EPIDEMIOLOGY, EVIDENCE-BASED MEDICINE AND PUBLIC HEALTH

Lecture Notes

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6th Edition

WILEY-BLACKWELL

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Contents

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Preface

It was both an honour and a challenge to take on the revision of a ‘classic’ textbook such as *Lecture Notes in Epidemiology and Public Health Medicine* already in its fifth edition (originally written by Richard Farmer and David Miller, the latter author being subsequently replaced by Ross Lawrenson). Much has changed in the field of epidemiology, public health and the scientific world in general since the first edition was published almost 35 years ago. When the current editors sat down to plan this new sixth edition, we felt there was now a need to restructure the book overall rather than updating the existing chapters. In the intervening period, we have seen the rise of new paradigms (conceptual ideas) such as life course and genetic epidemiology and the advance of evidence-based medicine. The latter was first covered in the fifth edition by a single chapter. We felt the need to rebalance the various topics so this new edition has now got three main subsections: Epidemiology, Evidence Based Medicine (EBM) and Public Health. Whilst much of the epidemiology section will appear familiar from the previous edition, we have added a new chapter on genetic epidemiology and there is a whole chapter on causality as this is so fundamental to epidemiological research and remains an issue with conventional observational epidemiology. The new section on EBM is very different with separate chapters on diagnosis, prognosis, effectiveness, systematic reviews and health economics. The Public Health section is less focussed on the National Health Service and we now have a new chapter on global health; a major topic given the challenges of ‘climate change’ and the interrelated globalised world that we all now live in. We have also included a new chapter specifically on the difficult task of evaluating public health

interventions, which presents unique challenges not found with more straightforward clinical trials. Inevitably, we have had to drop some topics but we believe that overall the new chapters better reflect the learning needs of contemporary students in the twenty-first century. We hope we have remained faithful to the original aims of this book and the previous authors would be proud of this latest edition.

In redesigning the structure of the book we have been guided by three underlying principles:

1. To fully utilise our collective experience based on decades of teaching undergraduate medical students (Ben-Shlomo, 2010). We have therefore used, where appropriate relevant materials from the courses we run at the University of Bristol that have been refined over many years. We wish to thank the many students we have encountered who have both challenged, provoked and rewarded us with their scepticism as well as enthusiasm. We fully appreciate that some students are put off by the more statistical aspects of epidemiology (a condition we termed 'numerophobia (Ben-Shlomo *et al.*, 2004)). Other students feel passionately about issues such as global health and/or the marked inequalities in health outcomes seen in both developing and developed countries (see http://www.medsin.org/ for more information around student activities).

2. The need to have a wide range of expertise to stimulate and inspire students. We therefore decided to make this new edition a multi-author book rather than relying on our own expertise.

3. The desire to make our textbook less anglocentric and of interest and relevance to health professionals and students other than those studying medicine. We appreciate that the examples we have taken are predominantly from a developed world perspective but the fundamental principles and concepts are generic and

should form a sound scientific basis for someone wishing to learn about epidemiology, evidence based medicine and public health regardless of their country of origin. It would be wonderful to produce a companion book that specifically uses examples and case studies that are more relevant to developing countries. But that is for the future.

As we work in the United Kingdom, our curriculum is heavily influenced by the recommendations of the UK General Medical Council and the latest version of *Tomorrow's Doctors* (GMC, 2009). We have tried to cover most of the topics raised in sections 10–12 of *Tomorrow's Doctors* though this book will be inadequate on its own for areas such as medical sociology and health psychology, covered in more specialist texts. We appreciate that students are usually driven by the need to pass exams, and the medical curriculum is particularly dense, if you forgive the pun, when it comes to factual material. We have, however, tried to go beyond the simple basics and some of the material we present is somewhat more advanced than that usually presented to undergraduates. This was a deliberate choice as we believe that the inevitable over-simplification or 'dumbing down' can turn some students off this topic. We feel this makes the book not merely an 'exam-passing tool' but rather a useful companion that can be used at a postgraduate level. We believe that students and health-care professionals will rise to intellectual challenges as long as they can see the relevance of the topic and it is presented in an interesting way. We have therefore also included further readings at the end of some chapters for those students who want to learn more about each topic.

We have provided a glossary of terms at the end of the book to help students find the meaning of terms quickly and also highlighted **key terms** in **bold** that may help students revise for exams. Finally we have included some self-

assessment questions and answers at the end of each section that will help the student test themselves and provide some feedback on their comprehension of the knowledge and concepts that are covered in the book. We appreciate that very few medical students will become public health practitioners, though somewhat more will become clinical epidemiologists and/or health service researchers. However the knowledge, skills and '*scepticaemia*' that we hope students gain from this book, will serve them well as future doctors or other health care professionals regardless of their career choice. Improving the health of the population and not just treating disease is the remit of all doctors. As it states in *Tomorrow's Doctors:*

> *Today's undergraduates – tomorrow's doctors – will see huge changes in medical practice. There will be continuing developments in biomedical sciences and clinical practice, new health priorities, rising expectations among patients and the public, and changing societal attitudes. Basic knowledge and skills, while fundamentally important, will not be enough on their own. Medical students must be inspired to learn about medicine in all its aspects so as to serve patients and become the doctors of the future.*

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Part 1

Epidemiology

1

Epidemiology: defining disease and normality

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Learning objectives

In this chapter you will learn:

- what is meant by the term epidemiology;
- the concepts underlying the terms ‘normal, abnormal and disease’ from a (i) sociocultural, (ii) statistical, (iii) prognostic, (iv) clinical perspective;
- how one may define a case in epidemiological studies.

What is epidemiology?

Trying to explain what an epidemiologist does for a living can be complicated. Most people think it has something to do with skin (so you're a dermatologist?) wrongly ascribing the origin of the word to epidermis. In fact the Greek origin is *epidēmia* – ‘prevalence of disease’ (taken from the Oxford online dictionary) – and the more appropriate related term is epidemic. The formal definition is

> *‘The study of the occurrence and distribution of health-related states or events in specified populations, including the study of the determinants influencing such states and the application of this knowledge to control the health*

problems' (taken from the 5th edition of the Dictionary of Epidemiology)

An alternative way to explain this and easier to comprehend is that epidemiology has three aims (3 Ws).

Whether	To describe *whether* the burden of diseases or health-related states (such as smoking rates) are similar across different populations (descriptive epidemiology)
Why	To identify *why* some populations or individuals are at greater risk of disease (risk-factor epidemiology) and hence identify causal factors
What	To measure the need for health services, their use and effects (evidence-based medicine) and public policies (Public Health) that may prevent disease – *what* we can do to improve the health of the population

Population versus clinical epidemiology – what's in a name?

The concept of a population is fundamental to epidemiology and statistical methods (see Chapter 3) and has a special meaning. It may reflect the inhabitants of a geographical area (lay sense of the term) but it usually has a much broader meaning to a collection or unit of individuals who share some characteristic. For example, individuals who work in a specific industry (e.g. nuclear power workers), born in a specific week and year (birth cohort), students studying medicine etc. In fact, the term population can be extended to institutions as well as people; so, for example, we can refer to a population of hospitals, general practices, schools etc.

Populations can either consist of individuals who have been selected irrespective of whether they have the condition which is being studied or specifically because they have the condition of interest. Studies that are designed to try and understand the causes of disease (**aetiology**) are usually population-based as they start off with healthy individuals who are then followed up to see which risk factors predict disease (**population-based**