

Global urbanization and impact on health

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Abstract

Nearly half the world's population now lives in urban settlements. Cities offer the lure of better employment, education, health care, and culture; and they contribute disproportionately to national economies. However, rapid and often unplanned urban growth is often associated with poverty, environmental degradation and population demands that outstrip service capacity. These conditions place human health at risk. Reliable urban health statistics are largely unavailable throughout the world. Disaggregated intra-urban health data, i.e., for different areas within a city, are even more rare. Data that are available indicate a range of urban health hazards and associated health risks: substandard housing, crowding, air pollution, insufficient or contaminated drinking water, inadequate sanitation and solid waste disposal services, vector-borne diseases, industrial waste, increased motor vehicle traffic, stress associated with poverty and unemployment, among others. Local and national governments and multilateral organizations are all grappling with the challenges of urbanization. Urban health risks and concerns involve many different sectors, including health, environment, housing, energy, transportation, urban planning, and others. Two main policy implications are highlighted: the need for systematic and useful urban health statistics on a disaggregated, i.e., intra-urban, basis, and the need for more effective partnering across sectors. The humanitarian and economic imperative to create livable and sustainable cities must drive us to seek and successfully overcome challenges and capitalize on opportunities. Good urban planning and governance, exchange of best practice models and the determination and leadership of stakeholders across disciplines, sectors, communities and countries will be critical elements of success.

Key words: Global health – urban health – environmental health – cities

Introduction

Cities play a vital role in the social fabric of countries and in national and regional economies worldwide. In theory and in popular opinion, cities offer opportunities for education, employment, services,

and cultural enrichment, and the expectation of better health. In reality, these opportunities may not be as uniformly promising as hoped.

On one hand, national income and level of human development are strongly and positively correlated with level of urbanization (UNCHS, 2001). Urban

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areas in almost every country account for a disproportionately large share of gross national product (GNP). For example, Bangkok produces 40% of Thailand's GNP but has only 12% of its population (UNEP, 2002). As a whole, cities in the developing world account for 50 to 80 percent of their nation's respective GNP (UNCHS, 1996). Child survival rates may be better in cities than in rural areas because of better access to health care (UNCHS, 2001). On the other hand, rapid and often unplanned urban growth is also associated with settlement on marginal land, environmental degradation, and population demands that outstrip environmental service capacity, such as drinking water, sanitation, and waste disposal and treatment. Unemployment is also common, especially among the burgeoning populations of peri-urban poor. Urban poverty is a fundamental problem associated with rapid urbanization, particularly in developing countries. The United Nations Environment Program (UNEP) noted that "Managing the urban environment sustainably will therefore become one of the major challenges for the future" (UNEP, 2002). However, the importance of cities in national and global economies, and the inevitability of increasing urbanization create an imperative to achieve livable and sustainable cities. Well-managed cities offer better economies of scale in terms of land use, environmental resource and service efficiency, and proximity to services (UNEP, 2002).

Urbanization trends and patterns

"Cities" or "urban areas" have been defined in different ways. A functionally useful definition should address demographic, geopolitical and social dimensions of such population settlements. Two common definitions involve settlements with populations of at least 2000 or 5000. Some countries distinguish between rural and urban settlements based on a threshold as low as 200 or as high as 10,000 residents. Global urbanization data are often based on self-reporting and thus are not necessarily based on criteria strictly standardized across countries. Nonetheless, available data portray a world that is becoming increasingly urban in nature, with more and larger cities in all geographic regions. The percentage of the global population residing in urban areas has increased from 32% in 1955 to 38% in 1975 and 45% in 1995 (WHO, 1998). The most recent estimate from 2002 is 47%, with projected growth of 2 per cent per year between

2000 and 2015, yielding approximately 65% by 2015 (UNEP, 2002).

The number of cities with a population greater than 1 million has increased sharply over the past half century. In 1955, there were 90 such urban agglomerations with 26% of urban residents in cities of at least this size; by 1995 there were 336 such cities, with 36% of the world's urban population (WHO 1998). While nearly half of the world's people now live in urban centers, the proportion of the world's total population residing in urban areas of greater than 1 million increased from 12.8% in 1975 to 18.5% in 2000 (UNPD, 2001), with an additional approximately 30% in smaller urban settlements. Developing countries experienced the greatest growth in number of cities with greater than 1 million population: between 1970 and 1996, from 83 to 221, compared with 82 to 115 in more developed countries. Megacities (greater than 10 million population) have also been on the rise in the past half century. In 1950 only New York City had a population greater than 10 million. By 1995 there were 14 megacities, with projections of 21 megacities by 2015 (WHO, 1998). Current data indicate 18 cities with a population of greater than 10 million (UNPD, 2001).

Increasing city size creates environmental challenges independent of the commercial and personal activity within the limits of the city. Location near desirable natural resources, such as a river, lake or prime agricultural land, is often the reason for the founding of a city. As cities expand, the resulting growth forces agricultural uses onto less agriculturally productive land, including previously forested areas, encouraging erosion and desertification. Urbanization in coastal areas can result in destruction of essential wetlands and alter critical habitats, such as beaches and coral reefs. The loss of both of these habitats can result in seasonal flooding, mud slides, loss of food production, increases in certain insect and animal vectors (UNEP, 2002). Urban encroachment into previously wild habitat has resulted in significant increases in urban leishmaniasis, leptospirosis, and yellow fever – three previously predominantly zoonotic infections (Ko et al., 1999; Desjeux, 2001; Monath, 2001).

Urban health data and statistics

What is the status of health among urban residents worldwide – is it better or worse than in rural areas, and how is health status distributed within a city? How does health status relate to city size, density and

design? Reliable, relevant and timely information is the basis for informed policy and targeted intervention. To be most helpful, health data among urban residents should be available, accessible, and actionable. Based on what is known about current urbanization patterns and urban poverty, cities are not necessarily islands of healthy living as traditionally assumed, and health status within cities is not necessarily evenly distributed. Therefore, disaggregated, i.e., "intra-urban", health data presumably would be most useful for understanding urban health problems and ultimately targeting interventions efficiently.

What indicators are relevant, and what information is available? As discussed in further detail in the next section, many health problems in urban settings arise from environmental conditions. It is important to monitor both environmental hazards, i.e., risks, and health effects, i.e., human health outcomes. The World Health Organization and others have described various models for linking environment and health analysis. Some early attempts at models include a core set of indicators for environmental performance reviews developed by the Organization for Economic Development and Cooperation (OECD, 1993), the U.S. Environmental Protection Agency's conceptual framework to support the development and use of environmental information (USEPA, 1995), and the United Nations Environment Program's overview of environmental indicators (UNEP/RIVM, 1994), as discussed in a WHO review of environment and health analysis (Briggs et al., 1996). One such model is the comprehensive "DPSEEA" framework applicable to a range of environment and health issues (Briggs et al., 1996). The acronym refers to Driving forces, Pressures, State (of the environment), Exposures (in people), Effects (human health effects) and Actions (to address the preceding factors). Indicators can be developed and data collected, analyzed, and used based on this framework. We focus considerations here on health outcome data, i.e., the "effects" element of the model. Relevant health data would seem to derive from examination of hazards and associated potential health effects. Both research and health monitoring, including vital statistics and public health surveillance, from national ministries of health and multilateral organizations (such as the World Health Organization) would be expected sources of relevant health data.

To explore urban health statistics and ascertain the availability and accessibility of relevant data, one of us (BSK) undertook a several-month comprehensive search for data corresponding to approximately half the world. (Responsibilities for the worldwide

search were divided between two student researchers.) The universe of concern reported here included 162 cities of interest in 62 countries in Eastern Europe, parts of Central and Southern African, Asia and the Pacific (excluding Australia and New Zealand). A list of 37 primary and secondary health indicators of interest was developed, reflecting the health problems one might expect in urban settings, for which available data might reasonably be expected. The eleven primary indicators included infant, child, and maternal mortality rates; incidence of malaria, measles, gastro-intestinal illness, respiratory illness, and unintentional injuries; percentage of children wasted, stunted, and percentage of wasted adult females. Secondary indicators included gender-specific infant and child mortality and life expectancy, immunization rates, various indicators related to HIV, tetanus incidence, cholera incidence, use patterns for oral rehydration therapy, and rates of availability of hospital beds and physicians. Researchers were to record the availability of data for each indicator at various levels of political aggregation: national, rural (total), urban (total), capital city, all non-capital cities, intra-capital city areas, and intra-non-capital city areas. Sources examined included the Internet (both publications and national statistical agencies), scholarly journals, reports from agencies and major non-governmental organizations, and personal communications with colleagues in other countries, to the extent possible. The results of this comprehensive search yielded very few data points below the national level for most of the indicators and for most of the countries examined. While aggregated data, particularly mortality data, for capital cities were often available, intra-urban data were available in only three of the 62 countries. Availability of data for urban areas did not seem to vary by economic status (as measured by either Gross City Product or income disparity) or city population growth rate. The sources of data were more often specific studies rather than vital statistics or systematic monitoring by the countries or cities themselves.

Other researchers have sought urban and intra-urban health data, also to little avail (Harpham and Blue, 1995; Asthana, 1995). Those who have found intra-urban data or conducted their own research have documented major health disparities within cities. As expected, the urban poor bear the greatest burden (Cairncross et al., 1990; Harpham, 1996; Stephens et al., 1997; Asthana, 1995; Benbow et al., 1998; EHP, 1996). Aggregated data, i.e., statistical averages for a city as a whole, can be extremely misleading – masking problems within urban sub-populations and not drawing the needed attention of

policy makers. Researchers studying urban health tend to conclude that disaggregated intra-urban health data are critically needed to inform policy and target interventions (Harpham and Blue, 1995; Ruel, 1999).

This review suggests at least two major areas of need regarding health data and statistics. First, systematic collection and use of health data within cities appears to be either rare, or data are not readily accessible. Critical data for public policy should not depend on isolated research studies, but rather on more systematic public sector data collection systems. Data should be relevant – with well-designed indicators reflecting potential environmental risks and health outcomes specific to the city, and ultimately actionable if problems are detected. Data should also be reliable – reflecting reality to the extent possible – and readily available to all levels who need the information for policy or intervention purposes. Second, since research studies have consistently shown uneven distribution of health status within cities, with the greatest burden borne by the poor, urban health data should be collected, reported and used on a dis-aggregated basis, i.e., reflecting statistics for different parts of a city rather than simply aggregated into city-wide averages.

Urban health hazards and health risks

Rapid, and often unplanned, urban growth is the source for many of the environmental hazards faced by cities within the developing world. Substandard housing on marginal land, crowding, increasing levels of air pollution, water pollution and over usage, inadequate sanitation services, inadequate solid waste collection, and motor vehicle traffic and traffic injuries are all associated with rapid growth of urban centers.

Rapid construction of poor quality housing is a feature of many urban centers in the developing world. These poorly built tenements, shacks, and in some cases little more than tents are a response to the demands of ever increasing urban poor for some form of housing. In some cases, well-intentioned zoning regulations combined with corruption making both land and construction expensive. Illegal construction fills the void in other areas. Over half of Turkey's urban population lives in such unplanned and dubious housing, known as "gecekondu" (World Bank, 2000). The majority of those who died in the recent earthquakes in Turkey were from these gecekondu.

One factor in urban life is the close proximity of people. Poverty compounds crowding, for example when multiple families must live in the same small space because they cannot afford otherwise. Crowding increases the contact with the air and surfaces that other people breathe and touch. Diseases transmitted through respiratory and fecal-oral routes are more frequent in situations involving crowding, for example tuberculosis (Antunes and Waldman, 2001), rheumatic heart disease (caused by group A beta-hemolytic *Streptococcus* species) (Longo-Mbenza et al., 1998), and helminthic infections (Carneiro et al., 2002). The stress of living with limited privacy in tight quarters contributes to the rates of intentional injuries, both suicide and homicide, and to mental illness in general (Krieger and Higgins, 2002).

Air pollution is a major cause of morbidity and mortality in the developing world, and its effects are mainly felt where air pollution is worst – cities. Asthma, chronic obstructive pulmonary disease, lead and beryllium poisoning are associated with increasing air pollution. Air pollution can have both indoor and outdoor sources. The outdoor sources for particulates and organic and inorganic pollutants are primarily motor vehicles and industrial sites. In Mexico City, three-quarters of the air pollution is caused by motor vehicular exhaust. Lead poisoning from air contaminated with lead is a significant problem in countries where gasoline still contains lead, or where small local refineries are in close proximity to housing (Tong et al., 2000). Indoor air pollution in the developing world is most often associated with the use of biomass fuels – coal, wood, animal dung, and kerosene, although indoor tobacco smoke is also an increasing contributor. Indoor air pollution affects both rural and urban populations (Bruce et al., 2000) In cities in China, household use of biomass fuels contributes approximately 30 percent of the outdoor particulate and sulfur dioxide air pollution, with industrial use contributing an additional 50 percent (World Bank, 1997). Air pollution, from both indoor and outdoor sources, is one of the major risk factors for developing acute respiratory infections, the most important cause of death for children between 1 and 5 years of age in developing countries (Bruce et al., 2000; EHP, 1999).

Urbanization often results in significant excess demand and over usage of water from municipal water sources. Water treatment plants for municipal water supplies are sometimes inadequate to meet the demand. Prices are often not market driven, with significant government subsidies to keep prices low. As a result, individuals and industries may have little

incentive for water conservation (UNEP, 2002). In poorer neighborhoods, the cost of water may be significantly higher than in other urban neighborhoods (World Bank, 2000). The urban and suburban poor may also divert water from municipal pipes, sometimes referred to as "tapping". Outstripping the capability of the municipal water supply to keep the water flowing can result in intermittent disruption of water supply, increasing the bacterial counts as a result of stagnation. "Tapping" can worsen this predicament when sectors of the city have their water stopped, because of backflow of contaminated water into the pipes. Newer sections of the city, often with high concentrations of poverty, may also not have direct access to running water and may have to rely on a common pump (or 'tapped' water pipe). The risk for gastrointestinal pathogens is strongly associated with the lack of a direct source of water in the home (Carneiro et al., 2002; McGranahan and Songsore, 1996). Additionally, the lack of a direct source of water limits hand washing, cleaning food and utensils, bathing, and washing laundry. Studies of louse-borne diseases and scabies show a high association of the presence of these diseases in households with limited access to water (Landwehr et al., 1998; Strickland et al., 2000).

Human fecal waste is an important source of disease causing organisms, and is probably the single most dangerous pollutant in surface water supplies (UNICEF, 2000). Inadequate sanitation is a major risk factor for diarrheal and parasitic disease, including schistosomiasis.

Solid waste collection is a major problem in cities in the developing world. Inadequate waste collection services present a variety of hazards, especially in the shantytowns often erected rapidly in any available space in and around the city. In addition, available landfill space is becoming harder to find as housing space for planned and squatter settlements competes with landfill space. To the abject poor, the small to large waste piles of the better off provide opportunities for recycling (UNEP, 2002) but place those sifting through trash at risk for injury from sharps, poisons, and animal bites. Alternatives to landfill use, such as incineration, involve tradeoffs. While reducing the demand for precious urban space, incineration of solid waste can increase air pollution and create new pollutants such as dioxin (Smith, 2000).

Uncollected solid waste may also prevent adequate water drainage and contribute to water pollution (Mabogunje, 2002). Solid waste also can serve as breeding sites for a variety of vectors of infectious disease, such as sandflies and mosquitoes. Tires, cans, or other items facilitating small collections of

relatively clean water can serve as breeding places for mosquitoes such as *Aedes* sp. and *Anopheles stephensi*. The resurgence in *Aedes aegypti* and the rapid colonization of the Asian tiger mosquito *Aedes albopictus* have contributed to very large epidemics of dengue fever throughout the Americas (Tauli, 2001; Gratz, 1999).

Disease vectors, such as rodents and insects, find new habitats within the changing urban landscape. Rapid urbanization, with encroachment into previously wilderness areas, especially near the tropical rain forest, brings the urban environment into close proximity with the wild, allowing for close contact between vectors, their natural animal hosts, and their new human hosts. Diseases that were relatively uncommon because they needed humans to enter the forest or wilderness area to have contact with these vectors are increasing in frequency. Leishmaniasis in the Americas was largely confined to rubber tappers in the rainforest, but is now increasingly an urban problem throughout Latin America, as sandflies find new habitats within the city (Desjeux, 2001). Yellow fever is increasing in urban communities on the periphery of rainforests as the mosquito that best transmits the disease favors the small pools found in urban habitats, but needs the forest animals with sufficient virus in their bloodstream to transmit to humans (Monath, 2001). The tsetse fly is making inroads into human habitat (Bilengue, 2001), just as human agriculture and population growth is moving into tsetse habitat (D'Amico et al., 1992; Fournet et al., 2000) resulting in increasing amounts of African sleeping sickness. Urban agriculture is an increasingly important source of food for urban residents. However, it also creates opportunities for the multiplication of mosquitoes that transmit malaria, with urban malaria becoming an emerging health problem.

Industrial facilities that are no longer functioning, but are too costly to clean up, are increasingly common within the developing world. In addition to taking up potentially valuable land and disturbing the visual landscape, these "brownfields" are a hazard in some cases to the poor who attempt to take up residence and are exposed to the chemicals previously used in the manufacturing processes. Cleaning up these brownfields is hampered by a lack of knowledge about contaminated land management (Butler, 1996)

Motor vehicle traffic, and the associated noise and air pollution, are a major hazard in the urban areas of both the developed and developing world. Urban sprawl, combined with the status symbol appeal of the automobile, has contributed to the vast increase in the numbers of motorized vehicles in the cities of

the developing world. In addition to the significant air pollution these vehicles cause, motor vehicular accidents are now among the leading causes of death worldwide. By 2020, motor vehicle crashes are projected to rank third in the order of causes of disease burden in the developing world (as measured in disability adjusted life years or DALYs) (Murray et al., 1996). Motor vehicle crashes are now the leading cause of death worldwide in adolescents and young adults (Odero et al., 1997). Recent reviews summarize vulnerable population groups and reasons for high burden from motor vehicle injuries and deaths in developing countries, drawing conclusions about the need for better data and better protection for vulnerable urban populations (Nantulya and Reich, 2002), suggesting changes in road user behavior and traffic laws and enforcement (O'Neill and Mohan, 2002), and proposing ways to improve road vehicle design to better protect pedestrians (Crandall et al., 2002). Motor vehicles also contribute significantly to noise pollution within cities, through honking and engine noise (Tapia Granados, 1998). Motor vehicle traffic is also economically stressful: estimates of the monetary losses to Bangkok, Thailand, from traffic jams per year have been reported at upwards of \$1 billion annually (World Bank, 2000).

The urban environment's principal lure of security in all its varied forms – jobs, education, refuge from conflict – attracts the rural poor, and in some cases displaced populations, even when an individual city may offer some or none of this security to its new arrivals. New stresses await these hopeful migrants – where to find food and water, where to sleep, how to pay for these and other services. Unemployment further heightens these stressors. Unemployment, poverty and crowding all contribute to violence, substance abuse, and mental illness (Ludermir, 1998).

Finally, city life can be more sedentary than rural life. Decreases in activity, whether someone is working or not, combined with access to processed food high in calories and low in nutrition, contribute to the burgeoning epidemic of obesity and diabetes worldwide (McMichael, 2000, Gracey, 2002).

Current approaches to addressing issues related to urbanization and health

The 1992 United Nations Conference on Environment and Development (“Earth Summit” in Rio de

Janeiro, Brazil) resulted in Agenda 21, a 40-chapter action plan with an entire chapter dedicated to sustainable human settlement development (Agenda 21, 1993). In Istanbul, in June 1996, the Second United Nations Conference on Human Settlements (Habitat II) adopted a global plan and declaration committing governments to improving living conditions in urban and rural settlements and to moving forward on providing adequate housing. In his message for World Health Day 1996 focusing on Healthy Cities for Better Life, then WHO Director-General Hiroshi Nakajima said, “The health of urban populations deserves our urgent attention. If we continue to let our cities grow without proper planning, local government authorities will be overwhelmed and unable to provide even the most basic conditions for health such as housing, employment, and safe environment.” (WHO, 1996) More recently, the September 2000 Millennium Summit Declaration proposed a “Cities without Slums” initiative to improve the lives of at least 100 million slum dwellers worldwide (UN, 2000). The Johannesburg Plan of Implementation from the World Summit on Sustainable Development in August-September 2002 addressed issues related to urbanization in six of its ten major chapters, including health.

Beyond special events such as those noted above, various United Nations organizations address issues related to urbanization and health through studies, reports, and/or programming. These include most notably the United Nations Environment Programme (UNEP), UN-Habitat, and the World Health Organization (WHO). At least two programs bear special mention within the context of urbanization and health – that of UN-Habitat and WHO's Healthy Cities Program. UN-Habitat, formerly known as UNCHS (Habitat) was established to implement the agenda of the Istanbul Habitat II Conference. UN-Habitat's operational activities include housing and urban development, infrastructure, water supply and basic services, environmental planning and management, disaster management, municipal finance and management, urban safety and security, and participatory decision making and planning (UN-Habitat, 2002). The WHO Healthy Cities and Urban Governance Programme has as its goal the promotion and support of comprehensive and partnership-based approaches for health development at the city and local level, and involves broad political commitment, intersectoral planning, city-wide partnerships, community participation and monitoring and evaluation (WHO, 2002).

Countries and cities themselves are also grappling with problems of urban environment and health, for different reasons and in different ways. Countries

are sometimes motivated by crisis to mobilize resources that they would not ordinarily invest in urban infrastructure. The outbreak of plague in two cities, Surat and Ahmedabad, in India in 1994 caused heavy losses related to tourism, one of India's main industries. Public sector agencies often neglectful of these municipalities focused on solid waste collection and disposal. These actions have transformed Surat into one of India's cleanest cities (World Bank, 2000).

Some cities have developed programs that are held up as models for others. For example, Curitiba, Brazil, has developed a model public transportation and road system that moves more than one million people each year, while keeping pollution down. Concentric circles of local bus lines connect to five lines that radiate from the center of the city. On the radial lines, triple articulated buses travel in dedicated lanes carrying three hundred passengers each. The system is as fast as a subway, but at one-eightieth the cost. The bus stops are large, clear plastic tubes, designed for passengers to enter at one end to pay their fare and wait to board. Exiting passengers go out through the other end. All this contributes to a highly efficient system (Rabinovitch and Leitman, 1996).

Local communities with non-governmental organization assistance have been successful at improving their environment and hence their health. For example, in an unplanned settlement on the outskirts of Karachi, the lack of adequate and appropriate human and solid waste disposal was appalling. In 1980, there were only bucket latrines or soak pits and open sewers in a community of over a million persons. The Orangi Pilot Project helped motivate and educate the community to install underground pipe sewers that now service almost 100,000 households within the community, and continue to be well-maintained. As it focused on affordable methods, with easily visible and olfactory results, the poor community accepted the approach, and community educators have now gone out to other communities within Pakistan to create similar programs (World Bank, 2000).

The breadth of issues related to health in urban settings, and the breadth of multilateral organizations and events addressing them, underscores the cross-sector nature of the problems and suggests the cross-sector nature of effective solutions. For example, the health effects associated with inadequate drinking water and sanitation, air pollution, road traffic crashes, and unsafe and crowded housing are a function of planning and infrastructure across such sectors as environment, transportation, energy, housing, industry, and finance. The Curitiba trans-

portation program described above is an example of successful cross-sector partnership. The 1965 master plan to limit central area growth, which has successfully guided the city's growth and development, integrates traffic management, transportation, and land-use planning. Industrial development zones and local community self-sufficiency have been key (Rabinovitch and Leitman, 1996). Another successful cross-sector program is the Stockholm Partnerships for Sustainable Cities. It supports cross border sharing of information about urban projects combining technology, creative urban management and community-based initiatives for urban sustainability (Stockholm Partnerships for Sustainable Cities, 2002a). In Stockholm, the Hammarby Sjostad is an example of an urban development project encouraging ecological and environmentally friendly construction work, housing, workplaces, recreation, public transportation, utilities, and more (Stockholm Partnerships for Sustainable Cities, 2002b).

Discussion: policy implications and recommendations

Protection of human health is an implicit or explicit priority of a wide range of sectors addressing urban development. What are the policy implications and directions for action? We propose two main areas needing greater attention.

First is the need to have available, accessible, relevant health data and to use such data to inform policy and target and evaluate interventions. More research is needed to better describe and quantify relationships between environmental hazards and specific human health effects. Such information will improve the design and targeting of intervention. For example, better understanding of the relationship between indoor and outdoor air pollution and asthma will guide environmental regulators, housing and social service providers and others. Monitoring data for urban areas are also essential, and as described above are largely unavailable and/or inaccessible.

Vital statistics and public health surveillance should be developed or modified to provide information on selected health indicators on a disaggregated basis, i.e., for areas within cities rather than city averages as a whole. Such information is useful for targeting interventions across sectors, including the health sector, and for evaluating the health impact of such interventions. Data should be accessible and understandable to those who need

them most, from local communities to central level, and both government and private, non-government sectors.

Relevant indicators can be selected based on local environmental conditions and political priorities. A number of groups have developed model indicators that could be used as a basis for selection or adaptation. Environmental and health indicators were an area of fruitful discussion at the World Summit on Sustainable Development in Johannesburg in 2002. Environmental health indicators offer promise for much-needed international cooperation and action related to collection and use of relevant urban health data. "Ensuring timely access to accurate information is a robust policy, as it allows for early warning of environmental problems, can stimulate voluntary action by business and industry, and can support formal and informal market-based mechanisms that promote good environmental conduct." (UNEP, 2002). Moreover, timely access to accurate information can redirect public policy to avert or minimize disaster, and motivate individuals and communities to change. One or more national, bilateral or multinational entities may wish to help focus additional attention on developing tools, guidelines, and exchange of "best practices" regarding urban environment and health data collection and use, to offer to stakeholders across sectors and worldwide.

The second main area for attention and action to safeguard urban health is more effective partnering across sectors. Because there are important health implications of planning and actions taken in vastly different sectors, the health sector should be included in urban planning and decision-making together with environmental regulators, urban zoning authorities, energy and transportation planners, housing authorities, and municipal service providers, among others. Health authorities should provide relevant health information to other appropriate sectors for their planning and regulation purposes. For example, in the United States, the Department of Health and Human Services (through its Centers for Disease Control and Prevention) provides biomonitoring data from a nationally representative sample of Americans to the Environmental Protection Agency to inform regulatory decisions related to a range of chemicals such as heavy metals, pesticides and others.

Current worldwide urbanization presents important challenges and opportunities. The challenges of urban poverty, megacities, environmental degradation, and social deterioration may seem daunting. However, both the humanitarian and economic imperative to create livable and sustainable cities

must drive us to seek and successfully capitalize on opportunities. Critical elements of success are likely to include good urban planning and governance, sharing of successful experiences and best practice models, and the determination and leadership of stakeholders across disciplines, sectors, countries and communities around the world.

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