



# American Journal of EPIDEMIOLOGY

Volume 145

Number 6

March 15, 1997

Copyright © 1997 by The Johns Hopkins University

School of Hygiene and Public Health

Sponsored by the Society for Epidemiologic Research

---

## REVIEWS AND COMMENTARY

---

### The Failure of Academic Epidemiology: Witness for the Prosecution

---

Carl M. Shy

Academic epidemiology has failed to develop the scientific methods and the knowledge base to support the fundamental public health mission of preventing disease and promoting health through organized community efforts. As a basic science of public health, epidemiology should attempt to understand health and disease from a community and ecologic perspective as a consequence of how society is organized and behaves, what impact social and economic forces have on disease incidence rates, and what community actions will be effective in altering incidence rates. However, as taught in most textbooks and as widely practiced by academicians, epidemiology has become a biomedical discipline focused on the distribution and determinants of disease in groups of individuals who happen to have some common characteristics, exposures, or diseases. The ecology of human health has not been addressed, and the societal context in which disease occurs has been either disregarded or deliberately abstracted from consideration. By essentially assuming that risk factors for disease in individuals can be summed to understand the causes of disease in populations, academic epidemiology has limited itself to a narrow biomedical perspective, thereby committing the biomedical fallacy of inferring that disease in populations can be understood by studying risk factors for disease in individuals. Epidemiology should be redefined as a study of the distribution and societal determinants of the health status of populations. This definition provides a stronger link to the primary mission of public health and places an appropriate emphasis on the social, economic, environmental, and cultural determinants of population health. Epidemiology must cross the boundaries of other population sciences and add to its scope a macro-epidemiology, a study of causes from a truly population perspective, considering health and disease within the context of the total human environment. *Am J Epidemiol* 1997;145:479-84.

epidemiology; history of medicine, 20th cent.; population; public health

---

#### CAST OF CHARACTERS

Judge

Prosecuting Attorney

Counsel for the Defense

Witness for the Prosecution

#### THE CASE

JUDGE: Will the Prosecution please state its charge in this case?

---

Received for publication September 25, 1995, and accepted for publication November 1, 1996.

From the Department of Epidemiology, School of Public Health, University of North Carolina at Chapel Hill, CB #7400, Chapel Hill, NC 27599-7400. (Reprint requests to Dr. Shy at this address.)

PROSECUTOR: Thank you, Your Honor. The State charges academic epidemiology with failure to serve as the basic science of public health. Academic epidemiology has failed to develop the scientific methods and the knowledge base to support the public health mission. The substance of this mission, according to the Institute of Medicine, is "*organized community efforts* [emphasis added] aimed at the prevention of disease and promotion of health" (1, p. 41). Research methodologies elaborated by academic epidemiologists over the past four decades, rather than enabling public health to develop community intervention programs, have served the clinician's interest in understanding why individuals become sick and what counsel they might give to their patients to prevent disease.

The preponderance of current published articles in epidemiologic journals deal with risk factor and disease associations at the individual rather than at the population level of understanding. By abstracting from the societal context in which disease occurs, epidemiologists have failed to provide the public health community with scientifically tested choices among alternative community actions for promoting health. It is one thing to identify the risk factors for lung cancer in individuals and another to understand what changes occurred in society to result in an epidemic of lung cancer in the 20th century. As Rose expresses it, "To find the determinants of prevalence and incidence rates, we need to study characteristics of populations, not characteristics of individuals" (2, p. 34). Therefore, the State charges academic epidemiology with a failure to develop the methodology and to generate the knowledge required by the public health community to fulfill its fundamental mission of creating and "assuring [the] conditions in which people can be healthy" (1, p. 7).

JUDGE: Will the Counsel for the Defense please make your opening statement?

COUNSEL FOR THE DEFENSE: Yes, Your Honor. Far from being a failure, the discipline of epidemiology, as taught by academicians and as practiced through their research has, in the words of Milton Terris (3, p. 27), brought about a "second epidemiologic revolution." The first "revolution" came about when epidemiologists discovered the causes of disease epidemics prevalent in the 19th century. These discoveries gave birth to the sanitary reforms of the 19th and early 20th centuries. Then, in the past 40 years, epidemiology developed methods to identify the risk factors for chronic diseases, and this knowledge has served as a basis for preventive actions both at an individual and societal level, resulting in a second epidemiologic revolution, a dramatic decline in mortality from cardiovascular and cerebrovascular diseases. Witness the change in exercise and food consumption habits over the past two decades, and the major reduction in cigarette smoking in this country. It was through epidemiologic research that these lifestyle risk factors were identified in the first place. Academic epidemiologists, along with their colleagues in biostatistics, developed the design and analysis strategies that enabled researchers to study the major risk factors for the chronic diseases that are the leading causes of death in industrialized societies. Furthermore, epidemiologic methods are being used more widely by clinicians in their efforts to practice an evidence-based clinical medicine. The knowledge gained through epidemiologic research over the past

four decades provides the basis for public health action at the community level.

JUDGE: Thank you, Counsel. Will the Prosecution please proceed with the State's case?

PROSECUTOR: Thank you, Your Honor. I wish to call upon my witness. [The witness for the prosecution takes the stand, is duly sworn to tell the truth, and is certified as a qualified expert in epidemiology.]

PROSECUTOR: Will you please state the definition of epidemiology as it applies to this case.

WITNESS: The standard textbook definition of epidemiology is: "the study of the distribution and determinants of disease in populations." The phrase "disease in populations" is critical to distinguish between epidemiology as a basic public health science and epidemiology as a biomedical science primarily concerned with the etiology of disease in individuals. As a public health discipline, epidemiology should attempt to understand disease as a consequence of how society is organized and behaves, what impact social and economic forces have on incidence rates, and what community actions will be effective in altering incidence rates. That is, epidemiology should look upstream, beyond the immediate causes of disease in individuals (4). Raoul Stallones (5) attempted to capture this broader perspective by characterizing epidemiology as a branch of human ecology. However, as taught in most textbooks and as widely practiced by academicians, epidemiology is a study of the distribution and determinants of disease in groups of individuals who happen to have some common characteristics or exposures. The ecology of human health is not addressed, and the societal context in which disease occurs is either disregarded or deliberately abstracted from consideration (6). For example, in most epidemiologic studies, race, social class, and economic status are typically treated only as potential confounding factors, and the effect of political policies on population health is rarely considered. Yet, in cross-national studies, per capita gross national product and society's allocation of resources to the health status of its citizens are major predictors of differences in mortality and morbidity (7).

PROSECUTOR: But, should epidemiology spend its time and energy on social and economic factors that are beyond its current disciplinary scope, even if these societal factors are predictive of health status?

WITNESS: If epidemiology is indeed a study of the determinants of disease in populations, and if public health has as its aim the generation of organized community efforts to promote health, then the answer is clearly "yes." To understand the population determi-

nants of disease, we must use and incorporate population sciences such as demography, economics, sociology, and even political science, since political action is often the means to bring about community change. In making this claim, I do not mean to imply that epidemiologists need to become demographers and economists, or, for that matter, activists for social and political change, but rather that the discipline of epidemiology needs to incorporate the principles and methods of these disciplines in order to study disease as a consequence of social, economic, cultural, and environmental forces that largely account for population differences in disease rates. To date, academic epidemiology has limited itself to a narrow biomedical perspective of disease (8). This narrowness has led to a biomedical fallacy, that is, the error in inferring that risk factors for diseases in individuals can be summed to understand the causes of disease in populations, or that the health of a population can be explained entirely in terms of the characteristics of individuals (9). The biomedical fallacy is likely to occur with far greater frequency, and with greater consequences for public health, than its inverse, the ecologic fallacy.

PROSECUTOR: How, then, would you redefine epidemiology to encompass the broader population perspective you describe?

WITNESS: I would define epidemiology as a study of the distribution and societal determinants of the health status of populations. By including the phrase "societal determinants" in the definition, an appropriate emphasis is given to the important contribution of social, economic, and political influences on the health status of population groups. The societal and environmental determinants of disease are the principal objects of public health policy and practice.

PROSECUTOR: Why does the latter part of your definition refer to "health status" rather than disease?

WITNESS: The term "health status," as opposed to "disease," more strongly links epidemiology to the primary mission of public health, that of preventing disease and promoting health through organized community efforts. Epidemiology should serve this mission by making population health status a principal object of research (10). Furthermore, by focusing on variations in health status of populations, epidemiology may be induced to enlarge its perspective beyond the biomedical, and to begin to develop national indicators of health, similar to the indicators of economic vitality such as gross national product, national savings, and the prime interest rate. As Wolfson comments (11, p. 294): "The most common measures of a population's 'health status' are actually their death status—infant mortality and life expectancy—and

these are the only measures available over time." He adds, "the absence of health status data at the national level means that we do not have a solid statistical basis for judging whether the health of the . . . population is generally improving, let alone for setting the relative priorities for allocating resources to acute care, chronic care, social services, or early childhood intervention." Clearly, our limited biomedical perspective on disease in populations will not lead us to a knowledge of the societal determinants of the health status of populations. Yet, academic epidemiology is largely restricting itself to the biomedical perspective.

PROSECUTOR: Can you expand on your concept that academic epidemiology, as presently taught and practiced, fails to serve the fundamental mission of public health?

WITNESS: The epidemiologist's study of the lung cancer epidemic of the 20th century is a classical example of the limited biomedical perspective. We blame lung cancer on an individual's smoking habit. Epidemiologists should have moved "upstream" by attempting to understand why smoking became so highly prevalent in the 20th century, or, more importantly, what public health interventions would have most effectively reduced the high prevalence of smoking. Academic epidemiology failed to study the underlying societal factors that are causes of disturbances in health at the population level, factors that can be the object of public health interventions. Instead, our research on disease in populations is divorced from a societal context, emphasizes the immediate biologic determinants of disease, and thus serves the medical care system, but provides no clues as to what organized efforts society should undertake to promote health and prevent disease. If epidemiology is to function as a basic science of public health, it must address the underlying population determinants of disease and of health status. To understand how to deal with important public health problems, such as sexually transmitted diseases, violence in society, teenage pregnancies, and disparities in mortality rates between economic classes, the public health community needs research on the population determinants of these problems and on the effectiveness of interventions at the community level. It is insufficient to conclude that social and economic inequalities are important determinants of health. Epidemiology should research these sociocultural factors as potentially modifiable determinants of patterns of disease in populations. Cross-cultural studies, such as those conducted by cultural anthropologists, and macro-level studies, such as those commonly employed by economists, are needed to understand the role of different social, cultural, eco-

nostic, and physical environments in the incidence and prevalence of disease at the population level. The point is, epidemiology must cross the boundaries of other population sciences and develop a "macro-epidemiology," in order to integrate knowledge from the social, environmental, and biologic sciences insofar as they help us to understand population health, disease, and well-being (8). Academic epidemiology has failed to cross these boundaries and has largely remained at the individual, micro-level of research into the determinants of disease. In doing so, it has neither been a study of disease in populations nor has it served the needs of the practicing public health community.

**PROSECUTOR:** How do you characterize this new macro-epidemiology?

**WITNESS:** A new paradigm for epidemiology has been discussed in several recent workshops and papers (6, 8, 10, 12, 13). The fundamental change needed is one of perspective, considering disease within the context of the total human environment, rather than abstracting from this environment, and keeping in clear focus the purpose of epidemiologic research, which is to develop the knowledge base for public health action. According to the Leeds Declaration (13), development of the appropriate knowledge base for public health action requires a response in three broad areas: 1) an extension of the search for causes of disease from the individual to the community and sociopolitical system, 2) a broadening of the methods of epidemiologic research to include qualitative and participatory research methods, and 3) integrating lay knowledge with scientific knowledge, to take account of the richness and complexity of community life. To accomplish this widening of scope and methods, epidemiology needs to adopt principles and methods from more disciplines, particularly from the population sciences that include economics, sociology, demography, anthropology, ecology, and political science. Persons with advanced training in these disciplines should be recruited for doctoral level training in epidemiology. An environment for collaboration with these disciplines needs to be created. Furthermore, epidemiologic research should be explicitly designed for public health action, which often implies social or environmental change. Thus, academic epidemiologists need to be in closer contact with the public health community, in order to develop research methods and to design research that serves the needs of this community (3). Epidemiologic research should be clearly relevant to prevention and intervention, and the policy applications of research should become an object of

research itself, if epidemiology is to inform public health action.

**PROSECUTOR:** Thank you. Your Honor, this concludes my witness's testimony on behalf of the State's case.

**JUDGE:** Does the Counsel for the Defense wish to cross-examine the Witness?

**COUNSEL FOR THE DEFENSE:** Yes, Your Honor. [Turning to the Witness.] Your characterization of this new macro-epidemiology appears to encompass all social, environmental, and biologic sciences in one discipline. The likely result will be a superficial and ineffective knowledge of each of them, and equally ineffective research.

**WITNESS:** While epidemiology can draw upon each of these disciplines, it is not necessary for every epidemiologist to develop expertise in all of them. The field of chemistry includes inorganic, organic, physical, and atomic chemists, and the discipline of environmental science has engineers, biologic scientists, and researchers in air and water pollution, radiation, and environmental management. What draws these scientists together in one unit or discipline is a common purpose and a degree of common methods, principles, and technical language. Scientific disciplines expand as old questions are addressed, and the answers lead to new insights and challenges. The methods of classical infectious disease and chronic disease epidemiology developed out of a need to address those public health concerns. From this work, we have begun to appreciate the limitations of these methods and the importance of the societal context of current public health problems, such as violence, teenage pregnancy, sexually transmitted diseases, racial differences in mortality, and occupationally induced psychosocial disorders. Epidemiology must enlarge itself as a discipline to address these issues.

**COUNSEL FOR THE DEFENSE:** Would you agree that epidemiology achieved considerable success in identifying risk factors for acute and chronic diseases by applying biologic knowledge and theories to the study of disease in population groups? If anything, the discipline is moving in the direction of molecular markers, rather than toward your concept of macro-epidemiology. Your ideas are not in step with these new developments.

**WITNESS:** It is entirely appropriate that epidemiologists use molecular methods to understand more completely the role of biologic factors in disease causation. But, as Rose (2) argued, the causes of disease in individuals and of incidence rates in populations are different. Molecular epidemiology will not give us



insights into the causes of an increasingly violent society, of stress-induced behavioral disorders, or of the profound differences in mortality between African-Americans and European-Americans. I do not claim that classical epidemiologic methods and more recent developments in molecular applications are without value, but rather that they are inadequate for epidemiology to achieve its mission of serving as the basic science of public health. There is a great unmet need for a balance between micro- and macro-epidemiology; the scale is heavily tilted toward the former.

**COUNSEL FOR THE DEFENSE:** Then what you label as a failure of academic epidemiology, is this nothing more than an evolution of the discipline to address new public health concerns?

**WITNESS:** On the contrary, the need for a macro-epidemiology has been with us for many decades. The major diseases of the 20th century are more determined by our social, economic, and cultural environments than by biologic factors, yet epidemiology has not moved away from the biomedical perspective. If anything, the discipline has swung even more completely away from a population perspective, as compared with the first part of this century when most epidemiologists were also public health practitioners and policy makers (3). In the 1960s and 1970s, epidemiology was developing holistic, community-based models of disease (3, 5, 14, 15) that began to incorporate social and cultural factors. But this movement faded. During recent decades, the emphasis in academia has been on "analytical" and molecular epidemiology and on increasingly sophisticated statistical analyses of individual risk factors in a multivariable setting. Ecologic studies, the only whole-population strategy that has evolved in epidemiology, are more discussed for their limitations (16) than for their utility. Surely, the other population sciences could offer us considerably more in sophisticated methodologies to study disease as a population phenomenon. The evolution of epidemiology toward a macro-perspective was largely in remission during the past two decades.

**COUNSEL FOR THE DEFENSE:** Your argument is contradicted by a substantial body of epidemiologic research, especially cross-national, cross-cultural, and community-based studies of cardiovascular disease. Keys (17) and Gordon (18), among others, described cross-national differences in cardiovascular mortality and followed these observations with studies of individual risk factors that provided an important scientific basis for preventive measures. Marmot (19) identified the importance of cultural factors in his comparison of disease rates among native Japanese, Japanese immi-

grants to the United States, and their offspring. The contributions of psychosocial factors to health status have been extensively studied (14, 20), and the influence of the social environment on levels and trends in cardiovascular mortality has been characterized (21). Community-based cardiovascular risk studies have examined the interplay of sociocultural and individual life-style factors (22, 23). This research has been pre-eminent in developing a synthesis of knowledge at the societal and individual levels, or, in your terms, from the micro-epidemiology and macro-epidemiology perspectives.

**WITNESS:** While it is true that some arenas of epidemiologic research—and cardiovascular epidemiology is an exceptional example—have attempted to integrate societal and individual perspectives on disease risk, the focus of this work still remains on understanding the proximate and individual rather than the underlying and societal determinants of disease. Even in their research on coronary heart disease, epidemiologists, who have elaborated a complex "web of causation," have failed to study the impact of potential changes in public policy or in community-organized activity on cardiovascular health status. They tell us that a lower fat content of the diet, a lower population-average body weight, or a lower prevalence of smoking will reduce the population risk of coronary disease. But they do not explore societal policies, incentives, or other interventions at the "organized community" level that would bring about a shift in the population distribution of fat consumption, body weight, or smoking habits. Epidemiologists should undertake such macro-level research in order to produce the science-based evidence needed for public health policies and interventions.

**COUNSEL FOR THE DEFENSE:** How far afield is it reasonable for a single discipline to go? You espouse having epidemiology become not only a study of disease and health status in populations but a science for converting empirical findings into programs of action. Not only does this perspective cross over into the boundaries of social science, but it moves the discipline into the arena of politics itself. Do you really believe that we can expect scientific evidence to be the major driving force toward choosing rightist or leftist political agendas? Will epidemiologic studies of the "underlying" societal determinants of health convince any society to choose between capitalist and socialist courses of action? Hardly. These choices are made largely on the basis of public persuasion and political consensus, which have little to do with "scientific" evidence. Moreover, your scientific conclusions themselves are always carefully qualified by expressions of

their limitations and uncertainties—hardly a driving force toward public persuasion. Thus, the “failure” you ascribe to academic epidemiology is, in reality, a failure of public health advocates and policy makers to incorporate epidemiologic findings into public programs of health promotion and disease prevention. Academic epidemiology has, in fact, been so successful that it is well ahead of the public health community, in that it has generated a full plate of empirical evidence sufficient to feed from for the next several decades.

**WITNESS:** I do not agree that the empirical findings generated by present-day epidemiologic research provide a sufficient basis for public health action. A large gap exists between knowledge of individual risk factors and science-based societal interventions. One has only to explore the tables of contents of epidemiology textbooks to see the dearth of chapters on community diagnosis, indicators of population health, public health surveillance, public health interventions, and applications of epidemiologic studies to public health policy. If epidemiology were truly the basic science of public health, these topics would be major headings in any basic epidemiology textbook, and they would be vital areas of epidemiologic research and publications.

**COUNSEL FOR THE DEFENSE:** The topics you cite are more appropriately within the boundaries of public health-related social and behavioral sciences. There is, after all, more to public health than epidemiology. Academic public health draws on the disciplines of demography, sociology, behavioral science, economics, and business management to develop scientific guidelines for its actions. Epidemiology can be, and has functioned well as, the basic science of public health without extending itself far afield into social and political theories of societal behavior.

Your Honor, I have no further questions of this witness.

**JUDGE:** Counsel, would you like to call your witnesses?

**COUNSEL FOR THE DEFENSE:** I would, Your Honor.

**WITNESS FOR THE DEFENSE:** [Let the readers reply.]

#### ACKNOWLEDGMENTS

The author expresses his thanks to the readers of an earlier draft for suggesting modifications and additions to this paper, in particular to Drs. H. A. (Al) Tyroler, Steve Wing, Dana Loomis, Michel Ibrahim, Berton Kaplan, and John DiLiberti, and Ms. Darrah Degnan.

#### REFERENCES

1. Committee for the Study of the Future of Public Health, Institute of Medicine. The future of public health. Washington, DC: National Academy Press, 1988.
2. Rose G. Sick individuals and sick populations. *Int J Epidemiol* 1985;14:32–8.
3. Terris M. The changing relationships of epidemiology and society: the Robert Cruikshank Lecture. *J Public Health Policy* 1985;6:15–36.
4. Population health looking upstream. (Editorial). *Lancet* 1994; 343:429–30.
5. Stallones RA. To advance epidemiology. *Ann Rev Public Health* 1980;1:69–82.
6. Tesh SN. Hidden arguments: political ideology and disease prevention policy. New Brunswick, NJ: Rutgers University Press, 1988.
7. Sen A. The economics of life and death. *Sci Am* 1993;268(5): 40–7.
8. Krieger N. Epidemiology and the web of causation: has anyone seen the spider? *Soc Sci Med* 1994;39:887–903.
9. Hertzman C, Frank J, Evans RG. Heterogeneity in health status and the determinants of population health. In: Evans RG, Barer ML, Marmor TR, eds. Why are some people healthy and others not? The determinants of health of populations. New York: Aldine de Gruyter, 1994:67–92.
10. Long AF. Understanding health and disease: towards a knowledge base for public health action. Leeds: Nuffield Institute for Health, University of Leeds, 1993.
11. Wolfson MC. Social proprioception: measurement, data, and information from a population health perspective. In: Evans RG, Barer ML, Marmor TR, eds. Why are some people healthy and others not? The determinants of health of populations. New York: Aldine de Gruyter, 1994:287–316.
12. Evans RG. Introduction. In: Evans RG, Barer ML, Marmor TR, eds. Why are some people healthy and others not? The determinants of health of populations. New York: Aldine de Gruyter, 1994:3–26.
13. Directions for health: new approaches to population health research and practice. The Leeds Declaration. Leeds: Nuffield Institute for Health, University of Leeds, 1993.
14. Cassel J. The contribution of the social environment to host resistance. The fourth Wade Hampton Frost Lecture. *Am J Epidemiol* 1976;104:107–23.
15. MacMahon B, Pugh TF, Ibsen J. Epidemiologic methods. Boston: Little Brown & Co, 1960.
16. Greenland S, Robins J. Invited commentary: Ecologic studies—biases, misconceptions, and counterexamples. *Am J Epidemiol* 1994;139:747–60.
17. Keys A, Menotti A, Karvonen MJ, et al. The diet and 15-year death rate in the Seven Countries Study. *Am J Epidemiol* 1986;124:903–15.
18. Gordon T. The diet-heart idea. Outline of a history. *Am J Epidemiol* 1988;127:220–5.
19. Marmot M. Acculturation and coronary heart disease in Japanese Americans. PhD dissertation. Berkeley, CA: University of California, 1975.
20. Syme SL. Social determinants of disease. In: Last JM, Wallace RW, eds. Maxcy-Rosenau-Last public health and preventive medicine. 13th ed. Norwalk, CT: Appleton and Lange, 1992:687–700.
21. Marmot M. Socioeconomic determinants of CHD mortality. *Int J Epidemiol* 1989;18(Suppl 1):S196–S202.
22. Kannel WB. Contributions of the Framingham Study to the conquest of coronary artery disease. *Am J Cardiol* 1988;62: 1109–12.
23. Garrison RJ, Gold RS, Wilson PW, et al. Educational attainment and coronary heart disease risk: the Framingham Offspring Study. *Prev Med* 1993;22:54–64.