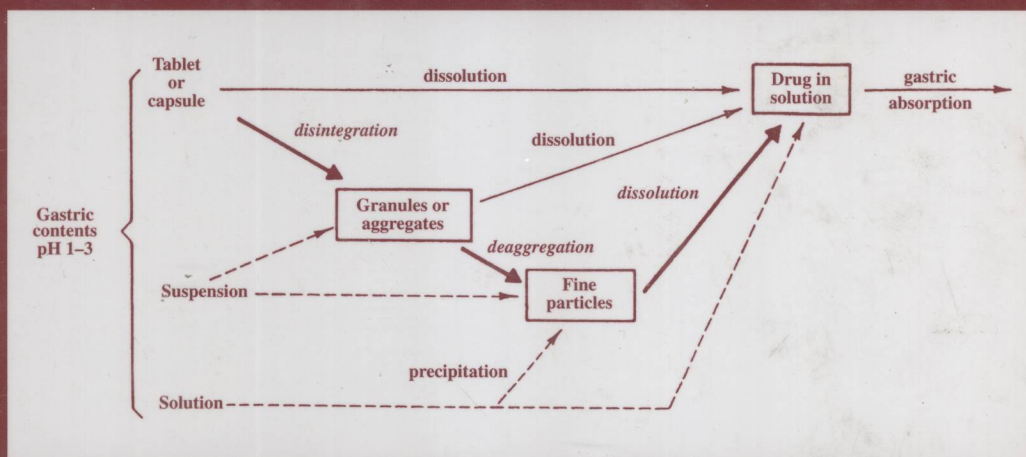


Modern Pharmaceutics

Fourth Edition, Revised and Expanded



edited by
Gilbert S. Banker
Christopher T. Rhodes

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Modern Pharmaceuticals

DRUGS AND THE PHARMACEUTICAL SCIENCES

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Preface

The first edition of *Modern Pharmaceutics* was published in 1980, the second in 1989, and the third in 1995. During the more than 20 years since we developed the concept of this text we have been privileged to work with many of the most notable pharmaceutical scientists as chapter authors. Some of our original first edition team are still with us. Others, for a variety of reasons—including change of career focus, retirement, and death—are no longer with us or able to cooperate in this endeavor. We place on record our gratitude to all our colleagues who have so unselfishly assisted us in any or all of our four editions.

We are also grateful to all those readers of our book who have provided comments on their perceptions of the value of *Modern Pharmaceutics* and suggested to us ways in which the book might be improved. We have most carefully considered all such ideas and some of the changes that we have implemented in this edition derive from advice given to us by industrial pharmaceutical scientists, university faculty, and students.

The fourth edition of *Modern Pharmaceutics* follows the same format and has the same goals as previous editions. Chapter 1 sets the stage by reviewing the role of drugs and drug products in treating and preventing disease, while also summarizing their primary quality features. Chapters 2 through 6 provide background that is fundamental to an understanding of drug action and the design of drug products. Chapter 7, on preformulation, is another fundamentals chapter, describing the manner in which drugs are characterized for their physical, chemical, and pharmacokinetic properties to provide a rational and scientific basis for drug product design.

Chapters 8 through 16 describe drug products and dosage forms, together with the routes of administration by which they are given. Chapters 17 through 28 also treat topics critical to drug product quality such as packaging, optimization, and food and drug laws, in addition to examining more specialized product classes and introducing several new chapters. As in previous editions, this book once again ends with a view to the future.

In the planning of this edition, we identified certain areas of recent growth that seemed to merit increased attention in this text, while attempting to further recognize pharmacy's international character. Also, we gave attention to topics that are of relatively more importance than previously. Overall the book has grown in size because there are a number of critical areas that justify significant additional coverage. We have been fortunate in obtaining the services of a number of distinguished individuals to cover topics not allocated whole chapters in previous editions.

The growing importance of botanicals and other natural products has been recognized by devoting one of our new chapters to this topic. Also, we have a new chapter on managed care since this is an area of great importance and impacts all facets of pharmacy. Further, we expect this topic to gain additional recognition in parts of the world where at present the implications of this discipline are not fully recognized. Also, appreciating the growing importance of generic products, especially in North America and the European Union, we have included in this edition

a chapter focused on bioequivalence. Finally, recognizing the impact of the information revolution, catalyzed by computers and the Internet, we have included a new chapter on drug information.

With one exception, all the chapters from the third edition of *Modern Pharmaceutics* that appear in the fourth edition have been revised and updated. Many chapters were extensively updated, and some, such as the first and last chapters, were extensively rewritten. Due to the illness of Dr. Robinson, the chapter on sustained and controlled release drug delivery systems was updated with the assistance of Gil Banker, with Dr. Robinson's approval.

Although *Modern Pharmaceutics* continues to evolve, our basic goals remain those which we developed in the 1970s when we first delineated the concept of this comprehensive and integrated treatment of pharmaceutics, with a focus on drug product quality and performance. We are committed to producing an up-to-date, authoritative, multiauthored treatise on pharmaceutics, which can be used by both students and practitioners.

Gilbert S. Banker
Christopher T. Rhodes

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Chapter 1

Drug Products: Their Role in the Treatment of Disease, Their Quality, and Their Status and Future as Drug-Delivery Systems

Gilbert S. Banker

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I. ROLE OF DRUGS AND DRUG PRODUCTS IN THE TREATMENT AND PREVENTION OF DISEASE

The methods of treating illness and disease as we enter the twenty-first century include the use of the following forms of therapy: (a) surgery, including organ transplantation; (b) psychotherapy; (c) physical therapy; (d) radiation, and (e) chemo or pharmacotherapy. Of these various methods, pharmacotherapy (treatment with drugs) is the most frequently used technique for treating disease, has the broadest range of application over the greatest variety of disease states, and is usually the most cost-effective and preferred treatment method. Although surgery is the preferred method of treating some ailments or disease states, when alternative methods are available, these methods (usually pharmacotherapy) will be employed first if feasible, in the initial attempt to secure satisfactory relief or control of the condition or a complete cure. As pharmacotherapy continues to improve, it is replacing other forms of treatment as the preferred method of therapy. Pharmacotherapy is, for example, increasingly becoming the treatment of choice in treating various forms of cancer, including breast cancer, replacing the use of radical surgery. Pharmacotherapy is now an effective option to surgery in the treatment of some forms of prostate disease. When cure rates or reliability of disease control by pharmacotherapy can match surgical treatment

(e.g., prostate surgery or radical mastectomy), most patients will strongly prefer the chemotherapeutic approach or the use of chemotherapy combined with less radical surgical approaches.

In some surgical procedures, such as organ transplantation, the success of that procedure will be only as great as the course of pharmacotherapy that follows. Organ transplant recipients are required to continue drug therapy for the balance of their lives for control of their immune systems and to prevent organ rejection.

Pharmacotherapy is also very important in the prevention of disease, since vaccines and other immunizing agents are drug products. The impact of vaccines in eliminating or reducing the incidence of six diseases is shown in Fig. 1. Some diseases that previously killed or crippled tens of millions of people worldwide, often reaching epidemic proportions, are now virtually unknown in most of the world. Table 1 shows the average number of deaths in the United States per million people as a result of various diseases in a nonepidemic situation over the last century. The table lists diseases that have been obliterated or nearly obliterated in the United States through drug immunology as shown in Fig. 1, together with diseases that have now been brought largely under control or greatly reduced by the discovery and effective use of anti-infective drugs than can combat bacterial infections. Examples of diseases in this latter category are