Managerial Epidemiology for Health Care Organizations
CONTENTS

List of Tables, Figures, and Exhibits xiii
Preface xix
The Authors and Contributors xxiii

1 Epidemiology in Health Care Administration
  Introduction  2
  Philosphic Framework  4
  Focus and Uses of Epidemiology  4
  Observational Epidemiology  •  Experimental Epidemiology  •  Preventive Medicine
  Current Issues in Health Care Administration  6
  The Concept of Populations and Communities  8
  Managing Health Care for Populations and Communities  9
  The Role of Epidemiology  10
  Summary  11
  Study Questions  12
2 Description of Health  13
   Introduction  14
   Health and Disease  14
   Definitions • International Classification of Diseases and Related Problems • Health Status
   Descriptive Information  17
   Person Variables • Place Variables • Time
   Other Descriptive Variables  32
   Sources of Descriptive Information  33
   Vital Statistics • Medical Records
   Reportable Diseases  36
   Reimbursement Approaches  39
   Current Procedural Terminology • Diagnosis-Related Groups
   Summary  40
   Study Questions  41

3 Measurement of Health  43
   Introduction  44
   Measures  44
   Counts • Rates • Ratios • Proportions
   Measuring Morbidity  51
   Incidence Rate • Prevalence Rate • Period Prevalence
   Measuring Mortality  60
   Death Rates • Potential Years of Life Lost
   Measuring Health  70
   Survival Rate • Health-Related Quality of Life • Other Rates
   Summary  72
   Study Questions  72

4 Designs for Studying the Health and Health Needs of Populations  75
   Introduction  76
   Risk and Causation  76
   Study Designs  78
   Experimental Studies • Clinical Trials • Observational Studies
Contents

Association of Risk Factors and Health and Disease 86
Measuring Association in Prospective Studies 87
Measuring Association in Retrospective Studies 90
Application to Population Health Management 92
Summary 95
Study Questions 95

5 Standardizing Population Health Information 97
Introduction 98
Stratification 100
Matching 100
Standardization of Information 102
Direct Method of Standardization • Indirect Method of Standardization
Risk Adjustment 114
Summary 116
Study Questions 117

6 Medical Management in Population Health Care 125
Introduction 126
Medical Management 127
Clinical Effectiveness • Validity • Managerial Aspects of Validity • Reliability
• Impact of Test Information • Clinical Practice Analysis
Managing Chronic Diseases 143
Managing Infectious Epidemics 144
Infectious Disease Epidemiology • Infectious Epidemics • Surveillance
Bioterrorism 151
Summary 152
Study Questions 153

7 Planning Health Care for Populations 157
Introduction 158
The Planning Process 158
Strategic Planning 158
Contents

Evaluation and Monitoring Population Health 160
Data Types • Community Health Status Evaluation
Integrated Health Care Services 161
Performance Improvement 161
Rapid Cycle Improvement • Statistical Process Control
Planning for Need 164
Summary 168
Study Questions 169

8 Population Health Outcomes and Quality of Care 171
Introduction 172
Assessing Health Outcomes 172
Health Status Assessment • Patient Satisfaction and Expectations Assessment
Monitoring Health Outcomes 179
Managing with Health Outcomes 180
Uses of Outcomes Assessment • Benchmarking • Best Practices and Practice Guidelines • Application of Best Practice Assessment
Quality of Health Care 187
Statistical Process Control • Six-Sigma Technology • The Malcolm Baldrige National Quality Program
Quality of Life and Global Burden of Disease 195
Summary 196
Study Questions 197

9 Marketing Health Care for Populations 199
Introduction 200
Marketing and Population Health 200
Marketing • The Role of Marketing • Marketing the Health Care System
Market Research 202
Sampling • Market Research Data Analysis • Patient Satisfaction • Demand Estimation • Validity and Reliability of Market Research
Summary 211
Study Questions 211
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Economic Analysis of Health Care for Populations</td>
<td>213</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
<td>214</td>
</tr>
<tr>
<td></td>
<td>Economic Evaluation</td>
<td>216</td>
</tr>
<tr>
<td></td>
<td>Cost Analysis</td>
<td>216</td>
</tr>
<tr>
<td></td>
<td>Cost-Benefit Analysis</td>
<td>218</td>
</tr>
<tr>
<td></td>
<td>Cost-Effectiveness Analysis</td>
<td>219</td>
</tr>
<tr>
<td></td>
<td>Discounting</td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>Cost-Utility Analysis</td>
<td>223</td>
</tr>
<tr>
<td></td>
<td>Sensitivity Analysis</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>Burden-of-Disease Analysis</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>Example of Economic Analysis</td>
<td>228</td>
</tr>
<tr>
<td></td>
<td>Summary</td>
<td>229</td>
</tr>
<tr>
<td></td>
<td>Study Questions</td>
<td>230</td>
</tr>
<tr>
<td>11</td>
<td>Expanding Emergency Health Care Services</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
<td>234</td>
</tr>
<tr>
<td></td>
<td>Emergency Department Use</td>
<td>237</td>
</tr>
<tr>
<td></td>
<td>Description of Hospitals</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td>Time Analysis</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td>Payment Sources</td>
<td>241</td>
</tr>
<tr>
<td></td>
<td>Patient Disposition</td>
<td>243</td>
</tr>
<tr>
<td></td>
<td>Reason for Visit</td>
<td>243</td>
</tr>
<tr>
<td></td>
<td>Risk of an Urgent Visit</td>
<td>244</td>
</tr>
<tr>
<td>12</td>
<td>Quality of Hospital Care</td>
<td>247</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
<td>248</td>
</tr>
<tr>
<td></td>
<td>Population Characteristics</td>
<td>249</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>249</td>
</tr>
<tr>
<td></td>
<td>Days of Care</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>Age and Sex</td>
<td>252</td>
</tr>
<tr>
<td></td>
<td>Primary Payment Source</td>
<td>255</td>
</tr>
</tbody>
</table>
LIST OF TABLES, FIGURES, AND EXHIBITS

Tables

2.1 Number, Percentage Distribution, and Rate of Injury-Related Emergency Department Visits, by Age, 2001 19
2.2 Number of Persons Lacking Health Insurance, by Age, 2000–2002 20
2.3 Cancer Deaths Rates per 100,000 Population, by Age, 1999–2001 20
2.4 Tuberculosis Cases, by Age, 2002 21
2.5 Discharges from Short-Stay Hospitals, by Sex and Age, 1998 22
2.6 Number, Percentage Distribution, and Rate of Injury-Related Emergency Department Visits, by Sex and Age, 2001 22
2.7 Frequency of Selected Respiratory Diseases, Persons 18 Years of Age and Older, by Race, 2001 23
2.8 Number, Percentage Distribution, and Rate of Injury-Related Emergency Department Visits, by Race and Age, 2001 23
2.9 Frequency of Cancer in Persons 18 Years of Age and Older, 2001 25
2.10 Number of Home Health and Hospice Care Discharges, by Marital Status, 1999–2000 25
2.11 Percentage of Uninsured Persons Under 65 Years of Age, by Age and Poverty Status, 1997–2003 26
2.12 Percentage of Persons Lacking Health Insurance Coverage, by Educational Status, January Through June 2003 27
2.13 Inpatient Discharges from Short-Stay Hospitals, by Region, 1998 29
2.14 Discharges from Short-Stay Hospitals, 1975–1998 32
2.15 Number and Percentage of Office Visits, by Source of Payment, 2001 34
2.16 Incidence of Notifiable Diseases in the United States, 2001 38
3.1 Cases of AIDS in the United States and Selected U.S. Territories, 2002 45
3.2 Cumulative Cases of AIDS in the United States, by Age, 2002 47
3.3 AIDS Case Rate per 100,000 Population, 2002 48
3.4 Number of Physician Office Visits, by Age, Sex, and Race, 2001 49
3.5 Emergency Department Visits, United States, 2001 50
3.6 Male-Female Death Ratios, by Age and Race, Mississippi, 2001 50
3.7 Home Health and Hospice Care Discharges, United States, 1999–2000 51
3.8 Home Health and Hospice Care Agencies, by Ownership, Geographic Region, and Location, 2000 52
3.9 Incidence Rate of Selected Diseases by Race, Los Angeles County, 2000 55
3.10 Average Annual Age-Adjusted Cancer Incidence Rates per 100,000 Population, by Sex, 1996–1999 55
3.11 Asthma Prevalence Rate, by Race and Sex, 2000 57
3.12 Prevalence (Percentage) of Women Aged 18 Years and Older Who Reported Ever Having a Pap Test, by Age, 2001 58
3.13 Prevalence (Percentage) of Women Aged 40 Years and Older Who Reported Ever Having a Mammogram, 1991 and 2001 59
3.14 Crude Death Rate, by Race and Sex, United States, 2000 and 2001 61
3.15 Cause-Specific Mortality Rates for the Ten Leading Causes of Death, 2001 62
3.16 Age-Specific Mortality Rate (Deaths per 100,000), Malignant Neoplasm, Mississippi, 2002 63
3.17 Infant Mortality Rate (Deaths per 1,000 Live Births), by Race of Mother, 1980–2001 64
3.18 Neonatal Mortality Rate (Deaths per 1,000 Live Births), by Race of Mother, 1980–2001 65
3.19 Postneonatal Mortality Rate (Deaths per 1,000 Live Births), by Race of Mother, 1980–2001 66
3.20 Proportionate Mortality Ratios for Malignant Neoplasms, by Age, Mississippi, 2002 68
3.22 Calculating Potential Years of Life Lost (PYLL) Using Individual-Level Information 69
3.23 Calculating Potential Years of Life Lost (PYLL) Using Age Group Information 69
4.1 Calculation of Relative Risk 89
4.2 Association of Smoking and Coronary Heart Disease: Relative Risk Analysis 90
List of Tables, Figures, and Exhibits

5.31 Expected MI Complications, Washington County 124
6.1 Calculation of Likelihood Ratios in Tests with Dichotomous Results 140
6.2 Calculation of Likelihood Ratios in Tests with Polychotomous Results 140
6.3 Worldwide Impact of SARS as of July 2003 150
6.4 Mammography and Pap Smear Results for Fiscal 2003–2004 155
7.1 Weighted Variables Used in the Planning Model 167
8.1 Mortality at Twenty-Four- and Forty-Eight-Month Follow-Ups in the Study 180
9.1 Incidence of CVD in the East Bank Regional Hospital Service Area 212
10.1 Cost Analysis, Year 1 217
10.2 Program Costs, by Year 218
10.3 Benefits of Community Outreach Program: Reduction in Incidence (Cases per 100,000 Population) 220
10.4 Cost Utility of Selected Medical Procedures 224
11.1 Service Area Population, by Age and Sex 235
11.2 Emergency Department Visits, by Age 238
11.3 Emergency Department Visits, by Age and Sex 238
11.4 Emergency Department Visits, by Age and Race 239
11.5 Emergency Department Visits, by Hospital 240
11.6 Duration of Emergency Department Visits 241
11.7 Duration of Emergency Department Visits, by Hospital 241
11.8 Primary Payment Source 242
11.9 Primary Payment Source, by Hospital 242
11.10 Emergency Department Disposition 243
11.11 Major Reasons for Emergency Department Visits 244
11.12 Alcohol- and Drug-Related Emergency Department Visits 244
11.13 Relative Risk of an Urgent Emergency Department Visit 245
11.14 Relative Risk of an Alcohol- or Drug-Related Emergency Department Visit 245
12.1 Age Distribution in Mid-City Hospital Service Area, 2003 249
12.2 Number of Discharges, 2001–2003, by Age 250
12.3 Discharge Rate, per 1,000 Population, 2001–2003, by Age 251
12.4 Number of Days of Care, 2001–2003, by Age 251
12.5 Rate of Days of Care, per 1,000 Population, 2001–2003, by Age 252
12.6 Average Length of Stay, 2001–2003, by Age 252
12.7 Number of Discharges, Discharge Rate, and Average Length of Stay, 2003, by Age and Sex 253
12.8 Primary Payment Source, 2003 255
13.1 Age Distribution in the Service Area 265
13.2 Expected Primary Payment Sources for Pediatric Services 266
13.3 Expected Primary Payment Sources, by Age of Patient 267
13.4 Length of Stay, by Population Characteristics 268
List of Tables, Figures, and Exhibits

13.5 Distribution of Short and Long Stays, by Population Characteristics 269
14.1 Age Information for the Pediatric Population 273
14.2 Payment Sources for the Pediatric Population 274
14.3 Length of Stay for the Pediatric Population 274
14.4 Age Distribution of the Adult Population 275
14.5 Alcohol Drinking Status 275
14.6 Cigarette Smoking Status 276
14.7 Body Mass Index (BMI) Values 277
14.8 Trends in Overweight and Obesity 278
14.9 Body Mass Index of Adults in the Service Area Population 278
14.10 Visits to Doctors’ Offices in the Past Twelve Months 279
14.11 Self-Assessed Health Status 280
14.12 Reported Change in Health Status over the Past Twelve Months 281
14.13 Prevalence of Cancer (Percentage of Population) 282
A.1 Type I and Type II Errors 288
A.2 Sample Data 293
A.3 Expected Length of Stay 295

Figures

1.1 Epidemiologic Data 12
2.1 Population Pyramid for the United States, 2003 28
2.2 Graph of a Typical Point Exposure Epidemic 31
3.1 Incidence Rate of Readmissions 54
4.1 A 2-by-2 Contingency Table 77
4.2 Experimental Study Designs 80
4.3 Framework of a Randomized Controlled Clinical Trial 82
4.4 Observational Study Designs 84
5.1 Direct Method of Standardization 104
5.2 Indirect Method of Standardization 109
6.1 Validity 2-by-2 Contingency Table 129
6.2 Validity Parameters for Arthritis Screening Tests with a Prevalence of 3% 131
6.3 Validity Parameters for Arthritis Screening Tests with a Prevalence of 10% 132
6.4 Validity Parameters for Colorectal Cancer Screening 133
6.5 Predictive Validity of a Preadmission Screening Test 135
6.6 Reliability Index 137
6.7 Calculation of the Reliability Index 137
6.8 Likelihood Ratios 139
6.9 A Receiver-Operating Characteristic (ROC) Curve 142
<table>
<thead>
<tr>
<th>Exhibit</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 International Classification of Disease</td>
<td>17</td>
</tr>
<tr>
<td>2.2 Nationally Notifiable Infectious Diseases in the United States, 2003</td>
<td>37</td>
</tr>
<tr>
<td>10.1 Leading Causes of Death Worldwide, 1990, Ranked by DALYs</td>
<td>227</td>
</tr>
<tr>
<td>10.2 Leading Causes of Death Worldwide, 1990 and 2020</td>
<td>227</td>
</tr>
<tr>
<td>11.1 Certificate of Need Regulations</td>
<td>236</td>
</tr>
</tbody>
</table>
This book is intended to introduce the student and practitioner of health care management to the notion of health care for populations and the science of epidemiology. Outside the field, epidemiology may be viewed as a questionably relevant but complicated set of terms, formulas, and statistics. In fact, epidemiology is a core discipline pertinent to all branches of health care, including management. The motivating purpose of the text is to illustrate both the relevance and the benefit of epidemiology in the field of health care management and population health management, and it has been jointly written by authors who bring both a managerial and an epidemiologic perspective to the work. Contemporary applications of epidemiology in health care management are found in monitoring the quality and effectiveness of clinical services, strategic and program planning, marketing, and managing insurance and managed care. Traditional applications are found in such areas as tumor registries, infection control programs, and public health programming. This text is an updated version of the first edition of this book, published in 2000. This new edition has been substantially rewritten to introduce epidemiologic principles, reinforce the traditional uses of epidemiology, and illustrate its contemporary uses in planning, evaluating, and managing health care for populations.

Teaching the practical application of epidemiology in health care management is an important purpose of this text. Each chapter first presents epidemiologic principles, followed by examples and applications. Concepts, examples, and case studies
allow students and practitioners to understand epidemiology and its application in the design and management of health care for populations.

The text is organized in the following manner. Chapter One introduces the reader to the science of epidemiology. Definitions of epidemiology and an overview of its history in management are presented. Also, epidemiology’s transition from its traditional role in health care management to its new role in population health care management is outlined. The chapter also features a historical perspective on the development of epidemiology into a scientific discipline. Chapter Two describes the health and needs of populations and their relevance to management. Included in this chapter is a discussion of the commonly available sources of data. Chapter Three presents epidemiologic measures used in health care, with an emphasis on measures of importance to managers. Chapter Four presents study designs and measures of the cause-and-effect relationship of health and disease across and among populations. Clinical trials, as an example of experimental study designs, are presented, along with the more commonplace observational designs. Chapter Five introduces the concept of confounding, the problem of misleading data interpretation, and methods to address this problem. It includes a discussion of the standardization of epidemiologic data and risk adjustment.

Chapter Six introduces clinical epidemiology as the core discipline of clinical outcomes research, clinical effectiveness, and medical management. Topics covered include validity and reliability, other measures of test performance, infectious disease epidemiology (including epidemiologic surveillance and monitoring infections), and the role of epidemiology in bioterrorism. Chapter Seven, which was written by Brian W. Amy, presents the relationship of epidemiology to planning health care for populations. Emphasis is placed on community health evaluation, performance improvement, and planning based on need. Chapter Eight, which is the result of the work of Miguel A. Zúñiga, provides a discussion of health outcomes assessment and the relationships among traditional epidemiologic concepts; benchmarking, best practices, practice guidelines, and the measurement of quality of care are examined. Chapter Nine focuses on the use and benefit of epidemiology in planning and marketing. Chapter Ten describes the relationship between epidemiology and economic analysis, including the manner in which epidemiologic measures are used in the evaluation of health care delivery and the formulation of health care policy for populations. Burden of disease is discussed, with a focus on the economic impact of disease.

Chapters Eleven through Fourteen present case studies of the application of epidemiology to the planning for and management of health care for populations. Chapter Eleven presents a case study focusing on emergency care. The intent of this chapter is to apply general concepts presented throughout the text to establishing a plan for expansion of emergency health care services. The case study in Chapter Twelve focuses on quality of hospital care, and the one in Chapter Thirteen illustrates the
application of epidemiology to the study of the pediatric inpatient services in a hospital network. Chapter Fourteen presents a case study focusing on community relations in a hospital service area, specific to both a pediatric and an adult population.

An appendix presents concepts not directly covered in the body of the text. These concepts are important for understanding the relevance of epidemiology to managing health care for populations. Topics included in the appendix are statistical power, hypothesis testing, categorical data analysis, sample size considerations, and the handling of outliers.

Each chapter is supplemented with study questions, intended to aid the reader in understanding and applying the epidemiologic concepts presented in a management context.

We anticipate that the primary users of this text will be health care management students and practitioners, for whom we have presented the material in a practical and applied manner. This book can serve as a classroom text as well as an on-the-job reference for practitioners. We expect that after reading and using this book, the student or practitioner will understand and appreciate the relevance of epidemiology and look forward to using it in everyday health care management practice.

This work has been the result of a multiyear collaboration. The special contributions of two of our former students, Miguel A. Zúñiga, M.D., M.H.A., Dr.P.H., who is now the director of the Health Informatics program at the Medical College of Georgia, and Brian W. Amy, M.D., M.H.A., M.P.H., the State Health Officer in Mississippi, are gratefully acknowledged, particularly with respect to the chapter each contributed.

Finally, we would like to thank the students at Tulane University Medical Center School of Public Health and Tropical Medicine, the University of Wisconsin-Madison Medical School, the University of Indiana at South Bend, the University of St. Thomas Graduate School of Business, and the University of Alabama in Birmingham School of Health-Related Professions, whose comments on the first edition have been incorporated into this book. Their collective feedback has improved the book significantly.

P.J.F.
D.J.F.
For Lori Ann, Tammy, Tim, and Maggie
The loves of my life
PJF

For Jeffrey Fine
And his bright future
DJF
THE AUTHORS AND CONTRIBUTORS

Peter J. Fos is dean and professor of the College of Health at the University of Southern Mississippi. He earned his doctorate in health care decision analysis at Tulane University Graduate School following a career in clinical dentistry. Before he assumed the position of dean at the University of Southern Mississippi, he served as the chief science officer of the Mississippi State Department of Health, after spending almost twenty years at academic institutions, where he was active in curriculum development in the application of epidemiology to management, as well as the practice of managerial epidemiology, clinical effectiveness, and health outcomes research. He maintains adjunct faculty positions at Tulane University Health Sciences Center, the University of Mississippi Medical Center, the University of Alabama in Birmingham School of Health-Related Professions, and Dillard University.

David J. Fine is chief executive officer of the St. Luke’s Episcopal Health System in Houston, Texas. Fine is a nationally and internationally known health care executive and consultant who has directed hospitals, hospital systems, multispecialty group practices, and managed care organizations. He has published extensively in leading journals and books. In 1985, Fine was the recipient of the prestigious Hudgens Medal from the American College of Healthcare Executives. He is a member of Delta Omega, the national public health honor society, and Omicron Delta Epsilon, the national economics honor society. Fine was recently named one of the one hundred most
influential people in health care today by *Modern Healthcare*. He is professor of medicine at Baylor College of Medicine, professor of public health at the University of Texas Health Sciences Center, and professor of the practice of management at Rice University.

**Contributors**

**Brian W. Amy** is Mississippi State Health Officer and head of the Mississippi State Department of Health. He holds faculty positions at the College of Health, The University of Southern Mississippi, and the University of Mississippi Medical Center.

**Miguel A. Zúñiga** is associate professor, Department of Health Informatics, School of Allied Health Sciences, Medical College of Georgia. He previously held faculty positions at Tulane University Health Sciences Center and Texas A&M University Health Science Center.
Managerial Epidemiology for Health Care Organizations
CHAPTER ONE

EPIDEMIOLOGY IN HEALTH CARE ADMINISTRATION

Chapter Outline

Introduction
Philosophic Framework
Focus and Uses of Epidemiology
Current Issues in Health Care Administration
The Concept of Populations and Communities
Managing Health Care for Populations and Communities
The Role of Epidemiology
Summary
Study Questions

Learning Objectives

Upon completing this chapter, the reader will be able to do all of the following:

- Define epidemiology
- Discuss the history of epidemiology
- Define managerial epidemiology
- Discuss the distinction between observational and experimental epidemiology
- Describe the uses of epidemiology
- Describe the field of social epidemiology
- Discuss the concept of populations and population health care management
Epidemiology is recognized as a core discipline within the field of public health. It is a unique discipline that formally began as a result of the sanitary reform movement in seventeenth- and eighteenth-century England. Epidemiology is formally defined in a number of ways. First, epidemiology is the study of the distribution and determinants of diseases and injuries in human populations (Mausner and Kramer, 1985). A second definition emphasizes the study of all factors that affect the occurrence of health and disease in populations and their interdependence. Finally, epidemiology is the study of the distribution and determinants of health-related states and events in defined populations and the application of this study to the control of health problems (Last, 1995).

Common to all of these definitions is the concept of populations. Individuals are not the focus of epidemiology; groups of individuals are. Populations may represent large groups, such as the total population of the United States, or small groups, such as the employees of a factory, store, or government agency. Central to the concept of populations is that groups of individuals exhibit certain commonalities. For example, a group of individuals who are related geographically, such as those living in the same city, represent a population. A group of individuals who work in the same setting are a population. And a group of individuals who live and work together are a population, as in the case of military personnel. Groups of individuals of the same race or ethnic group are also considered populations.

Historically, epidemiology is a discipline that has experienced long and distinct development stages. It is reasonable to think that epidemiology began when humans first walked on earth. Darwin’s theory of the “survival of the fittest” can be extended to assume that early humans acquired, over time, an understanding of the relationship between environment and health. One simple example is the use of animal hides and furs as protective clothing.

The relationship between the environment and health and disease is mentioned in the Old Testament. However, it wasn’t until the Greek civilization was established that epidemiology began to emerge as a scientific discipline. Hippocrates (460–377 B.C.) wrote the classic work “On Airs, Waters, and Places,” the first known treatise on what is referred to today as environmental epidemiology. His writing discussed the link between the environment and human health. Hippocrates provided accurate descriptions of the diseases tetanus, typhus, and phthisis (Singer and Underwood, 1962). His contribution, which is also the first documented use of observational techniques, earned Hippocrates the title of “father of epidemiology” and the designation as the first epidemiologist (Newcomb and Marshall, 1990).

In the 1600s, John Graunt developed the demographic approach to health and disease investigations. Graunt used quantitative methods to study sex differences in deaths and diseases, geographic differences in death rates (rates were found to be higher...