Chapter 1

Introduction

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Learning Objectives

By the end of this chapter, the reader will be able to:

- Define epidemiology.
- Describe how applied epidemiology is related to public health practice.
- List the conditions that require field epidemiology.
- List programs that include field epidemiology training.

Epidemiology is the study of the distribution and determinants of disease, risk factors and exposures, and health status in specified populations to improve population health. Epidemiology can be used to study the health risks associated with specific exposures, it can be used as a tool to identify and help control epidemics, and it can monitor population rates of disease and exposures.

Applied epidemiology is the application of epidemiologic methods to public health practice. It is based on five core ideas that seek to (1) synthesize the results of etiologic studies to assess cause; (2) describe disease and risk factor patterns to set priorities; (3) evaluate public health programs, laws, and policies; (4) measure the patterns and outcomes of health care; and (5) communicate epidemiologic findings.[1] In contrast to academic epidemiology, applied epidemiology is closely linked to public health practice and typically has widespread application in the community.

Historically, applied epidemiology was the mainstay of epidemiologic inquiry. British epidemiology in the nineteenth century was primarily a practice-oriented field, with few epidemiologists engaging in research.[2] Notably, many of epidemiology's heroes—including John Snow, who implemented public health measures in response to an 1854 cholera outbreak in London; Ignaz Semmelweis, who found that maternal mortality could be reduced by hand washing in obstetric clinics; and Joseph Goldberger, who established that a nutritional deficiency was the cause of pellagra—are admired for their thoughtful application of epidemiologic knowledge to public health intervention.[3,4] It was not until after World War I, however, that epidemiology was adopted as an academic science in prominent universities, where etiologic research was the primary goal.[2] Over time, the discipline has broadened to include epidemiologists with primary interests in methodology, statistics, genetics, and molecular biology.

The tension between academic and applied epidemiology is well documented in the epidemiologic literature. Some believe that epidemiology is external to public health practice and that its extension into advocacy and policymaking compromises the validity and objectivity of the science.[5,6] Others view making policy recommendations, implementing public health interventions, and participating as an advocate as *responsibilities* of the epidemiologist.[3,7] Still others argue that this tension between the desire to conduct objective science and the social responsibility to improve the public's health is *essential*—overemphasizing either of these components places epidemiology at risk of neglecting to improve the health of the public.[8] Considering that epidemiology has always been interdisciplinary in nature and inclusive of emerging methodologies, this diverse range of viewpoints is characteristic of modern epidemiology. Indeed, epidemiology finds strength in its integrative nature and willingness to accept new methods, fields of inquiry, and scientific perspectives.

The principal areas of applied epidemiology include public health surveillance, cluster and outbreak investigations, survey sampling, risk assessment, and bioterrorism preparedness—skills that apply to students in all areas of epidemiology, not simply those who focus on infectious diseases. For example, while methods such as outbreak investigation are generally taught in the context of infectious diseases, practicing epidemiologists know that some conditions that may be originally suspected to have infectious origins can turn out to have noninfectious causes (e.g., environmental and industrial contaminants and toxins). Further, epidemiologists in all focus areas may use data from surveillance programs and registries that require sophisticated statistical analysis. Clusters of chronic disease and occupational injury can be investigated with field methodology. Finally, survey design, sampling, and implementation are critical skills to collect valid and reliable data across all subject areas.

The term *field epidemiology* is used to describe the application of epidemiology under a set of general conditions that include an unexpected public health problem that demands a timely response, a time-constrained investigation due to the need for quick interventions, and the need for epidemiologists to work in the field to solve the problem.[9] Although epidemiologic investigations in the field share many similarities with planned epidemiologic studies, they differ in a few important ways. Field investigations often start without a clear hypothesis and require the use of descriptive studies to generate hypotheses; analytic studies are then conducted to test the hypotheses. Field investigations are undertaken when urgent public health problems emerge and there is an immediate need to protect the community's health and attend to their concerns. These aspects of the investigation require that epidemiologists do more than simply collect and analyze data: They must also take public health action, and they must act in a timely fashion. In fact, action must often be taken before the causal agent is definitively identified. Therefore, in field investigations epidemiologists must decide when they have sufficient data to take action rather than wait until they have all the answers (from extensive data collection).[9]

There are many opportunities for applied epidemiologic learning experiences external to academic epidemiology in the United States. Of particular note are the Centers for

Disease Control and Prevention's (CDC's) Epidemic Intelligence Service (EIS), the CDC's and Council of State and Territorial Epidemiologists' (CSTE's) Applied Epidemiology Fellowship Program, and the numerous fellowship programs managed by the Association of Schools of Public Health. These kinds of applied programs have strengthened the public health workforce, made important contributions to the literature, and rapidly responded to evolving public health needs.[10,11]

These programs have a limited number of positions open on an annual basis, however, and all of them are directed at students who have completed their degrees. The EIS program accepts physicians, doctoral-level scientists, medical professionals with a master of public health (MPH) or equivalent degree, and veterinarians with an MPH (or equivalent degree) or public health experience. The CSTE Fellowship Program requires an MPH, master of science in public health, master of science in epidemiology, or an equivalent degree or advanced degree in a health-related field. Some EIS-like programs are also available in certain states, including California and Florida, that require a master's or doctoral degree in a health-related field (and some academic course requirements). For medical and veterinary students, the CDC offers an Epidemiology Elective Program for fourth-year students to do a six- to eight-week rotation at the CDC to gain a public health perspective during their clinical training.

Globally, additional field epidemiology training programs are available. Canada offers a two-year Canadian Field Epidemiology program. The European Centre for Disease Prevention and Control sponsors the two-year European Programme for Intervention Epidemiology Training (EPIET) program, and other countries offer field epidemiology training programs that bear similarities to the EIS program. The Training Programs in Epidemiology and Public Health Interventions Network (TEPHINET) provide information on field epidemiology training programs worldwide.

While this book is not exhaustive, the topics covered here are relevant to anyone engaged in an epidemiologic field investigation. Its coverage begins with a look at surveillance, which underpins many investigations; continues with the basic components of an investigation and specific types of investigation in which an epidemiologist might become involved, such as forensic epidemiology, contact tracing, and environmental investigations; and concludes with resources that might come into play during investigations, such as public health laboratories, the incident command system, and geographic information systems.

This book does assume some knowledge of the vocabulary used in medicine, public health, and epidemiology, although we have tried to define many of the technical terms when they are first mentioned. A reader may benefit from an accompanying dictionary of epidemiology and a medical dictionary. Following is a list of other resources that may be helpful:

- Chin J, ed. *Control of Communicable Diseases Manual*. 19th ed. Washington, DC: American Public Health Association; 2008.
- Porta M, ed. *A Dictionary of Epidemiology*. 5th ed. New York, NY: Oxford University Press; 2008.

These sources are available online:

- Beaglehole R, Bonita R, Kjellström T. *Basic Epidemiology*. Geneva, Switzerland: World Health Organization; 1993. http://whqlibdoc.who.int/publications/9241544465.pdf
- Council to Improve Foodborne Outbreak Response (CIFOR). *Guidelines for Foodborne Disease Outbreak Response*. Atlanta, GA: Council of State and Territorial Epidemiologists; 2009. http://www.cifor.us/documents/CIFORGuidelinesforFoodborneDiseaseOutbreakResponse-updated.pdf
- Pickering LK, ed. *Red Book: 2009 Report of the Committee on Infectious Diseases*. 28th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2009. http://aapredbook.aappublications.org/current.dtl

References

1. Brownson R, Hoehner C. Epidemiology, a foundation of public health. In: Brownson R, Petitti D, eds. *Applied Epidemiology: Theory to Practice*. New York, NY: Oxford University Press; 2006:3–29.
2. Amsterdamska O. Demarcating epidemiology. *Sci Technol Hum Val*. 2005;30:17–51.
3. Weed DL, Mink PJ. Roles and responsibilities of epidemiologists. *Ann Epidemiol*. 2002;12(2):67–72.
4. Noakes TD, Borresen J, Hew-Butler T, et al. Semmelweis and the aetiology of puerperal sepsis 160 years on: An historical review. *Epidemiol Infect*. 2008;136(1):1–9.
5. Rothman KJ, Poole C. Science and policy making. *Am J Public Health*. 1985;75(4):340–1.
6. Savitz DA, Poole C, Miller WC. Reassessing the role of epidemiology in public health. *Am J Public Health*. 1999;89(8):1158–61.
7. Parascandola M. Objectivity and the neutral expert. *J Epidemiol Commun H*. 2003;57(1):3–4.
8. Morabia A. Epidemiology and bacteriology in 1900: Who is the handmaid of whom? *J Epidemiol Commun H*. 1998;52(10):617–8.
9. Gregg M. *Field Epidemiology*. 2nd ed. New York, NY: Oxford University Press; 2002.
10. Thacker SB, Buffington J. Applied epidemiology for the 21st century. *Int J Epidemiol*. 2001;30(2):320–325.
11. Moolenaar RL, Thacker SB. Evaluation of field training in the epidemic intelligence service: publications and job choices. *Am J Prev Med*. 2004;26(4):299–306.