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# Epidemiology for Public Health Practice

Fourth Edition

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# New to This Edition

- Information on new disease outbreaks:
  - *E. coli* in spinach
  - Avian influenza
  - Extensively drug resistant tuberculosis (XDR TB)
- Expanded coverage of history of epidemiology
- New coverage of the natural history of disease
- Updated coverage of morbidity and mortality data throughout the text
- Method for rate adjustment updated to the 2000 standard population
- New information on health disparities, including the Hispanic mortality paradox
- Updated information on data sources including notifiable diseases
- Additional statistical measures provided, e.g., measures of life expectancy
- New coverage of models of causality
- New chapter on professional issues in epidemiology
- Exciting new figures, tables, and exhibits provided throughout
- Additional exercises and study questions



# Introduction

Epidemiology is an exciting and rewarding field! Evidence of the importance of epidemiology to society comes from the incessant flow of media reports on flare-ups of new diseases, outbreaks of illness on cruise ships, and, even more ominous, the intentional spread of pathogenic microorganisms through acts of bioterrorism. One of the difficult tasks for the authors has been to incorporate with sufficient breadth and depth all of the fascinating components of this discipline.

Since the publication of the earlier editions of this book, epidemiologic researchers have continued to develop an even greater wealth of findings that have won the attention of the popular media as well as space in professional journals. It has indeed been a challenge to select information from all the excellent research that has been published within the past few years balanced with those during the entire history of the field. 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 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.

This *Fourth Edition* presents new information on infectious disease threats associated with *E. coli* foodborne illness and avian influenza. We have expanded the historical background of epidemiology as well. Chapter 3, “Measures of Morbidity and Mortality Used in Epidemiology,” has been updated to reflect the use of the 2000 standard population in age standardization. In this chapter as well as Chapter 12, we have updated tables and figures in order to provide the most recent information. A new Chapter, 16, is titled “Epidemiology as a Profession.” Numerous changes have been made elsewhere in the text.

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. While 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 coordinated web page is available for the text. This web page provides extensive resources for students and instructors. We recommend that instructors

navigate through the web page during class time. For example, flashcards available on the web page may be used as part of an in-class activity to drill students for the class examinations. Robert Friis uses in-class Internet access in order to show students how to locate resources for the project shown in Appendix 4 (end of Chapter 4). Completion of the project, “Descriptive epidemiology of a selected health problem,” can be one of the major assignments in an epidemiology class. In addition to completing a written version of the assignment, students 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 flashcards, giving an in-class report, and accessing other links shown in the web page.



# 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 psychologic 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 two 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 fledging 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 nine years I studied learning styles (and even codeveloped and cotaught 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 three 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 was responsible for offering me my first professional employment in epidemiology at the School of Public Health, Columbia University. He and Dr. Zena Stein helped me to increase greatly 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, Associate Dean, California College of Medicine, University of California at Irvine, provided extremely valuable instruction 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, Associate 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 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. California State University graduate student Ibtisam Khoury 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.

*R.H.F.*

I have been most fortunate to have received 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.

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For the *Fourth Edition*, I would like to particularly thank my wonderful friends and colleagues at the Moffitt Cancer Center (especially Yifan Huang, Cathy Phelan, Jong Park, and Anna Giuliano) and the Mayo Cancer Center (especially Ellen Goode, Jim Cerhan, Celine Vachon, and Shane Pankratz) for their brilliance and dedication. I’ve learned that the application of the epidemiologic method can be fun if you work with the right team. I have certainly benefited from being around such a wonderful cast of bright and stimulating people. This has translated into exciting research projects, new knowledge, and practical insights added to this edition. Moreover, they share my hope and dream for an end to cancer and the terrible impact of this disease.

T.A.S.



# About the Authors

**Robert H. Friis, PhD**, is a Professor of Health Science and Chair of the Department of Health Science at California State University, Long Beach, and Director of the CSULB-VAMC, Long Beach, Joint Studies Institute. He is also Clinical Professor of Community and Environmental Medicine at the University of California at Irvine. Previously, he was an Associate Clinical Professor in the Department of Medicine, Department of Neurology, and School of Social Ecology, University of California at Irvine. His entire professional career has been devoted to the field of epidemiology. He has conducted research and taught epidemiology and related subjects for more than three decades at universities in New York City and Southern California. In addition to previous employment in a local health department as an epidemiologist, he has conducted research and has published and presented numerous papers related to mental health, chronic disease, disability, minority health, and psychosocial epidemiology. His new textbook, *Essentials of Environmental Health*, is also published by Jones and Bartlett. Dr. Friis has been principal investigator or co-investigator on grants and contracts from University of California's Tobacco-Related Disease Research Program, from the National Institutes of Health, and from other agencies for research on geriatric health, depression in Hispanic populations, nursing home infections, and environmental health issues. His research interests have led him to conduct research in Mexico City and European countries. He has been a visiting professor at the Center for Nutrition and Toxicology, Karolinska Institute, Stockholm, Sweden; the Max Planck Institute, Munich, Germany; and Dresden Technical University, also in Germany. He reviews articles for scientific journals, including *International Migration Review* and *Social Science and Medicine*. Dr. Friis is a member of the Society for Epidemiologic Research, the American Public Health Association (epidemiology section), is a past president of the Southern California Public Health Association, and is a fellow of the Royal

Academy of Public Health. Among his awards were a postdoctoral fellowship for study at the Institute for Social Research, University of Michigan, and the Achievement Award for Scholarly and Creative Activity from California State University, Long Beach. His biography is listed in *Who's Who in America*.

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