# Pharmacokinetics and pharmacogenetics – principles, applications, and challenges

## Farmakokinetika i farmakogenetika – principi, primene i izazovi

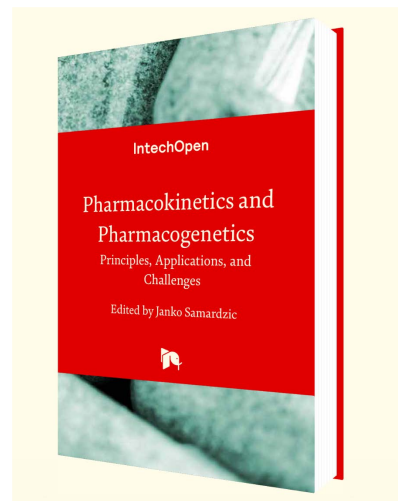The book *Pharmacokinetics and Pharmacogenetics – Principles, Applications, and Challenges*, edited by Prof. Janko Samardžić, brings together contributions from distinguished scientists whose expertise encompasses the molecular, preclinical, and clinical aspects of drug research. It is intended for academic researchers, pharmacologists, geneticists, clinicians, and professionals engaged in drug development and precision medicine. The volume will be particularly valuable to readers seeking an integrated understanding of pharmacokinetics and pharmacogenetics, as well as to those interested in translational applications, including central nervous system drug delivery, ocular pharmacokinetics, analytical method development, and population-level pharmacogenomics.

The central aim of the book is to illustrate how pharmacokinetics and pharmacogenetics intersect to advance precision pharmacotherapy. The six chapters, each reviewed by experts in the field, present up-to-date research and review data in pharmacokinetics and pharmacogenetics – two of the most dynamic and rapidly evolving disciplines within contemporary pharmaceutical and biomedical sciences. Each contributing author provides insights grounded in rigorous scientific investigation, ensuring that the content is both methodologically sound and directly relevant to current challenges in therapeutic development. The scientific content demonstrates a strong methodological foundation, drawing on molecular, preclinical, and clinical research, as well as advanced analytical and computational approaches. Several chapters address ongoing scientific and clinical challenges, including optimization of central nervous system drug delivery, overcoming ocular barriers, and managing interindividual variability in antipsychotic response driven by genetic polymorphisms. The integration of artificial intelligence, machine learning, and multi-omics approaches further underscores the book's alignment with emerging technological and clinical trends shaping modern precision therapeutics.

The opening chapter, "Integrating Pharmacokinetics and Pharmacogenetics in the Era of Personalized Medicine," outlines the fundamental principles of pharmacokinetics and pharmacogenetics, emphasizing how their integration supports more precise dosing strategies, optimization of clinical trial design, and the development of safer and more effective therapeutics. The chapter also underscores the expanding role of artificial intelligence, machine learning, and pharmacogenetic databases in predicting individual drug responses. Building on this conceptual foundation, Chapter 2, "Pharmacokinetic Considerations for Drugs Targeting the Central Nervous System (CNS)," addresses one of the most complex and clinically relevant domains of pharmacokinetics. It examines the intricate interplay between drug physico-

chemical properties, the blood–brain barrier, and CNS pharmacodynamics. The chapter provides a structured overview of how factors such as lipid solubility, protein binding, active transport mechanisms, and pathological alterations in the blood–brain barrier permeability influence CNS drug disposition. The chapter also discusses emerging strategies to overcome these barriers, including nanocarrier-based delivery systems. Chapter 3, "Ocular Pharmacokinetic Studies: Challenges and Best Practices," focuses on another organ system in which distinct anatomical and physiological characteristics significantly affect drug disposition. The chapter highlights the limitations of extrapolating systemic pharmacokinetic data to ocular exposure and offers a comprehensive discussion of experimental and computational methodologies. It outlines best practices in study design, sample collection, and pharmacokinetic modeling, emphasizing the translational importance of understanding intraocular drug kinetics. Chapter 4, "Development and Validation of an HPLC–PDA Method for Quantitative Bioanalysis of Curcuminoids and Its Application to Preclinical Pharmacokinetics," addresses the analytical dimension of pharmacokinetic research. It describes the development and validation of a robust high-performance liquid chromatography–photodiode array (HPLC–PDA) method for the simultaneous quantification of curcuminoids, bioactive compounds with considerable therapeutic potential but limited bioavailability. Chapter 5, "Comprehensive Pharmacogenetic Allele Landscape from Whole Exome Sequencing: Single-Center Cohort Analysis in the Population of North Macedonia," extends the focus from molecular analysis to population-level pharmacogenetics. Utilizing whole exome sequencing data, this chapter presents a comprehensive pharmacogenetic landscape of the population, identifying both common and novel variants with po-

tential clinical relevance. The final chapter, "The State of the Art: Pharmacogenomics, Multi-Omics, and Translational Barriers in Antipsychotic Therapy," rounds the discussion off by applying pharmacogenetics concepts to one of the most challenging areas of clinical pharmacology – neuropsychopharmacology. It synthesizes current knowledge on key metabolic enzymes, receptor polymorphisms, and emerging multi-omics data that collectively influence therapeutic response and clinical outcomes.

Together, the chapters in this volume demonstrate that the integration of pharmacokinetics and pharmacogenetics is not merely a theoretical concept but a necessary progression toward precision pharmacotherapy. The multidisciplinary perspective further promotes collaboration across pharmacology, genetics, and clinical sciences. Certain limitations should also be noted, such as the specialized nature of some chapters focusing on ocular pharmacokinetic methods or HPLC–PDA analytical techniques, which may reduce accessibility to readers without a strong technical background. However, given the book's target audience, primarily researchers and specialists, this limitation is understandable and does not diminish the overall value. In summary, *Pharmacokinetics and Pharmacogenetics – Principles, Applications, and Challenges* offers a cohesive, informative, and methodologically rigorous examination of two foundational disciplines driving the advancement of personalized medicine.

The book is available both in print and as a freely accessible online edition on the following link: https://www.intechopen.com/books/1004701

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