

FIFTH  
EDITION

# Epidemiology for Public Health Practice

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# New to This Edition

## Chapter 1: History and Scope of Epidemiology

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- New and updated images
- Updated chart: three presentations of epidemiologic data
- Updated chart: pneumonia and influenza mortality
- New chart on the interdisciplinary nature of epidemiology
- Glossary of terms used in the yearly bill of mortality for 1632
- Expanded information on cholera and John Snow

## Chapter 2: Practical Applications of Epidemiology

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- Updated information on leading causes of death from 1900 to 2009
- Expanded discussion of population dynamics and predictions about the future
- More information provided on the health of the community and health disparities, including the GINI index

## Chapter 3: Measures of Morbidity and Mortality Used in Epidemiology

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- Expanded coverage of epidemiologic measures (e.g., sex ratios)
- More information on prevalence given with figure to show interrelationships between prevalence and incidence
- Further clarification of perinatal mortality provided

## Chapter 4: Descriptive Epidemiology: Person, Place, Time

---

- Updated coverage of morbidity and mortality data by descriptive epidemiologic variables provided throughout the chapter
- New examples of case studies and case series
- New information on age effects associated with morbidity and mortality
- Many new charts added to this chapter
- Updates from the 2010 Census, with current definitions of race/ethnicity

## Chapter 5: Sources of Data for Use in Epidemiology

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- Updated information on data sources including notifiable diseases
- Further clarification of criteria for the quality of epidemiologic data
- Rationale strengthened for the need for high-quality epidemiologic data

## Chapter 6: Study Designs: Ecologic, Cross-Sectional, Case-Control

---

- Clarification regarding design and applications of case-control studies
- More information on matching in case-control studies
- Clearer definitions of terms provided
- Further discussion of comparisons between cross-sectional and case-control studies

## Chapter 7: Study Designs: Cohort Studies

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- Introduction updated
- Additional clarification of terminology used in cohort studies
- Exhibit on life table methods updated to the most recent information

## Chapter 8: Experimental Study Designs

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- Expanded coverage of intervention studies
- Several new images, including an image of a scurvy victim
- Discussion of phase 4 clinical trials
- New table and a glossary of terms used in clinical trials
- Applications of epidemiology to vaccines and prevention: HPV vaccine

## Chapter 9: Measures of Effect

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- Introduction revised
- STROBE guidelines and quality of epidemiologic studies
- Meta-analysis and systematic reviews

## Chapter 10: Data Interpretation Issues

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- More information on Simpson's Paradox, including a new figure
- Information bias and screening mammography

## Chapter 11: Screening for Disease in the Community

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- New figure showing participants in a mammogram and a blood pressure screening test
- New figure showing participation rates in screening for colorectal cancer, breast cancer, and cervical cancer
- Updated discussion on controversies in screening
- Difficulties with false positive screening test results

## Chapter 12: Epidemiology of Infectious Diseases

---

- Many updated charts showing data on disease incidence and prevalence (e.g., measles, malaria, hepatitis, valley fever, Lyme disease)
- Information on the cholera epidemic in Haiti
- Revised exhibit on viral hepatitis

## Chapter 13: Epidemiologic Aspects of Work in the Environment

---

- New information on methodologic topics (e.g., exposure assessments, clustering, and confounding)
- Updated data on blood lead levels and mercury advisories
- New topics include global warming, the BP oil spill, and the Japanese tsunami and its effects on the Fukushima nuclear reactor
- Many new images to capture students' interest in this topic

## Chapter 14: Molecular and Genetic Epidemiology

---

- New diagram of Mendelian inheritance
- Additional discussion of the population genetics concept of linkage disequilibrium
- Expanded discussion of the concept of haplotypes
- A thorough update of this chapter with the latest developments in the field

## Chapter 15: Social, Behavioral, and Psychosocial Epidemiology

---

- Many new illustrations added to this chapter
- The concept of community-based participatory research added
- New information on the social context of health (e.g., poverty, the Glasgow effect)
- *Healthy People 2020* overarching goals included
- Update on depression

## Chapter 16: Epidemiology as a Profession

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- Updated to show current professional resources and issues

## Other

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- Exciting new figures, tables, and exhibits provided throughout
- Additional exercises and study questions

# Introduction

Epidemiology is an important, exciting, and rewarding field for the public health practitioner! Almost daily, one hears dramatic media reports about flare-ups of diseases, either previously known or seemingly new conditions. These accounts demonstrate how epidemiologists help to uncover the causes of human illnesses in the population and thereby underscore the importance of epidemiology to society. Deadly outbreaks of communicable diseases, the ongoing threat of resurgent epidemics, and the possible intentional spread of pathogenic microorganisms through acts of bioterrorism present challenges to the field. By assisting the reader in understanding why and how diseases occur and how they may be prevented, epidemiology is a valuable pursuit. In this text you will learn that many epidemiologic investigations into the causes of mysterious outbreaks are similar to detective work.

One of the challenges for the authors has been to distill with sufficient breadth and depth all of the fascinating components of this discipline. As the *Fifth Edition* is being finalized, new and resurgent health conditions challenge public health practitioners; some current examples are resurgent whooping cough, outbreaks of foodborne diseases, hantavirus infections (which normally are infrequent) in a national park, fungal meningitis associated with epidural steroid injections, and a West Nile virus epidemic. Thus, the ongoing flow of accounts of disease outbreaks (noted in the *First Edition*) has not been staunch and, in fact, is continuing unabated during the second decade of the 21st century.

Since the publication of the earlier editions of this book, the wealth of epidemiologic research findings has continued to proliferate and win the attention of the popular media and professional journals. For example, some of these recent discoveries relate to continuing advances in genetics and molecular biology, recognition of emerging infections, and the growing use of the Internet. As a result, the *Second Edition* introduced several enhancements: a new chapter on molecular and genetic epidemiology, a new chapter on experimental

epidemiology, material on epidemiology Internet sites, and updated charts and tables throughout the text.

The *Third Edition* incorporated a new chapter on cohort designs, a glossary, and an expanded coverage of ecologic and case-control study designs. The *Third Edition* also included new material on the role of epidemiology in policy making, epidemiology and geographic information systems, and the definition of race used in Census 2000. A new Appendix A provided an extended guide to critiquing published research studies in public health and epidemiology. Several new tables summarized unadjusted measures of morbidity and mortality, contrasted different types of observational study designs, and compared observational versus intervention study designs.

The *Fourth Edition* presented new information on infectious disease threats associated with *E. coli* foodborne illness and avian influenza as well as expanded coverage of the historical background of epidemiology. Chapter 3, “Measures of Morbidity and Mortality Used in Epidemiology,” was updated to reflect the use of the 2000 standard population in age standardization. A new Chapter 16, titled “Epidemiology as a Profession,” covered methods for accessing the profession and employment opportunities in the field.

The *Fifth Edition* provides an extensive update of information from the previous editions. Examples are coverage of the 2009 H1N1 influenza epidemic, the 2010 U.S. Census, and numerous additional and updated figures, charts, and photographs throughout the book. Trends in morbidity have been updated to reflect the most recently available information. New information is presented throughout the text: for example, in Chapter 12 (infectious diseases), Chapter 13 (environmental health), and Chapter 14 (molecular and genetic epidemiology). Definitions used in the text have been aligned with the 2008 *Dictionary of Epidemiology*, a standard reference in the field.

We intend the audience for the textbook to be beginning public health master’s degree students, undergraduate and graduate health education and social ecology students, undergraduate medical students, nursing students, residents in primary care medicine, and applicants who are preparing for medical board examinations. These students are similar to those with whom both authors have worked over the years. Students from the social and behavioral sciences also have found epidemiology to be a useful tool in medical sociology and behavioral medicine. We have included study questions and exercises at the end of each chapter; this material would be helpful to review for board examinations. Appendix B contains an expanded answer set to selected problems.

Each chapter begins with a list of learning objectives and an outline to help focus the reader's attention to key points. Some of the major issues and examples are highlighted in text boxes and tables. Chapter 1, which defines epidemiology and provides a historical background for the discipline, is complemented by Chapter 2, which provides examples of practical applications of epidemiology as well as a discussion of causal inference. Although examples of epidemiologic statistical techniques are interspersed throughout the book, Chapter 3 focuses on the “nuts and bolts” of measures of morbidity and mortality. Chapters 4 through 11 deal with the important topics of descriptive epidemiology: data sources, study designs, measures of effect, data interpretation, and screening. Chapters 12 through 15 focus on four content areas in epidemiology: infectious diseases, occupational and environmental health, molecular and genetic epidemiology, and psychosocial epidemiology. Finally, Chapter 16 covers professional issues in epidemiology. This text provides a thorough grounding in the key areas of methodology, causality, and the complex issues that surround chronic and infectious disease investigations. The authors assume that the reader will have had some familiarity with introductory biostatistics, although the text is intelligible to those who do not have such familiarity. A companion website for students is available for the text. This website provides extensive resources for students, including the student study guide that was included with the last edition. We recommend that students and instructors navigate through the site during class time. For example, the flashcards available may be used as part of an in-class activity to drill students for the class examinations. Dr. Friis uses in-class Internet navigation in order to show students how to locate resources for the project shown in the Appendix at the end of Chapter 4. Completion of the project can be one of the major assignments in an epidemiology class. In addition to completing a written version of the assignment, students may enjoy delivering a brief PowerPoint presentation of their research to the entire class. Students' motivation and success in an epidemiology course are enhanced by reviewing the various activities provided.





# Preface

My interest in epidemiology began during the 1960s when, as an undergraduate student at the University of California at Berkeley and a graduate student at Columbia University, I observed the student revolts and activism that occurred during that era. Student unrest was, I believed, a phenomenon that occurred in large groups and could be explained by a theoretical framework, perhaps one that would include such concepts as alienation or anomie. I became interested in studying the distribution of these psychological states in student populations. Unknowingly, I had embarked upon epidemiologic research. I find epidemiology to be a field that has great personal appeal because it is capable of impacting the health of large groups of people through improvements in social conditions and environmental modifications.

My formal training in epidemiology began at the Institute for Social Research of the University of Michigan, where I spent 2 years as a postdoctoral fellow. My first professional position in epidemiology was as an assistant professor in the Division of Epidemiology at the School of Public Health, Columbia University. As a fledgling professor, I found epidemiology to be a fascinating discipline, and began to develop this textbook from my early teaching experiences. I concluded that there was a need for a textbook that would be oriented toward the beginning practitioner in the field, would provide coverage of a wide range of topics, and would emphasize the social and behavioral foundations of epidemiology as well as the medical model. This textbook has evolved from my early teaching experience at Columbia as well as later teaching and research positions at Albert Einstein College of Medicine, Brooklyn College, the University of California at Irvine, and the California State University system. Practical experience in epidemiology, as an epidemiologist in a local health department in Orange County, California, is also reflected in the book.

—*Robert H. Friis*

Like many others now reading this book, I had absolutely no idea what epidemiology was before I took my first required class in it at Tulane University School of Public Health and Tropical Medicine. What I discovered was a method to combine my training in nutrition and interest in health with an aptitude for math and analytical reasoning. This led to a change in majors and ultimately a PhD in epidemiology.

My first faculty appointment was at the University of Minnesota School of Public Health. Before I knew it, I was assigned to teach the introduction to epidemiology course during the winter quarter. This was the time of year when only nonmajors enrolled. I quickly learned, as had my predecessors, that my teaching and learning style was quite different from those of my students. Moreover, most of the textbooks available at that time were geared toward epidemiology majors. For 9 years, I studied learning styles (and even co-developed and co-taught a graduate course on teaching) and experimented to find new ways to present the fundamentals of epidemiology in a nontechnical, nontheoretical, intuitive manner. This text reflects these learning experiences.

—*Thomas A. Sellers*

# Acknowledgments

First, I express my gratitude to my teachers and colleagues at the settings where I have worked during the past 4 decades. Their insights and suggestions have helped me clarify my thinking about epidemiology. Among these individuals are the late Dr. Sidney Cobb and the late Dr. John R. P. French, Jr., who were my postdoctoral supervisors at the University of Michigan's Institute for Social Research. Dr. Mervyn Susser offered me my first professional employment in epidemiology at the School of Public Health, Columbia University. He and Dr. Zena Stein helped me to greatly increase my fund of knowledge about research and teaching in the field. The late Professor Anna Gelman provided me with many practical ideas regarding how to teach epidemiology. Dr. Stephen A. Richardson also contributed to my knowledge about epidemiologic research. Finally, Dr. Jeremiah Tilles, former Associate Dean, California College of Medicine, University of California at Irvine, helped to increase my insights regarding the epidemiology of infectious diseases.

I also thank students in my epidemiology classes who contributed their suggestions and read early drafts of the *first edition*. The comments of anonymous reviewers were particularly helpful in revising the manuscript. Jonathan Horowitz, former instructor in Health Science at California State University, Long Beach, spent a great deal of time reviewing several chapters of a very early version of the text, and I acknowledge his contributions. Sherry Stock, a former student in medical sociology at Long Beach, typed the first draft and provided much additional valuable assistance in securing bibliographic research materials. Dr. Yee-Lean Lee, Professor, Infectious Disease Division in the Department of Medicine at the University of California at Irvine, reviewed and commented on the chapter dealing with the epidemiology of infectious diseases. Also, Dr. Harold Hunter, Professor Emeritus of Health Care Administration, California State University, Long Beach, reviewed several chapters of the manuscript.

Finally, my wife, Carol Friis, typed the final version of the manuscript and made helpful comments. Without her support and assistance, completion of the text would not have been possible.

For the *second edition* of the text, I again thank my epidemiology students, who continued to provide much useful feedback. Graduate students Janelle Yamashita, Cindy Bayliss, and Jocelin Sabado were extremely helpful in conducting literature searches and preparing the text. Sharon Jean assisted with typing the manuscript.

With respect to the *third edition*, I would like to thank students at my home university and at other universities who provided many worthwhile suggestions for enhancement of the text. I am also grateful for the informal feedback I received from faculty members (across the United States and in several foreign countries) who adopted this text in their courses. Former California State University graduate student Ibtisam Khoury, now a lecturer in the Health Science Department, conducted background research, provided ideas for clarification of complex concepts, and helped to develop several new tables. Faculty members Dr. Javier Lopez-Zetina and Dr. Dennis Fisher, housed at the same university, reviewed several of the chapters. Critiques from anonymous reviewers also were instrumental in development of the *third edition*. Once again, I am deeply indebted to my wife, Carol Friis, who assisted with editing and typing the manuscript. Without her keen eye, writing this book would have been a much more difficult task.

Regarding the *fourth edition*, I once again acknowledge my students' suggestions for continued improvement of this book. Although many students are worthy of recognition, I would especially like to thank graduate student Lesley Shen. Claire Garrido-Ortega, a former student and now a lecturer in the Department of Health Science, contributed her ideas to the new edition. I have received many suggestions from the readers of the previous edition of this text; I would like to thank them also—particularly Dr. Lee Caplan at Morehouse University. Once more, I recognize the support of my wife, Carol Friis, who helped with preparation of the text.

The *fifth edition* benefited from the input of students and faculty members in the Department of Health Science. Particularly noteworthy were the suggestions provided by faculty member Dr. Javier Lopez-Zetina and former graduate students (and now faculty members) Ibtisam Khoury, Che Wanke, and Claire Garrido-Ortega. Jaina Pallasigui, MPH graduate, helped with background research for this revision. Roxanne Garza reviewed the manuscript.

—R.H.F.

I have been most fortunate to receive training and guidance from a significant number of individuals. First and foremost, I thank Dr. Dorothy Clemmer, who taught me my first course in epidemiology at Tulane University School of Public Health and Tropical Medicine. Her enthusiasm and support helped me to “see the light.” The early years of my education included mentorship with Dr. Gerald Berenson and Dr. Robert C. Elston. Both have been extremely influential in my practical and theoretical understanding of this discipline. Dr. J. Michael Sprafka was a great supporter and colleague for those first precarious episodes of teaching. I owe many thanks to the numerous bright and challenging public health students at the University of Minnesota for their support, encouragement, and patience while I experimented with methods of presentation to find out what worked best for “nonmajors.” Finally, I acknowledge my father, Gene R. Sellers, who has published many fine textbooks and gave me the courage to attempt this project; my loving wife, Barbara, for her understanding and enduring belief in me; and my two sons, Jamison Thomas and Ryan Austin, who are my inspiration and loves of my life.

For the *second edition*, I acknowledge the encouragement of the students and colleagues who had used the *first edition* of this text. I also thank our publisher and their staff for their professionalism. Finally, I acknowledge the drive and creativity of Bob Friis, whose energies made this book a reality and a success.

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—T.A.S.



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