Macao Polytechnic Institute

School of Health Sciences and Sports

Bachelor of Science in Biomedical Technology

(Pharmacy Technology)

Module Outline

Academic Year 2020 / 2021 Semester 2

Learning Module	Pharmacokinetics			**Class Code**	BSPK3102
Pre-requisite(s)	Nil				
Medium of Instruction	Chinese / English			**Credit**	2
Lecture Hours	30 hrs	**Lab/Practice Hours**	0 hrs	**Total Hours**	30 hrs
Instructor	Tao Yi, Aaron		**E-mail**	yitao@ipm.edu.mo	
Office	Room M707, 7/F, Meng Tak Building, Main Campus		**Telephone**	8599-3471 (Aaron)	

Description

This is a 30-hour learning module that introduces students to the basic theories and clinical application of pharmacokinetics. Students will also learn how to develop monitoring plans for certain drugs and individualize drug dosage regimens based on patients' clinical conditions.

Learning Outcomes

After completing the learning module, students will be able to:

1. Describe basic concepts of pharmacokinetics.
2. Define and explain various pharmacokinetic parameters and models.
3. Describe the processes of absorption, distribution, metabolism and excretion and apply the knowledge in clinical settings.
4. Solve clinical pharmacokinetic problems for some specific drugs.

Content

1. Introduction to pharmacokinetics
   - 1.1 Introduction and terminology
   - 1.2 The ADME processes
   - 1.3 Pharmacokinetic modeling
   - 1.4 The rate processes

   (UNDERSTAND: describe the basic concepts of pharmacokinetics, define and explain various pharmacokinetic parameters and models.)

2. Intravenous bolus administration
   - 2.1 Equations of drug elimination following IV bolus dose
   - 2.2 Apparent volume of distribution
   - 2.3 Elimination half life
   - 2.4 Elimination rate constant
   - 2.5 Monitoring drugs in urine

   (MASTER: describe the basic concepts, calculate various pharmacokinetic parameters.)

3. Drug elimination and clearance
   - 3.1 Introduction to clearance and kidneys
   - 3.2 Estimation of clearance by various models
   - 3.3 Renal clearance
   - 3.4 Hepatic clearance

   (MASTER: describe the basic concepts, calculate various pharmacokinetic parameters.)

4. Intravenous infusion
   - 4.1 Introduction to intravenous infusion
   - 4.2 IV infusion of one-compartment model drugs
   - 4.3 Steady-state drug concentration and time needed to reach Css
   - 4.4 Infusion method for calculating elimination half-life
   - 4.5 Loading dose plus IV infusion

   (MASTER: describe the basic concepts, calculate various pharmacokinetic parameters.)

5. Midterm exam

6. Oral administration
   - 6.1 Pharmacokinetics of drug absorption
   - 6.2 Zero- and first-order absorption models
   - 6.3 Bioavailability and bioequivalence

   (MASTER: describe the basic concepts, calculate various pharmacokinetic parameters.)

7. Multiple dosage regimens
   7.1 Introduction and principle of superposition
   7.2 Repetitive IV injections
   7.3 Intermittent IV infusion
   7.4 Multiple oral dosing

   (MASTER: describe the basic concepts and solve clinical pharmacokinetic problems for multiple dosage regimens.)

8. Non-linear pharmacokinetics
   8.1 Linear vs non-linear pharmacokinetics
   8.2 Characteristics of drugs following nonlinear kinetics
   8.3 Michaelis-Menten kinetics
   8.4 Determination of Michaelis-Menten parameters: K_M and V_{max}

   (MASTER: describe the basic concepts, calculate various pharmacokinetic parameters.)

9. Clinical applications of pharmacokinetics: Aminoglycoside antibiotics
   9.1 Introduction to aminoglycosides
   9.2 Key pharmacokinetic parameters
   9.3 Pharmacodynamics
   9.4 Extended interval dosing
   9.5 Traditional dosing

   (MASTER: Solve clinical pharmacokinetic problems for some specific drugs.)

10. Final

Date	Time	Content
21/01/2021	09:00-11:00	1. Introduction to pharmacokinetics 1.1 Introduction and terminology 1.2 The ADME processes 1.3 Pharmacokinetic modeling 1.4 The rate processes
28/01/2021	09:00-11:00	2. Intravenous bolus administration 2.1 Equations of drug elimination following IV bolus dose 2.2 Apparent volume of distribution 2.3 Elimination half life 2.4 Elimination rate constant 2.5 Monitoring drugs in urine

04/02/2021	09:00-11:00	3.	Drug elimination and clearance
			3.1 Introduction to clearance and kidneys
			3.2 Estimation of clearance by various models
25/02/2021	09:00-11:00		3.3 Renal clearance
			3.4 Hepatic clearance
04/03/2021	09:00-11:00	4.	Intravenous infusion
			4.1 Introduction to intravenous infusion
			4.2 IV infusion of one-compartment model drugs
			4.3 Steady-state drug concentration and time needed to reach Css
			4.4 Infusion method for calculating elimination half-life
			4.5 Loading dose plus IV infusion
11/03/2021	09:00-11:00		Active learning and Group discussions (I)
18/03/2021	**09:00-11:00**		**Midterm exam**
25/03/2021	09:00-11:00	5.	Oral administration
			5.1 Pharmacokinetics of drug absorption
			5.2 Zero- and first-order absorption models
			5.3 Bioavailability and bioequivalence
01/04/2021	09:00-11:00	6.	Multiple dosage regimens
			6.1 Introduction and principle of superposition
			6.2 Repetitive IV injections
08/04/2021	09:00-11:00		6.3 Intermittent IV infusion
			6.4 Multiple oral dosing
		7.	Non-linear pharmacokinetics
			7.1 Linear vs non-linear pharmacokinetics
			7.2 Characteristics of drugs following nonlinear kinetics
			7.3 Michaelis-Menten kinetics

15/04/2021	09:00-11:00	7.4 Determination of Michaelis-Menten parameters: K_M and V_{max}
22/04/2021	09:00-11:00	8. Clinical applications of pharmacokinetics: Aminoglycoside antibiotics
		8.1 Introduction to aminoglycosides
		8.2 Key pharmacokinetic parameters
29/04/2021	09:00-11:00	8.3 Pharmacodynamics
		8.4 Extended interval dosing
		Traditional dosing
06/05/2021	09:00-11:00	Active learning and Group discussions (II)
18/05/2021	**11:00-13:00**	**Final examination**

Teaching Method

Lectures, case studies, active learning, presentations, and class discussion. Approximately 10% of the course contents will be taught using active learning instructional strategies.

Attendance

Attendance requirements are governed by the "Academic Regulations Governing Bachelor's Degree Programmes of Macao Polytechnic Institute". Students are not eligible to attend the final examination and re-sit examination, moreover, an "F" will be given as the final grade to students who have less than the stated attendance for the enrolled module.

Assessment

This learning module is graded on a 100 point scale, with 100 being the highest possible score and 50 being the passing score. Any students scoring less than 35% of the total mark in the final examination will be given an "F"grade for the learning module even if the overall grade is 50% or higher.

	Item	Description	Percentage
1.	In Class oral Tests	Question answering competitions	7%
2.	Group discussions	Active learning and case studies	8%
3.	Midterm exam		40%
4.	Final exam		45%
		Total Percentage:	100%

Teaching Material(s)

Textbook(s)

1. Winter ME. 2018. *Winter's Basic clinical pharmacokinetics*. 6th ed. Philadelphia: Wolters Kluwer Health.

Reference

Reference book(s)

1. Shargel L, Yu A, Wu-Pong S. 2016. *Applied biopharmaceutics & pharmacokinetics*. 7th ed. New York: McGraw-Hill Medical.
2. Jambhekar SS, Breen PJ. 2012. *Basic pharmacokinetics*. 2nd ed. London: Pharmaceutical Press.