing in national information systems to improve health." Although these urban and intra-urban elements are not addressed in the HMN Framework, the RULER group sees an opportunity to build more explicit elements of urban health (i.e., health beyond health care) onto the existing HMN framework to make it a richer multi-sectoral tool for policy making.

HMN and Urban Indicators Although the HMN Framework does not use the words "urban health," it addresses some of the same domains of health measurement used in urban health. For example, data from the census provide population health variables (such as indicators for poverty) and with addresses, for those who have them, the potential for disaggregation by intra-urban units. All that is needed is to explicitly include the urban health component in the next version of the Framework by adjusting, and perhaps extending, some domains beyond health. In

addition, novel elements from other sectors beyond health, such as environmental audits (e.g., surveys of housing, vacancy, and amenities), would be valuable in assessing disease prevention and health promotion from an SDH perspective. The new edition of the Framework is in development, providing an opportunity to make this enhancement.

HMN and Disaggregation A major theme of this report is the importance of creating and using disaggregated data at the urban and intra-urban levels. As HIS systems are built and refined, attention to recording and coding geospatial coordinates will enhance the value of the data for public health and urban management systems. In many developing countries, the ability to develop and refine health information systems will most likely be feasible first in urban settings. By emphasizing the delineation of urban and intra-urban areas, countries will show evidence of feasibility and progress in building effective health information systems that can then be scaled up countrywide.

The Health Information System Maturity Model Countries differ in their readiness to adopt and refine health information systems; not all can be expected to be at the same stage. The President's Emergency Program for AIDS Relief (PEPFAR) and HMN have worked together to articulate a maturity model (MM) for the development of national health information systems. The advantage of an MM is that countries can identify where they are in the model and what phases or stages are necessary to move toward a fully mature model. The model has six axes: governance, multi-sectional engagement, strategic planning/financing, system and data interoperability, information use, and infrastructure. Each axis is described according to a crescent maturity model, as shown in Figure 6, kindly provided as a personal communication by Mark Landry from PEPFAR (March 6, 2010). In the figure, a country is considered mature in terms of its health information systems when it has an articulated and coherent strategy, with the involvement of different government sectors, and with clearly defined standards that guarantee data sharing and information sharing to support decisions and planning.

Adding Geospatial Dimensions to the HIS Maturity Model Following up on the discussion in previous chapters, we suggest that the MM can be extended on two dimensions: disaggregation and the incorporation of measures of health determinants. For the first, the model could be extended to include a row topic of "Disaggregation." The earliest stage of maturity might be the use of remote sensing techniques, followed by slum surveys, and then access to and use of census data at the intra-urban level. For the second, the model could be extended to include a row topic of "Measures of health determinants." The earliest stage of maturity might be the use of individual and family household variables from the census, maturing to the incorporation of administrative data from non-health sectors (e.g., transportation, crime/violence), toward collection of new data such as environmental audits. The value of the Measures of Health Determinants will be enhanced if examined in conjunction with the development and then utilization of disaggregation measures.

In summary, the HMN builds local capacity to produce routine administrative data. Defining a limited set of indicators that includes measures of disaggregation that are especially relevant to urban health is likely to be an imperfect exercise, given the wide and varied dimensions that must be considered. If metrics for action are to
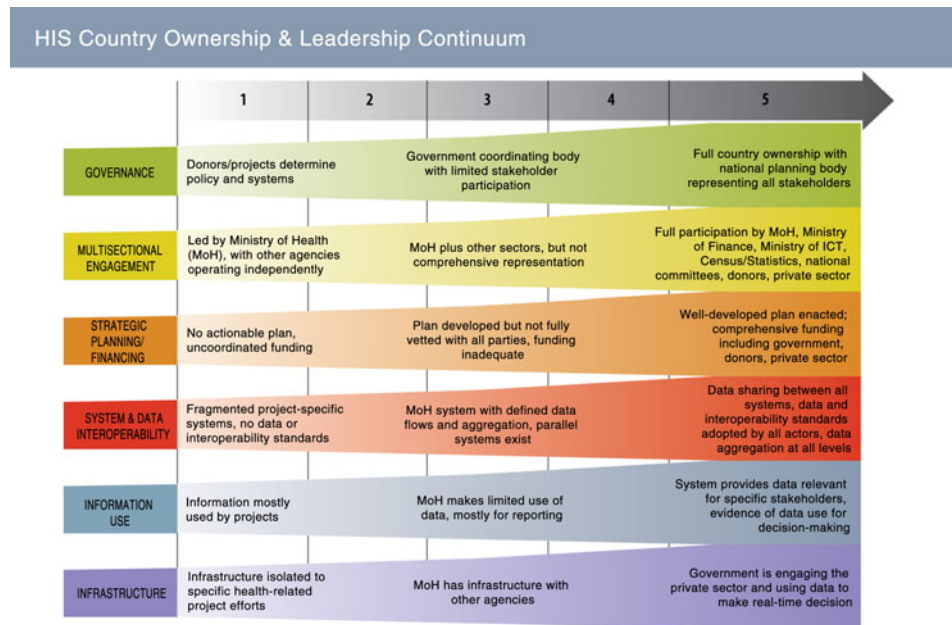
FIGURE 6.   The HIS country ownership maturity model (M. Landry, PEPFAR, 2010).

be developed, however, it is important that policymakers—including government and civil society officials—are presented at the outset with a comprehensive yet concise set of indicators to consider. These indicators should provide sufficient information to generate debate on the setting of priorities for action in all contexts; they should also help identify areas or domains requiring in-depth analysis to suit the local context. Although there is no universal algorithm to address this issue, RULER has reviewed and presented information from international reports to determine an appropriate set of indicators that can then be included in HMN.

Standardizing Measures for Cross-National, Inter-urban, and Intra-urban Comparisons: The WHO Indicator and Metadata Registry and the SDMX-HD[*]   The WHO Indicator and Metadata Registry (IMR) is an attempt to leverage the strengths of knowledge in data exchange and in monitoring and evaluation (M&E) to build a more mature infrastructure for managing indicator definitions. Together with HMN, it is a key initiative in the development, management, harmonization, and distribution of indicator definitions. The IMR provides the missing link between M&E analysts and software developers (http://www.sdmx-hd.org/projects/show/imr). With international standards for metadata and semantic content, indicator definitions can be shared and implemented in multiple computer systems. Complete data dictionaries can easily be prepared—a historically labor-intensive (and thus neglected) task that promotes data comparability. An added benefit of centralized indicator management is the assignment of global identifiers, which facilitates data aggregation and report preparation at national and international levels.

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[*]This section was kindly provided by Patrick Whitaker, Technical Officer, Health Informatics Unit, World Health Organization, and one of the coordinators of the IMR and SDMX-HD initiative.

To facilitate the exchange of indicator definitions and data in aggregate data systems, the SDMX-HD was created. SDMX-HD makes software development more cost-effective by leveraging an existing application's functionality, e.g., geographic mapping (for areas that are mapped), and eliminating costly data mapping between systems. Through web services, applications can access these definitions directly over the Internet, enabling the use of common indicator definitions among disparate systems (http://www.sdmx-hd.org).

Analysts from different organizations or reference groups can use an Indicator Registry to harmonize indicator definitions, which can then be loaded into computer applications from a computer-readable format such as SDMX-HD. An indicator management infrastructure improves the ability to define, collect, and analyze indicator data. The accuracy and timeliness of analyses will improve as variant definitions converge and data moves in a more streamlined manner via automated international reporting. It is therefore essential to explicitly represent urban health needs in the HMN Framework and to have the core indicators from urban health included in the WHO Indicator Registry.

The Institute for Health Metrics and Evaluation   The IHME is an independent research center at the University of Washington that rigorously measures the world's most pressing health issues and provides scientific evaluations of health system and health program performance in order to guide health policy and accelerate global health progress. As noted in their description, their research focuses on health outcomes, health services, resource inputs (health finances), decision analysis (including sub-national disparities), evaluations (policies, interventions, programs relating to health system performance), and development of tools and instruments to harness data in health information systems and locally available resources.

With support from the Bill & Melinda Gates Foundation, the IHME has projects on health metrics that include Burden of Disease, Malaria, Disease Control, and the "Population Health Metrics Research Consortium Project." The latter is a multi-institutional project whose goal is to improve strategies for population health measurement and produce instruments that are science-based, standardized, and widely applicable across different resource-poor settings; to provide data and resources that will be the basis for rapid and effective field assessment of population prevalence of specific diseases and causes of death; and to enable policymakers and researchers to address persistent inequities in health outcomes in both the developed and the developing world. Activities include developing methods to measure mortality where vital registration methods are incomplete, to measure cause-specific mortality where cause of death coding is incomplete, to measure prevalence and incidence of major diseases, and to measure effective delivery of priority health interventions.

Although IHME materials refer to methods for addressing sub-national disparities, which is in the spirit of the international agency reports summarized in "Disaggregation to Uncover and Address Health Inequities in Urban Settings" of this report, the information available on the institute's web site (http://www. healthmetricsandevaluation.org) does not speak further to the themes raised here, namely disaggregation at the level of intra-urban comparisons, including measures of the urban physical, social, service, and governance environments. More recently, IHME has produced work on small-area analysis at the county level within the USA.[127] This is in the direction of developing and testing methods that can be

applied to intra-urban comparisons within developing countries. The Institute could be an important resource to advance metrics for health in the urban setting.

UN-HABITAT Global Urban Observatory   The GUO was established by UN-HABITAT in response to a decision of the United Nations Commission on Human Settlements to call for a mechanism to monitor global progress in implementing the Habitat Agenda and to monitor and evaluate global urban conditions and trends. The three main work areas are assistance to governments, local authorities, and organizations of local civil society to amplify their ability to collect, manage, and maintain and use information on urban development; enhancing the use of knowledge and urban indicators for policy formulation, planning, and urban management through participatory process; and collection and dissemination of results of global, national, and city-level monitoring activities, as well as dissemination of good practices in the use of urban information worldwide. The GUO provides technical support to form Local and National Urban Observatories (LUOs and NUOs, respectively) which comprise governmental agencies, research centers, and educational institutions that are designated as the "workshops" where monitoring tools are developed and used for policy making through consultative processes. Technical support is provided for the development of urban indicators, training (e.g., GIS), design and analysis of surveys (including the Monitoring Urban Inequities Survey), archiving data (i.e., UrbanInfo), and networking between observatories. An LUO or a city or town is the focal point for urban policy development and planning where collaboration among policymakers, technical experts, and representatives of partner groups is fostered. Networks of LUOs are facilitated by NUOs where necessary. NUOs coordinate capacity-building assistance and compile and analyze urban data for national policy development.

CONCLUSION

Reports from a variety of international agencies have established the need to make health inequities in urban areas a public health priority at the beginning of the 21st century. Earlier pronouncements such as the MDGs did not emphasize "urban"; in fact, they tended to emphasize rural development. This reflects the fact that at the time the MDGs were developed, most people in LMICs lived in rural areas and that data aggregated as "urban/rural" showed worse outcomes in rural areas. With the projection showing that the majority of people in LMICs will be living in urban areas after 2020 and that disaggregated data are emerging to show areas in urban settings that have worse health outcomes than their rural counterparts, the time to act is now. As this and other reports make clear, meeting the MDGs requires addressing the inequities in the urban context. Now is also the time to look beyond the MDGs toward developing the next set of goals that will take up this challenge.

Vanguard cases demonstrate refined urban environment health metrics that are used to shape policy and create programs to tackle health inequities in urban areas. One example is Belo Horizonte, Brazil, which has incorporated remote sensing and GIS mapping to identify areas of concentrated disadvantage, as defined in their Index of Vulnerability using census data. These data are used directly in the participatory budgeting process to allocate resources in a way

that is directed toward alleviating health inequities. Their work is described briefly in the box below.

As the Belo Horizonte case study shows, methods and measures exist for detailing the areas of concentrated disadvantage associated with poor health; but for them to be implemented in low-resource settings, additional work is needed in terms

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Text Box: Belo Horizonte, Brazil: Data for social action

In Belo Horizonte, Brazil, quantitative measures were used to create three indicators about various dimensions of cities. The Quality of Urban Life Index is an intra-urban index currently composed of the following multi-variable indicators: (1) Supply, (2) Culture, (3) Education, (4) Housing, (5) Urban Infrastructure, (6) Environment, (7) Health, (8) Urban Services, and (9) Security. This indicator, along with population information, was used to help allocate resources as part of a participatory budget (PB) process. Fifty percent of the total budget is divided equally among nine city regions; this is to ensure that some less populated regions that have a higher average income but also have slums receive at least some project funding. Allocation of the other 50% of the PB is based on a score derived from two measures: the population size and the Quality of Urban Life Index *for each planning unit*. By supporting democratic participation of the population through PB, the initiative was able to advance a new model of governance and develop several interventions in the city with public health implications. The participatory budgeting process is weighted toward services and infrastructure for the most vulnerable populations. Evidence showed that resources were distributed in such a way as to address the more vulnerable populations.[24]

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of refinement and affordability. Fortunately, international attention is now focused on this issue and structures are already in place that can prepare national and municipal managers to plan and execute action to make "urban" a healthy place.

While this report has identified the urgency of taking on better measurement in an increasingly urban world and has highlighted an existing framework of international platforms, concluding that the agencies responsible for these platforms will prioritize interest and resources to produce effective and efficient metrics for action is insufficient. There is limited evidence from these international agencies to follow through on recommendations that came from earlier reports such as the National Research Council report in 2003. The potential should be developed with explicit foundation support to formalize in conjunction with appropriate international agencies a limited consortium of six cities in LMICs using the Belo Horizonte Urban Health Observatory (UHO) as a model. The strength of the UHO is that it is a partnership of government, academia, and civil society that develop meaningful local level data primarily for action on health determinants within the urban environment. The consortium members and collective can be charged to develop, test, and validate model urban health metrics with sufficiently disaggregated data and key variables that are valid and are not cost prohibitive for planning and managing urban health at the local level.

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