PHARMACIST

EVALUATING EXAMINATION

SYLLABUS

The Pharmacy Examining Board of Canada

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# Table of Contents

## INTRODUCTION

INTRODUCTION .................................................................................................................. 3

## BIOMEDICAL SCIENCES

BIOMEDICAL SCIENCES .................................................................................................. 4

- BIOCHEMISTRY ........................................................................................................... 5
- MOLECULAR BIOLOGY AND GENOMICS ..................................................................... 6
- PHYSIOLOGY/ FUNCTIONAL ANATOMY ......................................................................... 7
- IMMUNOLOGY ............................................................................................................... 12
- MEDICAL MICROBIOLOGY .......................................................................................... 13

## PHARMACEUTICAL SCIENCES

PHARMACEUTICAL SCIENCES ......................................................................................... 16

- PHARMACEUTICS AND DRUG DELIVERY SYSTEMS .................................................. 17
- PHARMACOKINETICS & BIOPHARMACEUTICS ......................................................... 23
- MEDICINAL CHEMISTRY ............................................................................................... 26
- PHARMACOLOGY .......................................................................................................... 28
- TOXICOLOGY AND CLINICAL TOXICOLOGY .............................................................. 33
- BIOTECHNOLOGY AND PHARMACOGENETICS .......................................................... 35

## PHARMACY PRACTICE – CLINICAL SCIENCES

PHARMACY PRACTICE – CLINICAL SCIENCES ............................................................... 40

- PATHOPHYSIOLOGY ...................................................................................................... 41
- CLINICAL BIOCHEMISTRY / LABORATORY AND DIAGNOSTIC TESTING .................. 45
- PHARMACOTHERAPEUTICS ............................................................................................ 49
- HEALTH PROMOTION AND DISEASE PREVENTION ................................................. 54
- PATIENT CARE PROCESS .............................................................................................. 55
- SPECIAL POPULATIONS ................................................................................................. 56
- NUTRITION ...................................................................................................................... 56

## PHARMACY PRACTICE - PROFESSIONAL PRACTICE SKILLS.

PHARMACY PRACTICE - PROFESSIONAL PRACTICE SKILLS. 57

- PRESCRIPTION PROCESSING AND PRODUCT PREPARATION .................................... 58
- PRESCRIPTION CALCULATIONS ..................................................................................... 59
- COMMUNICATION / PATIENT COUNSELLING ................................................................ 60
- DRUG INFORMATION ...................................................................................................... 61
- LITERATURE EVALUATION / RESEARCH METHODS / EVIDENCE-BASED DECISION-MAKING .................................................................................................................................................. 62
- MEDICATION / PATIENT SAFETY PRACTICES ............................................................. 63
- LAW / JURISPRUDENCE .................................................................................................. 64
- PROFESSIONALISM/ ETHICS ......................................................................................... 65
- COLLABORATIVE PATIENT CARE ................................................................................ 66

## BEHAVIOURAL, SOCIAL AND ADMINISTRATIVE PHARMACY SCIENCES

BEHAVIOURAL, SOCIAL AND ADMINISTRATIVE PHARMACY SCIENCES ................................. 67

- PHARMACY MANAGEMENT .......................................................................................... 68
- CANADIAN HEALTH CARE SYSTEM ............................................................................. 70
- PHARMACOECONOMICS ............................................................................................... 73
- BIOSTATISTICS ............................................................................................................... 74
EVALUATING EXAMINATION SYLLABUS

INTRODUCTION

This syllabus has been compiled to guide candidates who are preparing to write the PEBC Pharmacist Evaluating Examination. It contains sample outlines of Canadian university level pharmacy course outline material, in subject areas that are considered important to the foundational knowledge base for preparation for the practice of pharmacy. It is emphasized that the material found within this syllabus gives selected sampling from a variety of sources, and its purpose is to serve as a guide to the curriculum content of current pharmacy education in Canada. This information may be helpful in your preparation to write the Pharmacist Evaluating Examination. However, this syllabus should not be interpreted to be the blueprint for the construction of any questions for the Pharmacist Evaluating Examination. PEBC examination questions are developed independently of this syllabus.

The syllabus is organized into four sections that correspond to the four major subject areas represented on the Pharmacist Evaluating Examination. These include:

- Biomedical Sciences
- Pharmaceutical Sciences
- Pharmacy Practice
  - Clinical Sciences
  - Professional Practice Skills
- Behavioural, Social and Administrative Pharmacy Sciences

Both formal education and practice experience prepare you for the Pharmacist Evaluating Examination, Pharmacist Qualifying Examination and licensure as a pharmacist. In order to determine what additional learning needs you have, prior to taking the examination, you should assess the knowledge and skills that you have already acquired, in comparison with the subject areas evaluated in the Pharmacist Evaluating Examination.

Remember that language proficiency will also affect your performance. Written and verbal language proficiency and communication skills, at a level satisfactory for a health professional, are essential for your preparedness for taking the PEBC examinations.

Once you have identified your learning needs, it is your responsibility to find suitable reference sources, materials and/or additional experience to prepare for the Pharmacist Evaluating Examination. A partial list of references and learning resources (review guides, textbooks, federal legislation and internet resources) is available on the PEBC website.
BIOMEDICAL SCIENCES

Biochemistry
Genomics and Molecular Biology
Physiology/Functional Anatomy
Immunology
Medical Microbiology
BIOCHEMISTRY

GENERAL DESCRIPTION

The following topics should provide a fundamental understanding of biochemistry covering the topics of: intermediary metabolism of carbohydrates, lipids, proteins, nucleic acids and porphyrins; photosynthesis; the biochemical significance of hormones; and the molecular basis of information transfer for cell integrity and well-being.

TOPICS OF STUDY: BIOCHEMISTRY

Intermediary Metabolism

Enzymes reaction rates and kinetics, the influence of xenobiotics, vitamins and trace elements

Carbohydrates, structure and function, synthesis/degradation

Glycolysis

Citric acid cycle, glyoxylate cycle and pentose phosphate cycle

Biosynthesis of lipids, regulation by insulin and glucagon, steroid hormones and atherosclerosis

Oxidative degradation of amino acids

Fatty acid oxidation, formation of ketone bodies

ATP and bioenergetics including oxidative phosphorylation, electron transport and the effects of xenobiotics

Macromolecules

Nucleic acids

Protein synthesis

Chromosome structure, DNA replication and transcription, effects of antibiotics, cancer-causing viruses

Lipids and membranes
MOLECULAR BIOLOGY AND GENOMICS

GENERAL DESCRIPTION

Molecular biology is an area of study that concerns the molecular basis of cell regulation, control of biochemical functions such as metabolism, secretion, gene expression, response mechanisms and other activities to preserve cell integrity and life.

Genomics encompasses recent advances in the field of molecular biology and the rapidly developing understanding of genetic information in life forms. Study of genomics aims to understand the structure and functions of the human genome and focuses on identifying the mapping of genes and DNA sequences, and the molecular interplay of genes and their role in biochemical processes and disease.

TOPICS OF STUDY: MOLECULAR BIOLOGY AND GENOMICS

Molecular Biology: Basis of Information Transfer for Cell Integrity and Well-being

Structure and functions of proteins and lipids
Biochemistry and cellular organization
Essential amino acids, degradation of purines and uric acid production
Cell signalling (neurotransmitters, hormones)
Cellular growth (the cell cycle)

Genomics

Organization of the human genome
  Gene expression and regulation

DNA structure and function

Instability of the human genome
  Replication, mutation and DNA repair
  Recombination and developmental genetics

Relationship between genes and proteins
  Structure and function of proteins
  Protein folding and conformation
  Transcription into RNA
  mRNA translation into proteins

Genetic engineering and cloning of genes
  Cell-based DNA cloning
  Cloning vectors

Molecular pathology - Identifying human disease genes
Applications: Gene therapy and other molecular genetic-based therapeutic approach
PHYSIOLOGY/ FUNCTIONAL ANATOMY

GENERAL DESCRIPTION

This course of study includes normal physiology of the human body (with emphasis on cellular mechanisms), and a general review of systemic human anatomy (with clinical applications). The goal is to provide a basic understanding of how the human body is structured, in order to understand its function or dysfunction in the presence of disease.

TOPICS OF STUDY: HUMAN PHYSIOLOGY

Respiration
How the body obtains oxygen and eliminates carbon dioxide
The balance of respiration and of the pH level in body fluid
Changes during exercise and various disease states

Kidneys
How kidneys regulate the volume and composition of the body fluids
How kidneys function during malnutrition and various diseases
Hormonal regulation

Blood and the Immune System
Cellular and molecular components of the blood and their roles in oxygen transport, clotting mechanisms and body’s defence mechanisms
Immunology dealing with normal immune reactions

Cardiovascular System
The structure and contractile properties of the heart
Mechanical forces regulating blood pressure
Hormonal and neural regulating mechanisms
TOPICS OF STUDY: HUMAN PHYSIOLOGY cont’d.

Gastrointestinal System
Gastric acid secretion
How the body obtains nutrients, water, and electrolytes
Transfer into plasma and various tissues
Hormonal and neural regulatory factors in normal and diseased states
Elimination of undigested food

Neurophysiology
Description of biological membranes and ionic channels
The basis of bioelectricity
Detailed explanation of synaptic transmission
  The synapse as a primary subject of action of various drugs which act upon the nervous system
Major sensory systems such as the somatosensory, visual and auditory systems
The pain perception
Neural control of skeletal musculature
Mental illnesses

Temperature Regulation
The homeostatic mechanisms regulating body temperature
  In normal condition
  During disease
  During exercise

Endocrinology & Reproduction
The hypothalamic system controlling hormonal release
The pituitary gland; the thyroid gland; the adrenal gland
The reproductive cycle and its hormonal controls
TOPICS OF STUDY: FUNCTIONAL ANATOMY

Introduction to Anatomy
The anatomical position; movement
Ultrastructure of the cell
Examination of basic tissue types of the body, and their function

The Integument
Histology of skin

The Musculoskeletal System
Types of muscle; histology of muscle
How movement occurs
Regional study - role of calcium in skeletal contraction
Diaphragm; upper limb; lower limb; clinical aspects

The Cardiovascular System
Mediastinum
Arteries versus veins - histological approach
Blood as a tissue
Heart - adult versus fetal structure and flow of blood
Coronary circulation; conducting system; clinical aspects
Regional supply

The Respiratory System
Histological survey
Pleura and pleural cavity; breathing movement
Clinical aspects, development of respiratory system
TOPICS OF STUDY: FUNCTIONAL ANATOMY cont’d.

The Digestive System

Anterior abdominal wall

Palate and oral cavity; salivary glands

Esophagus

Peritoneal cavity

Abdominal viscera

Histological aspects and function

Clinical anatomy: Small intestine, large intestine, liver, pancreas

Blood supply including portal venous system and the “first-pass effect”

The Nervous System

Introduction to terminology

Synaptic morphology; neurotransmission

Organization of the nervous system

Central Nervous System

Spinal Cord: anatomy; meninges; major ascending and descending tracts
Brain: gross anatomical features, location and function meninges
Cerebral Hemispheres - sulci, gyri, major sensory and motor regions
Brain Stem: cerebellum; ventricles
CSF: flow, composition, function; blood supply- clinical anatomy

Peripheral Nervous System

Cranial nerves; spinal nerves; dermatomes; brachial plexus;
lumbosacral plexus - pudendal and sciatic nerves

Autonomic Nervous System

Centres of control; sympathetic and parasympathetic systems;
neurotransmitters

Organs of Special Sense

Eye, Ear, Olfaction, Taste
TOPICS OF STUDY: FUNCTIONAL ANATOMY cont’d.

The Urinary System

Function; components and relations

Kidneys - location, gross anatomy; histology; flow of urine; ureter, bladder, male and female urethra; pelvic diaphragm

The Reproductive System

Bony pelvis and perineal region; urogenital triangle; anal triangle; male external genitalia; the breast; the placenta; early embryology; susceptibility of the fetus to critical periods of development

The Endocrine System

Pituitary gland

Thyroid gland

Pancreas

Parathyroid glands and adrenal glands

The Lymphatic System

Significance

Gross anatomy and histology of lymphatic tissue

Lymphatic vessels; lymph node

Spleen, thymus, appendix
IMMUNOLOGY

GENERAL DESCRIPTION

This course of study provides an overview of the immune system, immune responses, and defence mechanisms against infectious disease. The study of vaccines and vaccine-preventable diseases is included.

TOPICS OF STUDY: IMMUNOLOGY

Overview of the Immune System

Specificity and memory

Cells and organs of the immune system

Clonal selection theory

Humoral Immune Responses

Antibodies: structure, classes, and function

Cell Mediated Immune Responses

T cell subsets and functions

T cell receptor

MHC (Major Histocompatibility Complex) molecules

Antigen processing and MHC-restricted presentation

T cell recognition of antigens

Implications to Vaccine Design

Conventional and modern vaccines

Hybridoma Technology and Monoclonal Antibodies

Clinical applications: as research tools and as diagnostic and therapeutic agents

See also: Section under Biotechnology and Pharmacogenetics
MEDICAL MICROBIOLOGY

COURSE DESCRIPTION

This course of study includes the general biology of microorganisms and an overview of the host response to infection. Focus is on the main categories of human infections, their epidemiology, prevention, and antimicrobial treatment. Topics also included are sterility and disinfection.

TOPICS OF STUDY: MEDICAL MICROBIOLOGY

Introduction to Microbiology

Bacterial structure, replication and classification

Bacterial pathogenesis and virulence factors

Normal microbial flora / Host response to infection

Principles of diagnostic microbiology

Bacterial Infections

Infections of the circulatory system
   Endocarditis

Infections of bones and joints
   Osteomyelitis, arthritis, protheses

Skin and wound infections
   Cellulitis, impetigo, wounds

Infections of the gastrointestinal tract
   Food poisoning, gastroenteritis, antibiotic-associated colitis

Infections of the eye
   Conjunctivitis, keratitis

Infections of the urogenital tract
   Urinary tract infections
   Sexually transmitted infections

Infections of the CNS
   Meningitis
   Abcesses
TOPICS OF STUDY: MEDICAL MICROBIOLOGY cont’d.

Infections of the respiratory tract
   Otitis, pharyngitis, sinusitis
   Pneumonia, bronchitis, croup
   Tuberculosis

Antimicrobial Agents

β-Lactams
Quinolones
Macrolides, clindamycin, tetracyclines
Aminoglycosides, vancomycin
Sulfonamides and trimethoprim
Metronidazole

Viral Infections

Properties, structure, replication, and transmission

Viral pathogenesis, host response, and principles of diagnostic virology

Sites/types of viral infections
   Respiratory tract
   CNS
   Gastrointestinal tract
   Genitourinary tract
   HIV and AIDS
   Hepatitis
   Measles, mumps, rubella
   Chickenpox and shingles
   Infections in the fetus and newborn

Antiviral agents
TOPICS OF STUDY: MEDICAL MICROBIOLOGY cont’d.

Parasitology

Protazoal diseases
  Protazoas and helminths

Malaria

Ectoparasites
  Lice, scabies, ticks

Mycology

Properties, structure, replication, and transmission

Systemic mycoses
  Candidiasis
  Aspergillosis
  Histoplasmosis
  Blastomycosis
  Coccidiodomycosis
  Cryptococcosis

Superficial mycoses
  Dermatophytes

Antifungal agents

Sterilization and Disinfection

Infection control methods

Immunoprophylaxis and Vaccines
PHARMACEUTICAL SCIENCES

Pharmaceutics and Drug Delivery Systems
Pharmacokinetics and Biopharmaceutics
Medicinal Chemistry
Pharmacology
Toxicology and Clinical Toxicology
Biotechnology and Pharmacogenetics
PHARMACEUTICS AND DRUG DELIVERY SYSTEMS

GENERAL DESCRIPTION

In this course of study, the emphasis is on physico-chemical properties related to the design and formulation of dosage forms and optimal delivery of drugs to a site of action for therapeutic usefulness. This includes the role of biopharmaceutics, pre-formulation principles, drug stability and physical pharmacy in the development of safe and effective dosage forms. Bioequivalence, routes of administration and new design innovations are included.

TOPICS OF STUDY: PHARMACEUTICS & DRUG DELIVERY SYSTEMS

Solids and Solid Dosage Forms

The solid state
- Bonding - Van der Waal’s, hydrogen, covalent, electrostatic, metallic crystal systems and habits
- Crystallization - saturated and supersaturated solutions, crystal growth
- Crystallinity - amorphous solids, degree of crystallinity, crystal defects
- Polymorphism - effects on formulation, bioavailability
- Hydrates and solvates - hygroscopicity, deliquescence, phase diagrams, effects on formulation, bioavailability, lyophilization
- Eutectic mixtures, solid solutions, clathrates and inclusion compounds

Solid dosage forms
- Properties of powders, handling of powders, drying, mixing and milling
- Particle size analysis - definitions, methods
- Tableting - excipients and formulation, methods of granulation, tablet compression
- Tablet coating - methods and types of coating
- Capsules - hard gelatin, soft gelatin, non-gelatin based capsules, formulation
- Evaluation tests - uniformity of weight, content, dissolution, disintegration, hardness, friability
- Sustained/controlled release - formulation, effect on bioavailability
- Effervescent powders and tablets - formulation, storage
TOPICS OF STUDY: PHARMACEUTICS & DRUG DELIVERY SYSTEMS cont’d.

Solutions and Solubility

Thermodynamics of pharmaceutical solutions
   1st law, enthalpy, work
   2nd law, entropy
   Gibbs free energy and chemical potential
   Phase equilibria

Pharmaceutical solvents
   Waters, alcohols, hydroalcohols, cosolvents

Aqueous and non-aqueous solutions
   Syrups, elixirs, tinctures, collodions, spirits, liniments

Solvent/solute interacation
   Intermolecular bonding, functional groups, prediction of drug solubility in water

Liquid-liquid solutions
   Ideal and non-ideal solutions, Raoult’s law, partial miscibility

Solid-liquid solutions
   Colligative properties, solutions of electrolytes and non-electrolytes, ionic equilibria, buffers, isotonicity

Gas-liquid solutions
   Solubility of gases, Henry’s law.

Factors affecting solubility
   pH, pKa, salts, temperature, esterification, complexation, solubilization, particle size, cosolvency, polarity, solubility parameters

Dissolution
   Theory, methods of measuring dissolution rate, factors affecting dissolution rate
   Hixon-Crowell Cube-Root Relation, Noyes-Whitney equation
   Types of dissolution apparatuses
   USP Dissolution monographs and acceptance criteria
   In vitro-in vivo correlation

Partition
   Fick’s first and second laws, Nernst distribution law, pH-partition theory, steady state and non-steady state diffusion
TOPICS OF STUDY: PHARMACEUTICS & DRUG DELIVERY SYSTEMS cont’d.

Surface Chemistry and Dispersed Dosage Forms

Surface chemistry
- Interfacial tension, spreading, contact angle, tendency of wetting
- Nature & properties of surfaces, interfaces-absorption at liquid & solid interfaces
- Surfactants - classification, properties, pharmaceutical applications (HLB, wetting, solubilization, detergency)

Emulsions
- Emulsion types, applications, emulsifying agents
- Physical stability - creaming, coalescence, cracking, inversion
- Formulation, preservation
- Microemulsions - formulation, physicochemical properties, applications

Suspensions
- Desired characteristics, applications
- Electrical properties, Zeta potential, Nernst potential
- Physical stability - flocculation, deflocculation, sedimentation
- Formulation
- Rheological properties of vehicles including hydrocolloids, thixotropy, rheopexy, structured vehicles

Drug Stability

Drug stability
- Physical, chemical, microbiological stability - definitions, causes of instability

Chemical stability
- Mechanisms of degradation - hydrolysis, oxidation, photolysis
- Zero and first order degradation - rate equations, half-life, shelf-life
- Effect of temperature, ionic strength, solvents and pH on reaction kinetics
- Factors affecting rates of hydrolysis and oxidation, stability programs, stability testing, accelerated stability studies
- Stabilization of drugs against hydrolysis, oxidation and photolysis

Pulmonary Drug Delivery

Components of aerosols - propellants, valves, containers
Formulation of aerosols - solutions, suspensions, emulsions
Design of aerosols - metered dose inhalers, dry powder inhalers, nebulizers, spacer devices
Inhalation therapy - deposition of particles in the lungs, metered dose inhalers, powder inhalers, nebulizers
TOPICS OF STUDY: PHARMACEUTICS & DRUG DELIVERY SYSTEMS cont’d.

Dermal and Transdermal Drug Delivery

Skin structure - nature of barrier to percutaneous absorption

Percutaneous absorption - diffusion, partitioning, flux

Factors affecting percutaneous absorption - skin intactness, age, site, hydration, partition coefficient, solubility, penetration enhancers and formulation

Types of dermatological vehicles - ointments, creams, gels, liquids, pastes, selection of appropriate vehicle in topical drug therapy

Parenteral Drug Delivery

Methods of sterilization, sterility testing, pyrogen testing, tests for particulate matter

Routes of administration - advantages, disadvantages

Formulation - vehicles, additives, osmolarity, osmolality, particle size

Principles of aseptic technique, reconstitution, intravenous admixtures and causes of incompatibilities

Total parenteral nutrition - design of solution, preparation, administration, complications

Ophthalmic, Otic, Nasal Drug Delivery

Ophthalmic drug delivery
  Cornea as a barrier to drug absorption
  Formulation - tonicity, sterility, pH additives

Otic drug delivery
  Site of drug administration
  Formulation

Nasal drug delivery
  Formulation – pH, additives

Rectal and Vaginal Drug Delivery

Physiology, local and systemic effects

Rectal and vaginal suppositories
  Definition and uses
  Preparation, excipients, density displacement factors
  Stability

Vaginal tablets, ointments, creams, gels and aerosol foams
TOPICS OF STUDY: PHARMACEUTICS & DRUG DELIVERY SYSTEMS cont’d.

New Drug Delivery Systems

Controlled/targeted delivery
  Controlled drug release, targeted drug delivery - definitions, rationale, comparison to conventional delivery systems
  Parenteral polymeric delivery systems - biodegradable, non-degradable polymers, reservoirs, matrices, mechanisms of drug release, formulation of implants, microspheres, nanospheres
  Liposomes - formulation, interaction with cells, applications, targeting
  Transdermal drug delivery - applications, mechanisms of controlled release formulations
  Immunoconjugates and new innovations

Protein drug delivery
  Protein drug delivery - formulation strategies to stabilize proteins, formulation of protein/peptide drugs using conventional injections, formulation of polymer implants or microspheres
  Nasal and pulmonary delivery - physiology, use of penetration enhancers
  Buccal delivery and other potential delivery systems

Good Manufacturing Practices (GMP)

Batch record

International Organization for Standardization (ISO)

Lot number

Product Quality Control and Risk Management

Places
  Premises and equipment

People
  Personnel and quality assurance

Processes
  Sanitation program and operations

Products
  Specifications, stability, samples, batch records, recall reporting, sterile products
TOPICS OF STUDY: PHARMACEUTICS & DRUG DELIVERY SYSTEMS cont’d.

Pharmaceutical Analysis

Chromatographic separation methods
  High Pressure Liquid Chromatography (HPLC)
  Gas Liquid Chromatography (GLC)

Other chromatographic detectors
  Fluorescence
  Radiometric assays (gamma and beta counting)

Spectrophotometry and other analytical methods
  Ultraviolet-visible
  Infrared and Nuclear Magnetic Resonance (NMR) spectrometry
  Atomic absorption
  Mass spectrometry
  Gel electrophoresis and Western blot
PHARMACOKINETICS & BIOPHARMACEUTICS

COURSE DESCRIPTION

This course of study is designed to cover biopharmaceutics and pharmacokinetics concepts. Biopharmaceutics considers the interrelationship of the physicochemical properties of the drug, the dosage form in which the drug is given, and the route of administration on the rate and extent of systemic drug absorption. Pharmacokinetics involves the time course of drug disposition in the body: the kinetics of drug absorption, distribution and elimination (excretion and metabolism). This includes the effect of pathophysiological changes on the pharmacokinetics of drugs and applications in pharmacotherapy. A selected group of drugs is discussed in the context of therapeutic drug monitoring.

TOPICS OF STUDY: PHARMACOKINETICS & BIOPHARMACEUTICS

Compartment Concepts

One compartment open model
Multicompartmental models
Model-independent pharmacokinetics

Absorption

Kinetics of oral drugs (absorption and elimination)
Kinetics after one dose
Kinetics after multiple doses
Zero-order absorption model
First-order absorption model
Significance of absorption rate constant
Physiologic factors related to oral absorption
Modified release of drug products

Distribution and Protein Binding

Physiologic factors
Volume of distribution
Kinetics of protein binding
TOPICS OF STUDY: PHARMACOKINETICS & BIOPHARMACEUTICS cont’d.

Elimination and Clearance Concepts

Drug clearance
Renal clearance
Hepatic clearance
Biotransformation

Kinetics of Intravenous (IV) Drugs

IV Bolus
IV infusion
IV intermittent infusion
Multiple daily dosage regimens

Kinetics of Doses

After constant input
After 1st order input

Model-Independent Pharmacokinetics

Nonlinear pharmacokinetics

Bioavailability and Bioequivalence Issues

Clinical Application of Pharmacokinetics

Dosage regimens

Effects of pathophysiologic changes: monitoring and adjustment of doses in renal and hepatic dysfunction

Kinetics of drug interactions

Special populations
  Pediatric patients
  Pregnant and lactating women
  Geriatric patients
TOPICS OF STUDY: PHARMACOKINETICS & BIOPHARMACEUTICS cont’d.

Therapeutic drug monitoring
   Drugs in renal failure: Aminoglycosides, cyclosporine
   Drugs with saturable kinetics: Phenytoin
   Drugs with linear kinetics: Digoxin

Examples of Pharmacokinetics Calculations

Pharmacokinetic rate constants
   Apparent volume of distribution, elimination rate constant, half-life, clearance

Blood drug concentration following IV bolus dose administration
   One compartment model
   Two compartment model

Drug concentration vs. time curves
   Determining what model the drug follows

Clearance rates

Loading doses and time to reach steady state

Pharmacokinetic-pharmacodynamic modeling
MEDICINAL CHEMISTRY

GENERAL DESCRIPTION

The following list of topics indicates the breadth of material presented in medicinal chemistry courses. Some topics are closely integrated with other courses, and therefore it is difficult to define the precise depth of knowledge that is required in all sections.

TOPICS OF STUDY: MEDICINAL CHEMISTRY

Fundamental Aspects of Organic Chemistry

Chemical bonding: introductory aspects, such as atomic orbitals, molecular orbitals, localized versus delocalized chemical bonding, specific bond types (e.g., covalent and ionic), aromaticity, and tautomerism.

Stereochemistry

Solubility

Acidity and basicity

Functional groups
   Aliphatic and aromatic hydrocarbons
   Alcohols and phenols
   Ethers
   Aldehydes and ketones
   Amines
   Carboxylic acids
   Functional derivatives of carboxylic acids
   Sulfonic acids and sulfonamides
   Heterocycles
   Nitrates and nitrites

Fundamental Concepts of Medicinal Chemistry:

Structure-activity relationships

Ionization and pKₐ values: electronic effects in medicinal compounds

Metabolism: routes of metabolism, specific isozymes, induction and inhibition of enzymes giving rise to specific drug interactions, and genetic polymorphism of clinical relevance.

Transporters

Chemical and physical properties of related medicinal compounds
TOPICS OF STUDY: MEDICINAL CHEMISTRY cont’d.

Drug/Receptor Interactions: Theory and Practice

Drug-receptor binding: importance of the equilibrium dissociation constant

Fraction of bound receptors and the analogous enzyme-substrate relationships

Importance of hydrophilic and hydrophobic interactions
GENERAL DESCRIPTION

The study of basic pharmacological principles is applied to representative clinically important drugs having their primary actions on various organ systems of the body. It includes the study of chemotherapeutic agents used in the treatment of infectious and neoplastic diseases.

TOPICS OF STUDY: PHARMACOLOGY

General Principles of Pharmacology

Drug absorption, disposition, biotransformation, elimination

Receptors

Receptor theory, macromolecular structure of receptors, signal transduction mechanisms, molecular pharmacology

Drug/receptor interactions
- Evidence of specific receptor-mediated processes
- Agonists/antagonists
- Dose-response curves
- Desensitization and supersensitivity

Autonomic Pharmacology

Drugs and catecholamine metabolism

Sympathomimetics (adrenergic agents)

Sympatholytics (adrenergic blocking agents)

Cholinergic drugs

Anticholinesterases

Anticholinergics

Skeletal muscle relaxants

Anaesthetics

Local anaesthetics

General anaesthetics
TOPICS OF STUDY: PHARMACOLOGY cont’d.

Pharmacology of Inflammation

Chemical mediators of inflammation
Histamine, prostaglandins, leukotrienes, bradykinin, platelet activating factor, cytokines

Anti-inflammatory drugs
ASA, NSAIDs, COX-2 inhibitors
5-ASA

Immunosuppressive drugs

Drugs used in the treatment of inflammatory diseases
Asthma
Rheumatoid arthritis
Gout

Biologic response modifiers

Central Nervous System Pharmacology

Pain and opioid analgesics

Anxiolytic drugs

Sedative/hypnotic drugs

Antipsychotics

Antidepressants

Psychostimulants

Anti-Parkinson drugs

Antiseizure drugs

Drugs for Alzheimer’s disease

Drugs for migraine

Drugs Affecting the Haematopoietic System

Iron, folic acid, vitamin B₁₂, erythropoietin, filgrastim
TOPICS OF STUDY: PHARMACOLOGY cont’d.

**Cardiovascular Pharmacology**

- Antiarrhythmic drugs
- Cardiac glycosides and inotropic drugs
- Vasodilators
- Calcium channel blockers
- Beta-blockers
- ACE inhibitors
- Angiotensin receptor antagonists
- Nitrates
- Antihypertensive agents

**Hemostasis and Thrombosis**

- Vitamin K
- Oral anticoagulants
- Heparins (including low molecular weight heparins)
- Anti-Xa inhibitors
- Direct thrombin inhibitors
- Anti-platelet drugs
- Thrombolytics

**Drugs for Dyslipidemia**

**Diuretics**

**Cancer Chemotherapy**

- Alkylating agents, antimetabolites, cytotoxic antibiotics, plant alkaloids, hormones, biologic response modifiers
- Adjunctive agents including antiemetics
TOPICS OF STUDY: PHARMACOLOGY cont’d.

Gastrointestinal Pharmacology

Drugs affecting GI motility

Drugs affecting gastric secretion

Anti-obesity drugs

Endocrine Pharmacology

Insulin and oral antihyperglycemics

Corticosteroids

Thyroid and anti-thyroid drugs

Androgens and anabolic steroids

Estrogens and anti-estrogens, progestins, hormonal contraception (oral and other routes)

Gonadotropins

Vasopressin

Oxytocin

Bone mineral homeostasis

Anti-Infective Agents

Antibacterial drugs
  - Beta-lactam antibiotics, carbapenems, sulphonamides, trimethoprim, tetracyclines, aminoglycosides, macrolides, fluoroquinolones, vancomycin, metronidazole, nitrofurantoin

Antiviral drugs

Antifungal drugs

Antiprotozoal drugs

Anthelmintic drugs
TOPICS OF STUDY: PHARMACOLOGY cont’d.

Respiratory Drugs

Antihistamines

Antitussives

Anti-inflammatory agents

Bronchodilators

Ophthalmic Drugs

Antiglaucoma agents

Mydriatics

Drugs of Abuse

Ethanol, amphetamines, barbiturates, benzodiazepines, nicotine, cannabis, GHB, cocaine/crack, fentanyl, heroin, ketamine, methadone, nitrites, solvents, hallucinogens (ecstasy, PCP, LSD, mescaline)
TOXICOLOGY AND CLINICAL TOXICOLOGY

GENERAL DESCRIPTION

Concerned primarily with drug-induced diseases, this course of study provides a framework for understanding the broad spectrum of toxicological problems encountered in pharmacy practice, in drug development and regulation, and in medical research. Central biochemical mechanisms and the relevance of factors influencing toxicological expression will be included.

TOPICS OF STUDY: TOXICOLOGY & CLINICAL TOXICOLOGY

Introduction to Toxicology

Perspective: subdisciplines, magnitude, monitoring, resources

Pharmacological principles: relation of toxic response to frequency, dose and tissue concentration

Discrimination among toxins

Mechanisms

Receptor-mediated vs. reactive intermediate-mediated toxicity

Covalent binding, oxidative stress

Elimination, bioactivation, detoxification, cytoprotection and macromolecular repair

Modulators of Chemical Toxicity

Pharmacological factors
  Disposition, biotransformation, renal elimination

Physiological factors
  Species, strain, age, sex, genetics, diet, pregnancy, functional reserve capacity, tolerance

Pathophysiological factors
  Diseases of hepatic, renal cardiovascular, pulmonary, gastrointestinal and biochemical systems
TOPICS OF STUDY: TOXICOLOGY & CLINICAL TOXICOLOGY cont’d.

Toxicological Evaluation

Chemical measurements
  Biological relevance of measuring active and inactive parent chemical and metabolites, stereoisomers and reactive intermediary metabolites

Biochemical measurements of cellular response

Histological and functional measurements, animal models, in vivo and in vitro studies, ex vivo human assessment

Chemical Teratogenesis

Carcinogenesis/Mutagenesis

Immunological Toxicology

Chemicals and Environmental Toxins

Alcohols, glycols, aldehydes, nitrates and nitrites, sulfide, hydrocarbons

Carbon monoxide, cyanide

Pesticides

Metals

Corrosives

Plants

Warfare chemical weapons

Drug Toxicity

Analgesics and anti-inflammatory drugs

Opioids

CNS stimulants and depressants, antidepressants, hallucinogens

Anticholinergics

Cardiovascular drugs

Vitamins
BIOTECHNOLOGY AND PHARMACOGENETICS

GENERAL DESCRIPTION

In this course of study, the basic science and the pharmacotherapeutic implications of biotechnology-derived drugs are dealt with in some depth. The emphasis is on recent developments in the area and on the probable direction that future research in that field will take. An overview of the immune system, immune responses and treatment applications is also presented.

TOPICS OF STUDY: BIOTECHNOLOGY AND PHARMACOGENETICS

Introduction to Biotechnology

Modern biotechnology and its impact on development of drugs and pharmacy practice

Pharmacoeconomics of biotechnology drugs

Recombinant DNA Technology and Production of Protein Drugs

Review of protein biosynthesis in prokaryotic and eukaryotic cells

Regulation of gene expression

Methods of creating recombinant DNA

Isolation of cloned genes
  cDNA cloning, genomic DNA cloning

Expression of recombinant proteins
  Host cells, expression vectors
  Strategies in design of recombinant plasmids for pharmaceuticals (e.g., human growth hormone)

Industrial Production of Protein Drugs

Modern fermentation technology

Requirements for bacterial, yeast and mammalian cell culture

Overview of fermenter design and fermentation processes

Large-scale production of protein pharmaceuticals with examples

Production of biotechnology drugs
  Cultivation and downstream processing
  Issues to consider in production and purification of proteins
TOPICS OF STUDY: BIOTECHNOLOGY AND PHARMACOGENETICS cont’d.

Formulation of biotechnology drugs
   Sterility, pyrogen removal
   Excipients used in biotechnology drugs (parenteral formulations)
   Shelf-life of biotechnology drugs
   Delivery of biotechnology drugs: route of administration and absorption enhancement; rate-controlled delivery; site-specific delivery

Pharmacist’s role with biotechnology products
   Dispensing biotechnology drugs: handling and special considerations; storage; preparation; administration; patient assessment and monitoring; outpatient/home care issues

Pharmacotherapeutics of approved biotechnology products (clinical and regulatory aspects)
   Hematopoietic growth factors
   Interleukins and interferons
   Insulin
   Growth hormones
   Recombinant tissue-type plasminogen activator
   Gonadotropins
   Monoclonal antibody-based pharmaceuticals

Biotechnology-related Techniques

Polymerase chain reaction

DNA sequencing

DNA hybridization

Protein engineering
   Site-directed mutagenesis
   Antibody engineering

Peptide chemistry/medicinal chemistry
   Peptidomimetic drugs
   Rational design of peptide drugs

Nucleic acid technologies
   Antisense oligonucleotides
   DNA triplex technology
   Ribozymes

Catalytic antibodies (abzymes)

*In vitro* screening and combinatorial chemistry
TOPICS OF STUDY: BIOTECHNOLOGY AND PHARMACOGENETICS cont’d.

Transgenic (TG) Animals

Production of TG animals by DNA injection (gain-of-function)

Production of TG animals by homologous recombination (loss-of-function)

Protein production in TG animals

TG animal models of disease and application in drug discovery and development

TG animal patents

Gene Therapy

Approaches and targeted diseases

Methods for ex vivo and in vivo delivery of genes to somatic cells

Applications to diseases
  ADA deficiency, cystic fibrosis, and cancer

Case studies of current clinical trials

Potential diseases where gene therapy could be applied to or is currently used for treatment

Gene transfer methods
  Viral vectors (retrovirus vectors, adenovirus vectors, etc.)

Pharmacogenomics and genotyped prescribing (future role for pharmacists)

Antisense Oligonucleotide Therapy

Inhibition of gene expression by oligonucleotides

Design of oligonucleotides and approaches to delivery

Small interfering RNA (siRNA)

Mechanism, potential applications
TOPICS OF STUDY: BIOTECHNOLOGY AND PHARMACOGENETICS cont’d.

Immunology: Overview of the Immune System

Specificity and memory

Cells and organs of the immune system

Clonal selection theory

Humoral immune responses
  Antibodies: structure, classes, and function

Cell mediated immune responses
  T cell subsets and functions
  T cell receptor
  MHC molecules
  Antigen processing and MHC-restricted presentation
  T cell recognition of antigens
  Implications to vaccine design

Monoclonal Antibodies

Hybridoma technology

Applications: as research tools, and as diagnostic and therapeutic agents

Vaccines: Biotechnology Approaches

Cloned proteins: Hepatitis B

Synthetic peptides: AIDS

Synthetic carbohydrates: Cancer

Attenuated organism with site-specific mutation: Cholera

Vaccine delivery systems
  Live vectors
  Pharmaceutical formulations

Cytokines

General characteristics, classification

Origin, molecular characteristics and physiological function of each cytokine

Therapeutic cytokines
  Interferons, interleukins and colony stimulating factors
TOPICS OF STUDY: BIOTECHNOLOGY AND PHARMACOGENETICS cont’d.

Erythropoietin

Thrombolytic Agents

Formulation of Protein and Peptide Drugs

Problems: stability, bioavailability and routes of administration

Recent approaches in protein and peptide drug delivery
PHARMACY PRACTICE – Clinical Sciences

Pathophysiology

Clinical Biochemistry/ Laboratory and Diagnostic Testing

Pharmacotherapeutics (including Prescription, Non-prescription and Complementary Therapy)

Health Promotion and Disease Prevention

Patient Care Process (Assessment/ Intervention/ Monitoring/ Follow-up/ Documentation)

Special Populations (including Geriatrics, Pediatrics, Pregnancy and Lactation)

Nutrition
PATHOPHYSIOLOGY

GENERAL DESCRIPTION

This course of study is designed to cover the basic mechanisms of pathophysiology, laboratory investigation and follow up associated with diseases.

TOPICS OF STUDY: PATHOPHYSIOLOGY

Cell Injury and Death

Mechanisms of cell injury
   Ischemia/hypoxia
   Free radicals
   Chemical injury

Laboratory investigation
   Morphology - reversible injury, necrosis, apoptosis
   Biochemical changes

Genetics

Common chromosomal syndromes

Pharmacogenetics

Fluid and Electrolyte Disorders

Metabolic acid-base disorders

Disorders of oxygenation

Inflammation

Acute inflammation

Chronic inflammation
   Inflammatory events and mediators

Edema

Immunopathology

Hypersensitivity reactions
   Four major types: immediate (anaphylactic), cytotoxic, immune complex, delayed

Autoimmune diseases
TOPICS OF STUDY: PATHOPHYSIOLOGY cont’d.

Obstructive Lung Disease

Asthma

Chronic obstructive pulmonary disease (COPD)

Gastrointestinal Disease

Gastroesophageal reflux disease (GERD)

Peptic ulcer disease

Inflammatory bowel disease
  Crohn disease
  Ulcerative colitis

Zollinger-Ellison syndrome

Liver Disease

Cholestasis

Hepatitis (A, B, C)

Cirrhosis

Drug-induced hepatotoxicity

Renal Disease

Acute renal insufficiency

Chronic renal insufficiency
TOPICS OF STUDY: PATHOPHYSIOLOGY cont’d.

**Endocrine Disorders**

Thyroid disorders
- Hyperthyroidism
- Hypothyroidism

Adrenal disorders
- Cushing’s Syndrome
- Addison’s Disease

Metabolic bone disorders
- Osteoporosis
- Osteomalacia
- Paget’s Disease

Glucose metabolism and disorders
- Diabetes mellitus (type 1 and type 2)

**Cardiovascular**

Dyslipidemia

Ischemic heart disease

Myocardial Infarction

Hypertension

Heart failure

Dysrhythmias

Coagulation and thrombotic disorders

**Haematology**

Anemias
- Normocytic (i.e., thalassemias, sickle cell anemia)
- Microcytic (i.e., iron deficiency anemia)
- Macrocytic (i.e., vitamin B_{12} deficiency and folic acid deficiency)

Haemostatic disorders
TOPICS OF STUDY: PATHOPHYSIOLOGY cont’d.

Neurology

Neurodegenerative diseases
   Alzheimer’s disease and dementias
   Parkinson’s Disease

Pain and headache
   Acute or chronic
   Migraine

Seizure disorders

Stroke

Psychiatry

Anorexia, bulimia, and eating disorders

Anxiety

Attention deficit hyperactivity disorder (ADHD)

Bipolar disorder

Depression

Insomnia

Schizophrenia

Carcinogenesis and Neoplasia

Sites
   Lung neoplasms
   Gastrointestinal neoplasms
   Gynecologic neoplasms
   Urinary tract neoplasms
   Hematology (e.g., leukemia and lymphoma)
   Skin neoplasms (e.g., malignant melanoma and others)
   Cancer of the bone, brain, breast, prostate
CLINICAL BIOCHEMISTRY / LABORATORY AND DIAGNOSTIC TESTING

GENERAL DESCRIPTION

This course of study examines the important elements of clinical biochemistry and relevant diagnostic tests and laboratory investigations associated with organ systems and diseases.

TOPICS OF STUDY: CLINICAL BIOCHEMISTRY / LABORATORY AND DIAGNOSTIC TESTING

Routine Hematology

Hematocrit and hemoglobin
Red blood cell count
Red cell indices (MCV, MCH, MCHC)
Complete blood count (CBC)
WBC differential (components)
Platelets

Hematologic Diagnostic Tests

Anemias (iron, ferritin, TIBC)
Coagulation tests (INR, aPTT)

Electrolytes and Blood Chemistry

Sodium
Potassium
Chloride
Glucose (random or FBG)
Uric Acid
TOPICS OF STUDY: CLINICAL BIOCHEMISTRY / LABORATORY AND DIAGNOSTIC TESTING cont’d.

Arterial blood gases (PaO$_2$, PaCO$_2$)

pH

Anion gap

Bicarbonate

Liver Biochemistry

Bilirubin

Alkaline phosphatase (ALP)

Transaminases (AST, ALT)

Albumin

α-Fetoprotein

Bone Metabolism

Bone mineral density

Minerals (calcium, phosphate)

Magnesium

Vitamin D

Renal Function and Disorders

Urinalysis

Urine electrolytes

Blood urea nitrogen (BUN)

Serum creatinine

Estimation of Glomerular Filtration Rate (GFR) and Renal Blood Flow

Methods of calculation and use of nomograms

Creatinine clearance
TOPICS OF STUDY: CLINICAL BIOCHEMISTRY/LABORATORY AND DIAGNOSTIC TESTING cont’d.

Gastrointestinal Tract

Schilling’s test
Occult blood
Endoscopy

Pulmonary Function Tests

Pulmonary function testing
Histamine, methacholine challenge test

Neurology

Cerebral spinal fluid (CSF)

Cardiovascular Diagnostic Tests

Cardiac isoenzymes (including creatine kinase)
Troponin
Lipoprotein profile (LDL, HDL, triglycerides, total cholesterol)

Neoplasm Screening

Prostate-specific antigen (PSA)
Breast self-examination
Mammogram
Pap smear
TOPICS OF STUDY: CLINICAL BIOCHEMISTRY/LABORATORY AND DIAGNOSTIC TESTING cont’d.

Endocrinology

Hypothalamus-pituitary axis
  Prolactin
  Growth hormone (GH)
  Gonadotropins (LH and FSH)
  Adrenocorticotropic (ACTH)

Adrenal disorders
  Plasma cortisol
  Urine and serum osmolality

Thyroid function
  TSH
  Free T\textsubscript{3}
  Free T\textsubscript{4}

Sex hormones
  Pregnancy testing

Diabetes and glucose monitoring
  Glucose tolerance test
  Fasting blood glucose
  Urine ketones
  Glycosylated hemoglobin (A1C)

Infectious Disease / Immunologic / Rheumatologic / Other Tests

HIV tests

Western blot

CD4+ T-cell counts

Erythrocyte sedimentation rate

Laboratory Aspects of Antimicrobial Agents

Culture and sensitivity tests
GENERAL DESCRIPTION

This course of study reviews the therapeutic approaches to the most frequently encountered diseases and critical issues relevant to pharmacy practice, using a problem-solving approach. Prescription medication, self-care (nonprescription) medications, non-pharmaceutical (e.g., lifestyle) approaches, as well as alternative therapies are included. Patient-specific factors, goals of treatment, desired patient-specific outcomes, care plan (options and management), patient education, monitoring parameters (including laboratory investigations) and evaluation of efficacy and adverse effects of therapy must be considered, in order to optimize patient care.

BASIC PRINCIPLES

Using a patient-centred care approach, a drug therapy problem is prevented or resolved using a process which involves the following steps:

1. Identifying pertinent patient information and assessing its relevance
2. Establishing desired clinical and therapeutic outcomes
3. Determining and assessing possible pharmaceutical and non-pharmaceutical treatment options
4. Selecting the most suitable option for the patient
5. Justifying the proposed therapy (explaining the rationale)
6. Developing and implementing the care plan (including education and monitoring)
7. Following up on the interventions (assessing efficacy and adverse effects)
8. Documenting findings related to the patient’s care

TOPICS OF STUDY: PHARMACOTHERAPEUTICS

For the following diseases, therapeutics considerations should include prescription medication, self-care (nonprescription) treatments, non-pharmaceutical approaches, as well as alternative (complementary) treatments.

Respiratory Diseases

Asthma
Chronic obstructive pulmonary disease (COPD)
Croup
Smoking cessation
TOPICS OF STUDY: PHARMACOTHERAPEUTICS cont’d.

Dermatology

Acne
Acne rosacea
Allergic contact dermatitis
Atopic dermatitis
Burns
Cellulitis
Dermatomycosis
Diaper rash
Dry skin
Impetigo
Pediculosis and scabies
Onychomycosis
Sunburn and photosensitivity reactions
Viral infections (including chicken pox, herpes and shingles)

Eye, Ear, Nose and Throat

Acute otitis media
Allergic rhinitis
Bacterial conjunctivitis
Bacterial sinusitis
Glaucoma
Mucositis
Otitis externa
Pharyngitis
Teething
Viral upper respiratory tract infections

Gastroenterology

Cirrhosis
Constipation
Diarrhea
Dyspepsia and peptic ulcer disease
Esophagitis
Gastroesophageal reflux disease (GERD)
Gastrointestinal bleeding
Hepatotoxicity and liver dysfunction
Infant feeding problems including colic
Inflammatory bowel disease: including Crohn disease and ulcerative colitis
Irritable bowel syndrome
Nausea and vomiting
Pseudomembranous colitis
TOPICS OF STUDY: PHARMACOTHERAPEUTICS cont’d.

**Cardiovascular diseases**

Angina  
Cardiac insufficiency (including heart failure)  
Cerebrovascular accident (including ischemic stroke)  
Venous thromboembolism (DVT and PE)  
Dyslipidemia  
Endocarditis prophylaxis  
Hypertension  
Myocardial infarction  
Rhythm disorders

**Genitourinary diseases**

Benign prostate hypertrophy  
Prostate cancer  
Urinary incontinence  
Urinary tract infections (cystitis, pyelonephritis, and prostatitis)

**Musculoskeletal diseases**

Chronic pain  
Multiple sclerosis  
Osteoarthritis  
Osteoporosis  
Rheumatoid arthritis  
Skeletal pain  
Post-operative pain  
Tendonitis and sport injuries

**Gynecology**

Bacterial vaginitis  
Contraception (including emergency contraception)  
Endometriosis  
Erectile dysfunction  
Fertility  
Menopause  
Pregnancy  
Premenstrual syndrome (PMS)  
Vaginal candidiasis
TOPICS OF STUDY: PHARMACOTHERAPEUTICS cont’d.

Infectious Diseases

Bone and joint infections (osteomyelitis)
Central nervous system infections (meningitis)
Infections related to travel
Endocarditis
Fungal infections
Gastrointestinal infections (including *C. difficile*-associated diarrhea
HIV and AIDS (including opportunistic infections)
Intra-abdominal infections
Malaria
Pneumonia (community acquired pneumonia and nosocomial)
Respiratory tract infections (lower and upper)
Sepsis and septic shock
Sexually transmitted infections
Skin and soft tissue infections
Surgical prophylaxis
Tuberculosis
Urinary tract infections (UTIs)

Neurology

Alzheimer’s disease and other dementias
Headaches (migraine, tension-type, cluster, medication overuse)
Neuropathic pain
Parkinson's disease
Seizure disorders (including partial, generalized, status epilepticus and others)

Endocrinology

Breast cancer
Diabetes mellitus (types 1 and 2)
Hypothyroidism
Hyperthyroidism

Psychiatry

Aggressive behaviour
Anxiety disorders
Bipolar disorder
Depression
Drug withdrawal syndromes
Insomnia and sleep disorders
Obsessive-compulsive disorder
Panic disorder
Personality disorders
Schizophrenia
TOPICS OF STUDY: PHARMACOTHERAPEUTICS cont’d.

Nephrology

Chronic renal dysfunction
Nephrotoxicity
Renal transplantation

Other

Anemias
Chemotherapy and related toxicities
Dehydration
Fluid and electrolyte disorders
Obesity
HEALTH PROMOTION AND DISEASE PREVENTION

GENERAL DESCRIPTION

This course of study reviews the principles of health and wellness in the provision of individual, as well as population-based health and wellness information.

TOPICS OF STUDY: HEALTH PROMOTION AND DISEASE PREVENTION

Development of health promotion strategies
   Health and wellness of individuals and groups
   Collaboration with other health care providers

Public Health Agency of Canada
   Travel health
   Vaccines and immunizations
   Disease prevention

Preventative health services (e.g., immunizations, tobacco cessation counselling)
PATIENT CARE PROCESS

TOPICS OF STUDY: PATIENT CARE PROCESS

Assessment

Meet the patient and establish the therapeutic relationship
Elicit relevant information from the patient
Determine whether the patient's drug-related needs are being met and identify drug therapy problems:
• The patient requires drug therapy but is not receiving it,
• The patient is taking or receiving the wrong drug,
• The patient is taking or receiving too little of the right drug,
• The patient is taking or receiving too much of the right drug,
• The patient is not taking or receiving the drug or is taking or receiving the drug inappropriately,
• The patient is experiencing an adverse reaction to the drug,
• The patient is experiencing a drug interaction (including drug-drug, drug-food, drug-laboratory test, drug-disease, or drug-blood product),
• The patient is taking or receiving a drug for no medically valid indication or substance abuse.

Care plan

Establish goals of therapy
Select appropriate interventions for:
• Resolution of drug therapy problems
• Achievement of goals of therapy
• Prevention of drug therapy problems
Schedule a follow-up evaluation

Follow-up evaluation

Elicit clinical and/or lab evidence of actual patient outcomes and compare them to the goals of therapy to determine the effectiveness of drug therapy
Elicit clinical and/or lab evidence of adverse effects to determine the safety of therapy
Assess patient for any new drug therapy problems
Schedule the next follow-up evaluation

Documentation

Document clinical status and any changes in pharmacotherapy that are required
Application of privacy legislation and ethical considerations
Preparation and maintenance of patient records (includes profiles, charts, etc)
SPECIAL POPULATIONS

TOPICS OF STUDY: SPECIAL POPULATIONS

Unique pharmacotherapeutic considerations for special populations including:
- Neonates
- Pediatrics
- Geriatrics
- Pregnant women
- Lactating women

NUTRITION

TOPICS OF STUDY: NUTRITION

Digestion

Function of nutrients in the body

Dietary requirements and Canada’s Food Guide

Assessment of nutritional status

Malnutrition and effects on health

Metabolism and transport of nutrients

Regulation of blood glucose

Weight management and eating disorders
PHARMACY PRACTICE - Professional Practice Skills

Prescription Processing and Product Preparation (including Non-sterile and Sterile Compounding)

Prescription Calculations

Communication / Patient Counselling

Drug Information

Literature Evaluation / Research Methods / Evidence-Based Decision Making (including Pharmacoepidemiology)

Medication / Patient Safety Practices

Law / Jurisprudence

Professionalism / Ethics

Collaborative Patient Care
PRESCRIPTION PROCESSING AND PRODUCT PREPARATION

TOPICS OF STUDY: PRESCRIPTION PROCESSING AND PRODUCT PREPARATION

Accurate interpretation of prescription orders

Application of legislative requirements (federal legislation only) - see Law/Jurisprudence section also

Non-sterile and sterile compounding

Handling of hazardous drugs

Cold chain management

Checking processes for dispensing prescriptions, including:
  Appropriateness of medication choice
  Therapeutic duplication
  Correct dosage, route, dosage form, frequency, and duration of therapy
  Allergies and contraindications
  Drug interactions
  Adherence issues
  Financial considerations (pricing, third party billing, quantity restrictions, etc)
PRESCRIPTION CALCULATIONS

TOPICS OF STUDY: PRESCRIPTION CALCULATIONS

Systems and units of measure (including metric system, SI)
  Intersystem conversion

Dosage calculations
  Amount of drug
  Number of doses
  Dosing based on body weight, body surface area
  Dosing based on age or pharmacokinetic parameters

Compounding calculations (non-sterile and sterile)
  Ratio and proportion
  Percentage
  Dilution and concentration
  Stock solutions
  Alligation
  Electrolyte solutions (milliequivalents, millimoles, osmolarity)

Dosing calculations for parenteral medications
  Reconstitution
  Infusion flow rate
  Total parenteral nutrition (TPN)

Prescription processing calculations
  Dispensing fees
  Insurance co-payments
COMMUNICATION / PATIENT COUNSELLING

TOPICS OF STUDY: COMMUNICATION / PATIENT COUNSELLING

Pharmacist interactions in the workplace
- Effective dialogue with patients, caregivers, and other health providers
- Individual consultations
- Presentations to a group
- Staff relations

Development of effective communication skills
- Dialogue and interviewing techniques/process
- Verbal and nonverbal listening
- Probing and gathering information
- Empathy, assertive skills
- Cultural diversity and other patient variables

Patient counselling and education on prescription medications, including:
- Confirmation of identity of the client
- Indication for use of the medication
- Directions for proper use
- Duration of therapy and onset of action
- Management of common adverse effects, interactions and therapeutic concerns
- Storage and handling requirements
- Adherence issues and missed doses
- When to seek medical attention and follow up
- Nonpharmacological and lifestyle measures

Patient counselling and education for administration of various dosage forms, including:
- Pulmonary delivery
- Ophthalmic, otic, and nasal delivery
- Topical products
- Vaginal and rectal delivery
- Transdermal delivery
- Oral, sublingual, and buccal dosage forms
- Parenteral products
- Other

Patient counselling and education to promote adherence to regimens and therapy
- Strategies to optimize adherence
- Identification of under-utilization of medication
- Identification of over-utilization of medication

Patient counselling and education on diagnostic/monitoring tools, including:
- Home blood glucose monitoring
- Blood pressure monitors
- Home pregnancy/ovulation test kits
- Thermometers
- Peak flow meters
TOPICS OF STUDY: COMMUNICATION / PATIENT COUNSELLING cont’d

Patient counselling and education on nonprescription medications
   Self-care topics and issues

Patient counselling and education on “no public access” medications

Patient counselling and education on herbal and complementary therapies

Patient counselling and education on home health care, including:
   Medical supplies
   Aids for daily living
   Foot care
   Wound care
   Other

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DRUG INFORMATION

TOPICS OF STUDY: DRUG INFORMATION

Selection of suitable references and information databases
   Cochrane Collaborative Library
   Medline
   Micromedex
   Lexicomp
   RxFiles
   RxTx
   Primary, secondary, tertiary references

Response to drug information requests
LITERATURE EVALUATION / RESEARCH METHODS / EVIDENCE-BASED DECISION-MAKING (including PHARMACOEPIDEMIOLOGY)

TOPICS OF STUDY: LITERATURE EVALUATION / RESEARCH METHODS / EVIDENCE-BASED DECISION-MAKING (including PHARMACOEPIDEMIOLOGY)

Evaluation of drug literature and scientific information (critical appraisal)
Clinical Trials
Evidence-based medicine
Clinical practice guidelines
Systematic reviews and meta-analysis
Observational studies
Conflict of interest, publication bias, research funding source, research ethics, institutional review boards (IRB)
Cochrane Collaboration and similar agencies

Research Methods

Design
Placebo-controlled, cross-over, washout, factorial, N of 1, parallel
Randomized, cohort, case-control, cross sectional, case reports, population studies
Experimental, causal-comparative, correlational, descriptive, historical

Measures
Frequency
Prevalence, incidence, cumulative incidence, risk
Association
Relative risk reduction or benefit, absolute risk reduction or benefit, odds ratio, number-needed-to-treat, hazards ratio

Validity
Internal
Bias and confounding
External
Generalizability

Diagnostic testing
Sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratio
MEDICATION / PATIENT SAFETY PRACTICES

TOPICS OF STUDY: MEDICATION / PATIENT SAFETY PRACTICES

Policies and procedures to ensure safety and effectiveness of persons, medical products and pharmacy services

Canada Vigilance Program - adverse drug reaction monitoring

Health Canada MedEffect: advisories, warnings and recalls

Development of strategies and actions to prevent medication incidents
  Error-prone abbreviations and dosage designations
  Look-alike and sound-alike drug names

Identification, management, and documentation of medication incidents – National System for Incident Reporting (NSIR) and Canadian Medication Incident Reports and Prevention System (CMIRPS)

Institute for Safe Medication Practices (ISMP)

Medication reconciliation

Canadian Patient Safety Institute (CPSI)
TOPICS OF STUDY: LAW / JURISPRUDENCE

Provincial Regulatory Authorities (PRAs)
   Mandate, Roles, Responsibilities

NAPRA
   Mandate, Roles, Responsibilities

Federal legislation
   Prescriptive authorities and regulatory issues pertaining to the profession of pharmacy

Food and Drugs Act and Regulations

Controlled Drugs and Substances Act
   Precursor Control Regulations
   Benzodiazepines and other Targeted Substances Regulations
   Marihuana medical access

Narcotic Control Regulations

Privacy legislation
   Personal Information Protection and Electronic Documents Act (PIPEDA)

Hazardous Products Act
   WHMIS
PROFESSIONALISM/ ETHICS

GENERAL DESCRIPTION

The study of professionalism and ethics encompasses consideration of basic principles and values that form the ethical foundations for the provision of care by health care professionals including pharmacists.

TOPICS OF STUDY: PROFESSIONALISM / ETHICS

Ethical principles
- Beneficence, nonmaleficence, autonomy, justice, veracity, fidelity

Patient consent and decision-making
- Capacity, encumbrances, competency
- Patient surrogates: substituted judgement, best interest judgment, advance directives, living wills, children and minors, the place of the family

Confidentiality and privacy

Continuity of care

Advocacy for the patient

Conflict between the pharmacist and other health care providers about patient care

Respect for life and the autonomy of patients
- Contraception, emergency contraception, abortion
- Euthanasia, assisted suicide, Medical Assistance in Dying (MaiD)
- Palliative care, pain management, and end-of-life care

Respecting professional boundaries

Pharmacist conscientious objection (right to refuse)

Other Issues in pharmacy and health care ethics
- Clinical drug trials research
- Health reform and allocation of limited resources
- Interdisciplinary decision-making
- Ethics committees
- Conflict of interest (gifts from patients and the pharmaceutical industry)

Professionalism
- Trust, integrity, competence, respect, altruism, compassion, collegiality
COLLABORATIVE PATIENT CARE

TOPICS OF STUDY: COLLABORATIVE PATIENT CARE

Collaboration with other health care professionals to optimize patient outcomes

Referral to other health care providers for specific services
  Identifying need
  Most appropriate resource or health care professional

Effective working relationships
  Establishing rapport
  Decision-making strategies
  Accountability
  Conflict resolution
  Scopes of practice

Promotion of health and wellness in the community
BEHAVIOURAL, SOCIAL AND ADMINISTRATIVE PHARMACY SCIENCES

Pharmacy Management (including Financial, Personnel, Marketing, Quality Improvement, Risk Management and Workplace Safety)

Canadian Health Care System

Pharmacoeconomics

Biostatistics
PHARMACY MANAGEMENT

TOPICS OF STUDY: PHARMACY MANAGEMENT

Basic Responsibilities of Management

The classical functions of management
Planning, organizing, staffing, directing, coordinating, controlling, reviewing, leading, managing conflict, budgeting, managing risk

Entrepreneurship
Risk and innovation

Components of the business plan
Market analysis (SWOT)
Business structure and corporate governance
Product or service offering
Competitive strategy
Positioning
Financing
Human and physical resources, operations and monitoring of performance
Risk management

Workplace safety
WHMIS (Workplace Hazardous Materials Information System)

Marketing Management in Pharmacy

General principles of marketing
"4 P's" of marketing management
Merchandising

Human Resource Management in Pharmacy

Theories of management and organizational behaviour
Job descriptions, delegation, leadership, styles of management
Trade unions, contracts, collective bargaining
Employee motivation, performance appraisal, discipline
Recruitment and retention of staff
Scope of practice for pharmacists, pharmacy technicians, non-regulated staff
TOPICS OF STUDY: PHARMACY MANAGEMENT cont’d

Financial Management in Pharmacy

Financial statements
  Basic accounting procedures
  Interpretation of balance sheet, income statement information

Measures (ratios) of financial performance of a business
  Profitability, solvency, liquidity, inventory control

Community Pharmacy Management

Forms of legal ownership
  Sole proprietorship, partnership, corporation, cooperative

Pharmacy ownership structures
  Independents, chain, franchise, mass merchandise, specialty, mail order, banner groups, central fill facilities

Medication Use Management Procedures
  Cognitive pharmacy services, medication reconciliation, medication safety procedures, medication error reporting, continuous quality improvement

Risk Management

Hospital Pharmacy Management

Drug Distribution Control Systems
  Unit dose, automated dispensing devices, IV additive services, computer-based order entry and prescribing, controlled drug handling, drug disposal procedures, drug identification and labelling, investigational drugs, automated medication records, electronic health records, inventory management

Medication Use Management Procedures
  Clinical pharmacy activities, formulary systems, Pharmacy and Therapeutics committees, medication reconciliation, medication safety procedures, medical errors, documentation by pharmacists in the health record, drug use review, continuous quality improvement

Risk management
CANADIAN HEALTH CARE SYSTEM

TOPICS OF STUDY: CANADIAN HEALTH CARE SYSTEM

Governance and Standards

About Health Canada
  Branches and agencies
  Canada's health care system (Medicare)
  Responsibilities of federal government in regulating health care services, new
drug approval and manufacturing (Health Canada) and the Canada Health Act

Health Canada: Delivery of drugs and health products
  New drug development and approval
  Drug Product Database
  Special Access Programme
  MedEffect: advisories, warnings, and recalls
  Canada Vigilance Program - adverse drug reaction monitoring
  Natural health products

Responsibilities of provincial governments in regulating health care services, professions
and drug distribution

Function of provincial regulatory authorities in the establishment of standards for
pharmacy practice and registration of pharmacists and pharmacy technicians

National Association of Pharmacy Regulatory Authorities (NAPRA)
  National drug scheduling (schedule I, schedule II, schedule III, and unscheduled
  status)
  Model Standards of Practice

PIPEDA- Personal Information Protection and Electronic Documents Act

The Pharmaceutical Industry and Related Agencies

Pharmaceutical industry
  New drug development and approval by Health Canada
  Pharmaceutical marketing and advertising
  Regulation of advertising
  Canada’s Research-Based Pharmaceutical Companies (Rx & D)
  Canadian Generic Pharmaceutical Association (CGPA)
  Nonprescription Drug Manufacturers Association of Canada (NDMAC)

Canadian Agency for Drugs and Technologies in Health (CADTH)
  Healthcare technology assessment
  Common Drug Review directorate
TOPICS OF STUDY: CANADIAN HEALTH CARE SYSTEM cont’d

Patented Medicines Prices Review Board (PMPRB)
Institute for Safe Medication Practices (ISMP) Canada
Canadian Institute for Health Information (CIHI)
Canadian Institutes for Health Research (CIHR)
Public Health Agency of Canada (PHAC)

Contemporary Issues in the Structure and Functioning of the Canadian Health Care System

- Financing and the cost of health care services
- Delivery of health care (primary, secondary)
- Care and changing models of primary care
- Access to privately funded (market driven) health care providers and facilities
- Telehealth resource services
- Human resources (shortages of health care personnel and changing scopes of practice)

Pharmacy Law and Regulation of the Profession

- Provincial regulation of pharmacy practice and the operation of pharmacies
- Potential liability of pharmacists under federal and provincial statutes
- Potential liability of pharmacists in civil disputes
- Application of business law to the operation of pharmacies

Scientific and Humanistic Approaches to Modern (‘Western’) Medicine and Pharmacotherapy

- Evidence-based practice
- Complementary and alternative therapies
- Pharmacist’s role in preventing medical error and drug-related misadventure
- Medication adherence and promotion of healthy lifestyles and wellness
- Health literacy
- Cultural competency and diversity
- Health care of “at risk” populations (e.g., mental illnesses, First Nations, seniors, drug dependencies)

Hospital Pharmacy Practice Developments

- Medication reconciliation
- Regional management of institutional health system pharmacies
- Recruitment and retention of pharmacy personnel
- Medication use safety systems
- Promoting seamless care
TOPICS OF STUDY: CANADIAN HEALTH CARE SYSTEM cont’d

Community Pharmacy Practice Developments

- Reimbursement for clinical pharmacy services
- Influence of 3rd party drug insurance plans on pharmacy practice
- Rural and remote pharmacy practice
- Prescriptive authority for pharmacists
- Collaborative medication management with physicians and other providers
PHARMACOECONOMICS

TOPICS OF STUDY: PHARMACOECONOMICS

Health Care Economics

Supply and demand factors
- Hospitals and health care facilities capacity
- Physician services
- Population demographics and incidence of disease
- Chronic disease management

Pricing and demand for pharmaceuticals and pharmacy services in Canada
- Influence of pharmaceutical industry marketing and advertising
- Patented Medicines Prices Review Board (PMPRB)
- Pharmacist professional fees and cognitive fees
- Markups, rebates and discounts

Third party prescription insurance plans and payment policies
- Role of private payers and provincial drug plans
- Formulary restrictions (generic substitution, therapeutic interchange and non-formulary drugs)
- Role of copayments and deductible limits
- Prescription quantity limitations
- Prior (special) authorization policies
- Reference-based drug policies

Drug use management strategies
- Drug use review agencies
- Academic detailing and educational support to prescribers and pharmacists
- Clinical practice guidelines and protocols

Pharmacoeconomics

Types of pharmacoeconomic analyses
- Cost-effectiveness
- Cost-benefit
- Cost-minimization
- Cost utility

Related pharmacoeconomic concepts
- Health utilities
- Quality of life tools
- Willingness to pay
- Time trade-off analyses
- Discounting
- Preferences
- Societal costs and benefits vs. individual costs and benefits
- Sensitivity analyses
- Perspective
TOPICS OF STUDY: BIOSTATISTICS

Definition of population
- Sample, sampling, sample size, clusters, stratified
- Sample error, sampling bias, representativeness, generalizability
- Inclusion criteria, exclusion criteria

Characteristics of data:
- Types of data: continuous, interval, ordinal, nominal, ratio, qualitative, surveys
- Distribution of data: normal, non-normal, skewed
- Precision, validity, reliability, accuracy
- Variables: dependent, independent, confounding, covariant
- Outcomes and endpoints: primary, secondary, clinical, laboratory, quality of life, economic

Data analysis
- Descriptive analysis: mean, median, mode, relative position, variability, relationships
- Inferential: hypothesis testing, significance, variance, confidence interval, power, error, probability, frequency, prediction, causality, correlation
- Statistical Tests: parametric, nonparametric, meta-analysis
- Significance: clinical, statistical, limitations, assumptions