*Series Editor: Richard Riegelman*

*Friis'*

# Epidemiology 101

THIRD EDITION


## Scott Quinlan, PhD, MS

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Milken Institute School of Public Health
Washington, DC



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This Third Edition is dedicated to the memory of Robert H. Friis, PhD.

# Brief Contents

# Contents

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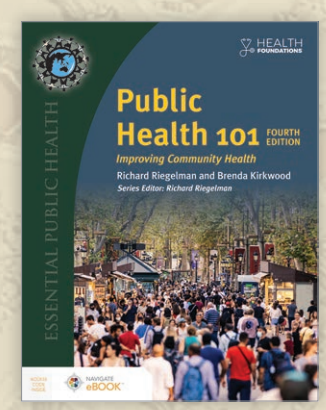


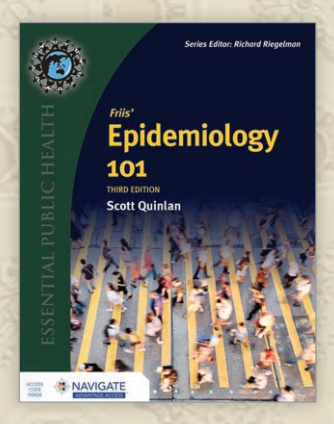


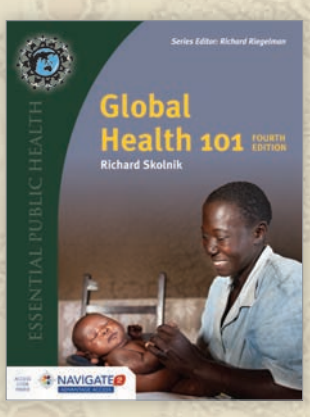


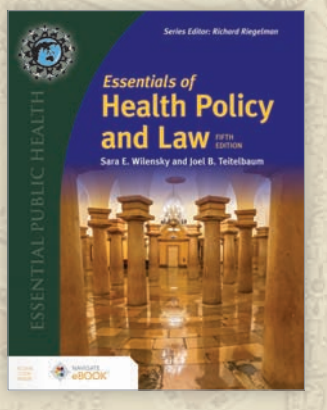


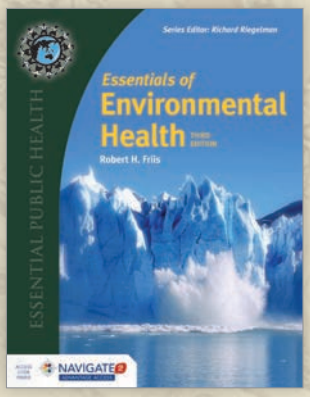


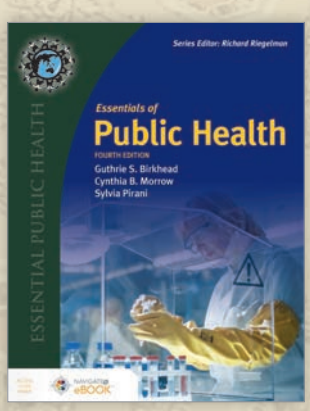


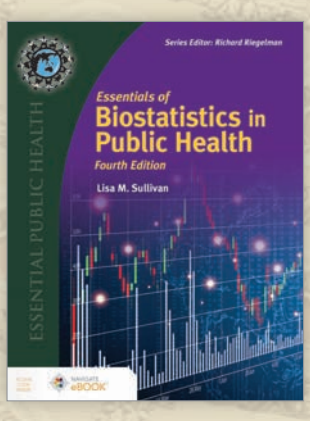


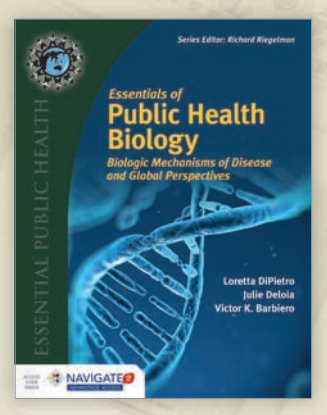


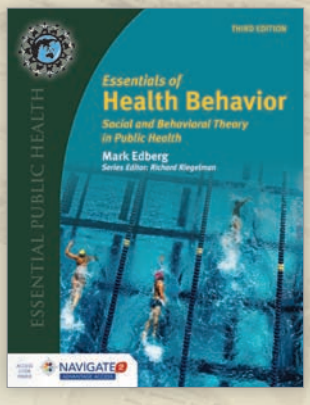


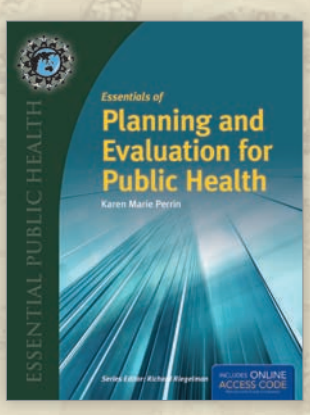

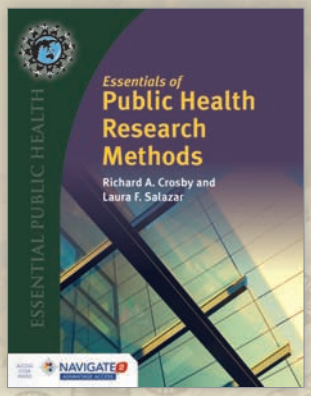


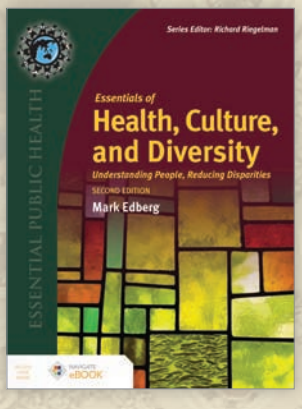


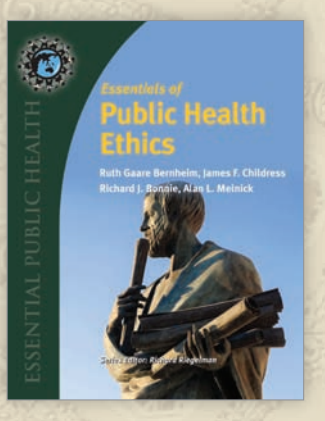


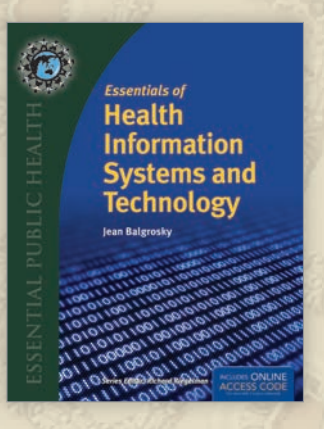


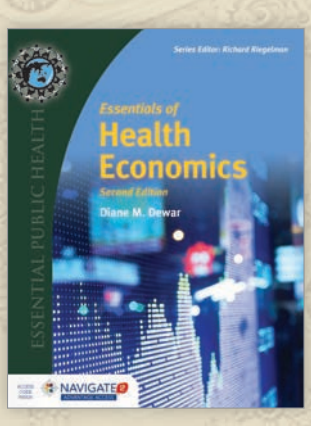


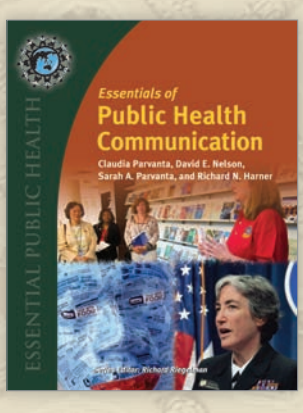


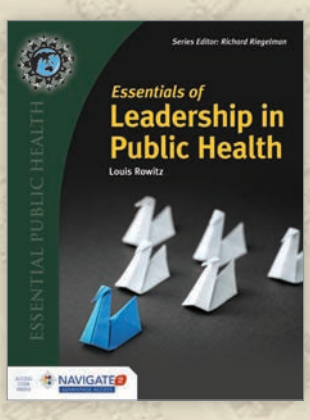


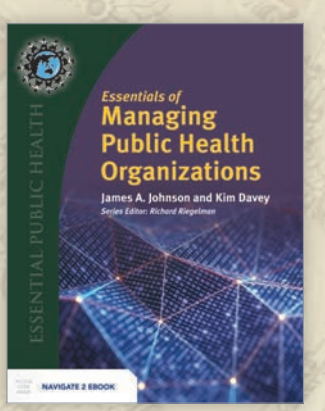


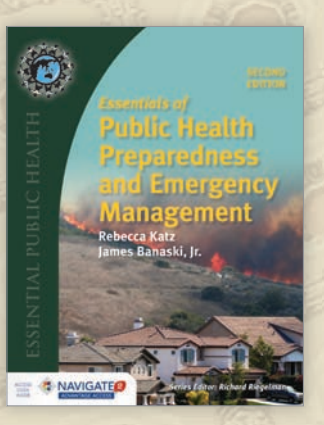


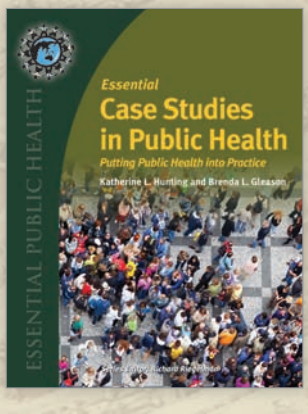


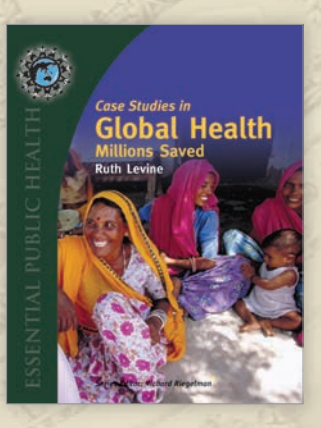


## About the Editor

**Richard Riegelman, MD, MPH, PhD,** is professor of epidemiology and biostatistics, medicine, and health policy, and founding dean of The George Washington University Milken Institute School of Public Health in Washington, DC. He has taken a lead role in developing the Educated Citizen and Public Health Initiative, which has brought together arts and sciences and public health education associations to implement the Institute of Medicine of the National Academies' recommendation that "… all undergraduates should have access to education in public health." Dr. Riegelman also led the development of The George Washington University's undergraduate major and minor and currently teaches "Public Health 101" and "Epidemiology 101" to undergraduates.

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# Editor's Preface

*Epidemiology 101* was one of the first books in the *Essential Public Health* series. It set a high standard for the series, which has now expanded to over 20 textbooks designed for the growing field of undergraduate public health education.

Robert Friis, PhD, author of the first two editions of *Epidemiology 101*, developed an accessible, engaging, and groundbreaking textbook that has been widely used as part of undergraduate public health education.

I am pleased to welcome Scott Quinlan, PhD, as the author the *Third Edition* of *Epidemiology 101*. Dr. Quinlan is an award-winning teacher of epidemiology. He has extensive experience in public health consulting and curriculum development. I have been delighted to see his approach to continuing the tradition established by Dr. Friis as he updates and revises *Epidemiology 101*.

*Epidemiology 101* introduces you to the world of epidemiology, the basic science of public health, and shows you the many ways that epidemiology affects all of our lives. *Epidemiology 101* clearly conveys the key concepts of epidemiology with a minimum of mathematics. It presents epidemiology as a scientific way of thinking applicable to a wide range of fields from basic and clinical sciences to public policy.

The *Third Edition* includes revisions and updates for each chapter, including the impact of COVID-19, the prevention and control of pandemic diseases, and the important role of social determinants of health, which helps to make *Epidemiology 101* relevant to today's epidemiology. Additional use of graphs and figures is an important feature of the new edition.

Dr. Quinlan has continued Dr. Friis' tradition of making epidemiology come to life—even for students who are taking the course as a requirement and those who fear the math. The new edition continues to be accessible and engaging. I am confident that you will find it provides the key concepts and understandings that are essential to developing an appreciation of the art and science of epidemiology.

Richard Riegelman, MD, MPH, PhD
*Essential Public Health* Series Editor

# Author's Preface

*Epidemiology 101* was written in response to a call to increase the epidemiologic content of undergraduate programs. A growing movement advocates for incorporating epidemiology into undergraduate curricula as a liberal arts subject. Consequently, students in undergraduate liberal arts programs, as well as those with limited public health or mathematical backgrounds, are the target audience for *Epidemiology 101*. No extant epidemiologic textbook is tailored exactly for this audience.

Epidemiology is ideally suited as a topic for liberal arts because habits of mind, such as problem analysis, deductive and inductive reasoning, and applying generalizations to a larger context, are key features of epidemiology. The discipline provides reinforcement of basic skills acquired in the natural sciences, mathematics and statistics, and the social sciences. Thus, a course in epidemiology might be taken in order to fulfill a distribution requirement in one of the basic or applied sciences. Furthermore, knowledge of epidemiology equips citizens with informed opinions regarding crucial health issues that appear daily in the media.

In addition to covering basic epidemiologic concepts, the text demonstrates how these concepts can be applied to problems encountered in everyday life, e.g., hazards posed by the food supply, risks associated with lifestyle choices, and dangers associated with youth violence. One of the features of *Epidemiology 101* is its emphasis on socially related determinants of health and health disparities. This text is one in the *Essential Public Health* series published by Jones & Bartlett Learning and edited by Richard Riegelman.

*Epidemiology 101* is written for students who have not had extensive backgrounds in health and biostatistics. The audience might include the following:

- Those seeking a simplified introduction to epidemiology. They could be nonmajors, people from allied fields, or students who are building a foundation for further work in epidemiology.
- Medical students who are preparing for the MCAT exam. The text provides instruction relevant to Skill 4: Scientific Inquiry and Reasoning Skills: Data-Based Statistical Reasoning on the MCAT exam. Chapter 2 provides content on basic statistical reasoning. The study questions and exercises section of this chapter contains sample questions for drilling for the MCAT.
- Beginning statistics students. Chapter 2 provides a brief introduction to elementary statistics and preparation for a statistics course.
- Those who would like to study epidemiology in order to fulfill a requirement for a course in science.
- Advanced high school students who are enriching their educational experience.

In the wake of the COVID-19 pandemic, interest in epidemiology has soared and this represents a critical time to teach and learn the discipline. Increasingly, curriculum designers recognize that as a discipline, epidemiology embodies many useful critical-thinking skills, including gathering facts, forming hypotheses, and drawing conclusions. These processes are the hallmark of the scientific method and embody modes of thinking that benefit well-educated citizens even if they do not intend to become public health professionals.[1] In this respect, epidemiology resembles a liberal art.[2]

One of the joys in teaching and learning epidemiology is that it may be approached from a nontechnical point of view that students from a variety of backgrounds can appreciate. Examples of epidemiologic investigations into such problems as COVID-19, MPox, and studies of lifestyle and chronic disease are inherently appealing. Although epidemiology has strong quantitative roots, this text emphasizes the nonquantitative aspects of the discipline by creating a linkage with traditional liberal arts concepts, including social justice and health disparities. A background in mathematics and statistics is not required to use the book. The text incorporates numerous case studies, text boxes, vignettes, exhibits, photographs, figures, and illustrations to gain the interest of readers.

Epidemiology has evolved into a discipline that has applications in many fields. Once thought of

as being confined to the investigation of infectious disease outbreaks, epidemiologic methods are used increasingly in such diverse health-related areas as traditional clinical medicine, healthcare administration, nursing, dentistry, and occupational medicine. In addition, the applications of epidemiologic methods are expanding to manufacturing processes, law, and control of international terrorism. *Epidemiology 101* will provide examples of many of these applications.

The content of this book follows the outline of the curriculum titled *Epidemiology 101*, recommended by the Consensus Conference on Undergraduate Public Health Education, November 7–8, 2006, Boston, Massachusetts.*

In some instances, for didactic purposes, the arrangement of the topics departs somewhat from the order presented in the conference's Working Group Reports. However, the content of this text is similar to the content shown in the curriculum suggested for *Epidemiology 101*.

This text contains a total of 12 chapters, which begin with coverage of basic epidemiologic principles and then increase in complexity. Chapters 11 and 12 provide examples of current applications of epidemiology. The *Third Edition* has been updated throughout to reflect the current state of epidemiology, including discussion of the COVID-19 pandemic, MPox, and the greater appreciation for the role of social determinants on health disparities. This edition includes content on data presentation, basic statistical measures, policy, and screening. In addition to the wide-ranging impact of the COVID-19 pandemic on all aspects of life, other examples chosen—such as the Ebola outbreaks in Africa, the epidemic of drug overdose deaths, the increasing usage of e-cigarettes, and the role of distracted driving on motor vehicle–related injuries and deaths—are recent and command the attention of students. The course content can be covered during an academic quarter or a semester. Instructors can adapt this text for online learning in their own educational settings.

Selected chapters are keyed to exercises from the College Board's Young Epidemiology Scholars (YES) Program. The Young Epidemiology Scholars: Competitions website provides links to teaching units and exercises that support instruction in epidemiology. The YES program, discontinued in 2011, was administered by the College Board and supported by the Robert Wood Johnson Foundation. The exercises continue to be available at the following website: http://yes-competition.org/yes/teaching-units/title.html.

A full set of instructor support materials, e.g., slides in PowerPoint format, an instructor's manual containing two sample syllabi, a *Third Edition* transition guide, and a test bank, is available online at www.jblearning.com/Quinlan for students and instructors to access. Each chapter concludes with study questions and exercises for additional reinforcement. The study questions and exercises have been revised and updated for the *Third Edition*. Students should be encouraged to use the supportive materials that are available on the website for this text. The interest level of students can be increased by using group exercises, lectures from public health experts, and field visits. The Robert Wood Johnson Foundation's YES exercises can be implemented as a laboratory component of an epidemiology course.

## References

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*Web address: https://cdn.ymaws.com/www.aptrweb.org/resource/resmgr/undergraduateph/consensus_conference.pdf. (Accessed July 31, 2023).

# Acknowledgments

I am truly grateful and indebted to Dr. Riegelman and the editorial staff at Jones & Bartlett for giving me the opportunity to lead the revision of *Epidemiology 101*. I am honored to be given this opportunity and thankful and appreciative of the incredible work that Robert H. Friis has done to develop this text. I hope that I can honor his legacy with this update. The comments of anonymous reviewers aided me in updating and expanding the content of the *Third Edition*. I deeply appreciate their thoughtful comments. I offer my sincerest thanks and appreciation to my students and colleagues at The George Washington University Milken Institute School of Public Health who truly make it fun to come to work every day to teach and learn epidemiology. Last, but certainly not least, thank you to my family and friends for supporting me on this journey.

Scott C. Quinlan, PhD

# About the Author

**Scott C. Quinlan, PhD,** is an associate teaching professor in the department of epidemiology at The George Washington University. He has many years of experience teaching a range of graduate and undergraduate courses in epidemiology and biostatistics, both in the on-campus and online environments. He received his BS in biochemistry from the University of Delaware and his MS and PhD in epidemiology from The George Washington University. His dissertation research involved an examination of the role of infections in cancer development. Dr. Quinlan has enjoyed a varied career in epidemiology, with experience serving as an epidemiologist in industry, academic, and government settings. He has experience working in international clinical trials research as well as designing, conducting, and analyzing epidemiologic studies related to drug and vaccine safety. Dr. Quinlan has taught courses in introductory epidemiology and biostatistics, advanced data analysis methods for public health, and the epidemiology of drug and vaccine safety.