CHAPTER 1

Epidemiology for Evidence-Based Management

LEARNING OBJECTIVES

Having mastered the materials in this chapter, the student will be able to:

1. Explain what the terms *epidemiology* and *managerial epidemiology* mean.
2. Explain what the terms *management* and *evidence-based management* mean.
3. Explain how epidemiologic data can be used in evidence-based management.

CHAPTER OUTLINE

KEY TERMS

Epidemiology
Evidence-based management (EBM)
Evidence-based practice (EBP)
Management
Managerial epidemiology
Nonprogrammed decisions
Programmed decisions

1.1 Introduction

Good management involves decisions that are guided by both quantitative and qualitative evidence. By its very nature, effective healthcare management requires the collection of appropriate data and application of decision-support tools from different disciplines. The purpose of *managerial epidemiology* is to familiarize both aspiring and practicing healthcare managers with the tools available from the fields of epidemiology and management and give them the ability to make a concerted use of these tools for efficient and informed decision making. The combined use of techniques from epidemiology and management is the foundation of the emerging field of ***evidence-based management* (EBM)**. Before discussing the application of epidemiologic methods in healthcare management, it is important to remind ourselves of the nature of the two disciplines called *epidemiology* and *management*. In the following sections, we introduce the terminology and basic principles of epidemiology and management and then explain how EBM can use the quantitative evidence generated by epidemiologic investigations. Two case studies at the end of the chapter demonstrate how epidemiologic evidence can be used for effective healthcare management and policy formulation.

1.2 Epidemiology

Porta[1] defines **epidemiology** as "The study of the occurrence and distribution of health-related events, states, and processes in specified populations, including the study of the determinants influencing such processes, and the application of this knowledge to control relevant health problems." A less-comprehensive older definition states that epidemiology is "the study of the distribution and determinants of diseases and injuries in human populations."[2] The implication of both definitions is that diseases and their causes are distributed neither randomly nor evenly across populations. Understanding the distribution of diseases across populations, time, and space can give us valuable information about their causes, and this information can be used to develop prevention and control strategies. Recognizing that diseases differentially afflict dwellers of different regions or people of different colors, creeds, and sexes has been an important element in our quest to live a healthier and longer life.

The field of epidemiology has experienced tremendous growth and methodologic sophistication in the last few decades. The scope of epidemiologic investigations now spans from genetics to social sciences, from forensic medicine to veterinary medicine, and from pharmaceuticals to plant diseases. Concurrent with these developments, more refined analytic and statistical techniques have been developed to address issues resulting from the complexities of study design. Easy availability of vast amounts of clinical, public health, demographic, and socioeconomic data from a variety of sources that can be integrated and analyzed within minutes with the help of relatively inexpensive powerful computers has enormously increased the number of epidemiologic investigations being conducted. Every year, thousands of research articles based on epidemiologic investigations are being published in dozens if not hundreds of conventional and open-access journals from every corner of the world.

There is a mutually supportive and symbiotic relationship between the practice of medicine and epidemiology. Epidemiology is *population medicine* in that it deals with the identification, investigation, and control of diseases in populations. The same is done at the individual level by those who practice medicine—namely physicians.[2] Clinical medicine benefits from the knowledge of the frequency of a disease in a given population obtained through epidemiologic investigations. Conversely, epidemiologic investigations rely on accurate identification of diseases in individuals by physicians. Although epidemiologic information is essential for better practice of medicine and formulation of control strategies, assessment of the incidence and prevalence of disease in a population is entirely dependent on accurate diagnosis and reporting of disease by clinicians.[2] For example, community-level strategies for the prevention and control of AIDS or delivery of medical and social services to Alzheimer's disease patients require data regarding the frequency and distribution of these diseases in the population. Such data can only become available through accurate diagnosis and reporting by physicians.

1.3 Management

Management can be defined as "The act, manner, or practice of managing, supervising, or controlling."[3] Another way to describe management is that it involves "getting results through the work of others for the benefit of the client."[4] In either case, management involves the use of organizational resources and handling of processes, situations, and relations. A number of theoretical models have been developed to explain what managers do and how they do it.[4-6] Management of healthcare organizations such as hospitals, clinics, and nursing homes poses challenges that are different from those of other organizations. Healthcare management requires knowledge of healthcare policy,

regulatory environment, and insurance. Additionally, it requires an understanding of issues related to access, utilization, and biomedical ethics, as well as analytic skills to use epidemiologic data for decision making. Researchers explore how healthcare managers carry out their responsibilities and make decisions, and what factors explain different styles of management. For practitioners, management means attaining efficiency, improving quality, motivating staff, and achieving organizational goals. As practitioners, healthcare managers have to learn the principles of leadership, motivation, financial management, and quality improvement. They have to employ "soft power" and diplomatic skills, as well as "hard" analytic skills.[7]

The purpose of management is to specify, communicate, and achieve the goals and objectives of the organization in a consistent manner while providing a harmonious work environment for employees. Researchers have identified three main goals of healthcare management:[8] first, manage the financial affairs of the organization to ensure financial stability; second, provide highest quality services through efficient use of resources; and third, maintain high moral and ethical standards while serving competing or divergent interests of stakeholders. The success of an organization in achieving these goals is a direct measure of the success of its managers. Given the challenging economic, political, and social environment in which healthcare organizations operate, some of these goals can be in conflict with one another. For example, the necessity of attaining monetary success can compel managers to forego desirable social objectives, such as delivery of discounted care to socially marginalized populations.

While specific duties of managers inevitably vary from one organization to another or from one department to another, these duties are conventionally categorized into planning, coordination, directing, and control functions. Such a categorization is helpful in developing a framework in which appropriate empirical data or evidence can be used to understand managerial functions and to make a case for rational decision making. In practice, these roles merge and mix during the daily process of decision making and problem solving. Managers transition back and forth into these roles without compartmentalizing their work into these conceptual domains. In carrying out all these managerial functions, the use of data and empirical evidence can make the difference between an effective and ineffective manger.

Mintzberg[9] challenges the "planning, organizing, coordinating, and controlling" model of managerial functions developed in the earlier part of the 20th century and offers "interpersonal, informational, entrepreneurial, and decisional" activities as the main functions of managers. The interpersonal role involves leadership through motivation and mentoring. The informational role involves collection and dissemination of information and serving as a spokesperson for a department or the organization. As entrepreneurs, mangers set goals and objectives for their departments or organizations, and as "disturbance handlers," they resolve conflicts and solve problems.

In the "art" and "science" of management, the scientific component relies on systematic analysis of data and use of evidence, whereas the art of management requires creative thinking and innovation to solve a given problem.[5] The unique blend of art and science employed by a person creates his or her management style. Clearly, the management style of a person is also a function of individual characteristics, values, experience, analytic skills, and the level of authority enjoyed in the organization. Strong quantitative skills are essential for problem solving and finding the best solutions. Analytical tools are especially useful for solving problems that are discrete in nature and lend themselves to quantitative analysis. Although managers frequently encounter problems that are ambiguous or multidimensional, off-the-cuff decision making without quantitative analysis and empirical evidence can be very detrimental to the goals of an organization. The element of art in decision making is meant only to supplement the scientific approach toward decision making rather than replace it. Based on quantitative data, a good understanding of the demographic characteristics of the community, demand for services, and evolving patterns of morbidity and mortality are critically important for excellence in healthcare management.

1.4 Decision-Making Process

According to management theory, managerial decisions vary in complexity and can be divided into two main categories: *programmed* and *nonprogrammed* decisions.[10] **Programmed decisions** address problems that are encountered frequently and are repetitive in nature. In dealing with these problems, managers do not need to find new solutions. Because of the familiarity of managers with such problems, rules and procedures usually exist to resolve them. The level of risk associated with such decisions is minimal because of successful past application of similar decisions. **Nonprogrammed decisions**, on the other hand, are unprecedented and demand innovative solutions. In both programmed and nonprogrammed situations, managers are expected to adopt a rational and systematic approach to problem solving and decision making.

Researchers have also identified four different approaches toward decision making.[10] The underlying premise in all these approaches is that important decisions are complex, and individuals are constrained in their ability to make sound decisions because of their inability to simultaneously process multiple dimensions of a complex problem.[11] The first of these approaches focuses on the application of operations research or management science methods such as linear programming, Bayesian probabilities, and simulation modeling. The second approach emphasizes that decisions are not made individually by top managers such as the chief executive officer, but through an alliance and coalition-building process involving multiple participants. A collective or participatory process is primarily needed for clarifying the nature and importance of the problem and for negotiations among internal stakeholders to determine organizational priorities. The third model posits that decisions are made in multiple steps through an incremental process in which a series of smaller decisions finally lead to the culminating decision. According to this model, the process of arriving at a decision evolves over time and goes through the stages of *identification*, *development*, and *selection*. The fourth model, known as the "garbage can" model, characterizes the decision-making process to be highly chaotic, nonlinear, and fluid.[12] This model applies to organizational environments characterized by a high level of uncertainty in which participants come and go, and the emergence of ideas, problems, and solutions is independent or even a random event. As a result, in the garbage can model, solutions may be offered or implemented when a problem does not even exist, choices may be made that do not solve a problem, or people may stop trying to solve the problem, either because they become used to it or no suitable solutions exist.

The use of any of these decision making models depends on the characteristics of the organization as well as the specific situation or problem that calls for a decision. Therefore, approaches toward decision making vary across different organizations as well as within the same organization at different occasions.

1.5 Evidence-Based Management

In conjunction with the development of electronic health records, two other developments that have altered the practice of medicine in the last couple of decades are (1) emphasis on **evidence-based practice (EBP)** of medicine and, (2) focus on the whole person rather than episodic treatment of "cases" of diseases. The demand for evidence-based decisions in the practice of medicine stems from studies showing that, in the past, only about 15% of physicians' decisions were based on evidence.[13] Following these developments in the practice of medicine, two similar developments occurred in health services management: (1) a growing emphasis on EBM and (2) a focus on population health. EBM simply means using data or statistical evidence to guide managerial decisions. Statistical evidence allows managers to make better decisions by rank-ordering priorities based on empirical evidence and following a systematic process in which steps are taken sequentially to arrive at the final decision. EBP is often used as an umbrella term instead of discipline-specific terms such as *evidence-based medicine*, *evidence-based nursing*, and *evidence-based management*. EBP is defined as "making decisions through conscientious, explicit and judicious use of the best available evidence from multiple sources."[14]

A variety of approaches, ranging from role modeling to teachable moments of the lived experiences of mentors, are recommended for teaching EBM. McAlearney and Kovner[15] have suggested the following six steps for EBM: first, framing a question for which an answer can be found; second, finding the data or evidence to answer the question; third, assessing the validity of the evidence; fourth, aligning the evidence to the specific circumstances of the organization; fifth, determining whether the evidence is adequate to guide the decision; and sixth, determining whether the organization can take action on the basis of the available evidence.

In contrast to clinical decisions, which are usually made by individuals in a relatively short timeframe, important managerial decisions are made by teams or groups of individuals through a consultative process over weeks and months.[16] The results of these decisions can take years to become clear. As such, there is enough time to collect data from various sources to guide important managerial decisions. Electronic resources and decision-support technologies can be used to identify, assess, and evaluate quantitative and/or qualitative evidence in the pursuit of EBM. Barends et al.[14] argue that the nature of "evidence" in EBP does not strictly translate into quantitative data, but rather should be interpreted as *information* that may be quantitative, qualitative, or descriptive in nature and that may come from a variety of sources. They argue that six misconceptions exist regarding the nature of evidence in EBM: (1) it "ignores the practitioner's professional experience"; (2) it "is all about

numbers and statistics"; (3) "managers need to make decisions quickly and don't have the time for EBM"; (4) "each organization is unique, so the usefulness of scientific evidence is limited"; (5) "if you do not have high-quality evidence, you cannot do anything"; and (6) "good-quality evidence gives you the answers to the problem." In their opinion, these myths are completely unfounded and should not be allowed to get in the way of EBM.

According to McVey et al.,[17] "Evidence Based Management (EBM) is about removing emotion, opinion, bias, and personal experience from decision-making." Similarly, Pfeffer and Sutton[13] argue that "gut feeling" and obsolete "best practices" have no place in decision making. They contend that instead of using empirical evidence generated by research studies, typically managers use the following six substitutes for best evidence: (1) obsolete knowledge, (2) personal experience, (3) specialist skills, (4) hype, (5) dogma, and (6) mindless mimicry of top performers.[13] Rather than using obsolete knowledge, hype, or dogma, Pfeffer and Sutton have developed the following guiding principles for the practice of EBM (http://evidence-basedmanagement.com/):

1. Face the facts and build a culture in which people are encouraged to tell the truth, even if it is unpleasant.
2. Be committed to "fact-based" decision making, which means being committed to getting the best evidence and using it to guide actions.
3. Treat your organization as an unfinished prototype—encourage experimentation and "learning by doing."
4. Look for the risks and drawbacks in what people recommend—even the best medicine has side effects.
5. Avoid basing decisions on untested but strongly held beliefs, what you have done in the past, or uncritical "benchmarking" of what winners do.

1.6 Epidemiology and Evidence-Based Management

The origins of various approaches to incorporating epidemiologic data into the healthcare management and decision-making process can be traced back to the techniques developed at the Central University of Venezuela in the early 1960s. These techniques were later refined by the U.S. Institute of Medicine by using data on the frequency and duration of disease in various age groups. In EBM, priority problems are identified and rank-ordered by combining data on disease frequency, severity, lethality, and responsiveness to treatment in mathematical algorithms and developing an index or a composite score for each disease. Recent efforts in using epidemiologic data for healthcare planning and setting priorities have relied on the estimation of years of potential life lost (YPLL) due to a disease. Calculation of YPLL in a population takes into account life expectancy at various ages and premature deaths due to one disease or another in a population. The disease or condition responsible for the most number of YPLL is usually ranked as the number one priority.

Epidemiologic data are also valuable in evaluating the comparative impact of various services, strategies, and technologies. Such an assessment involves comparison of population health statistics, such as infant mortality or teen pregnancy rates, before and after the implementation of new strategies and services. The outcome of interest or the measure of impact in such studies can be the reduction in disease-specific disability, mortality, or YPLL that can be directly attributed to the new strategy or intervention.

1.7 Managerial Epidemiology

Managerial epidemiology is defined in various ways. Fos and Fine[18] defined it as "the study of the distribution and determinant of health and diseases, including injuries and accidents, in specified populations and the application of the study to the promotion of health, prevention, and control of disease, the design of healthcare services to meet population needs, and the elaboration of health policy." Fleming et al.[19,20] defined it as "the application of the tools and principles of epidemiology to the decision-making process within healthcare settings." Accordingly, managerial epidemiology entails the use of epidemiologic tools in designing health services and formulating health policy to meet the needs of target populations. Because epidemiologic investigations provide critical information to managers and planners regarding the burden of disease in populations and potential demand for health services, it is "virtually impossible to develop a comprehensive strategic plan without incorporating estimates of the prevalence of disease."[20] Rohrer[21] posited that managerial epidemiology involves planning for populations rather than individuals, planning for prevention rather than treatment, and planning for health rather than disease. He argued that managers are primarily concerned with issues

related to cost, quality, and access; therefore, managerial epidemiology needs to draw from clinical epidemiology, the study of the determinants and impact of clinical decisions. Managerial epidemiology can do so by assessing the value of therapeutic and preventive interventions in relation to their costs, quality, and impact on access to health services. Inclusion of clinical variables in studies related to the cost and quality of care can be useful in addressing managerial concerns. The most direct application of clinical epidemiology to address a managerial concern is in the improvement of healthcare quality through reduction of healthcare-associated complications, morbidity, and mortality.[20]

1.8 Scenario for Application of Managerial Epidemiology

The management of Blue Sky Health, a hypothetical healthcare system that operates several urban and rural inpatient facilities and community-based outpatient clinics in St. Louis, Missouri, is interested in adding a full-service infertility treatment center to its portfolio. Blue Sky wishes to have this center go into operation by early 2020 in the Doctor's Plaza building adjacent to its main hospital in South St. Louis.

For planning and marketing the proposed infertility treatment center, Blue Sky would like to conduct a feasibility study in the fall of 2018. Mark Plato, the vice president for planning and marketing, has developed a list of epidemiologic questions he would like the feasibility study to address. These questions must be addressed before developing amortized projections of fixed and variable costs and determination of a fee structure to achieve a reasonable return on investment and a steady revenue stream. He believes the study proposal must also identify methods for primary data collection and a list of secondary data sources. Plato, who had taken a course in managerial epidemiology at Lyceum University, realizes that many of the questions in the feasibility study can be answered with the help of concepts, methods, and techniques described in the chapters of a good managerial epidemiology textbook. The following is a partial list of questions Mark Plato thinks he needs to have answered by the feasibility study.

1. How common is infertility, and what are the geographic, demographic, and socioeconomic characteristics of the affected population (i.e., what is the epidemiology of infertility)?
2. If epidemiologic data were not available to answer the above question, what kinds of investigations would be necessary to collect data regarding the demographic and socioeconomic characteristics of the target population?
3. What evidence exists regarding the success of treatment procedures such as artificial insemination and in-vitro fertilization, where did that evidence come from, and how good is that evidence?
4. What are the size, boundaries, and socioeconomic characteristics of the geographic market that would be served by the proposed center?
5. What is the projected volume of assisted reproductive services that Blue Sky can expect to provide every year?
6. Who are the competitors for infertility treatment services in this geographic market, and what is the current distribution of market shares among those providers?
7. What is the projected number of deliveries resulting from infertility treatment services and the volume of obstetric services that Blue Sky can expect to provide at its facilities?
8. What volume of patients and fee structure for various procedures would be necessary to make the proposed center financially viable?

Through a cursory examination of available literature, Mark Plato has collected the following epidemiologic information.

Currently 7.5 million American women aged 15–44 years—that is, 12.3% of women in this age group—have impaired ability to get pregnant or carry a baby to term. Nearly 6.9 million of them—that is, 11.3% of women aged 15–44—have used some form of infertility services.[22] Since 2003, there has been a 65% increase in in-vitro fertilization (IVF) in the United States. Every year, approximately 50,000 babies—about 1.6% of all babies born in the country—are born through IVF. In 2013, about 175,000 cycles of IVF were completed in the United States.[23] In a survey, 55% of those who had experienced infertility reported it to be more stressful than unemployment, and 61% reported it to be more stressful than divorce. Approximately 58% of respondents indicated that because of cost and lack of coverage by insurance companies as an essential health benefit, they would forgo infertility treatment.[24] Without assisted reproductive technology, fertile 30-year-old American women each month only have a 20% chance of conceiving.[25,26] About 61% of single-embryo transfers and 65% of two-embryo

transfers result in a live birth. Nearly 30% of all IVF pregnancies and 46% of two-embryo transfers result in a twin delivery. Births through assisted reproductive technology (ART) pose greater risk for both mother and child than a normal pregnancy. For example, women who deliver through ART are much more likely to have multiple births than women who conceive naturally. In 2013, more than 160,000 ART procedures were performed at 467 infertility clinics in the United States, with a use rate of approximately 2,520 procedures per million women aged 15–44 years. These procedures involved more than 135,000 embryo transfers and resulted in more than 65,000 pregnancies, with about 66,700 live-born infants.[27] The total cost for one embryo transfer was estimated to be approximately $48,500, and $90,500 for two-embryo transfers.[24]

With the help of tools and methods described in the following chapters and infertility-related epidemiologic information provided in the preceding paragraphs, the student can find answers to Mark Plato's questions. Naturally, some assumptions about the size of the geographic market and the number of competitors in the service area of Blue Sky will have to be made. At the completion of the course for which this text is being used, the student is encouraged to undertake this task and create multiple estimates by changing assumptions regarding population density, socioeconomic characteristics of the population, cost and coverage of fertility services by insurance companies, and the size of the service area.

1.9 Sources of Epidemiologic Data

A wide variety of demographic, epidemiologic, and socioeconomic data are available on the Internet. As is often the case with the sources of secondary data, the type and quality of available data varies from one source to another or from one agency to the next. However, cross-sectional and longitudinal data from these and other sources can be successfully integrated and analyzed to guide managerial decisions. In the United States, some of the most common and useful sources of epidemiologic and demographic data include the following:

1. U.S. Census Bureau – Census Data (http://www.census.gov/2010census/data/)
2. National Center for Health Statistics – National Vital Statistics System (https://www.cdc.gov/nchs/nvss/index.htm)
3. National Health Interview Survey (NHIS) (http://www.cdc.gov/nchs/nhis/index.htm)
4. National Survey of Children's Health (NSCH) (http://www.nschdata.org/)
5. Health Resources and Services Administration – Maternal and Child Health Bureau (http://mchb.hrsa.gov/)
6. Centers for Disease Control and Prevention – Behavioral Risk Factor Surveillance System (BRFSS) (http://www.cdc.gov/brfss/)
7. U.S. Census Bureau – American Community Survey (https://www.census.gov/programs-surveys/acs/)
8. Harvard University's Maternal and Child Health (MCH) Data Connect – A catalog of more than 150 sources of data (https://dataverse.harvard.edu/dataverse/dataconnect)
9. Cornell University's National Data Archive on Child Abuse and Neglect (http://www.ndacan.cornell.edu/)
10. U.S. Bureau of Labor Statistics – Injuries, Illnesses, and Fatalities (http://www.bls.gov/iif/)
11. Centers for Disease Control and Prevention – National Center for Injury Prevention and Control (https://www.cdc.gov/injury/)

CASE STUDY 1.1: Impact of Administrative Decisions on Patient Outcomes

The physician call schedule is an important determinant of the quality of care at a hospital. However, it also presents a paradox between two conflicting variables: (1) physician sustainability (i.e., a physician cannot be available at all times) and (2) continuity of care (i.e., patients prefer to interact with the same physician throughout their hospital stay). In a

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recent study, Yarnell et al. examined the impact of changes in the physician call schedule at an academic tertiary care hospital by comparing patient readmission rates before and after a change in the call system.

On January 1, 2009, Sunnybrook Health Sciences Center in Toronto, Canada, transitioned from the old "concentrated" (or "bolus") call schedule system for all general medicine inpatient physician teams to a new "distributed" (or "drip") system. The main feature of the old system was that one team was on call every fourth day and managed all admissions in that 24-hour period. The main feature of the new system was that admissions were distributed over all teams every day. The new system entailed a host of additional changes. For example, a different member from each team was on call each day, and one member from each team was absent postcall each day. The schedule of rotating attending faculty remained unchanged. The change from the concentrated to the distributed call system was intended to improve quality and continuity of care by having at least one team member from a given team be present each day. The general internal medicine service at Sunnybrook comprised four teams—each with an attending physician, a senior resident, two or three first-year residents, and two or three medical students. Each team was responsible for 15–25 patients.

The researchers identified all consecutive adult patients who were originally admitted through the Emergency Department at Sunnybrook hospital and were later discharged from internal medicine teams during the 10-year period (January 2004 through December 2013) and examined whether each patient was readmitted for any reason within 28 days following discharge. Patients discharged for a surgical, obstetric, or psychiatric diagnosis were excluded from the study.

The study reported that during the 10-year period, 89,697 patients were discharged from the general internal medicine service, of whom 10,001 (11%) were readmitted within 28 days following discharge, and 4,280 died. The risk of readmission increased by 26% after the change in the physician call system (from 9.7% readmission rate before the change in call system to 12.2% after the change; $P < .001$). Using a computer algorithm (LACE score), the risk of readmission was adjusted for patient characteristics such as predischarge length of stay in the hospital, total number of Emergency Department visits in the preceding 6 months, and the Charlson comorbidity index—a composite measure of the overall effect of all other coexisting medical conditions or diseases a patient might have. To assess whether increased readmission rates at Sunnybrook were related to the change in the physician call system, Sunnybrook's readmission rates were compared with readmission rates at a similar nearby hospital (North York General Hospital) during the same interval. North York General Hospital is similar to Sunnybrook in all other respects, except it did not experience a change in the physician call system.

Before the call system change, a total of 37,982 patients were discharged, of whom 1,643 died and 3,675 were readmitted within 28 days after discharge. After the call system change, a total of 51,715 patients were discharged of whom 2,386, died and 6,326 were readmitted within 28 days after discharge. The results showed that, even after adjusting for extraneous factors, increased risk of readmission after the change in the physician call system persisted across all patient age groups and medical diagnoses. The overall negative impact of change in the physician call system was estimated to be about 7,240 additional patient days in the hospital. However, no increased risk of patient deaths was found to be associated with increased hospital readmissions and change in physician call schedule. **TABLE 1.1** provides data and assessment of the relative risk of readmission or death within 28 days of discharge before and after the call system change.

Questions

Question 1. What was the purpose of this study?

Question 2. How does the study relate to managerial decisions?

Question 3. What were the overall findings of the study?

Question 4. What impact, if any, did the management's decision to change the physician call system have on the quality of care?

Question 5. How did the investigators ensure that their findings regarding the impact of the physician call system were not tainted by extraneous factors, such as the characteristics of the hospital?

Question 6. Based on the data presented in Table 1.1, after the change in the call system, how much higher or lower was the overall risk of readmission or death within 28 days following discharge? Explain your answer with the help of data shown in Table 1.1.

Question 7. Based on the data presented in Table 1.1, after the change in the call system, how much higher or lower was the risk of readmission or death within 28 days following discharge for men and for those with congestive heart failure? Explain your answer with the help of data shown in Table 1.1.

TABLE 1.1 Readmissions or Deaths Within 28 Days Following Discharge

Characteristic	Before Call System Change	After Call System Change	Relative Risk (95% CI)
Total	5,318 (14%)	8,712 (17%)	1.20 (1.17–1.24)
Age in Years			
18–49	802 (9%)	1,215 (11%)	1.31 (1.21–1.43)
50–64	910 (12%)	1,729 (16%)	1.29 (1.20–1.39)
65–79	1,651 (16%)	2,605 (18%)	1.17 (1.10–1.23)
80 or older	1,955 (18%)	3,163 (20%)	1.10 (1.05–1.16)
Sex			
Female	2,624 (14%)	4,206 (17%)	1.16 (1.11–1.22)
Male	2,694 (14%)	4,506 (17%)	1.24 (1.19–1.30)
*Medical Diagnosis**			
Congestive heart failure	919 (23%)	1,286 (25%)	1.10 (1.02–1.19)
Ischemic heart disease	1,067 (16%)	1,306 (17%)	1.08 (0.99–1.18)
Influenza or pneumonia	537 (18%)	786 (20%)	1.11 (1.01–1.23)
Renal failure	671 (22%)	997 (24%)	1.08 (0.99–1.18)
Fall or fracture	307 (6%)	394 (7%)	1.24 (1.08–1.44)
Stroke or delirium	396 (11%)	746 (16%)	1.36 (1.21–1.52)
Duration of Admission in Days			
0–2	973 (11%)	1,942 (13%)	1.21 (1.13–1.31)
3–5	1,310 (13%)	2,167 (15%)	1.21 (1.14–1.29)
6–10	1,190 (14%)	2,035 (19%)	1.32 (1.24–1.41)
11 or more	1,845 (18%)	2,568 (22%)	1.20 (1.14–1.27)

* Selected list, not comprehensive. 1 patient may have had more than 1 diagnosis.

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CASE STUDY 1.2: Epidemiologic Patterns That Can Guide Policy Decisions

Modified from: Anglemyer A, Miller ML, Buttrey S, Whitaker L. Rates and predictors of violent suicide within military. Ann Intern Med. 2016; 165(3):167–174.

Suicide rates have increased globally in the last half-century, and suicide now ranks as one of the leading causes of death among those between the ages of 15 and 44 years. In the U.S. military, the suicide rate nearly doubled between 2001 and 2011.

In a recent study, Anglemyer et al. calculated suicide rates per 100,000 active duty enlisted (nonofficer) U.S. military personnel from 2005 to 2011. The purpose of the study was to examine suicide rates in different years across different branches of the military and identify personnel at the highest risk. For mortality statistics and demographics, the researchers used data from the Suicide Data Repository, which combines data from the U.S. Centers for Disease Control and Prevention and the Military Mortality Database. To obtain the count of enlisted personnel in each branch of the military in each of the study years, researchers used data from the military. The study did not include suicides committed outside the United States. Altogether, 1,455 active duty enlisted personnel in the U.S. Army, Air Force, Marine Corps, and Navy committed suicide during the study period. With 29.44 and 29.15 suicides per 100,000 individuals in 2009 and 2010, respectively, the rates were highest among Army personnel (see **FIGURE 1.1**). The rates were lowest in the Air Force and Navy in 2005 (9.95 and 9.79, respectively). More than 95% of suicides were committed by men. Only 1 female Marine and 9 female Navy personnel committed suicide. Of the 1,455 total suicides, 1,416 were among nontrainees (**TABLE 1.2**). As shown in Table 1.2, about 60% of nontrainee suicides occurred in the lower ranks of enlisted personnel (E1 to E4). In the Navy and Air Force, less than 50% of suicides were in lower ranks, but in the Army, about 66.9% were in lower enlisted ranks. More than 75% of suicides in all branches were among white enlisted personnel.

Questions

Question 1. What percentage of suicides in the Marine Corps was among lower rank (E1 to E4) enlisted personnel?

Question 2. What percentage of suicides occurred in white Marines?

Question 3. Across various branches, was there much difference in the percentage of suicide by marital status?

Question 4. Across various branches, was there much difference in the percentage of suicides among those who were never married?

Question 5. What percentage of all suicides occurred in service members who only had a high school diploma?

Question 6. What was the overall number and percentage of female suicides across all branches of the military?

Question 7. Across all branches, what was the overall number and percentage of suicides among those who had education higher than a high school diploma?

Question 8. Based on the data presented in Table 1.2, what, if any, effect do education and rank have on the overall risk of suicide in the military and across various branches?

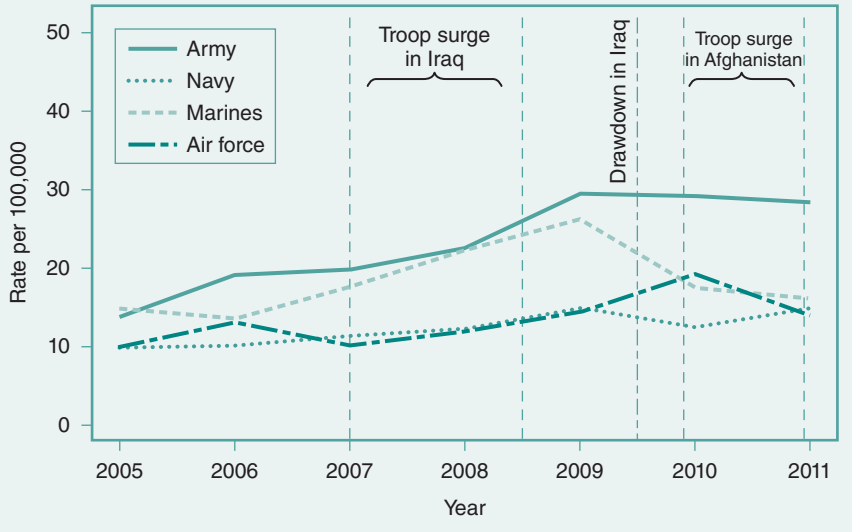

FIGURE 1.1 Suicide rates per 100,000 persons (2005 to 2011), by branch of service.

TABLE 1.2 Characteristics of Suicides Among Active Duty Military Personnel, 2005–2011*

Characteristic	Navy (n = 226)	Army (n = 744)	Air Force (n = 236)	Marines (n = 210)
Median age (IQR), yrs.	26 (23–32)	25 (22–30)	26 (22–32)	22 (20–25)
Sex				
Female	9 (4.0)	37 (5.0)	13 (5.5)	1 (<1.0)
Male	217 (96.0)	707 (95.0)	223 (94.5)	209 (99.5)
Rank				
E1	5 (2.2)	53 (7.1)	4 (1.7)	11 (5.2)
E2	3 (1.3)	73 (9.8)	7 (3.0)	32 (15.2)
E3	26 (11.5)	140 (18.8)	43 (18.2)	77 (36.7)
E4	67 (29.6)	232 (31.2)	63 (26.7)	30 (14.3)
E5	64 (28.3)	120 (16.1)	59 (25.0)	39 (18.6)
E6	45 (19.9)	63 (8.5)	35 (14.8)	14 (6.7)
E7	12 (5.3)	48 (6.5)	22 (9.3)	6 (2.9)
E8	2 (<1.0)	12 (1.6)	3 (1.3)	0 (0)
E9	2 (<1.0)	3 (<1.0)	0 (0)	1 (<1.0)
Race				
White	160 (70.8)	560 (75.3)	172 (72.9)	179 (85.2)
African American	33 (14.6)	104 (14.0)	34 (14.4)	14 (6.7)
Asian/Pacific Islander	11 (4.9)	33 (4.4)	6 (2.5)	4 (1.9)
American Indian/Alaska Native	8 (3.5)	13 (1.7)	6 (2.5)	1 (<1.0)
Missing	14 (6.2)	34 (4.6)	18 (7.6)	12 (5.7)
Marital Status				
Never married	108 (47.8)	347 (46.6)	82 (34.7)	106 (50.5)
Married	118 (52.2)	353 (47.4)	127 (53.8)	96 (45.7)
Divorced/separated/widowed	0 (0)	43 (5.8)	27 (11.4)	8 (3.8)
Missing	0 (0)	1 (<1.0)	0 (0)	0 (0)

(continues)

TABLE 1.2 Characteristics of Suicides Among Active Duty Military Personnel, 2005–2011* *(continued)*

Highest Level of Education				
No high school diploma	22 (9.7)	153 (20.6)	0 (0)	21 (10.0)
High school diploma	181 (80.1)	482 (64.8)	197 (83.5)	179 (85.2)
Some college	9 (4.0)	31 (4.2)	0 (0)	3 (1.4)
Associate degree	4 (1.8)	32 (4.3)	31 (13.1)	5 (2.4)
Bachelor's or graduate degree	7 (3.1)	22 (3.0)	8 (3.4)	1 (<1.0)
Missing	3 (1.3)	24 (3.2)	0 (0)	1 (<1.0)
Religion				
Catholic	32 (14.2)	125 (16.8)	41 (17.4)	44 (21.0)
Protestant	77 (34.1)	296 (39.8)	124 (52.5)	84 (40.0)
Other religion	7 (3.1)	38 (5.1)	9 (3.8)	10 (4.8)
No religion	103 (45.6)	196 (26.3)	54 (22.9)	48 (22.9)
Missing	7 (3.1)	89 (12.0)	8 (3.4)	24 (11.4)

** Values are numbers (percentages) unless otherwise indicated. Percentages may not sum to 100 due to rounding.*

1.10 Summary

The materials presented in this chapter introduce the student to the fields of management and epidemiology and bridge the two disciplines by discussing how qualitative and quantitative data can be used to set priorities and make evidence-based decisions. There is growing emphasis on the need for managers to make decisions that are informed by evidence rather than by personal preferences or anecdotal information. We also explain in this chapter what is meant by EBM and how epidemiologic data that are readily available from a variety of sources can be used by healthcare managers. It is important that managers find a balance between the art and science of management—the art of management relates to negotiation, compromise, and appreciation of the interests of various stakeholders, whereas the science of management relates to setting priorities, allocating resources, and convincing stakeholders based on empirical evidence. Such evidence may be derived from economic, market, and demographic data in the service area or may be generated through targeted epidemiologic investigations.

In Case Study 1.1, Yarnell et al.[28] show the impact of change in physician scheduling on hospital readmissions. This study demonstrates how epidemiologic studies can reveal the positive or negative impact of administrative decisions and can provide evidence to support a change in policy. In Case Study 1.2, Anglemyer et al.[29] provide comparative information on suicide rates in different branches of the U.S. military for different years. These kinds of studies generate data that reveal the characteristics of high-risk individuals. Such data can be used by public and private sector agencies for developing training programs and marketing resource centers for suicide prevention.

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