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The Contribution of Epidemiology to the Study of Drug Uses and Effects

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Abstract

This chapter is an introduction to the contributions of epidemiology to the study of drug uses and effects. Epidemiology is concerned with the distribution of disease and health in human populations. Drugs and vaccines are among the factors that influence such a distribution. Pharmacoepidemiology is defined as the application of the epidemiologic knowledge, methods, and reasoning to the study of the uses and effects (beneficial and adverse) of drugs in human populations. Pharmacoepidemiology aims to describe, explain, control, and predict the uses and effects of drugs and vaccines in a defined time, space, and population. In addition to the traditional role in pharmacovigilance, pharmacoepidemiology supports the drug development process, provides for the assessment of drug effectiveness/efficacy, and contributes to summarize the scientific evidence (meta-analysis of efficacy) in the development, evaluation, and maintenance of practice guidelines. Pharmacoepidemiology supports pharmaceutical outcomes research in health-related quality-of-life outcome evaluations and in establishing outcome probabilities for pharmaco-economic analysis. The actual contribution of epidemiology to the study of drug uses and effects has been only partially assessed. However, because the health of our society benefits from the dynamic cross-fertilization of pharmacology, epidemiology, economics, and clinical medicine, the field of pharmacoepidemiology is full of promise and potential.

Outline

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Medications have become an essential therapeutic tool in the hands of healthcare professionals. With the aging of Western populations and, consequently, a higher prevalence of medical problems, increasingly large numbers of people are exposed to multiple drugs for longer periods of time. Pharmacoepidemiology offers a way of reasoning, a rich set of methods, and a body of substantive knowledge that can both expand the health benefits of drugs and reduce their risks.

Although drug studies historically were the prerogative of biologists, medicinal chemists, pharmacologists, and clinicians, epidemiologic methods also have for many years been applied to the study of vaccines and drugs.^{1,2} Today, a significant number of medical, pharmacy, and public health schools have established programs in pharmacoepidemiology.³ Also, major pharmaceutical firms have launched medical surveillance and research programs based on epidemiologic methods. Thus, the value of epidemiology in drug research and development is gaining widespread recognition.

The purpose of this chapter is to provide the reader with an introduction to the potential contributions of pharmacoepidemiology to the study of drug uses and effects, as well as to indicate the common grounds that pharmacoepidemiology shares with other health disciplines. In fact, because the relationship between epidemiology and pharmacology is synergistic, as illustrated in this chapter, the study of drugs with epidemiologic methods furthers our understanding of the etiology of human illness. According to this view, pharmacoepidemiology becomes not only a subspecialty in epidemiology but also, in some respects, an extension of epidemiology.

Definition and Aims

Pharmacoepidemiology can be defined as the application of epidemiologic reasoning, methods, and knowledge to the study of the uses and effects (beneficial and adverse) of drugs in human populations. It aims to describe, explain, control, and predict the uses and effects of pharmacologic treatments in a defined time, space, and population. Its core lies at the intersection of two subspecialties: clinical pharmacology and clinical epidemiology.¹⁻³

Outlining questions that pharmacoepidemiology attempts to answer or that it poses to other disciplines can help define the interests and boundaries of this fledgling field. Thus, examples of the problems addressed within the realm of pharmacoepidemiology include the following:

1. Are there differences in the number of people with hypertension diagnosed and treated among different populations in a given geographic area? What is the impact on cardiocerebrovascular morbidity of such differences? How much of the past years' decline in coronary

heart disease can be accounted for by the effects of cardiovascular drugs? What are the most common uses of beta-blockers? Why is it that some of those uses do not agree with the academic recommendations? Will the treatment of hypertension be influenced by changes in the healthcare system in the next 10 years?

2. What is the effectiveness of psychotropic drugs in defined populations? Does the effectiveness of psychotropic drugs depend on age, gender, and sociocultural level? What changes can we predict in the prevalence of mental illness based on current drug consumption trends? How can new therapeutic developments improve the long-term outcome of psychiatric patients? Is therapeutic information a determinant of the quality of psychotropic drug prescriptions? What can we learn about our culture from the way mental illness is treated?
3. In the evaluation of practice guidelines, what is the effectiveness rate under general medical conditions or practice for the different antimicrobials indicated for the treatment of uncomplicated urinary tract infection? What is the effectiveness rate of conventional versus short-term treatment lengths? What is the cost of a treatment episode including physician visit, laboratory costs, and drug costs? Based on this information, what is the cost-effectiveness ratio for each of the antimicrobials under general medical practice conditions?

While these clusters of questions relate to antihypertensive, psychotropic, and antimicrobial drugs, similar questions can be developed for other therapeutic categories. Pharmacoepidemiology provides the key to answering many questions that arise in the process of drug development, prescribing, and use. More examples are presented in Table 1 to illustrate the scope of the discipline and common research questions that pharmacoepidemiology shares with other professions and disciplines, such as medicine, pharmacy, health economics, the social sciences, and the laboratory sciences.

Beyond specialty labels, one crucial set of questions expands throughout this book: How can different professional and scientific traditions, cultures, routines, reasonings, methodologies, techniques, and substantive bits of knowledge be *integrated* with each other so that we can increase our clinical and community impact, intervene more effectively upon risk groups and individuals, and implement preventive and therapeutic strategies at both the population and individual levels?⁴⁻¹⁶ With respect to the integration of genetics, pharmacology, and epidemiology, examples are provided in Chapter 7.

Three fundamental questions flow from the previous discussion: Can epidemiology help to improve the development and use of drugs? Can pharmacology help to expand our knowledge of the causes of illness? Is the health status of individuals and communities going to benefit from the

Table 1
Examples of Questions
Addressed by
Pharmacoepidemiology

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- How can we accelerate the process of discovery of new, clinically relevant, intended, and unintended drug effects?
- What factors in the physician–patient encounter influence treatment compliance and continuity of care?
- How clinically relevant is it to compare the effectiveness of an angiotensin-converting enzyme inhibitor with methyldopa for the treatment of mild hypertension?
- What is the most appropriate control group for a hospital-based case-control study of drug-related congenital malformations?
- How should the validation of large clinical databases be approached?
- What factors should guide the decision to conduct formal postmarketing epidemiologic studies?
- What is a good design for studying the factors that influence clinical decision-making, including prescribing?
- What is the relative effectiveness of nonsteroidal antiinflammatory drugs, acetaminophen, weight reduction, and exercise in osteoarthritis?
- What is the cost–effectiveness of hepatitis B vaccine, oral hypoglycemic agents, cerebrovascular vasodilators, hypolipidemic agents, estrogens, or cephalosporins for selected indications?
- What can be done by the pharmaceutical industry, government, and third-party payers to alleviate the burden of disease in older populations?
- In what type of clinical trials is it desirable to incorporate economic analysis?
- How does cancer chemotherapy interact with the natural course of the disease?
- What can be done to prevent the development of resistance to antibiotics in the general population?
- What algorithms are most useful to validate unintended drug effect reports?
- Is end-stage renal disease caused by regular analgesic use?
- Can we use a composite measure of health status in epidemiologic studies to evaluate patient outcomes?
- Can we learn something about the prognostic factors for juvenile arthritis from the way it is treated by primary care physicians?
- What psychological factors and sociocultural values influence risk perception?
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