

Nanotechnology-Based Approaches for Targeting and Delivery of Drugs and Genes

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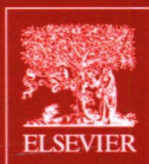
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Nanotechnology-Based Approaches for Targeting and Delivery of Drugs and Genes provides an overview of the important aspects of nanomedicine in order to illustrate how to design and develop novel and effective drug delivery systems using nanotechnology. Organized into three sections, this book begins with an introduction to nanomedicine and its associated issues. Section two discusses the latest technologies in nanomedicine, while the third section covers future developments and challenges in the field.

By focusing on the design, synthesis, and application of a variety of nanocarriers in drug and gene delivery, *Nanotechnology-Based Approaches for Targeting and Delivery of Drugs and Genes* provides pharmaceutical and materials science students, professors, clinical researchers, and industry scientists with a valuable resource aimed at tackling the challenges of delivering drugs and genes in a more targeted manner.

Key Features

- Explores a wide range of promising approaches for the diagnosis and treatment of diseases using the latest advances in cutting-edge nanomedical technologies
- Contains contributions from world-renowned experts and researchers working in the area of nanomedicine and drug delivery
- Covers the associated challenges and potential solutions to working with nanotechnology in drug delivery
- Highlights crucial topics, such as biopharmaceutical and toxicity issues, quality by design, and drug targeting



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NANOTECHNOLOGY- BASED APPROACHES FOR TARGETING AND DELIVERY OF DRUGS AND GENES

DEDICATION

I dedicate this work to the sacrifices and love of my wife Dr. Yachana Mishra and my adorable children Vidhi and Jay; to the love of my parents; and to the encouragement and confidence bestowed on me by my mentor Professor N.K. Jain, who has always helped me in my quest for learning.

Vijay Mishra

I would like to dedicate this book to my parents, my sister Dr. Poonam, and my brother Er. Pankaj who always encouraged me throughout the journey. I also dedicate this book to the love and sacrifices of my wife Garima, my sweet daughter Yashsavi, and finally my mentor Professor N.K. Jain for believing in me and always being there for me.

Prashant Kesharwani

This book is purely dedicated to my wife Maheran Mossadeq and my children Qothrunnadaa, Muhammad Fakhrurrazi, Saffiyyah Khadijah, and Muhammad Fakhrullah. May this book inspire our family for a successful life in the future and in the hereafter. I thank to Allah for His mercy and providing me with continuous well-being, energy, and dynamism in completing this book. May Allah accept this as one of my contributions to the scientific community.

Mohd C.I. Mohd Amin

This book is dedicated to my parents Mr. and Mrs. R.K. Iyer, my wife Thivya, and my adorable son, Athindra; their selflessness and love will always be remembered.

Arun Iyer

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Arun Iyer Dr. Iyer is an Assistant Professor of Pharmaceutical Sciences and Director of Use-inspired Biomaterials and Integrated Nano Delivery (U-BiND) Systems Laboratory at Wayne State University in Detroit, Michigan, United States. He also serves as a Scientific Member of the Molecular Therapeutics (MT) Program at the Barbara Ann Karmanos Cancer Institute in Detroit, Michigan, United States. Dr. Iyer received his PhD in 2008, in Polymer Engineering, under the mentorship of world-renowned scientist, Professor Hiroshi Maeda at Sojo University in Kumamoto, Japan. He was the recipient of the Controlled Release Society's (CRS) T. Nagai Research Achievement Award in 2012. Dr. Iyer completed his postdoctoral training in Cancer Radiology at the University of California, San Francisco (UCSF) in California, United States, and trained as an Associate Research Scientist and Research Assistant Professor in Pharmaceutical Sciences at Northeastern University in Boston, Massachusetts, United States. Dr. Iyer has authored more than 70 publications in peer-reviewed international journals and books of high repute. He has more than 100 scientific presentations and invited talks at International Conferences and Workshops. He has five patents issued/pending. His areas of research are broadly focused on designing use-inspired bio- and nanomedical technologies aimed toward clinical translation using biocompatible delivery systems that have enhanced disease targeting with reduced toxicity burden to patients. He has wide expertise in biomaterials and nanomedicine, polymer chemistry and formulation development, drug and gene delivery systems, molecular and functional imaging, and micro- and nanoparticles for treating diseases such as infection, inflammation, and cancer. His laboratory is funded by agencies such as the National Institutes of Health (NIH), Wayne State University, and other private and nonprofit organizations.

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PREFACE

Nanotechnology literally means any technology on a nanoscale that has applications in the real world. Extrapolating from known physical laws, Nobel Laureate Richard P. Feynman envisioned a technology using the ultimate toolbox of nature, building nanoobjects atom by atom or molecule by molecule. The use of nanoscale technologies to design novel drug delivery systems and devices is a rapidly developing area of biomedical research that promises breakthrough advances in therapeutics and diagnostics. Over the last few years, numerous breakthroughs in nanotechnology have made great impacts on different fields of scientific research. Out of these many breakthroughs, some have proved to be very promising for the diagnosis and treatment of diseases. It is widely felt that nanotechnology will be the next Industrial Revolution. However, there is a clear need for innovative technologies to improve the targeting and delivery of therapeutics as well as diagnostic agents in the body. Recent advancements in nanomedicine are now making it possible to deliver drugs, genes, and therapeutic agents to local areas of disease to maximize clinical benefit while limiting unwanted side effects.

There is an increasing need for a multidisciplinary, system-oriented approach to the manufacturing of nanodevices, which function reliably. This can only be achieved through the cross-fertilization of ideas from different disciplines and the systematic flow of information among different research groups. This book provides an overview of different aspects of nanomedicine, which help the readers to design and develop novel drug delivery systems and devices that take advantage of recent advances in nanomedical technologies. The organization of the book is straightforward. The book is divided into three major parts: SECTION I: Introduction and Issues in Nanomedicine; SECTION II: Current Technologies in Nanomedicine; and SECTION III: Future Developments and Challenges in Nanomedicine.

Focusing on the design, synthesis, and application of different nanocarriers in drug and gene delivery, this book will be a valuable resource for graduates, pharmaceutical scientists, clinical researchers, and anyone working to tackle the challenges of delivering drugs and genes in a more targeted and efficient manner. In totality, this book will prove to be one of the most comprehensive books available that combines both the fundamental pharmaceutical principles of nanocarriers along with the most important applications of nanotechnology in targeting and drug delivery. Featuring contributions

from field experts and researchers in industry and academia *Nanotechnology-Based Approaches for Targeting and Delivery of Drugs and Genes* provides state-of-the-art information on nanocarriers and their use in targeting, as well as drug and gene delivery.

We hope this book will stimulate further interest in the drug delivery field, and that the readers of this book will find it useful.

**Vijay Mishra, Prashant Kesharwani, Mohd C.I. Mohd Amin, and
Arun K. Iyer**