

Precision Medicine (MMD-996)

Credit Hours 3 (3-0)

Course Description

Improvements in modern medicine have come from a precision medicine approach. Precision medicine involves the use of biomarkers, genetic information and state-of-the-art technology to ensure that the patient receives the right diagnosis and receives the right medicine at the right dose for the right duration. This course will provide an overview of contemporary issues in medicine and pharmacology. This course aims to expand on concepts developed in Essential Understanding of Disease and Treatment.

Educational Objective

This course will introduce to develop

- The students' concepts in modern pharmacology, including basic pharmacokinetic concepts and drug-drug interactions, precision medicine and modern drug development.
- They will develop an understanding of the unique pharmacological factors impacting different population groups and disease outcomes and how this can be exploited in precision medicine for both disease treatment and prevention.

Course Outcomes

- After taking the course, the students will be able to have knowledge of contemporary concepts in pharmacology and how it may be exploited in precision medicine.
- They will be able to describe the multidisciplinary nature of the development and application of new tools in precision medicine.
- Introduction to modern technologies that have changed diagnosis, treatment, disease prevention and patient outcomes will help the students in understanding basic determinants of individual response to medicines and develop an understanding of how genetics alters therapeutic response to medicines.

Course Contents

1. Introduction to precision medicine
 - What is precision medicine
 - Brief review of fundamentals of genetics (DNA structure; RNA; protein structures; function of DNA; coding; DNA variations; types of genetic variants)
 - Brief review of statistical concepts and skills important to clinical data analysis (odds ratios, relative risk, P values, multiple testing, sensitivity, specificity, ROCs).
2. Studying genetic variation
 - Population genetics
 - Inheritance patterns, ancestry, and linkage
 - Evaluation of Biomarker Tests and Issues and Challenges
 - Analyzing the Effects of Genetic Variation in Noncoding Genomic Regions
 - Contemporary techniques and technologies used to study genetic variation, including genome-wide association and Sequencing in Precision Medicine
 - Analytical Methods to Identify Genetic Variations and Bioinformatics
3. Drug actions and reactions
 - General mechanisms underlying variability in drug responses
 - Drug metabolism and transport
 - Genetic variability in drug-handling molecules
 - Nongenetic Influences on Drug Metabolism
4. Principles of Pharmacogenomics
 - Pharmacokinetic, Pharmacodynamic, and Clinical Implications
 - Incorporating Pharmacogenomics in Drug Development: Industry and Regulatory Perspectives
 - Translating Pharmacogenomic Research to Therapeutic Potentials
 - Pharmacogenomics in Cancer Therapeutics, Cardiovascular Diseases, Psychiatry Disorders, Viral Infection, Autoimmune diseases
 - The Importance of Ethnicity Definitions and Pharmacogenomics in Ethnobridging and Pharmacovigilance
5. Case studies in personalized medicine

- Discuss specific cases as these apply to personalized medicine.
 - Case of familial hypercholesterolemia (how to use genomic medicine to move from a rare disease to a common medication, using genomics to find new drug targets, and a discussion of the side effects of statin therapy)
 - Cases that illustrate how personalized medicine informs treatment decisions related to specific diseases/conditions. (include cystic fibrosis, Marfan syndrome, heart failure, neuropsychiatric diseases, and diabetes.
 - How genomic medicine informs testing and treatment of cancer.
6. Personalized medicine in healthcare system
- What's on the horizon in personalized medicine.
 - Implementation of personalized using informatics. (Role of the electronic medical record in a learning healthcare system, how electronic records support discovery, and using electronic records in the delivery of personalized medicine.)
 - Biobanks as Basis of Individualized Medicine Challenges Toward Harmonization
7. Ethical Aspects of Precision Medicine
- An Introduction to the Ethics and Concept of Clinical Innovation
 - Regulatory Considerations in Pharmacogenomics
 - Ethical, Legal, and Social Issues Associated with Pharmacogenomics

Recommended Books

1. Kashuba, A., Ma, J. D., DeVane, C. L., & Fuhr, U. (2012). *Pharmacogenomics An Introduction and Clinical Perspective*. McGraw Hill Professional.
2. Daigner, H. P., & Kohl, M. (Eds.). (2018). *Precision medicine: tools and quantitative approaches*. Academic Press.
3. Ginsburg, G. S., Willard, H. F., & David, S. P. (Eds.). (2017). *Genomic and precision medicine: primary care*. Academic Press.
4. Aydogan, B., & Radosevich, J. A. (Eds.). (2020). *Precision Medicine in Oncology*.