

HEALTH AND THE ENVIRONMENT¹

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While well over a billion people in the developing world still confront the "old" environmental hazards arising from poor sanitation, they are now coming up against new threats posed by a horde of chemical, physical, and biological agents. Though recognizing that there are no quick and easy solutions to either set of problems, this article seeks to describe what steps should be taken to maintain a reasonable potential for progress in future years.

Introduction

Throughout history, man has been the unfortunate repository of diseases affecting his health, well-being, and comfort. No matter when or where he has lived he has shared this common heritage, the extent of the problem varying only in degree. It is also true that among the hundreds of nations encountered on the globe, no two are alike. Their diversity is reflected in their peoples' different population densities, occupations, incomes, political and social organizations, religions, cultures, attitudes, and standards of living. In fact, it may be said that if the world's nations and peoples have one thing in common, that which is most shared by them may well be their heritage and burden of disease.

Within an environment that tends to be equally variable throughout, diseases borne by or associated with that environment have contributed to man's dangers. When the impact of these diseases is measured, however, it must be recognized that the situation in a developed country like the

United States differs greatly from that prevailing in Africa, Asia, or Latin America.

At the risk of oversimplification, it is desirable to have a quantitative worldwide comparison of these hazards. The International Bank for Reconstruction and Development (IBRD) attempted such a comparison in 1975. Summary data from the Bank's report, which show the "pattern of disease" in the developing and developed countries, are presented below to help provide a basis for discussion:

Percentage distribution of deaths, by cause, in developing and developed countries.

Causes of death	Developing countries	Developed countries
Infectious, parasitic, and respiratory diseases	43.7	10.8
Cancer	3.7	15.2
Circulatory diseases	14.8	32.2
Traumatic injuries	3.5	6.8
All other causes	34.3	35.0

The Environment, Development, and Disease

The basic health problems of the less-developed countries, problems likely to prevail for some time to come, are essentially those related to: (a) fecal-oral transmission (diarrheal diseases, dysentery, cholera, shigellosis, typhoid); (b) vector-borne diseases

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(dengue, filariasis, malaria, onchocerciasis, schistosomiasis, trypanosomiasis); (c) air-borne diseases (influenza, measles, mumps, pneumonia, whooping cough); (d) diseases related to poor housing and hygiene (Chagas' disease, leprosy, syphilis, tuberculosis, yaws); and (e) malnutrition.

Implicit in each of these problems is an environmental component. Man's capacity to adapt to and control his ever-changing environment has been great, but has not been evenly applied throughout the world. Man does have a long history of managing the environment reasonably well, though sometimes this management has been done in a thoughtless and reckless manner. But, unfortunately, well over a billion people are still confronted today with what we euphemistically call the "old environmental hazards" of poor sanitation—primarily absence of adequate water supply and human excreta removal methods. These problems are widespread and affect both rural and urban areas.

To this base-load of hazards are now being added those of development itself and of pollution by chemical, physical, and biological agents that may adversely affect health. These additional hazards modify the health of communities and working populations by generating or spreading diseases, inducing accidents, adulterating or contaminating foods, and adversely affecting mental health.

The developing world finds itself the unfortunate victim of the old as well as the new insults. So as one strives to reduce the adverse impacts, it becomes increasingly clear that real progress often depends upon a vast socioeconomic advance, only dimly visible at the moment, of which health is a key element.

The health picture in the less favored parts of the world is dominated by an excessive prevalence of communicable disease. Much of the excess arises from poor to abysmal levels of personal hygiene and rural hygiene, as well as from failure to

comprehend or practice elementary sanitation procedures. In this same vein, the lack of basic water supply and excreta disposal systems literally plagues hundreds of millions of incredibly patient, long-suffering people.

In this age of space travel, it is sad to note that enteric diseases are still a principal cause of morbidity and mortality in many countries. Somehow, officialdom everywhere, as well as the public at large, needs to be reminded bluntly that human fecal matter remains an international culprit responsible for large-scale decimation of people, and that persistence of fecal-oral transmission is one of the common manifestations of underdevelopment.

As already pointed out, different regions have waged highly disparate struggles to control such disease transmission. The industrially rich and favored Western World has done the best, virtually eliminating communicable disease. Central and South America have lagged behind the developed regions but have done better than Asia. Africa still lags behind them all. In terms of the simplest sanitary criteria, water supply and excreta disposal, Tables 1 and 2 give an indication of the situation existing in 1975.

In general, data on these subjects are necessarily incomplete, particularly with respect to the continent of Africa, because the world still has a shortage of information systems, and those that exist have little or no continuity. The information shown

Table 1. Percentages of people served by community water supplies (house connections or public standposts) in 1975.

Region	Rural dwellers	Urban dwellers
Americas	32	81
Eastern Mediterranean	16	80
Europe	63	81
Southeast Asia	19	70
Western Pacific	30	90

Table 2. Percentages of people served by excreta disposal systems (via either household facilities or connections to public systems) in 1975.

Region	Rural dwellers	Urban dwellers
Americas	25	80
Eastern Mediterranean	14	63
Europe	18	38
Southeast Asia	6	79
Western Pacific	43	81

in the tables comes from an extensive survey—conducted in 1970 by the World Health Organization and updated, through data supplied by many of the countries involved, to 1975. Overall, 91 countries provided data on water supply and 61 provided data on excreta disposal. Globally, if China is excluded, important sanitation indices are currently available for some 90 per cent of the total population of the developing world.

Converting the percentages listed into numbers—the many million people actually affected—helps reveal the dramatic magnitude of the sanitation problem. Similarly, translating the capital investments required into dollar values demonstrates the staggering size of financial needs. In 1975, for example, and again excluding China, the population served adequately with water was some 763 million people, only 38 per cent of the total. At the same time, the number served adequately by excreta disposal facilities was 646 million, only 33 per cent of the total. In rural areas, the respective services reached only 22 and 13 per cent of the rural population.

Globally, the capital investments required for only five years (1976-1980) add up to 38 billion dollars. This World Health Organization estimate in 1975, considered much too low by some, naturally tends to alarm ministers of finance and economics.

Such restatement of the elementary needs of the world's "poorest billion" people can be quantitatively enlarged upon to the

point of intimidation. But not all impact indices need be listed to demonstrate the familiar actual and potential insults that confront the developing world. The spectrum of danger involves air, water, food, wastes, shelter, work places, and accidents. Hazards in each area pose difficult problems for national plans and commitments; and these problems require development of manpower, appropriate technology and design, proper operation and maintenance, public participation, institutional structures, management, and financial resources. Historically, this array of problems has been well-confronted in every developed region, but with greater resources than those available to the developing areas. Hence, not all the problems are likely to be addressed simultaneously, and the need to select from among a wide range of alternatives presents an unhappy political situation.

A critical case in point is the abysmal status of housing and shelter in the less favored countries. Stripped of the myriad platitudes about health necessities involved with human shelter and settlement, the fact remains that in terms of actual need, nowhere has housing policy or expenditure even touched the tip of the iceberg. And, as the figures in Table 3 indicate, the economic and social requirements are immense.

The most that one might realistically hope for, by the year 2000, is that people so poorly housed might be afforded at least such basic, elementary items as adequate water supply and excreta disposal facilities, roads, and schools. Examples of more comprehensive approaches to the problem already exist in some advanced developing countries.

What we have, therefore, are sensitive ecologic relationships continually getting out of balance and producing multiple disease impacts upon man. People often literally live surrounded by hostile rats, fleas, mosquitoes, lice, and pathogenic parasites,

Table 3. Urban squatter settlement and slum populations, in millions.

Area en city	Date	City population (millions)	Squatter and slum settlement population (millions)
<i>South Asia:</i>			
Manila	1972	4.4	1.54
Jakarta	1972	4.6	1.19
Seoul	1970	5.54	1.2
Karachi	1971	3.43	0.8
Bombay	1971	6.0	2.48
Calcutta	1971	8.0	5.33
<i>Latin America:</i>			
Lima	1970	2.88	1.15
Caracas	1974	2.37	1.0
Rio de Janeiro	1970	4.86	1.46
Bogotá	1969	2.29	1.38
<i>Africa:</i>			
Kinshasa	1969	1.29	0.775
Ibadan	1971	0.76	0.569

Source: Barbara Ward, *The Home of Man* (15), p. 193.

in surroundings highly propitious for these agents' existence and proliferation. Building them all out by taking sanitary measures, a reasonably successful strategy in industrialized countries, represents a major challenge for the developing world.

Furthermore, as if this challenge were not enough by itself, people of the developing world are now increasingly exposed to the same noncommunicable diseases confronting the more industrially advanced regions. Heart disease, cancer, and stroke are beginning to add to their troubles.

Possible Programs

Life expectancy in the developing countries rarely exceeds 50 years, and infant mortality commonly surpasses 75 to 100 deaths per 1,000 live births. Lack of a healthful environment bears considerable responsibility for some of these unfortunate circumstances. It is also true that the foundation of permanent public health progress rests upon familiar sanitary measures—because procedures for controlling and preventing most of the communicable diseases are already known.

But while the bases for action are provision of safe water and excreta disposal, other activities—including proper handling of solid wastes, control of mosquitoes and other vectors, simplification of technology, reduction of costs, adaptation to local situations, and sustained maintenance—must be pursued. These actions are necessary if costs are to be reduced and program productivity increased to levels that provide solutions within time-frames acceptable to those who wait for basic services.

In addition, the decisions to be taken must be based upon realistic assessment of existing options. These options may extend beyond simple transfer of Western practices to the areas involved if those practices are ill-suited to local use and custom. This point is especially pertinent with regard to excreta disposal methods.

If current patterns continue, hundreds of millions of people will go without minimum sanitary facilities for another half-century. Some say the projected delay is attributable to religion, customs, lack of money, lack of education, or politics. While no single cause accounts for all the

difficulty, and while there is no single remedy, positive government motivation and intent constitute significant prerequisites of progress. This motivation and intent does not wait upon scientific or technological discovery; nor does lack of money currently appear to be a major deterrent, provided sanitary amenities are fitted into social and economic programs instead of being independently pursued.

Simplified water treatment devices, simpler excreta disposal procedures, sturdier pumps, improved storage facilities, increased use of groundwater, and better program management techniques are only a few main items on the list of existing needs. Their installation or realization waits upon positive political intentions and individual understanding and acceptance.

Considering that the search for the perfect, optimally acceptable privy has been underway for the last 75 years, individual acceptance would appear to be in especially short supply. In this same vein, over 20 distinct excreta disposal methods have been diligently investigated and tested in the laboratory and field. Why the resulting designs are not built, or when built are unused, is because of man's lack of desire, or conviction, or both. Hence, the question of how to inculcate acceptance remains unanswered and in need of further study. Specifically, we need to listen more carefully to the user's opinion and return to the design table acutely conscious of his words.

Preventive measures for vector-borne diseases—malaria, yellow fever, dengue, onchocerciasis, filariasis, schistosomiasis—are reasonably well understood. And actual prevention and control of these diseases, while costly and difficult, is possible. So while one waits with high expectations for emerging vaccines against several of these diseases, familiar control methods should not be delayed. The time-honored engineering practices of draining swamps, build-

ing water supply systems, and providing for excreta disposal must be carried forward.

Of equal or even greater importance, emphasis should be placed upon the need to provide maximum stimulation of the political will, so often lacking in many countries. Efforts to provide such stimulation through newer sector planning have been undertaken by WHO and the IBRD. As these planning approaches are implemented, it is hoped that government intentions will become more manifest.

Unanswered Questions and Research Needs

A major unanswered question for the developing world is how to balance the use of very limited resources between efforts to reduce the basic burden of sanitation-related diseases and efforts to meet the challenges posed by increasing numbers and kinds of adverse health impacts presumably due to chemical, physical, and biological agents. In seeking answers to these issues, the health official finds he must become a member of a multidisciplinary team of experts. No longer can the answer be provided by one discipline or profession, for often the solution depends on a complex fabric of interwoven technical, financial, and managerial considerations relating to current and future human resources.

What is more, this balancing problem is complicated by the fact that protective measures must be provided where people work and live. Too often forgotten is the fact that our solutions must be carried out through people who will *use* our solutions. Our technology and management schemes must be adapted to their cultural and educational levels.

Furthermore, when one seeks to strike a balance between basic sanitation and more sophisticated measures, one often finds that no single solution will fit the entire range of issues. For example, a vaccination program is a specific solution directed at a

set of specific diseases, while a water supply program is a broad preventive measure affecting a broad range of diseases. As Table 4 indicates, each type of solution has its place.

In general, the health worker in developing areas must find a series of practical solutions to people-oriented problems. Answers must be found with people and for people—answers not only to growing chemical, biological, and physical hazards, but also to the age-old problems of basic sanitation.

In the industrialized countries, however, emphasis has shifted to other leading causes of death. Heart disease, atherosclerosis, and cancer may have environmental antecedents. All three seem related to some "factor" in the water, food, or air, or to some ingredient of a carcinogenic or mutagenic nature. Right now it is fashionable to assign this role to an undetermined chlorine-derived organic compound.

Overall, however, inorganic and organic compounds of a toxic nature share the stage of general public health interest. Concern about this Pandora's Box of chemicals is understandable; in 1974, for example, it was estimated that we would confront 100,000 chemicals in general use by the late 1970s, some 1,500 of them suspected carcinogens. Furthermore, to these chemicals dangers must be added the hazards of innumer-

able physical agents, ionizing radiations, lasers, and ultrasound.

An obvious field for long-term, high-priority research in already industrialized countries is provided by the number and complexity of toxic substances. In fact, however, such investigation must be pursued both in developed areas (including the United States) and in developing countries—because the former have long been exposed to the insults involved, while the latter, not yet heavily threatened, provide excellent control regions for epidemiologic inquiry.

The pages that follow give a few examples of problems deserving high research priority. This list of problems is manifestly incomplete—so much so that a great many others could be added to it. The specific examples chosen tend to illustrate problems—still a long way off in less favored areas—that now confront the developed world.

Drinking Water Contaminants

For more than half a century, experienced workers have judged disinfection of water by chlorine or its compounds to be the most effective chemical measure for safeguarding water quality. However, chlorine combines with organic materials in both surface and underground water to

Table 4. Typical solutions applicable in different areas.

	Areas with dispersed populations	Villages and slum areas	Non-slum metropolitan areas
General solutions	1) Individual water wells 2) Latrines	1) Piped water 2) On-site excreta disposal 3) Healthful housing	1) Piped water 2) Sewerage 3) Public housing 4) Food sanitation measures
Specific solutions	1) Vaccination	1) Vaccination 2) Health post activity	1) Vaccination 2) Hospital activity

produce chloroform—which under some dosages is carcinogenic in mice and rats. Concern about this was touched off by release of a less than satisfactory study attempting to correlate human cancer prevalence with a municipal water supply containing chlorine-derived chloroform. The excitement promptly generated among the public at large was to be anticipated. The important need now is to resolve this issue before chlorine is banned from global use, because no reliable and economical disinfectant substitute is at hand.

The long list of other potentially hazardous materials in water is intimidating. However, there is no need to draw up any new extensive shopping list of desirable inquiries, because priorities—arranged in various different categories—were developed by a World Health Organization Scientific Group in 1973. Overall, some 90 substances provide an obvious long-term opportunity for interested investigators. It should be kept in mind, however, that something suspect may be in everything we eat, drink, or breathe—and that before a ban is placed on everything, it is wise to reduce our vast ignorance and weigh the benefits against the risks—something that is no mean task.

Another equally worthy subject for authoritative study is the alleged association between water hardness and cardiovascular disease. For almost two decades this question has been the target of epidemiologic examination in a number of different countries. Its importance is great if in fact there is anything in water that does affect the incidence of heart disease and stroke; for in that case preventive measures, such as water treatment, would be far cheaper and more effective than most individually targeted efforts.

A comprehensive worldwide review of this subject has recently been prepared by George W. Comstock for the U.S. National Academy of Sciences. His conclusion is that “there may be a water factor associated

with the development of cardiovascular disease, although its existence is far from certain. The factor can hardly be hardness per se, because of its biological implausibility and the numerous exceptions to the negative association of hardness with cardiovascular disease.” Future research findings on this question will be of considerable practical importance to the massive waterworks industry—both in the U.S. and, ultimately, around the globe.

Air Contaminants

Almost 10 years have elapsed since passage of the U.S. Clean Air Act, and elaborate limitations or standards have been promulgated by official agencies. But the actual adverse health effects of a number of these air contaminants still remain to be validated, and laboratory and field studies of their impacts are badly needed. Overall, the health and economic implications of air contaminants need to be promptly assessed and clarified, particularly since U.S. laws and practices are frequently, and unduly, copied globally.

Areas of ignorance are especially great with respect to the following ambient air pollutants: sulphur oxides (including SO₂ and sulphur-containing aerosols); carbon monoxide; photochemical oxidants (such as ozone); nitrogen oxides (including NO₂, NO₃, and nitrate aerosols); and aeroallergens in general.

The Environment and Cancer

Present scientific opinion, as registered in the 1976 annual report of the International Agency for Research on Cancer, at Lyon, France, emphasizes the high significance, primarily in developed regions, of cancer epidemiology and environmental carcinogenesis. The Agency asserts that “Cancer is recognized as the most important chronic hazard of environmental pollution.”

The term "environment," as employed in the report, encompasses "exogenous" as well as "endogenous" life-styles—including such factors as excessive smoking, alcohol drinking, and overeating. In contrast, our present discussion is restricted to the exogenous and more familiar air, water, and food contaminants. These latter are said to account potentially for some 10 to 25 per cent of all cancers—instead of the 50 to 90 per cent for which they have at times been publicly blamed.

In any event, it is essential to emphasize the need for an international probe of environmental factors relating to cancer. This is perhaps the most pressing disease issue, from both the socioeconomic and health points of view, in industrial areas. Moreover, as time passes, more and more countries can be expected to move toward industrialization and to make concomitant contributions of carcinogenic and mutagenic substances to the environment. If intelligent control measures are to be developed, research priorities must be addressed to (a) evaluation of the risks posed for man by the carcinogens already present, and (b)

development of a mechanism for combined monitoring and evaluation of suspected new risks. In both of these areas, joint U.S. and developing country approaches will be helpful—especially because their disparate industrial situations permit comparisons that may disclose valuable epidemiologic information.

Data on levels of exposure—both local and international—are in short supply, in spite of the fact that we are being deluged by lists of dozens of presumed carcinogenic and mutagenic substances. Determining the real significance of these substances thus poses an immediate and difficult challenge to the world's scientific community. In this vein, the exciting development of short-cut laboratory techniques for detecting small amounts of critical substances may turn out to be a threat to the sanity of a fearful public or a remarkable aid to diagnosis and sensibly selective control. Careful approaches by our own country, the U.S., to these studies can do much to keep the serious issues involved at a competent level of investigation and understanding.

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SUMMARY

Well over a billion people in the developing world are still confronted with the "old" hazards of poor sanitation—primarily inadequate water supply and excreta disposal. What is more, to these basic problems are being added those arising from the development process—including pollution by various chemical, physical, and biological agents. Hence the developing

world finds itself besieged by both old and new perils.

The need is clear; if current patterns continue, hundreds of millions of people will go without even minimal sanitary facilities for at least another half-century. But there are no quick and easy solutions to these problems. While the foundation for health progress rests

on provision of safe water and adequate excreta disposal, other activities—solid waste disposal, technological adaptation, vector control, etc.—must be pursued. In all of these cases, positive government motivation and intent, as well as public acceptance of new methods, are prerequisites for advancement.

Another important need is for research on the

“Pandora's Box” of chemicals in general use—including some 1,500 suspected carcinogens. Such investigation must be performed in both developed and developing countries, because the former have long been exposed to many of these substances, while the latter, not yet heavily threatened, provide excellent areas for control studies.

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