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The Science Base and Social Context of Health Maintenance: An Overview

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Public interest in matters of health is very high in 1978. This interest is visible in the media, the Congress, and many forums of public discussion. Evidently people desire to have the best possible medical care, to live as long as possible, and to live well.

The health care sector, or "health industry" (a loose term generally applied to the total complex of goods and services related to health), is an expanding one and this year will account for about 9 percent of the gross national product. This means total health expenditures of about $160 billion. Economists estimate that the health industry is one of the three largest industries in the nation. The benefits of this growing enterprise are apparent in such diverse areas as an increased availability of health care services, including long-term care, a varied and highly trained cadre of health professionals, health insurance coverage of some form for close to 90 percent of the population (*1*), and innovative systems for both the organization and management of health services as demonstrated by the growth of various group practice models. Signs of progress in the last decade also include falling death rates from cardiovascular diseases, decreasing infant mortality rates in certain disadvantaged populations, and a sharp decline in the population in public mental hospitals.

It is probably true that long-term gains in health status have resulted largely from progress in sanitation, nutrition, and the balance between population and resources. In recent years, these broader movements have been joined by extraordinary advances in the life sciences. Understanding of basic life processes at both the cellular and subcellular level has expanded enormously. For medicine, this offers unprecedented, long-run promise for effective new diagnostic, therapeutic, and preventive interventions. For example, medicine is now able to offer antibiotics, immunizations for a variety of viral and other infectious diseases, and the detection of genetic defects in the human fetus through prenatal diagnosis. There has even been discernible progress in the development of therapies for selected chronic diseases such as hypertension and schizophrenia (*2*). The behavioral and social sciences, although newer than the biological sciences, have also developed substantially. In concert with the biomedical sciences, these disciplines are demonstrating their great potential for the protection and improvement of human health, as is suggested, for example, by studies on the relation of stress to disease (*3, 4*).

Despite such progress in the health sciences and in the delivery of care, significant problems, such as health care costs, are present. The rate of increase in these costs, both public and private, is proceeding much more rapidly than the rate of inflation in general. Yet effective means to contain these costs, through mechanisms that serve both the public health and the imperatives of limited resources, remain elusive. There is still reason for concern that some population groups—particularly the poor and socially deprived—do not benefit adequately from the scientific advances and health care improvements alluded to earlier. It is also apparent that certain age groups, such as the elderly and adolescent, experience serious gaps in health care, almost without regard to income or social status. This adolescent group, for example, is all but invisible in terms of health care services, research, or education focused on the prevention of disease. Yet it is during this key transitional period that so many habits—both health-enhancing and health-compromising—are developed and carried into adulthood (*4*). These behaviors, such as the use of alcohol, tobacco, and other drugs, hold significant consequences for health and well-being over both the short and long term of the individual's life-span.

Another serious problem involves the actual "tools" of medicine—the operations, diagnostic procedures, and equipment that are at the heart of much of medical practice. Despite professional standards that emphasize continuing improvement in the quality of care, events have moved so rapidly in recent decades that the evidence needed for science-based health professions has lagged behind clinical practice. It is clear that insufficient research has been devoted to assessing the costs, risks, and benefits of diagnostic, therapeutic, and preventive measures—both those just coming into widespread use and those already well disseminated.

There is also concern that the extent of public understanding of vital health matters is inadequate, as suggested, for example, by the poor level of the nation's polio immunization program and the continued prevalence of smoking. These same examples also point to the need to bring fundamental public health services, as well as health education, to the entire population.

In light of this confusing mix of progress and limitations in the health sector [neatly phrased in a recent issue of *Daedalus* (*5*) as "Doing Better and Feeling Worse: Health in the United States"] it is appropriate that *Science* devote major attention to aspects of health

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in this issue. The articles that follow have been developed by scholars whose backgrounds and disciplines are as varied as the determinants of health and disease.

The Health Sciences

Despite the obvious diversity of the articles that are oriented to the health sciences—spanning sports medicine to psychopharmacology—it might be helpful to envision the various topics as related to each other by the fact that they each occupy special and overlapping positions along a hypothetical health sciences "spectrum." At one end of this spectrum is basic research, usually laboratory-based, which is typically initiated by an investigator with no particular treatment or prevention goal in mind. Next on the continuum are small-scale clinical investigations on a few patients, and then large-scale controlled field trials (involving hundreds or thousands of individuals) that typically seek to delineate the effects of particular interventions or risk factors on human health. At the far end of the research continuum are health services research, concerned with the practical problems arising in the provision of health care, and prevention research, which explores strategies to prevent disease in the first place. This spectrum concept thus considers the utility of science for health, from laboratory bench to patient bedside, to the homes and communities that constitute the "firing line" of most therapeutic and preventive efforts. There are, of course, feedback loops throughout the continuum; some lines of investigation involve several parts of the spectrum, and in some instances the spectrum becomes a true circle, as when basic research points toward primary prevention of disease.

The basic research component of the health sciences is addressed by Comroe, particularly in terms of the long-range importance of basic research for future advances in the diagnosis, treatment, and prevention of disease. While it is true that, in the immediate future, basic research may not be applicable to problems of health and disease, there is no question that the support and nurturing of vigorous basic research is needed for some future, and still undefined, gains in health and well-being. Comroe develops the concept of the health sciences spectrum and formulates some components of a national biomedical science policy.

The articles of Barchas *et al.*, Berger, and Omenn each describe research in basic and clinical sciences that has resulted in remarkable increases in knowledge of human disease, its treatment and prevention. One of the principal frontiers in the life sciences is delineated in the article of Barchas *et al.* Elucidation of the structures and functions of neurotransmitters, neuromodulators, and hormones in the brain is currently an area of a great deal of research, and rapid progress is being made. The clinical benefits of this work are already impressive, and the potential for future progress is even greater. This article provides an excellent illustration of the value of basic science. The discovery of brain amines, their distinctive distribution within the brain, their relevance for Parkinson's disease, and the emergence of the first reasonable treatment of this serious illness all occurred within about a dozen years. For the future, understanding of the endogenous opiates holds much potential for the management of pain, and should help to clarify the nature of addiction and substance abuse.

Berger's article focuses specifically on progress in neurobiology and drug development that has led to new therapies for schizophrenia, mania, and depression. The progress he describes in managing mental illness is one of the great advances of recent years, even though significant limitations are apparent. The delineation of biological predisposing factors in major mental illness is important in that mental illness is a major burden on the nation, and accounts for much suffering, disability, and expenditure.

Basic and clinical research has also contributed to health maintenance through the developments of such techniques as amniocentesis, visualization of the fetus, sampling of fetal blood and serum, and the treatment of specific genetic fetal disorders in utero. Omenn cogently describes this research and its promise for the future. Its application is not without controversy. Scriver *et al.* also discuss the emerging role of genetics in our understanding of health and disease; they formulate a "genetic paradigm of health and disease." The implications of this paradigm are especially significant in terms of disease prevention. In principle, prevention programs could be directed to aid the specific subpopulations that bear an excessively heavy risk for developing specific diseases on the basis of genetically determined characteristics.

Farther along the health sciences continuum are the applied sciences such as health services research. The mode of organization of services, their quality, cost, and availability have a great bearing, in principle, on the health status of the population. Careful, systematic investigation of these matters is a recent development and does not yet have a secure insitutional base, either in government or in the universities. One important focus of health services research is the assessment of the costs, benefits, and risks of existing and emerging health care interventions and technologies, which in some ways is an extension of traditional clinical research. These investigations are difficult, sometimes expensive, and can pose complex ethical problems; but they are crucial in today's circumstances of greatly amplified benefits and risks, escalating costs, and intense public scrutiny of health care techniques. The articles of Frazier and Hiatt, Donabedian, Bunker *et al.*, and Mortimer describe and analyze the need for such evaluation studies in regard to the health system and medical practices generally, surgical innovations in particular, and immunizations, respectively. The fundamental thrust of such investigations is to increase the degree to which the practice of medicine is based on research evidence rather than on clinical impressions.

Of course, it is not realistic to suppose that the health professions can be entirely science-based. There is much that must rest on clinical observation, complex judgment, even art—and appropriately so. Moreover, we must not stifle innovation among talented clinicians. Yet the health professions generally wish to be as science-based as possible and are so perceived by the public. For both humanitarian and economic reasons, it is more important now than ever that health care interventions be based insofar as possible on scientific grounds.

At the far end of the health sciences spectrum is research on disease prevention that is focused on the risk factors associated with the development of disease and on strategies to lessen these risks. The articles of Breslow and Saward *et al.* discuss the reasons for the current upsurge of interest in disease prevention (as distinct from the treatment of illness) and outline promising approaches to prevention. Such approaches often require novel conjunctions of biological and behavioral science, clinical medicine, and public health. For example, Winikoff's discussion of the importance of breast-feeding and adequate nutrition for both maternal and infant health draws on many intersecting disciplines.

One special component of the expanding health sciences is the field of medical instrumentation and bioengi-

neering. Both Ream and Schoolman *et al.* describe these fields with special reference to the use of computers. It is interesting that the increased presence of technology in the healing arts has been accepted with ambivalence. However, technologies have greatly increased the capacity of medicine to cope with illness—as in the use of heart and lung machines, kidney dialysis, and artificial joints. But the great expense of much medical technology has contributed to the rapid rise of total health care costs, has diminished the personal element in medical practice, and has sometimes raised serious ethical and legal issues (as in the continuing agony over maintaining individuals' life support systems after brain function has ceased).

Changing Social Context

These many advances in the health sciences are embedded in a changing social context, not the least of which is a burden of illness profile that has shifted significantly in recent years. Whereas infectious disease used to be the chief limitation on life and health, accidents now rank as the leading cause of death among all persons age 1 to 38; and in all age groups from under 1 to 75, accidents are somewhere in the top six causes of death. Motor vehicle accidents in particular are a new 20th-century burden and are of great concern and cost in that they occur disproportionately to young people. Homicide and suicide are now the second and third leading causes of death for persons 15 to 24 years of age (*6*). Even though infectious diseases were the chief life-limiting factor for children and young adults at the turn of the century, accidents, homicide, and suicide are now the prime cause of premature death.

Another major category of illness in the United States in 1978 is cardiovascular disease, which ranks first in total economic cost, first in potential years of life lost, and second in number of hospital bed-days, physician visits, and limitation of major activity (*7*). Malignancies (particularly those of the lung and breast), mental disorders including the schizophrenias, and the problems associated with alcohol and other drug abuse are also widely prevalent, account for a large proportion of all complaints brought to physicians and to hospitals, and are exceedingly costly in terms of death, disability, and dollars. This change in the illness profile is accompanied also by a gradual aging of the population. This simple demographic fact has heightened the urgency of formulating new ways to address the social and health needs of older people, as discussed by Kane *et al.*

Such changes in both the illness and age profiles have been joined by equally significant, although less measurable, changes in consumer expectations of medicine and a new adversarial tone to relations between patient and physician, discussed in some detail by both Ingelfinger and Chapman. It is probably true that expectations about the scope and abilities of medicine are out of line with reality; and certainly the media bear some share of responsibility for this discrepancy. One particular side effect of the changed nature of medical practice and the relations between patient and physician has been an increase in malpractice claims against physicians. Tancredi *et al.* analyze this problem and point out that medical injury compensation issues may be usefully seen as symptomatic of more basic issues in the practice of medicine, such as the need for clearer standards of practice, increased determination of the efficacy of medical interventions, and a more sophisticated analysis of the amount of uncertainty that is tolerable in the relation between the patient and physician.

One of the most significant shifts in the social context of medicine is the renewed interest in national health insurance. Ball aptly describes the rationale for national health insurance: To make sure that every one can get good medical care at a price one can afford. Thus, the central issues are access, quality, and cost of care. These objectives are difficult to achieve in this era of complex expensive medicine in a very large, heterogenous society. Many approaches have been proposed over the years; the likelihood of a comprehensive government-owned and government-operated system, similar to those used in many European countries, appears very low.

During the past year, considerable ingenuity that has been evidenced in new proposals demonstrates, in our view, the socially as well as technically inventive character of American society. One trend reflected in Ball's article is the inclination to view a national health insurance plan (public and private) as an active purchaser of services, not merely a payer of bills. Thus, a national health insurance plan might actively seek to provide incentives for containing costs and improving the quality of care over the long term. These efforts might emphasize promising modes of organization (for example, health maintenance organizations) as well as new support for research on health care.

Concluding Comment

The health of our population is related to the enormous transition that our species has brought about since the industrial revolution, and especially in the 20th century. In a mere moment of evolutionary time, we have drastically transformed the world of our ancestors. Rapid population growth in most of the world, urbanization with its many ramifications, environmental damage and resource depletion, the risks of weapons technology, and new patterns of disease—are all largely products of changes that have occurred only in the most recent phase of human evolution. We have changed our diet, our activity patterns, our technology, the substances of daily use and exposure, our patterns of reproductive activity, tension relief, and human relationships. Many of these changes are truly epochal and are laden with new benefits and new risks, and most of the long-term consequences are poorly understood. Natural selection over millions of years shaped our ancestors in ways that suited earlier environments. We do not know how well we are now suited biologically and behaviorally to the world our species has so rapidly made (*8*).

This situation provides a powerful stimulus for the life sciences, broadly defined. A wide spectrum of research is needed to meet long-range health problems. We are entering now an era of testing the extent to which the methods of science can be brought to bear on the entire range of factors that determine the health of the public.

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