Editorial

Environmental exposures in the era of climate change

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The Pacific Basin includes countries in Asia, Australia, and North and South America. The Pacific Basin Consortium for Environment and Health (PBC), first established in 1986, is an international organization that brings together scientists, policy makers, and representatives from non-governmental organizations with interest in health-related issues specific to this wide region. Initially, the PBC focused on hazardous waste, particularly methods and policies related to remediation. Because hazardous wastes pose immediate threats to human health, the mission of the PBC has expanded to cover the full range of issues related to hazardous wastes: toxic substances; human health and methodologies to minimize the generation and release of toxic substances; clean up of existing sources of hazardous wastes; and reduction of human exposure. Information about the PBC can be found at http://www.pacificbasin.org.

That hazardous contaminants do not respect national boundaries is increasingly clear. Air pollutants travel from one continent to another. Foods produced in one country may be sold anywhere on the globe and may carry such contaminants as pesticides and metals. Too often toxic materials are produced in one country (usually the more affluent) for use or disposal in another. Although the Basel Convention of the United Nations was designed to prevent transport of hazardous wastes from one country to another, not every country (notably the United States) has ratified this Convention. Notable examples include asbestos (1), and worldwide traffic in electronic wastes (E-wastes) from computers, cell phones, and other electronic equipment (2). High-income, developed countries export these waste products to less-developed countries, where unskilled workers, frequently women and children, extract metals and other components from E-wastes in ways that pose serious threats to their health.

Few issues related to hazardous substances and wastes are unique to any one country. Every country has problems with air pollution from industry and traffic. Although the specific contaminants in drinking water may vary among countries, each must find appropriate ways to provide safe drinking water and treat wastewater. Every country must dispose of solid wastes in ways that protect the environment and human health. Chemicals and metals that pose hazards to human health are present in emissions from industry, consumer products, and waste sites. Often these toxic substances contaminate food, drinking water, and air, posing hazards to human health from eating the food, drinking the water, and breathing the air.

The issues related to environment and healthcare are likely to become more serious in the era of global warming and climate change. Climate change is a reality that already adversely affects health and the environment. As the ice sheets in Greenland and Antarctica melt, rising ocean levels threaten populations living near the coasts of many countries. This phenomenon will result in indirect impacts on health through ecological changes associated with altered land use and rising sea levels and through social changes resulting from economic effects (3). The increased frequency of violent weather, floods, and droughts is likely to cause serious harm to human populations. Access to adequate quantities of safe drinking water is almost certainly going to be a much greater problem in the future, as desertification engulfs previously arable land in geographic areas whose rainfall is already limited. Increases in global temperatures will not only disrupt patterns of rainfall and crops but also facilitate the spread of vectors of human disease, such as specific species of mosquitoes. Other direct impacts on health are likely to include changes in disease patterns, threats to food security, and changes in population growth and migration patterns (3).

Increases in global temperatures will increase the air transport of toxic chemicals. Without question, the issue of climate change and global warming is one of the most serious environmental threats mankind has known, and the failure of nations to deal with greenhouse gas emissions poses a serious threat to life as we know it.

The health of the world’s population, and indeed its very survival, depend on cooperation and collaboration among nations to reduce chemical exposures and adapt to the changing environment brought on by climate change. There is a growing recognition that we live in a changing, connected world. Globalization has an impact on health in ways not seen before. The recent rapid spread of the H1N1 "swine flu", which became a global pandemic in the space of months, is a recent example. Globalization can also produce a rapid destabilization of economies, both globally and locally, as seen during the recent so-called “global financial crisis”, with subsequent consequences for health and health-services delivery.

Universal access to clean water, sanitation, and other foundational environmental goals are probably second in priority to economic and security objectives. National wealth is sometimes described as a precursor to environmental, sanitary, and health improvements (4). In fact, a strong correlation has been found between wealth and sanitation/environmental health indicators, and significant progress has been made in the last two decades to reduce poverty, to provide better health, and to offer access to improved water supplies and sanitation in the developing world (5). There are also many examples of national progress in environmental protection...
and human health that have preceded major economic gains. Between 1990 and 2005, the percentage of people in developing nations living on less than US$1.25 per day, the arbitrarily selected “extreme poverty” level, dropped from 46% to 27%. From 1990 to 2008, those in developing nations without access to an improved water supply dropped from 29% to 16%. Clearly there has been effort and success in those areas – sufficient to stay marginally ahead of population growth. From 1990 to 2008, the estimated population of the developing world increased from 4.1 to 5.5 billion, so that the number of those living on <US$1.25 per day remains about 1.5 billion, and the number of those who do not take water regularly from an improved source is about 0.9 billion. Noteworthy is that the United Nations (UN) definition of an improved water source does not rest on chemical or microbiological water quality characteristics. That is, water from an improved source can be unfit to drink. Adequate sanitation is even more elusive, so that only half of the people in developing countries use improved sanitation, and there is little chance that the UN will meet its millennium development goal (MDG) in this area. China is the country most responsible for statistical improvements in worldwide access to primary education and health-related services – surely a product, at least in part, of a decade of rapid economic growth. Some of the poorer developing nations, including Burundi, Guatemala, Nicaragua, and Zambia, also made great strides in primary education during the same period; impressive reductions in under-five years of age mortality were achieved in Bangladesh, Laos, Mongolia, Ethiopia, Mozambique, and other exceptionally poor nations. In Ethiopia, the percentage of population living on less than US$1.25 per day decreased from 61% to 29% from 1990 to 2008. The percentage of children enrolled in primary education rose from 22% to 72% over roughly the same period (6).

The case can made that universal access to clean water is attainable at fairly modest cost – at least relative to what is spent in pursuit of security goals. Developed countries provided almost US$120 billion to the developing world in 2009 in the forms of official development assistance, development projects, humanitarian aid, and debt relief (6), amounting to 0.31% of the gross national income of developed nations, clearly a very large sum and 10% of worldwide military expenditures. At US$0.50 per cubic meter, the world’s municipal water demand could be satisfied entirely from seawater desalination at a cost that amounts to 0.5% of the global gross domestic product (7, 8), establishing an upper limit for the cost of universal access to safe water. This figure is exceptionally crude and not entirely appropriate because it does not include the cost of preparing potable water for rural communities or management costs. Nevertheless, the true cost of universal water service must be much less – perhaps an order of magnitude less for purposes of discussion. If so, the amortized cost of providing universal access to clean water might be in the order of a few billions of US dollars per year. The exercise is intended to provide economic perspective only, not a useful cost estimate, and to invite comment from those with actual responsibilities in this area.

Even worse, the gap in material wealth between the rich and the poor has widened, and the economic cost that is sometimes attributed to human underemployment has grown vanishingly small. The International Labour Organization estimated that the global “vulnerable employment” rate, i.e., the fraction of workers including family workers who are not protected by formal work agreements, increased slightly to 60% in developing countries and to 11% in developed regions during 2009, as millions lost their jobs in the global recession (5). The number of people living below the international poverty level in developing regions increased by approximately 20% in 2009, and the number of undernourished is again rising. During 2010–2020, more than 98% of the world’s population growth is projected to occur in developing countries, where the value of human labor is lowest. Unequal educational opportunities and seemingly unlimited sources of low-cost, unskilled labor produce inter-generational poverty in both developed and less developed nations. Institutions are generally better suited to protect wealth than to provide opportunity, and technological advance has not much mitigated the insecurity with which impoverished people approach each day. We enjoy unprecedented, exploding access to information and improved communication – seemingly the keys to extension of education and opportunity – but consensus on how those gifts can improve the quality of life is missing. The ongoing global recession apparently affects not only the trajectory of progress toward UN MDGs but also our resolve, or at least the confidence with which we approach global environmental and related health problems.

A focus on children’s health is one theme that resonates with every culture. Yet one of four children under 5 years of age in developing nations is undernourished, and 7% of the children born in those countries do not reach 5 years of age, mostly due to disease that is easily prevented or cured. Healthy children living in healthy environments are essential for our future. Every day, however, children are exposed to a range of environmental hazards in their physical, built, and social environment that may adversely affect their health. The World Health Organization (WHO) estimates that up to 25% of the global burden of disease is due to adverse and preventable environmental exposures. Children are especially vulnerable, receiving a relatively higher dose than adults and suffering more extreme consequences. The unborn child’s health can also be affected, as the environment can influence gene expression and organogenesis. The burden of disease is unevenly distributed, with greater exposure occurring among children in developing and low-income countries. Although children in such countries still have to cope with traditional threats, including a lack of access to safe water, poor sanitation and hygiene, and infectious diseases, such children suffer from disproportionate environmental exposures that threaten their health. Emerging environmental threats include (a) the effects of rapid globalization; (b) an upsurge in urbanization; (c) trans-boundary chemical transport; and (d) unsustainable consumption; all of which contribute to environmental degradation (9). With prevalent poverty and under-nutrition, children in developing countries are faced with a triple burden of disease. The WHO estimates that over 40% of the global burden of disease attributed to environmental factors falls on children below 5 years of age (10). With regard to family
planning and reproductive health care, a lack of funds that have decreased since 2000 as a fraction of total health-related aid to developing nations, ensures that fertility rates among the poorest families in the poorest nations will continue to be the highest on Earth – not a recipe for ending poverty or reducing the human cost of preventable disease. High-income developed countries and emerging countries have a growing awareness of the environmental contribution to chronic diseases, such as asthma, cardiovascular diseases, and neurodegenerative diseases.

“Environmental exposures in the era of climate change” was the theme of the 13th International Conference of the Pacific Basin Consortium for Environment and Health (PBC), held in Perth, Western Australia, in November 2009. The conference was attended by 120 participants from 18 countries, mainly around the Pacific Basin. The PBC Conferences provide a unique forum in which scientists and medical professionals from around the world have the opportunity to meet and exchange ideas and information in the field of environmental health and climate change.

The objectives of the conference were to (a) present research that related to the characterization and sources of environmental pollutants, human exposure to pollutants, and health effects of exposure; (b) describe advances in reducing the generation of hazardous chemical pollutants, methods for destroying or capturing them, and technology for remediating contaminated soils and ground water; (c) increase interdisciplinary and international cooperation in understanding and addressing threats to human and environmental health in the region; (d) motivate discussions of risks to human and environmental health within a larger context that addresses issues of equity, poverty, development, and sustainability; (d) encourage student and young scientist participation; and (e) offer training opportunities in areas related to protection of health and the environment. There is a growing understanding that a multi-sectoral effort will be required to understand the impact of climate change on health. In a recent commentary in Science, Rappaport and Smith (11) called for a broader approach to the assessment of environmental exposures, using the term “exposome” to represent the combined exposures from all sources from both the external environment and the internal chemical environment. The authors argued that the totality of exposure from conception onward is relevant to the development of chronic human diseases. In the context of global change, this paradigm will have to account for a changing “exposome” and must include the social and ecologic factors not generally considered in classic exposure sciences. Organizations such as the PBC have the potential to play an important role in understanding the health effects of climate change as they bridge the gap between exposure science and health outcomes.

References


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