Relationships between human and environmental health

Since life emerged on the planet 3.5 billion years ago, organisms have entered into a co-evolutionary,dialectic relationship with their environments in which each changes the other. Although modern humans evolved about 120,000 years ago, the qualities of ecological change created by population growth and technological achievements throughout the past several centuries, accelerating in the past fifty to one hundred years, are unique and deserve a closer look.

In 2005, the United Nations released the largest assessment of the health of the earth's ecosystems ever undertaken (UNEP 2005). More than one thousand experts from ninety-five countries prepared the report, which was then reviewed by a large independent board of editors and commented upon by hundreds of experts and governments before being released.

Among the findings

• In the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history.

• Approximately 60 percent of the ecosystem services examined, from regulation of air quality to purification of water, are being degraded or used unsustainably.

• Between one-third and one-half of the land surface of the earth has been transformed by human activity.

• The changes have contributed to substantial net gains in human well-being and economic development for many people.

These gains, however, have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, exacerbation of poverty for some groups of people, and growing disparities and inequities.

• In the past 50 years, the world's human population has increased from 2.4 billion to 6.4 billion people. Much of this growth has occurred in increasingly large cities where mega-slums proliferate. Mega-slums are incubators of new and re-emergent diseases that can quickly travel across the world via air travel. Greed, inequity, poor planning, and disrespect for human rights create the slums and tend to intensify the earth's natural forces.

• Those forces, ecological and biological, do not always behave predictably. Changes in ecosystems increase the likelihood of nonlinear changes (including accelerating, abrupt, and potentially irreversible changes), with important consequences for human well-being. Growing pressures from over-harvesting, climate change, invasive species, and nutrient loading push ecosystems toward thresholds that they might otherwise not encounter.

• Economic globalization forges ahead without concomitant investment in a global public health infrastructure. This is a formula for catastrophe.

• Large numbers of plant and animal species have been driven to extinction, and most marine fisheries are severely depleted. More than half the world's coral reefs are threatened by human activities. Loss of species and genetic diversity decreases the resilience of ecosystems (the level of disturbance that an ecosystem can undergo without crossing a threshold to a different structure or functioning).

• Positive carbon balance (net increase of carbon released into the atmosphere and oceans) has resulted in global climate change, greenhouse gas effects, and increased acidification of oceans threatening the marine food web.
• Anthropogenic nitrogen fixation from fertilizer production and use and fossil-fuel combustion exceeds all natural terrestrial processes combined. Nitrous oxides are greenhouse gas and ozone precursors. Nitrates contaminate ground and surface water and, along with phosphorous, cause eutrophication of marine and fresh-water systems, algal blooms, attendant health risks, and fish depletion.
• Over the past 50 years, there has been an accelerated release of artificial chemicals into the environment, many of which are long-lived and transformed into byproducts whose behaviors, synergies, and impacts are not well-known. Humans are at risk from inorganic and organic pollutants present in food and water.
Ironically, most but not all of the ecosystem damages were the direct or indirect result of attempts to meet demands for ecosystem services such as food, water, timber, fiber, and fuel. While it may be easy to conclude from this that these are basic human necessities and ecological decline is inevitable, it is important to remember that (1) there are choices among ways to satisfy these needs and (2) wants and needs are not the same.

Relevance to the healthcare sector

Asthma, neurodevelopmental disorders, some kinds of cancer, some birth defects, mental illness, obesity,diabetes, premature births, and newly emerging and some recurrent infectious diseases are all increasing throughout the world (US Dept. of HHS 2005, NCI 2006). These trends result from direct and indirect impacts of multiple interacting factors acting within a broad conceptualization of a changing ecosocial environment. Alone or in various combinations, dietary inadequacies or excesses (e.g., micronutrient deficiency, excessive fat or carbohydrate intake, etc.); exposure to toxic chemicals and pollutants in air, water, or food; inadequate exercise; exposure to infectious agents; and social and economic deprivation contribute to these trends.
People with these environmentally related disorders live, work, play, and go to school in our communities.
The healthcare sector generates thousands of tons of waste each day—including toxic materials and chemicals—and still relies heavily on incineration to “treat” portions of the waste stream including pathological and chemotherapy waste. Tons of ordinary solid waste from healthcare facilities are also burned, resulting in toxic air emissions related to incineration. Pharmaceutical products or byproducts are discarded or excreted into sewerage systems, contaminating surface waters throughout India
Healthcare food-procurement practices support an industrial agricultural system heavily reliant on fossil fuels in food production and transport and petrochemical pesticide use. These practices directly contribute to air and water pollution, climate change, biodiversity loss, top-soil loss, eutrophication of surface waters, and adversely impact the social and economic fabric of rural communities Moreover, this dominant agricultural system from which most healthcare systems obtain their food makes readily available a diet rich in calories but relatively poor in some nutrients, contributing to obesity, diabetes, and other adverse health outcomes treated in those same healthcare facilities

Today's healthcare institutions: What is their mission? What do they do?
Most healthcare institutions today say that their mission is to provide high-quality care and service to diagnose and treat human illness. Some mission statements also mention disease prevention. In practice, disease-prevention activities usually entail individual behavior modification (smoking cessation, weight control, exercise, etc.).
Disease prevention sometimes merges with early diagnosis through screening programs (hypertension detection, mammography, colonoscopy, etc). Early diagnosis and intervention can help to prevent complications of certain conditions, but secondary prevention differs from primary prevention of disease before it occurs. Prevention efforts in the healthcare sector focus largely on proximal contributors to disease that are closely connected to the specific pathophysiology in question and about which there is little uncertainty. Causal factors that are more distantly related to the biological manifestations of disease factors whose mechanistic contributions to disease processes are not well-understood, or factors for which data are limited tend to be ignored or given limited attention in clinical medicine.
Here are some examples.
• In clinical medicine, asthma prevention usually focuses on avoiding exposures to well-established asthma triggers subject to individual control such as cigarette smoke or dust mites in the home. The healthcare sector, however, is often silent about more socially determined factors such as outdoor air pollution, engine or incinerator emission standards, housing quality, city planning and traffic flow, stress, or labor standards that influence occupational exposures to asthmagens over which individual employees may have little control.
• Some kinds of cancer (e.g., prostate, brain, pancreatic, lymphoma, leukemia) are repeatedly positively associated with pesticide exposure in epidemiologic studies, although details of individual susceptibility and mechanistic understanding are limited
Not only is this information largely unknown within the healthcare sector and rarely taught in medical or nursing schools, but also, even when known, uncommonly leads to policy recommendations without considerable pressure, usually applied by advocacy groups.

Despite overwhelming evidence of the importance of diet and nutrition for human health, many healthcare facilities ignore obvious opportunities for modeling disease prevention by serving food to patients, staff, and visitors that is appealing, optimally nutritious, and produced in ecologically sustainable ways. Some hospitals even lease space to fast food restaurants selling food that contributes to diseases treated in that same institution. Moreover, the agricultural system supplying much hospital food employs practices that profoundly degrade ecosystems domestically
• The importance of social class and economic status as determinants of health is undeniable Disparities in health outcomes across social class are not fully explained by individual risk factors such as diet, smoking, and exercise. Rather, lower social class is independently related to poorer health.
Similarly, stress is independently causally related to a variety of adverse health outcomes. Yet, the ways in which these variables impact the pathophysiology of

disease are often insufficiently understood to attract the intentional intervention of clinicians or healthcare facilities on a community or societal level. The healthcare sector traditionally sees its role in preventing the social determinants of disease as limited or the responsibility of others.

Some institutional mission statements mention an obligation to contribute to the health of the surrounding community. This may be accomplished in various ways—perhaps by providing free care to indigent community members, free disease-screening opportunities from time to time, or supporting various community activities. By doing this, institutions acknowledge responsibilities beyond institutional walls and, in some ways, address traditional public health concerns. But most healthcare institutions do not intentionally focus significant resources on favorably influencing community determinants of health. In short, to the extent that the healthcare sector addresses disease prevention at all, it tends to focus on prevention of well-established proximal causes, while largely ignoring what epidemiologist Geoffrey Rose (1992) called the "causes of causes" .

First and foremost, healthcare institutions are really disease-care institutions. They provide care for people who are ill or injured. Programs aimed at primary-disease prevention are limited. To a large extent, healthcare institutions ignore or give limited attention to the range of environmental factors that directly or indirectly influence the health of their clients. They may justify this based on a restricted notion of their role, believing that many of these issues are in the domain of public health or environmental protection and not medicine.

Recent attempts to re-examine the distribution of roles and responsibilities related to human health call for closer collaboration between medicine and public health and re-thinking professional and institutional boundaries (Lasker 1997, IOM 2003). The realities of the early twenty-first century suggest that ecological health should be explicitly added to this collaboration. What is the potential role and responsibility of healthcare systems to address a fuller range of causes of morbidity and mortality in the communities that they serve? Given the steady growth of already oversized health (disease) care expenditures, this question becomes increasingly relevant as healthcare institutions consider their missions and plans for the future.

Hippocratic Lessons

Contemporary physicians and healthcare institutions pay little attention to more general ecosystem health, even though in his famous treatise, "On Airs, Waters, and Places," Hippocrates (400 BCE) saw the connections to medicine when he wrote

"Whoever wishes to investigate medicine properly, should proceed thus: in the first place to consider the seasons of the year, and what effects each of them produces for they are not at all alike,but differ much from themselves in regard to their changes. Then the winds, the hot and the cold,especially such as are common to all countries, and then such as are peculiar to each locality. We must also consider the qualities of the waters, for as they differ from one another in taste and weight, so also do they differ much in their qualities. In the same manner, when one comes into a city to which he is a stranger, he ought to consider its situation, how it lies as to the winds and the rising of the sun; for its

influence is not the same whether it lies to the north or the south, to the rising or to the setting sun. These things one ought to consider most attentively, and concerning the waters which the inhabitants use, whether they be marshy and soft, or hard, and running from elevated and rocky situations, and then if saltish and unfit for cooking; and the ground,whether it be naked and deficient in water, or wooded and well watered, and whether it lies in a hollow, confined situation, or is elevated and cold; and the mode in which the inhabitants live, and what are their pursuits, whether they are fond of drinking and eating to excess, and given to indolence, or are fond of exercise and labor, and not given to excess in eating and drinking. From these things he must proceed to investigate everything else. For if one knows all these things well, or at least the greater part of them, he cannot miss knowing, when he comes into a strange city, either the diseases peculiar to the place, or the particular nature of common diseases, so that he will not be in doubt as to the treatment of the diseases, or commit mistakes, as is likely to be the case provided one had not previously considered these matters.