EPIDEMIOLOGY FOR THE HEALTH SCIENCES

Seventh Printing

Epidemiology for the Health Sciences

A PRIMER ON EPIDEMIOLOGIC CONCEPTS AND THEIR USES

By

DONALD F. AUSTIN, M.D., M.S., M.P.H.
Medical Epidemiologist
Resource for Cancer Epidemiology
California State Department of Health
Berkeley, California
Lecturer in Epidemiology
School of Public Health
University of California
Berkeley, California

and

S. BENSON WERNER, M.D., M.P.H., F.A.C.P.M.
Medical Epidemiologist
Infectious Disease Section
California State Department of Health
Berkeley, California
Lecturer in Epidemiology
School of Public Health
University of California
Berkeley, California

CHARLES C THOMAS · PUBLISHER
Springfield · Illinois · U.S.A.

Published and Distributed Throughout the World by

CHARLES C THOMAS • PUBLISHER
2600 South First Street
Springfield, Illinois, 62717, U.S.A.

ISBN 0-398-02949-0 (paper)

Library of Congress Catalog Card Number: 73-10087

First Printing, 1974
Second Printing, 1976
Third Printing, 1977
Fourth Printing, 1978
Fifth Printing, 1979
Sixth Printing, 1981
Seventh Printing, 1982

With THOMAS BOOKS *careful attention is given to all details of manufacturing and design. It is the Publisher's desire to present books that are satisfactory as to their physical qualities and artistic possibilities and appropriate for their particular use.* THOMAS BOOKS *will be true to those laws of quality that assure a good name and good will.*

Printed in the United States of America
R-1

Library of Congress Cataloging in Publication Data

Austin, Donald F.
Epidemiology for the health sciences.

1. Epidemiology. I. Werner, Sanford Benson, 1939- joint author. II. Title. [DNLM: 1. Epidemiology. WA100 A935e 1973]
RA651.A95 616'.00723 73-10087
ISBN 0-398-02950-4
ISBN 0-398-02949-0 (pbk.)

PREFACE

THIS MANUAL had its origin in a teaching aid we developed for our graduate students in a basic epidemiology course at the School of Public Health, University of California, Berkeley. Each chapter was subjected to extensive student evaluation in subsequent classes at the University of California and was revised on the basis of those evaluations. It has helped students achieve an understanding of epidemiologic concepts with a freshness, ease and directness not possible with standard textbooks.

This manual is not intended to replace classic standard textbooks such as Fox et al and MacMahon et al; rather, we hope the interest in certain topics generated by this manual will encourage the serious student to pursue interests in those texts and in other literature.

The manual is intended primarily for non-epidemiology majors who must gain and retain a basic understanding of epidemiologic principles in their courses of *epidemiology* or *preventive medicine* wherein there is neither the time, interest, nor sophistication to read the standard textbooks. It will, therefore, be of value to medical students, students in schools of public health, nursing schools, dental schools, pharmacy schools and indeed of value to students in all the health sciences.

D.F.A.
S.B.W.

CONTENTS

EPIDEMIOLOGY
FOR THE
HEALTH SCIENCES

Chapter I

HOW TO USE THIS MANUAL

THIS MANUAL is not the kind that looks impressive sitting on a bookshelf—but since you have it, read it. Skip over the parts that you already know and the parts that are easy. If everything in it is easy for you, give the manual to somebody else or return it. Save any hard parts for a time when you can think about them a bit, like when it is quiet. None of it is really hard, but you are likely to miss a point if you try to read it while watching a sunset, listening to stereo, or eating a sandwich.

This manual was not written to satisfy a publisher or an editor, so we have taken some literary liberties with grammar and such. If that bothers you, you may prefer a textbook. This was written to help people who aren't in tune with the subject of epidemiology become people who are. It is written in conversational English, and some may feel insulted at certain points. Even so, after finishing this manual, you should understand the key concepts of epidemiology and be able to rap knowledgeably with epidemiologists, if for some reason you ever wanted to.

Each chapter is devoted to one or two concepts and there is a glossary of sorts in the back. You might scan through the glossary to see if we agree on meanings. If we don't, check a text; we're fallible.

Incidentally, you don't have to do any complex statistics to *understand* epidemiology (just adding, subtracting, multiplying, and dividing).

Chapter II

WHAT IS EPIDEMIOLOGY AND WHY

Development

EPIDEMIOLOGY is the study of how and why diseases are distributed in the population the way they are . . . in other words, the study of why some get sick and some don't. Epidemiologists consider epidemiology to be a science. Some also claim it is a philosophy, an art, or a methodology. Actually, epidemiology is just a way of looking at things in a slightly different way . . . because you appreciate what things are important. (Like after you read a book on psychology or anatomy you look at people slightly differently than you did before . . . because you have become aware of ids or egos or where the liver is, etc.) Two things epidemiologists keep in mind when making epidemiological considerations are called "the population at risk" and rates. These are explained later.

Non-historical people might skip this section. A long time ago people made their decisions based on observations and common sense. (Some still do.) For instance, people who noticed that those who ate the yellow snow made faces, like yech!, decided not to eat yellow snow. If people who lived near a river got sick more often than people who didn't, then the observant thinkers moved away from the river. Evidently, being near the river was risky. Epidemiologists today might say "Residing in proximity to the river is a risk factor." But the ancient types didn't say that. They just moved or got sick. Very observant and interested ancients noticed that a lot of other things affected the patterns of illness. Hippocrates discussed many of them in his treatise *On Airs, Waters, and Places*. Modern epidemiologists really turn on reading this, possibly because Hippocrates was so advanced for his time. (This makes a good gift for an epidemiologist if you're trying to make points.) The other possibility is that today's epidemiologists are somewhat backward. Either way they feel a special kinship with Hippocrates.

Throughout the years people have used their observations in a Sherlock Holmes fashion to understand the causes of diseases and stop epidemics. Most of these observations were simple comparisons of people who got sick with people who didn't. As all the more obvious differences got used up it became harder to compare. For instance, what if Hamlet A had 50 deaths last year and Hamlet B had 52 deaths, do you move to Hamlet A? If Hamlet A is only half as big as Hamlet B; then what? Obviously, the *number of residents* in each hamlet who *could* die is important. The slightly different way of looking at things that epidemiology has contributed to the world is the use of rates for comparing events instead of plain numbers. *Big deal* you say? Listen, it took quite a few centuries to realize this and a lot of people smarter than you still don't know about it. The use of rates is the epidemiologists' primary claim to fame and they make it work quite well for them. Of course, they've polished up the concept so that it seems rather sophisticated. Don't be snowed. Recognize it for what it is and use it yourself.

Rates and the population at risk

Epidemiologists have been described as men[1] in search of a denominator. First, what is a denominator? Write down "one-half" (the number, not the word) in the space:______. See the number 2? It's on the bottom. That's a denominator[2]. The number on top, the 1, is the numerator. Okay? A rate has one of each. It is one number divided by another, just like a ratio or a fraction. A rate is special because the bottom number is almost always 1,000 or 10,000 and like that, instead of 729 or 3864. The 1,000 or 10,000 is called the "base." When you say a rate it sounds like "thirty-two per thousand" or 'three hundred and twenty per ten thousand". Rates are used with such bases to make comparisons easier. It's much easier to compare figures like 20/1000 vs 16/1000 than 50/2500 vs 52/3250.

[1]Women's libbers: epidemiologists can just as easily be women. We use men in the generic, not sexual sense. When we mean MEN, we'll say males.

[2]At least one school of epidemiologists define "denominators" as a comparison group. We point this out in case you ever run into one of these people.

Simply, a rate is: $\frac{\text{events}}{\text{Population at risk}} \times$ 1000 (or 10,000 or other "base") = events/1000 (or other "base").

Denominators for rates are made up of people or things called collectively, "the population at risk." Memorize that phrase. It's important. The most intelligent question you can ask an epidemiologist is "What's your population at risk?" It's almost unheard of for an epidemiologist to ignore that question. (Just remember that once you've asked it you've tacitly agreed to play his game and he'll expect something from you in return.)

The numerators of rates are just the number of people or things something happened to in the *population at risk*. Note that last phrase. A lot of people get hung up on this point. Let's get it straight. The denominator (the population at risk) has to be *all* of the people or things that the numerator (the events) *could* have happened to—no more, no less. For instance, if in Hamlet A (50 deaths) the total population was 2500 and in Hamlet B (52 deaths) the total population was 3250, you could compare the rates of death (20/1000 against 16/1000) and decide if you wanted to move or not. See how important rates are? And see how it would mess things up if the numerator for Hamlet B also included thirteen deaths that occurred among people living outside the city limits? It would look like 65/3250 or twenty per thousand. Another mess would occur if the denominator included more people than really belonged there.

How can you tell who should be *in* the population at risk? If you're determining the rate of a disease (or event) for a town or group, then the population at risk is *all* the people *in* the town or group that *could* get the disease (or event). Generally, that's everybody but sometimes it is possible to exclude people you know *couldn't* get the disease (or event). For example, males, 90-year-old women, and little girls are not at risk of becoming pregnant. People wthout cancer are not at risk for surviving from cancer and are excluded from denominators in cancer survival rates. If a poisoned food becomes marketed, only those who eat some of it are at risk of getting ill (for calculating an attack rate) and only those who become ill (when computing a case-fatality rate) are at risk of dying from it.

Some things to remember about rates:

a) the numerator has to have *all* the events that you're measuring