17. Epidemiology and public health

Clinical versus the public health approaches

In their report of a major study conducted by the U.S. National Academy of Science's Institute of Medicine, the Committee for the Study of the Future of Public Health defined the mission of public health mission as:

> "the fulfillment of society's interest in assuring the conditions in which people can be healthy" (p 40)

The substance of public health was defined as:

> "organized community efforts aimed at the prevention of disease and the promotion of health. It links many disciplines and rests upon the scientific core of epidemiology." (p 41)

Public health focuses on the health of the community, but is a community an entity other than the people in a particular location or institutional unit? To begin exploring this question, let us first contrast two complementary approaches to maintaining and improving health – the clinical approach and the public health approach.

Clinical approach

The clinical approach deals with individuals, families. The provider's mission is to do what is best for the patient. Although it has been criticized for devoting insufficient attention to prevention, clinical medicine is not inherently tied to curative, rather than preventive approaches. In fact, in recent decades the time and resources devoted to preventing disease have greatly increased, especially in the realm of secondary prevention (e.g., management of hypertension and hypercholesterolemia). Pediatrics has long emphasized primary prevention.

What is more intrinsic to the clinical approach is the focus on the individual, or sometimes the family, in terms of diagnosis and intervention. Diagnostic inquiry is directed at the patient, e.g., her or his history, experiences, physiology, and so on. The scope of inquiry is primarily the prevention and treatment of medically recognized diseases, trauma, and psychiatric disorders.

Preparation of clinicians emphasizes core knowledge in biomedical sciences oriented towards understanding physiological and pathological processes, the effects of pharmacologic and surgical interventions, and techniques for investigation and intervention with the individual. In addition to allopathic medicine, numerous other approaches are offered in a clinical-type setting, including acupuncture, chiropractic, massage therapy, and many others. But the clinical encounter with an individual remains the framework.

Public health approach

The public health approach, in its ideal concept, deals with communities. The public health mission is to serve the community, even when particular individuals may well be disadvantaged in some way. There is some ambiguity in this statement, though, since any given population may be regarded as consisting of various "communities", whose interests are often perceived to differ. But typically public health focuses on a population or on subgroups within it.

The public health approach emphasizes prevention, though prevention in this context generally means preventing the occurrence of disease in individuals. At the level of the community, the distinction between prevention and cure may not be as clear.

The scope of public health is much broader than that of the clinical approach, because there is no framework of a clinical encounter to confine the time for diagnosis or intervention, and the variety of people and their situations in a community multiply the range of factors that can affect health. Therefore, in addition to specific and general causes of medically-recognized diseases, trauma, and psychiatric disorders, public health is concerned with the organization of society and the protection of the environment, and properly focuses on the future.

Public health providers have a small core of common training, due to the many fields of knowledge that become relevant when one deals with factors outside the individual. Channels for intervention are similarly broad, as they can deal with individuals, families, government organizations, the media, and the physical environment.

Contrasting the clinical and public health approaches

Two WHO reports on *in vitro* fertilization (IVF), published two years apart, illustrate the contrast in the clinical and public health approaches. The first (1990), issued by the WHO Regional Office for Europe in Copenhagen used a public health approach aimed at finding the best mix of curative and preventive health services, given existing resources, to maximize health status. The second (1992), issued by the WHO headquarters in Geneva, used a clinical approach to health policy development and focused on individual patients and their available treatment options. Here are some examples of these contrasting perspectives, taken from a commentary by Stephenson and Wagner (1993):

Prevention

- Copenhagen - options and recommendations for integration of preventive health services into an overall plan for the management of infertility in the community
- Geneva - no discussion of the prevention of infertility

Health services planning

- Copenhagen - a technology or procedure should have proven effectiveness, safety, and benefit as evaluated by clinical trials and other epidemiology methods, before acceptance as standard treatment.

- Geneva - " . . . IFV and allied procedures changed from being purely experimental in character to become accepted treatments for certain types of infertility and the numbers of centres offering them increased rapidly."

Rationing of health care

- Copenhagen - provision of services should be determined by the prevalence of the condition, the priority for infertility services within all human services, the medical and social options available to infertile people, and consumer views and choices. The public must have a voice in setting these priorities.
- Geneva - "Respect for the principle of quality of services requires the availability of medically assisted conception to the population requiring such service."

Standards of practice

- Copenhagen - recommendations for limits on age (40 years of age or younger), number of IVF treatment cycles per woman, and three eggs/embryos per IVF treatment cycle.
- Geneva - no recommendations

Research priorities

- Copenhagen - priority to epidemiological, social, and health services research
- Geneva - focuses on laboratory and clinical problems

The individual and population approaches have also been contrasted in regard to the epidemiology and prevention of sexually transmitted diseases and HIV (Aral et al., 1996).

Overlap

To be sure, there is considerable overlap between the two approaches, which at its best provides many opportunities for cooperation and complementary services and at its worst invites charges of duplication and turf wars. From the clinical side, the importance of prevention is being increasingly emphasized in primary care; from the public health side, interventions directed at the individual (e.g., inoculation, early detection and treatment, risk factor management) are typically carried out in one-on-one clinical settings. Pediatrics particularly has a strong orientation to prevention, and there are also disciplines of community medicine, community pediatrics, and social medicine.

There are also many activities and organizations that blend both clinical and public health approaches, as, for example, public health clinics, outreach services, patient education, clinical dietetics, clinical epidemiology, and questions of the availability, effectiveness, quality, and affordability of health services.

Obviously, both clinical and public health approaches are essential. Without health care at the individual level, much suffering occurs. Without public health, the brushfires of disease can easily overwhelm treatment resources. There is, however, a growing concern that the clinical approach has been gaining ascendency in confronting health needs out of proportion to the needs of public

health, particularly at the world level. Among the factors that favor the clinical approach over public health are:

- Symptoms and discomfort tend to motivate action much more than do theoretical concerns about low-level risks in the future.
- Individual victims of disease can be (or be made) highly visible and can elicit sympathy and a desire to help; by contrast, benefits from effective public health tend to be invisible and abstract.
- Effective treatment of a feared or disabling condition is highly visible and can be dramatic; by contrast, beneficiaries of effective public health measures typically do not think of themselves as being at risk nor as having benefited.
- Groups of individuals who have been affected by a disease can be highly influential in the political process; by contrast, public health benefits large groups, so specific individuals are not moved to action.
- Health care insurance systems provide an enormous revenue stream to support clinical services; by contrast, public health must compete with numerous other worthy constituencies for government appropriations.
- Clinical professions have many more people than do public health professions, which means more visibility, more potential letter-writers, and more membership dues for professional organizations.
- Much clinical care is delivered by the private sector, which has much greater ability to market its services and perspectives.

Thus, it is hardly surprising that resources devoted to health care services are orders of magnitude greater than those devoted to public health. Nevertheless, nations differ in their relative expenditure on public and private health services, and there are opportunities to influence the balance through public education (a.k.a. marketing) campaigns.

Academic versus public health perspectives

As noted in an earlier chapter, the modern history of public health has been shaped by advances in scientific knowledge and technology, and growth in the public's acceptance that disease control is possible and a public responsibility. These advances have come from and contributed to a major expansion of epidemiologic research and training, including the development of epidemiology as an academic discipline. But the rise of academic epidemiology and its access to federal resources for research have had effects on the field that are not universally welcomed. To be sure, epidemiology continues to be the discipline that conducts surveillance for diseases in the population, identifies and prioritizes threats to health, designs control and preventive measures, and evaluates their effectiveness. In this role, epidemiologic research has strong links to the needs of public health authorities and direct applicability to important public health needs.

Since World War II, however, as the importance of scientific and biomedical research for modern societies has become apparent, epidemiology has developed a strong role as a "basic" science and a position of growing respect among academic researchers. This role has fundamental importance for

public health, since the best opportunities to prevent disease and improve health often come from advances in basic understanding of the causes of disease, the development of new methods to study them, and the assessment of preventive and control measures. Nevertheless, there is an abiding concern about the weakening of the link between public health practitioners and academic epidemiologists, imbalances between allocation of research funding and importance of public health problems, and the forces that draw epidemiologists' efforts toward what is perceived as scientifically and academically valuable but further away from public health needs.

This concern has been expressed by major figures in epidemiology and public health. Nearly 20 years ago, Milton Terris (The epidemiologic tradition. *Public Health Reports* 1979;94(3):203-209) objected to the growing divide between academic epidemiology and public health practice, and Lilienfeld and Lilienfeld (1982:147-148) and Mervyn Susser have warned about the overemphasis on technique. The Committee for the Study of the Future of Public Health also made a number of strong criticisms of schools of public health. Cecil Sheps has warned about the "substitution of method for meaning".

How can teaching and research be in conflict with the mission of public health? There are many aspects to this question, but one is the familiar question of where to set priorities when not everything can be done. Although biomedical research has led to remarkable discoveries and capabilities, in many instances it is possible to accomplish a great deal of prevention without the full knowledge of the pathogenic agent. In the words of the late Ernst Wynder, ". . . as we reflect on the history of medicine, we may conclude that the complex disease entitles of the twentieth century, like the diseases of the past, will respond first to preventive strategies on the basis of new knowledge as well as of information already at hand." (EL Wynder, *Am J Epidemiol* 1994:549). Wynder provides these examples:

Comparison of the date of discovery of a measure to prevent a disease with the date of identification of its true causative or preventive agent

Disease	Discoverer of preventive measure	Year of discovery preventive measure	Year of discovery of agent	Discoverer of agent
Scurvy	J. Lind	1753	1928	A. Szent-Gyorgi
Pellagra	J. Goldberger	1755	1924	G. Casal et al.
Scrotal cancer	P. Pott	1775	1933	J.W. Cook et al.
Smallpox	E. Jenner	1798	1958	F. Fenner
Puerperal fever	I. Semmelweis	1847	1879	L. Pasteur
Cholera	J. Snow	1849	1893	R. Koch
Bladder cancer[a]	L. Rehn	1895	1938	W.C. Hueper et al.
Yellow fever	W. Reed et al.	1901	1928	A. Stokes et al.
Oral cancer[b]	R. Abbe	1915	1974	D. Hoffmann et al.

Causative or preventive agents

Scurvy	(Ascorbic acid)
Pellagra	(Niacin)
Scrotal cancer	Benzo(a)pyrene
Smallpox	Orthopoxovirus
Puerperal fever	Streptococcus
Cholera	Vibrio cholerae
Bladder cancer[a]	2-Naththylamine
Yellow fever	Flavivirus
Oral cancer[b]	N-nitrosonomicotine

[a] associated with aniline dye; [b] associated with tobacco chewing

Source: Wynder EL. Invited commentary: studies of mechanism and prevention. *Am J Epidemiol* 1994:547-549, Table 1.

The current health profile of the people of the world as a whole and of the United States (especially among minority groups) highlights many health problems where the application of existing scientific and medical knowledge could bring major improvements. It has been argued that nearly half of deaths in the United States could be prevented by the application of existing medical knowledge.

Deaths from Preventable Causes in the United States in 1990

Cause	Estimated No. of Deaths	Percentage of Total Deaths
Tobacco	400,000	19
Dietary factors and activity patterns	300,000	14
Alcohol	100,000	5
Microbial agents	90,000	4
Toxic agents	60,000	3
Firearms	35,000	2
High-risk sexual behavior	30,000	1
Motor vehicle injuries	25,000	1
Illicit use of drugs	20,000	<1
Total	1,060,000	49

Source: Carl E. Bartecchi, Thomas D. MacKenzie, Robert W. Schrier. The human costs of tobacco use (first of two parts). *New Engl J Med* 330;1994:907-912, Table 1, page 908. Reprinted from McGinnis JM and Foege WH. Actual causes of death in the United States. *JAMA* 1993;270:2207-12. Values are composite approximations drawn from studies that use different approaches to derive estimates, ranging from actual counts (e.g., firearms) to calculations of population-attributable risk (e.g., tobacco). The numbers have been rounded.

Individual-level versus societal level perspectives

The reasons – behavioral, social, political, and economic factors – for the lack of application of existing knowledge are rarely the subject of epidemiologic inquiry. Moreover, these factors are also the major determinants of health in populations, so that their position outside of the scope of epidemiology greatly restricts epidemiology's potential for improving health.

Geoffrey Rose (1985) has argued that concentration on the person as a unit and on a lessening of personal risk has led to the neglect of populations and of the preventive goal of reducing incidence. Similarly, Nancy Krieger (1994) has criticized definitions of epidemiologic theory that emphasize concepts pertaining to study design and causal inference, and ignore issues of what drives societal patterns of health and disease.

Poole (1994) contrasts two perspectives on the nature and role of epidemiology. In the first viewpoint (which he identifies with Milton Terris and Mervyn Susser), health of a group, cohort, community, or a people is more than the summation of the health of its individual members. Public health's special province is this "more". From this viewpoint, epidemiology "is not so much the study of disease and health IN human populations as the study of disease and health OF human populations" (Poole). Epidemiology is seen as a social science (a population science) that focuses on the forest, rather than on the trees.

In what Poole refers to as the newer view (advanced by Ken Rothman and Sander Greenland), epidemiology is seen "as a type of medical research, as a way of using populations to obtain biologic knowledge about disease and health in individual persons". Here, epidemiology is seen as natural science, the health of the population is the summation of health of individuals, and public health is medicine for the masses with an emphasis on prevention. This view presents epidemiology as a dispassionate science, rather than an activist one.

Multilevel statistical models (also called hierarchical regression models and various other names) represent a partial answer to this conflict, since they allows for the inclusion of both individual-level and group-level variables in the same regression model. However, while multilevel modeling addresses the statistical issues of correct estimation when variables are measured at different levels, the conceptual model and theoretical aspects, which lies at the heart of the debate, remain.

While the first viewpoint described by Poole tends to be associated with public health activism, it is certainly possible to focus on societal level factors without endorsing or promoting any particular course of action. The societal perspective may be more congenial to activists in that it appears to invite advocacy more directly than does the individual-level perspective. But many individual level factors (e.g., immunization, nutrition, tobacco use, fitness) are powerfully influenced by the social environment, which argues for an activist stance in regard to individual-level relationships as well. In some respects, therefore, the debate between the two viewpoints contrasted by Poole is another version of the debate, discussed in the first chapter, about whether epidemiology is more properly a science or a public health profession that includes advocacy as part of the job description.

Human behavior is also biology

The debate about individual-level versus societal-level viewpoints is likely to evaporate for several reasons. Perhaps the most important of these is that as society and scientific knowledge evolve the interacting influences of individuals and the environment become increasingly apparent and important. Advances in genetic science and technology, including the mapping of the human genome, are greatly expanding the possibilities to understand disease processes at the individual level. But as this understanding unfolds it will, of course, disclose environmental (in the broadest meaning of the term) influences. Indeed, identification of susceptibility genes will increase the power of epidemiologic studies to identify environmental factors, since inclusion of nonsusceptible persons weaken associations. At the same time, advances in understanding of societal factors will make clear the need to understand the individuals whose individual and collective behavior creates and maintains those factors (Schoenbach 1995).

Since the human species is, after all, a part of the animal kingdom, full understanding of human behavior requires a biological perspective as well as the perspectives of the psychological, sociological, economic, and political sciences. That biological perspective must encompass influences related to genetic factors, environmental exposures (e.g., lead), prenatal exposures, nutritional factors, pharmacologic factors, and neuroanatomical/neuroendocrinological effects of past experiences (e.g., nurturing, violence). It must also take account of behavioral and cognitive tendencies that our species has acquired in our journey through evolutionary time.

As our population numbers and density increase, and the growth of technology and organizations magnifies our potential impact, human behavior becomes an increasingly important factor on society and on the environment. One area where this impact is evident is war and conflict. In addition to millions upon millions of deaths from political, ethnic, and religious violence in the past century (an illustrative list: Armenia, Bosnia, Cambodia, Chechnya, China, Congo, Egypt, Korea, Kosovo, Lebanon, India, Iran, Iraq, Ireland, Israel, Japan, Russia, Rwanda, Spain, Syria, Timor, Vietnam – plus World Wars I and II and innumerable colonial wars) represent a direct impact, armed conflict devastates public health infrastructures, physically and psychologically maims many of the survivors, destroys agriculture and industry, creates massive numbers of displaced persons, and harms the environment. Nuclear war, the most dramatic anti-social behavior, could render irrelevant virtually all epidemiologic achievements. The ability of individual or small groups of terrorists to harm large numbers of people is attracting heightened attention as a result of such incidents as the Oklahoma and World Trade Center bombings and the sarin gas attack in Tokyo (and the belief that the organization responsible for the latter was also trying to obtain specimens of ebola virus).

Even more profound than these blatant harms to human life and health, however, may be the growing imbalance between population and environmental resources. Such imbalances are a familiar phenomenon in nature – and a temporary one, since population size adjusts to fit within available resources.

World population growth and urbanization

By 2030, world population is expected to grow to over eight billion from the current six billion (Lutz, 1994). Meanwhile the industrialized countries' share of population is expected to shrink to

14%, so that the burden of the environments in developing countries will intensify greatly. The impacts of population size on life, the environment, and public health are manifold and sometimes complex. The age structure of the population, its geographical distribution, and many other factors all influence the impact of population size. The governments of the world have yet to accept fully that there is an upper limit to the earth's carrying capacity. In 1982 the United Nations Food and Agriculture Organization (FAO) estimated that under optimal conditions the world could support over 30 billion people, though a more realistic figure for food sufficiency is 10 to 15 billion, a range that the world is projected to reach by the year 2050 (Lutz, 1994).

Population growth rates are a function of birth and death rates. Crude death rates are very similar between the developing countries as a whole and the developed countries, because the former have a much younger age structure (average age in 1990 was 38 years in Western Europe, 22 years in sub-Saharan Africa) (Lutz, 1994). Birth rates in the developing world are much higher, with only China, Hong Kong, and Taiwan having birth rates below 20 per 1,000 persons. Both younger age structure and higher total fertility rates (lifetime number of births/woman) are responsible for the higher birth rates. Although there are many uncertainties that underlie projections of birth rates, mortality, and population growth, "The question is not 'if' world population will grow, but rather 'how big' will it become." (Lutz 1994:34).

Birth rates in urban areas are generally smaller than those in rural areas, but urban areas also grow through rural-urban migration. Growing urbanization is bringing dramatic changes which are being largely ignored in thinking about the future (Meade and Earickson, 2000). In 20 years, India will double in size, adding nearly 800 million people to its cities. Lagos, Nigeria will grow to 25 million. According to the authors, we are approaching a qualitative change.

Historically, Meade and Earickson explain, many communicable diseases flourished when the development of cities created adequate population density for microbes like measles. But urbanization in the U.S. was "stepped migration", the classical pattern – people move from farm to town, then to a nearby city, then to a distant, larger city, acquiring an urban lifestyle in the process. In contrast, urbanization in the developing world is "chain migration" – people go directly from villages to cities, sometimes even bringing their farm animals with them. U.S. cities grew at 1%, doubling in 70 years. Many Asian and African cities are growing at 7%, doubling in 10 years!

Meade and Earickson explain further that urbanization, especially rapid urbanization, provides a larger host population for communicable diseases, more interaction (especially in a service economy), and shortages of pure water and sewage treatment. Urbanization brings changes in the host population (genes, gender, age), habitat (natural → built, social), and behavior (beliefs, social organization, technology). Urbanization leads to draining marshes, introducing artificial irrigation, and deforestation, all of which promote different species of vectors. For example, new disease vectors are developing that "like" organically polluted water. Bubonic plague had come to Europe before the Black Death but did not spread wildly because of the absence of rats in Europe. Enormous population growth in Europe in the Middle Ages overwhelmed the habitat – agriculture, sewage, grain storage, fluctuating yields – led to a large rat population and poor/malnourished human population, creating the conditions for the spread of plague. In fact, outbreaks of threatening communicable diseases, including plague itself, are a present reality (and if it can be characterized as such, a fascinating saga – see Laurie Garrett's *The coming plague*). Besides

communicable diseases, crowded, under-resourced urbanized areas spawn massive shantytowns and high rates of unemployment, desperation and crime. Unbreathable air and depletion of water supplies are major issues. For a vivid and disquieting portrait of some of these situations, see Robert D. Kaplan, The coming anarchy (*Atlantic monthly*, February 1994; 273:44-76; available at `http://www.theatlantic.com/politics/foreign/anarchy.htm`).

Global epidemiology?

Accurate knowledge is an essential for effective action. As illustrated by Ernst Wynder's examples, even partial knowledge can lead to successful prevention. However, partial knowledge can also lead to exchanging one set of problems for another, perhaps worse than those that motivated the original actions. Sir Austin Bradford Hill (1968: 300) wrote that the incomplete and tentative nature of scientific knowledge "… does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to demand at a given time." But the judgment of what action is demanded by existing knowledge is often complex and controversial.

The debate between contrasting views of epidemiology outlined earlier reflects to some extent the conflict between the desire to be confident in one's methods and data on the one hand and the need to tackle the major problems that confront public health. But that conflict is one for individuals to resolve in choosing where to work and what to work on, rather than a decision for the field. If epidemiology confines itself to studying biomedical questions that it has the tools for studying, to whom does it leave the other problems that confront public health? If the study of health in human populations is epidemiology, then whether the people who tackle these problems call themselves medical geographers, biological anthropologists, or epidemiologists, they will be practicing epidemiology. Challenges to human health are not constrained by the availability of methodologies to study them.

In principle, and increasingly in practice, the purview of epidemiology extends to the fauna and flora of the planet and their global environment. The importance of developing a global perspective becomes clearer every decade, as advances in science, production, transportation, and communication, with the accompanying changes in human activity, have created the conditions for global epidemics, global contamination, conflict between peoples separated by great distances, and even modification of the planet (McMichael 1993). In his book *Planetary Overload*, Anthony McMichael (1993) identifies international inequality as the key issue that must be addressed in order to protect the global environment on which human health depends:

1. The "one underlying problem is the entrenched inequality between rich and poor countries, which predominantly reflects recent imperial history, power relationships and the global dominance of Western industrial technology and economic values." (p. 7)
2. The "two central manifestations of this inequality are:
    1. rapid, poverty-related, population growth and land degradation in poor countries, and
    2. excessive consumption of energy and materials, with high production of wastes, in rich countries." (p. 7)
3. The "three possible (perhaps coexistent) adverse outcomes of those manifestations are:

1. exhausting various non-renewable materials,
2. toxic contamination of localised environments, and
3. impairment of the stability and productivity of the biosphere's natural systems." (p. 7)

Although the study of the world's people and our environment, living and nonliving, can neither be claimed by nor contained within any discipline or field, epidemiology's multidisciplinary perspective draws, as a matter of course, from all fields of knowledge. In that respect, epidemiology is as logical a field as any to include the study of global health, in its broadest interpretation, within its scope. John Last made this very point in accepting the Abraham Lilienfeld Award from the American College of Epidemiology: "There is a need for innovative, transdisciplinary approaches. Epidemiology is already transdisciplinary. Epidemiology is well placed to take leadership." (American College of Epidemiology Annual Meeting, Boston, September 22, 1997).

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