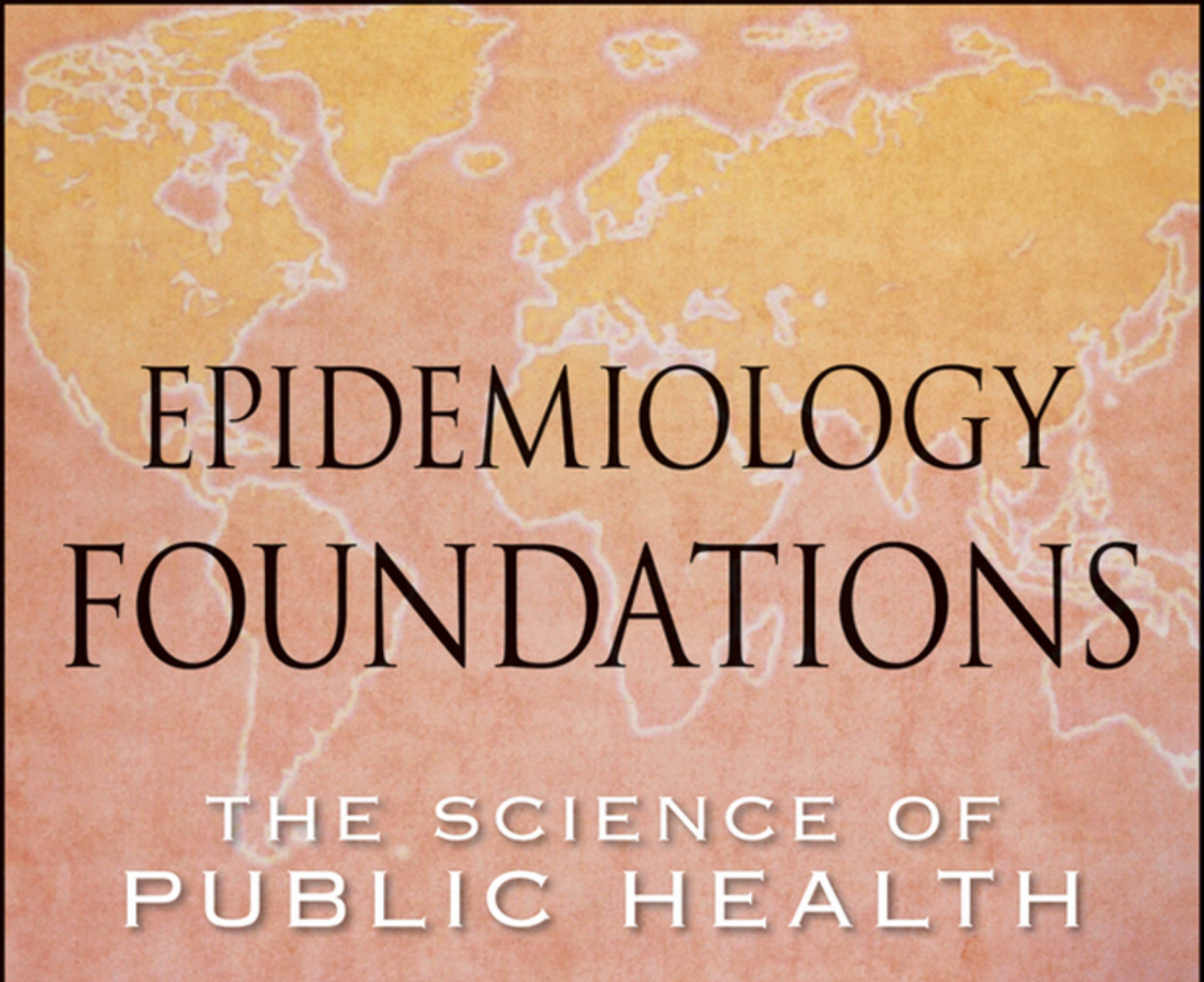




EPIDEMIOLOGY FOUNDATIONS

THE SCIENCE OF
PUBLIC HEALTH



PETER J. FOS

Table of Contents

Cover

Title page

Copyright page

Dedication

FIGURES

TABLES

PREFACE

THE AUTHOR

CHAPTER 1 WHY EPIDEMIOLOGY?

Introduction

Public Health and Community Medicine

Definition of Epidemiology

Population Health

Population Trends

Health Costs

Global Health Threats

Summary

Key Terms

CHAPTER 2 HISTORY OF EPIDEMIOLOGY

Historical Perspectives

Uses of Epidemiology

Examples of Cohort Studies

Summary

Key Terms

CHAPTER 3 HEALTH AND DISEASE

Definitions

Distinction Between Health and Disease

Disease Progression

Cause and Effect

Summary

Key Terms

CHAPTER 4 DESCRIBING HEALTH AND DISEASE

Descriptive Epidemiology

Hypotheses

Descriptive Variables

Examples of Use of Descriptive Information

Summary

Key Terms

CHAPTER 5 MEASURING HEALTH AND DISEASE

Morbidity

Mortality

Other Measures

Graphing Health and Disease

Measurements

Confounding

Summary

Key Terms

CHAPTER 6 EPIDEMIOLOGY STUDY DESIGNS: OBSERVATIONAL AND EXPERIMENTAL STUDIES

Definition of Observational Studies

**Framework and Types of Observational
Studies**

Descriptive Studies

Analytical Studies

Examples of Observational Studies

Definition of Experimental Studies

**Framework and Types of Experimental
Studies**

Clinical Trials

Bias and Validity

Examples of Experimental Studies

Summary

Key Terms

CHAPTER 7 USES OF EPIDEMIOLOGICAL STUDIES

Introduction

Observational Studies

Experimental Studies

Summary

Key Terms

CHAPTER 8 EPIDEMICS

Definition

Transmission

Response to Epidemics

Surveillance

Reportable Diseases

Examples

Summary

Key Terms

CHAPTER 9 EPIDEMIOLOGY AND SOCIETY

Introduction

Social Determinants

Socioeconomic Factors and Health

The Built Environment

Summary

Key Terms

CHAPTER 10 SCREENING FOR DISEASE

Prevention and Epidemiology

Screening

Accuracy of Screening Tests

Summary

Key Terms

CHAPTER 11 COMMUNITY PUBLIC HEALTH

Introduction

Community Health Workers

Community Level Planning and Evaluation

Examples

Public Health Programs

Public Health Agencies

Summary

Key Terms

CHAPTER 12 EPIDEMIOLOGY TODAY

Emergency Preparedness

Global Health

Emerging Diseases

Chronic Diseases

Summary

Key Terms

Index



EPIDEMIOLOGY FOUNDATIONS

The Science of Public Health

PETER J. FOS

 **JOSSEY-BASS**
A Wiley Imprint
www.josseybass.com

Copyright © 2011 by John Wiley & Sons, Inc. All rights reserved.

Published by Jossey-Bass

A Wiley Imprint

989 Market Street, San Francisco, CA 94103-1741—

www.josseybass.com

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400, fax 978-646-8600, or on the Web at www.copyright.com. Requests to the publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, 201-748-6011, fax 201-748-6008, or online at www.wiley.com/go/permissions.

Readers should be aware that Internet Web sites offered as citations and/or sources for further information may have changed or disappeared between the time this was written and when it is read.

Limit of Liability/Disclaimer of Warranty: While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your

situation. You should consult with a professional where appropriate. Neither the publisher nor author shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages.

Jossey-Bass books and products are available through most bookstores. To contact Jossey-Bass directly call our Customer Care Department within the U.S. at 800-956-7739, outside the U.S. at 317-572-3986, or fax 317-572-4002.

Jossey-Bass also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Library of Congress Cataloging-in-Publication Data

Fos, Peter J.

Epidemiology foundations : the science of public health
Peter J. Fos.—1st ed.

p. ; cm.

Includes bibliographical references and index.

ISBN 978-0-470-40289-4 (pbk.); ISBN 978-0-470-91070-2 (ebk.); ISBN 978-0-470-91071-9 (ebk.); ISBN 978-0-4709-1072-6 (ebk.)

1. Epidemiology. I. Title.

[DNLM: 1. Epidemiologic Methods. 2. Epidemiology. WA 950]

RA651.F647 2011

614.4—dc22

2010040026

*For Dylan and Madison Rose
May your futures be bright*

FIGURES

Figure 1.1: Cigarette smoking in the United States, 1965 to 2005 6

Figure 1.2: Leading causes of death, United States, 1950 to 2004 7

Figure 1.3: Projected population growth, 2010 to 2050, in the United States 11

Figure 1.4: Projected population percentage by race, 2010 to 2050, in the United States 12

Figure 1.5: Population growth in the United States, 2010 to 2050 12

Figure 1.6: Projected life expectancy in years by sex, United States, 2010 to 2050 13

Figure 1.7: Life expectancy from birth and at age 65 years by race and gender, United States, 1970 to 2005 14

Figure 1.8: Death rates of infants and newborns, United States, 1950 to 2005 15

Figure 1.9: Funding health care in the United States 16

Figure 1.10: Health insurance coverage among people younger than 65 years 16

Figure 3.1: Illness-disease matrix 37

Figure 3.2: Causation matrix 47

Figure 3.3: Web of causation 48

Figure 3.4: Epidemiologic triangle 49

Figure 3.5: Wheel of causation 49

Figure 4.1: Point-source epidemic 72

Figure 4.2: Propagated epidemic: estimated number of AIDS cases in adults and adolescents, United States, 1985 to 2006 72

Figure 4.3: Seasonal disease graph 74

Figure 4.4: Secular trend of hospitalizations associated with *Clostridium difficile* infection in Finland, 1996 to 2004 74

Figure 5.1: Period prevalence of overweight among children and teenagers by age group and selected period, United States, 1971 to 2002 89

Figure 5.2: Prevalence of diabetes in the United States, 2007, by age 103

Figure 5.3: AIDS rates by race or ethnic group, United States, 2006 104

Figure 5.4: Case-fatality rates for stroke per 100 people admitted to a hospital 104

Figure 5.5: Infant mortality and neonatal and postneonatal deaths in the United States, 2005 105

Figure 6.1: Framework of observational studies 115

Figure 6.2: Cross-sectional study 117

Figure 6.3: Prospective study 120

Figure 6.4: Retrospective study 122

Figure 6.5: Comparison of observational studies 125

Figure 6.6: Experimental studies 126

Figure 6.7: Framework for a randomized clinical trial 129

Figure 7.1: Relationship between risk factor and disease 140

Figure 7.2: Odds ratio calculation 145

Figure 8.1: Common-source epidemic 164

Figure 8.2: Propagated epidemic: Estimated number of AIDS cases in adults and adolescents, United States, 1985 to 2006 165

Figure 8.3: Legionnaires' disease outbreak 168

Figure 9.1: U.S. poverty rates, 1966 to 2005 182

Figure 9.2: Prevalence rate of overweight and obesity, United States, 1960 to 2004 188

Figure 11.1: Basic logic model of resources, program activities, public health services, and expected changes in

health 215

Figure 11.2: Logic model for program evaluation 216

Figure 11.3: Healthy People 2010 twenty-eight focus areas
221

Figure 11.4: Progress of objective 1-1 222

Figure 11.5: Rural Healthy People 2010 focus areas 224

Figure 12.1: Overweight and obesity prevalence trend,
United States, 1960 to 2004 250

TABLES

Table 4.1: Limitation of Activity (Percentage) Caused by Chronic Conditions, United States, 2005 and 2006 57

Table 4.2: Death Rates from All Causes by Age, United States, 2002 to 2005 58

Table 4.3: Death Rates Caused by Diabetes Mellitus by Age, United States, 2002 to 2005 58

Table 4.4: Current Cigarette Smoking Among Adults, Estimated Percentage, by Sex, United States, 2006 59

Table 4.5: Rate of Vision and Hearing Problems Among People Older Than 18 Years, United States, Selected Years from 1997 to 2006, by Sex 59

Table 4.6: Percentage of Medicaid Coverage Among People Younger Than 65 Years, United States, Selected Years from 1984 to 2006, by Sex 60

Table 4.7: Rate of Hospital Stays in the Past Year, United States, Selected Years from 1997 to 2006, by Sex 60

Table 4.8: Age-Adjusted Death Rates by Race, United States, 2002 to 2005 61

Table 4.9: Rate of Emergency Room Visits in the Past Year for Persons Younger Than 18 Years, United States, Selected Years from 1997 to 2006, by Race 62

Table 4.10: Percentage of Teenaged Childbearing, United States, 2002 to 2006, by Race 63

Table 4.11: Percentage of People Older Than 18 Years with Vision and Hearing Problems, United States, Selected Years from 1997 to 2006, by Race 63

Table 4.12: Age-Adjusted Death Rates Among Persons Aged 25 to 64 Years by Educational Attainment, Selected States, 2001 to 2005 64

Table 4.13: Percentage of People Older Than 18 Years with Vision and Hearing Problems, United States, Selected Years

from 1997 to 2006, by Educational Attainment 65

Table 4.14: Estimated TB Incidence Rate for Selected Countries, 2006 66

Table 4.15: Average Annual Age-Adjusted Death Rates, Regions of the United States, 2003 to 2005 67

Table 4.16: Average Annual Age-Adjusted Death Rates by Selected States, 2003 to 2005 67

Table 4.17: County-Level Estimated Diagnosed Diabetes, by Selected Counties in Mississippi, 2005 68

Table 4.18: Average Annual Age-Adjusted Death Rates, Urban and Rural Counties, United States, 1996-1998, 1999-2001, and 2003-2005 69

Table 5.1: AIDS Rates in the United States in 2006 by Race or Ethnic Group 81

Table 5.2: Cumulative Reported AIDS Cases Through 2006 in the United States 82

Table 5.3: Cumulative Reported AIDS Deaths Through 2006 in the United States 82

Table 5.4: Crude Invasive Cancer Incidence Rates by Primary Site and Race and Ethnicity, United States, 2004 84

Table 5.5: Incidence of Acute Hepatitis A by Selected States in the United States, 2002 to 2006 84

Table 5.6: Incidence Rates of Actual Viral Hepatitis by Type and Year, United States, 1997 to 2006 85

Table 5.7: Prevalence of Diabetes in the United States, 2007, by Age 87

Table 5.8: Prevalence of Obesity in Selected States, 2007 88

Table 5.9: Number of Deaths and Crude Death Rates for the 15 Leading Causes of Death, 2005 91

Table 5.10: Cause-Specific Death Rates by Age for the 15 Leading Causes of Death, United States, 2005, for Selected Age Categories 92

Table 5.11: Infant, Neonatal, and Postneonatal Mortality Rates in the United States, 2000 to 2005 94

Table 5.12: Infant, Neonatal, and Postneonatal Mortality Rates by Race of the Mother in the United States, 2000 to 2005 95

Table 5.13: Fetal Death Rates in the United States, 2000 to 2004 96

Table 5.14: PMR for Deaths in Infants Due to the Five Leading Causes of Death in the United States, 2004 97

Table 5.15: Five-Year Cancer Survival Rates for Selected Cancers by Race, 1987–1989 Through 1996–2003 98

Table 5.16: Estimated Vaccination Coverage (Percentage) Among Children Ages 19 to 35 Months, by Vaccine and Dosage, 2000 to 2004 99

Table 5.17: Estimated Fertility Rates in Selected Countries, 2008 100

Table 5.18: Self-Assessed Health Status, Poor or Fair, by Age, Sex, and Race in the United States, 2002 to 2006 101

Table 5.19: Potential Years of Life Lost (PYLL) Before Age 75, United States, 2005 102

Table 5.20: Age-Adjusted Invasive Cancer Incidence Rates by Primary Site and Race and Ethnicity in the United States, 2004 107

Table 5.21: Crude and Age-Adjusted Death Rates for Alcohol-Induced Causes, by Race, United States, 1999 to 2005 108

Table 7.1: Relative Risk 2 × 2 Contingency Table 141

Table 7.2: Relative Risk Calculation 142

Table 7.3: Relative Risk Calculation Example 1 143

Table 7.4: Relative Risk Calculation Example 2 144

Table 7.5: Odds Ratio 2 × 2 Contingency Table 146

Table 7.6: Calculation of Odds Ratio 147

Table 7.7: Odds Ratio Example 1 147

Table 7.8: Odds Ratio Example 2 148

Table 7.9: Odds Ratio Example 3	149
Table 7.10: Attributable Risk Table	150
Table 7.11: Attributable Risk Calculation	150
Table 7.12: Attributable Risk Calculation Example 1	151
Table 7.13: Lung Cancer and Alcohol Use	154
Table 7.14: Smoking Status Stratification for Lung Cancer	155
Table 8.1: Nationally Notifiable Diseases, 2009	172
Table 8.2: Diseases Under Surveillance by the World Health Organization, 2009	173
Table 8.3: West Nile Virus Cases, Selected States, 2008	175
Table 10.1: 2 × 2 Contingency Table	197
Table 10.2: Sensitivity: True-Positive Ratio	198
Table 10.3: Specificity: True-Negative Ratio	199
Table 10.4: False-Positive (FP) Ratio	199
Table 10.5: False-Negative (FN) Ratio	200
Table 10.6: Validity Calculation Example	200
Table 10.7: Validity Calculation Example: Sensitivity	201
Table 10.8: Validity Calculation Example: Specificity	201
Table 10.9: Validity Calculation Example: FN Ratio	202
Table 10.10: Validity Calculation Example: FP Ratio	202
Table 10.11: Predictive Value of a Positive Test Result (PV+)	203
Table 10.12: Predictive Value of a Negative Test Result (PV-)	203
Table 10.13: Validity Calculation Example: PV+	204
Table 10.14: Validity Calculation Example: PV-	204
Table 10.15: Reliability Index	206
Table 10.16: Reliability Index Example	207
Table 10.17: ECG Results	208
Table 11.1: Diabetes Focus Area	223

Table 12.1: Global Summary of AIDS Epidemic, December 2007 233

Table 12.2: Estimated Number of People Receiving Antiretroviral Therapy, by Region, December 2003 to December 2007 233

Table 12.3: Cumulative Number of Confirmed Human Cases of Avian Influenza A (H5N1), 2003 to 2008 235

Table 12.4: Cumulative Number of Confirmed Human Deaths from Avian Influenza A (H5N1), 2003 to 2008 235

Table 12.5: West Nile Virus Activity, United States, 2008 237

Table 12.6: Emerging Infectious Diseases 238

Table 12.7: Obesity Prevalence Rates, United States, 2007 249

Table 12.8: Lifetime Asthma Population Estimates by Age, United States, 2006 253

Table 12.9: Current Asthma Estimates by Age, United States, 2006 254

Table 12.10: Current Asthma Prevalence Rates by Age, Sex, and Race, United States, 2006 254

Table 12.11: Age-Specific Prevalence Rate of Diagnosed Diabetes per 100 Population by Sex and Race or Ethnicity, 2005 255

Table 12.12: Number of Persons with Diagnosed Diabetes, in Millions, United States, 1990 to 2005 255

Table 12.13: Crude and Age-Adjusted Prevalence Rates of Diagnosed Diabetes per 100 Population, United States, 1990 to 2005 256

PREFACE

Epidemiology? Many people have heard the term, but few really understand what it is, what it does, and how it influences our daily lives. This book is intended to inform students and practitioners about the vital role of epidemiology in enhancing the health of individuals and communities, to understand how to read and interpret epidemiological studies to become more enlightened citizens, and to understand the global effects of epidemiological studies.

The motivation for this book has developed over the years from the influence of several factors. I have taught epidemiology to graduate students for more than twenty years and have written other textbooks aimed at illustrating the relevance and benefit of epidemiology for specialized uses in health care administration and population health management. Through my years of teaching and writing, I have seen the positive response from students and practitioners to the myriad applications of epidemiology to their respective fields and everyday life. With this in mind, it makes sense to expose young scholars to epidemiology earlier in their intellectual journey. The more people who understand and appreciate the uses of epidemiology, the better chance its application will improve the public's health and well-being.

Another motivation for writing this book is the attention that epidemiology and public health education is receiving from national organizations. National public agencies have been warning that there is a crisis in the shortage of trained and qualified public health workers, especially epidemiologists.¹ There is a movement, which is gaining momentum, to expand the public health education downward from graduate programs to undergraduates, especially into community colleges.² This call to action must

be met with innovative curricula and instructional resource materials.

Organization

Chapters One and Two lay the foundation to the course by discussing both the historical perspective and future trends of epidemiology. Chapter One, “Why Epidemiology?” introduces the reasons why epidemiology is an important foundation to public health. The chapter presents the role that epidemiology plays in public health. Current and future characteristics of the United States population and of global health threats are presented with an epidemiological perspective. Chapter Two, “History of Epidemiology,” continues to provide background information by presenting a historical perspective of the development of epidemiology as the basic science of public health. Past contributors and their influence on the science of epidemiology are discussed.

Chapters Three, Four, and Five discuss health and disease and how they are measured. Chapter Three, “Health and Disease,” begins the core discussion of epidemiological principles, along with the foundations of health and disease. The notion of disease causation is discussed and stressed throughout the text. Chapter Four, “Describing Health and Disease,” discusses descriptive epidemiology and its uses as an information source and as a precursor to further study and investigation. Emphasis is placed on descriptive variables that are used to explain differences in health and disease in populations. Chapter Five, “Measuring Health and Disease,” introduces morbidity and mortality measures. How these measures assist in interpreting disease information is discussed.

Chapters Six and Seven discuss epidemiological studies and how they are used. Chapter Six, “Epidemiological Study

Designs: Observational and Experimental Studies,” presents study designs used to test hypotheses that result from descriptive information. Observation and experimental designs are introduced. Chapter Seven, “Uses of Epidemiological Studies,” covers the evaluation of cause-and-effect relationships between causal factors and diseases. Hypothesis testing and quantification of risk with epidemiological study designs are discussed.

Chapters Eight through Twelve discuss epidemiology from a social and community perspective and global diseases and epidemics. Chapter Eight, “Epidemics,” begins the section of the text that focuses on the use of epidemiological principles in everyday life. This chapter discusses epidemics and how they begin and spread. Modes of transmission of infectious agents are described as well as how public health agencies respond to epidemics. Disease surveillance methods, including reportable disease reporting, are presented. Chapter Nine, “Epidemiology and Society,” introduces one of the newer epidemiological disciplines. The influence of society and the neighborhoods in which people live on their health is the crux of social epidemiology. Chapter Ten, “Screening for Disease,” brings epidemiology to a personal level. Accuracy and precision of screening tests and the evaluation of their results are discussed. Chapter Eleven, “Community Public Health,” covers the link connecting epidemiology to improvements in daily life. Public health program planning, implementation, and evaluation are presented. The role of epidemiology in community public health is described through examples of public health programs. Chapter Twelve, “Epidemiology Today,” discusses current health and disease concerns, and the pending future impact of current health problems is portrayed from the epidemiological perspective.

Features

Each chapter is supplemented with exercises to aid in understanding the epidemiological principles. These chapter exercises consist of research assignments and problem solving. Most of these exercises are open-ended to challenge the reader to be creative and innovative. In addition, each chapter has a set of multiple-choice, true-or-false, and short-answer review questions. These chapter review questions are intended to provide immediate feedback.

Audience

I anticipate that the primary users of this textbook will be students in high school, community and junior colleges, and four-year colleges and universities. This book can serve as a first resource for students new to epidemiology. One objective is to engage young people in hopes that they will embrace epidemiology as a discipline in which they will continue their study and future work. My hope is that after reading and using this book, students will understand and appreciate the relevance and impact that epidemiology, as the basic science of public health, has on improving health and wellness.

Acknowledgments

This book is a product of more than thirty years of work and study of health and disease. My personal journey has been uncharted at times but thankfully has carried me in a positive and growing direction. I have had many mentors and supporters along the way. Their support has made this journey up to this point one characterized by more ups than downs. Included among my supporters are my students;

they have been my true motivation and inspiration. I thank each and every one of you. Finally, I must thank and acknowledge my family. They have allowed me to pursue my career and intellectual pursuits with no complaints, despite the hardships they may have confronted. They have always been my greatest supporters. I must thank my colleagues who have helped me often during my journey, as well as with this book. David J. Fine first convinced me to write books for students. He has been there for me often and is a source of inspiration and encouragement. Peggy Honoré was my student many years ago and now is my friend and colleague. Her encouragement has been invaluable. Miguel Zuniga, also a former student, is now my friend and collaborator in many of my accomplishments. He is a source of technical knowledge and has kept me on task throughout the writing of this book.

Sandra Kiselica edited this book, and her help and recommendations have been invaluable. Her expertise can be seen throughout in the sections that read easiest.

Peter J. Fos

Notes

1. State Public Health Employee Workforce Shortage Report: A Civil Service Recruitment and Retention Crisis. Arlington, VA: Association of State and Territorial Health Officials; 2004.

2. Honoré PA, Graham G, Garcia J, and Morris W. A call to action: Public health and community college partnerships to educate the workforce and promote health equity. *Journal of Public Health Management and Practice*. 2008; 14(56) Suppl:S82-S84.

THE AUTHOR

Peter J. Fos is provost and professor of health sciences at the University of Texas at Tyler. He is an internationally known decision scientist and epidemiologist. He earned his doctorate in health care decision analysis from Tulane University Graduate School and his master of public health degree from Tulane University Health Sciences Center, following a career in clinical dentistry. He has spent more than twenty-five years at academic institutions, where he is active in curriculum development in application of epidemiology to management, the practice of managerial epidemiology, clinical effectiveness, public-health practice, health-outcomes research, and terrorism-preparedness planning. He served, briefly, as chief science officer of the Mississippi State Department of Health. He maintains adjunct faculty positions at the University of Southern Mississippi College of Health and the University of Alabama in Birmingham School of Health-Related Professions, and is a visiting scholar at the Medical University of South Carolina, College of Health Professions.

CHAPTER 1

WHY EPIDEMIOLOGY?

LEARNING OBJECTIVES

On completing this chapter, you will be able to

Define epidemiology

Discuss the concept of populations and population health

Describe population trends and characteristics

Describe global health threats

Discuss the relationship and distinction between public health and medicine



Introduction 2

Public Health and Community Medicine 2

Definition of Epidemiology 3

Population Health 9

Population Trends 10

Health Costs 15

Global Health Threats 17

Introduction

Epidemiology is, for most, a word that seems to be from another language. It is certainly not a word we use in everyday conversation. But epidemiology is a science that affects all of us every day of our lives. We shop for food each day with little regard to or worry about whether what we purchase and eat is unsafe. For many of us, smallpox, polio, plague, diphtheria, yellow fever, and cholera are diseases that either we have never heard of or we do not give much thought or attention to. Human immunodeficiency virus (HIV) infection and acquired immunodeficiency syndrome (AIDS) are diseases that are well known, but they are becoming less of a daily concern. New, so-called emerging diseases such as bird flu are now garnering a great deal of our attention.

Public Health and Community Medicine

Before continuing the discussion on “why epidemiology,” the concept of public health must be explained further. *Public health* is the science and practice of protecting and improving the health of a community. This can be done with preventive medicine, health education, the control of communicable diseases, the use of sanitary measures, and the monitoring of environmental conditions. Public health is concerned with the health of the community as a whole. In other words, public health and community health are synonymous.

Public health is focused on three areas: assessment and monitoring of health and disease, development of public

health policies that assist in addressing health problems, and allowing for access to public health care services. These public health care services include disease prevention, health education, and health promotion. Often public health services are considered to be the same as medical care services because of the assumed similarities. The distinction is that public health services are focused on populations, not individuals. It is true that populations are made up of individuals, so public health acknowledges the importance of the welfare of individuals, but the focus of services is on larger populations. Public health services are centered on diagnosing and monitoring health issues and providing health education and health promotion services to communities.

An example of this communitywide perspective of public health is considered an accomplishment. Public health is concerned with immunization for preventable disease, such as smallpox, poliomyelitis, measles, rubella, tetanus, diphtheria, and *Haemophilus influenzae* type b. Since immunization programs (also referred to as vaccination programs) were established, smallpox has been eradicated, poliomyelitis has been eliminated in the United States, and the other diseases are now under control. Other infectious diseases (cholera, tuberculosis, and sexually transmitted diseases) also are under control, in part due to the efforts of public health agencies and programs.

Is public health the same as medicine? Despite the fact that medical and public health services both seek to improve health, they are not the same. Two easy-to-remember differences are (1) public health services are directed at populations, and medical services are focused on the individual; and (2) public health services are mostly concerned with the prevention of disease whereas medical services are concerned with the diagnosis and treatment of disease. Public health and medicine are different, but they

have the same objective of improving health and eliminating disease.

Definition of Epidemiology

Epidemiology is a word with Greek origins: from the Greek prefix *epi*, meaning “on, upon, or befall”; the Greek root *demos*, meaning “the people”; and the Greek suffix *logos*, meaning “the study of.” In other words, epidemiology studies that which befalls on people, which is disease. The word epidemiology was first used in the 1700s to describe the science and methods used to study epidemics. In the twentieth century, with the decline of infectious diseases, epidemiology expanded to study more than epidemics. This decline in infectious diseases can be attributed to improvements in nutrition, sanitation, and general living conditions that in part resulted from public health interventions. Of course, these public health interventions were established using information provided by epidemiology.

Given this new need for *epidemiology*, it has been defined as the study of the distribution and determinants of health-related states or events in specified populations and the application of this study to control health problems.¹ This means that epidemiology is used to identify the diseases in a population and to understand why these diseases exist. Another often-used definition is that 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.²

The Greek root of epidemiology and the two definitions have a common theme, namely, the people. The people are considered as a group, which is referred to as a *population*. This population-centered nature of epidemiology leads to

one of the differences between public health services and medical services. Populations are groups of people who share some common characteristics. These characteristics are personal (age, sex, race, health behaviors), geographical (live in the same neighborhood, city, region, country, continent), and time. Populations may be large groups of people (population of the United States) or small groups (people in a neighborhood or in a factory).

Epidemiology is the study of factors affecting the health and illness of populations. It serves as the foundation of interventions made in the interest of public health and preventive medicine. It is considered a cornerstone method of public health research and is highly regarded in medicine for identifying risk factors for disease and determining the best treatment approaches to clinical practice. Epidemiology is considered by many to be a critical branch of public health. In fact, it is often referred to as the basic science of public health.

Epidemiology provides a framework of methods and principles from which information can be reviewed and analyzed in a way that public health problems can be identified and addressed. The epidemiological methods allow for disease definition as well as classification, identification, and planning for disease control measures. Epidemiology also provides the way to understand the relationship between the presence of factors that cause disease, called *causal factors*, and the development of disease (for example, smoking and heart disease).

Epidemiologists are the people who work every day using epidemiological principles and methods to make our lives better. Epidemiologists identify, measure, count, and control diseases, injuries, and causes of death. They also look for connections between disease and genetic, environmental, and behavioral factors. Once these connections are established, epidemiologists plan and develop interventions

to prevent disease and promote health. This process of identifying connections and developing interventions is how epidemiology touches our lives in a positive way every day.



Let's discuss some specific examples of how epidemiology has affected public health. In general terms, most of the significant improvements in the health of the people in the United States can be traced to accomplishments of public health.

An example of how public health policy improved the health and well-being of large groups of people happened in the United States in 1955. At that time, results of field tests of the polio vaccine were announced indicating that an inactivated poliovirus could produce immunity. Within days of this announcement, a national vaccination program was