PHARMACIST

EVALUATING EXAMINATION

SYLLABUS

The Pharmacy Examining Board of Canada

2010

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EVALUATING EXAMINATION SYLLABUS

INTRODUCTION

The PEBC Pharmacist Evaluating Examination syllabus is available on our web site (www.pebc.ca), effective March, 2010. If you would like a printed copy of this syllabus, please send your request along with the fee of $35 (cheque, money order or international bank draft in Canadian funds only; cash is not accepted), to the PEBC office at 717 Church Street, Toronto, Ontario M4W 2M4.

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 background knowledge base in the pharmaceutical sciences and 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 pharmaceutical 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
- 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 outlined in the Pharmacist Evaluating Examination Information Booklet (available from the web site: www.pebc.ca).

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 printed in the Pharmacist Evaluating Examination Information Booklet (available from the web site: www.pebc.ca).

BIOMEDICAL SCIENCES

Biochemistry/Genomics and Molecular Biology/Nutrition/Clinical Biochemistry

Physiology/Functional Anatomy and Immunology

Pathophysiology and Pathology

Medical Microbiology

BIOCHEMISTRY/ GENOMICS AND MOLECULAR BIOLOGY/ NUTRITION/ CLINICAL BIOCHEMISTRY

GENERAL DESCRIPTION: BIOCHEMISTRY AND NUTRITION

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 AND NUTRITION

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, effects of puromycin, tetracycline, chloramphenical, streptomycin, tunicamycin and diphtheria toxin

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

Lipids and membranes

TOPICS OF STUDY: BIOCHEMISTRY AND NUTRITION contd.

Nutrition

Human biochemistry

Digestion

Function of nutrients in the body

Dietary requirements and Canada Food Guidelines

Assessment of nutritional status

Malnutrition and effects on health

Metabolism and transport of nutrients

Regulation of blood glucose

Weight management and eating disorders

Nutrigenomics
- Genetic make-up and diet influences on health

Nutritional Control of Chronic Disease Risk
- Obesity as a risk factor

GENERAL DESCRIPTION: GENOMICS AND MOLECULAR BIOLOGY

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: GENOMICS AND MOLECULAR BIOLOGY

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 approaches

GENERAL DESCRIPTION: CLINICAL BIOCHEMISTRY

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

TOPICS OF STUDY: CLINICAL BIOCHEMISTRY

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, PT and other factors)

Coomb's test

Electrolytes and Blood Chemistry

Sodium

Potassium

Chloride

Glucose (random or FBG)

BUN

Creatinine

Uric Acid

Cholesterol

Total serum protein

Arterial Blood Gases (PaO_2, $PaCO_2$)

TOPICS OF STUDY: CLINICAL BIOCHEMISTRY contd.

pH

Anion gap

Bicarbonate

Liver Biochemistry

Bilirubin

Alkaline phosphatase (ALP)

Transaminases (AST, ALT)

Albumin

Prothrombin and INR

α-Fetoprotein

Bone Metabolism

Bone mineral density

Minerals (calcium, phosphates)

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

Inulin clearance

Para-amino hippuric acid (PAH) clearance

TOPICS OF STUDY: CLINICAL BIOCHEMISTRY contd.

Gastrointestinal Tract

Fecal fat

Schilling's test

Occult blood

Endoscopy

Barium enema, CT scan

Pulmonary Function Tests

Pulmonary function testing (FEV_1)

Histamine, methacholine challenge test

Neurology

Electroencephalogram (EEG)

Cerebral spinal fluid (CSF)

Cardiovascular Diagnostic Tests

Cardiac Isoenzymes (including Creatine kinase)

Troponin

Lipoprotein profile (LDL, HDL, Triglycerides, Cholesterol)

Neoplasm Screening

Prostate-specific antigen (PSA)

Breast self-examination

Mammogram

Pap smear

Biopsy

TOPICS OF STUDY: CLINICAL BIOCHEMISTRY contd.

Endocrinology

Hypothalamus-Pituitary axis
- Prolactin
- Growth hormone (GH)
- Gonadotropins (LH and FSH)
- Thyrotropin (TSH)
- Adrenocorticotropin (ACTH)

Adrenal disorders
- Plasma cortisol
- Urine and serum osmolality

Thyroid Function
- TSH
- T_3 suppression test
- T_4 (Thyroxine - direct and indirect)
- Thyroid iodine uptake

Sex Hormones
- Androgens
- Estrogens
- Progestins
- Pregnancy testing

Diabetes and Glucometry
- Glucose tolerance Test
- Fasting blood glucose
- Serum and urine 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 Assay

PHYSIOLOGY/ FUNCTIONAL ANATOMY AND IMMUNOLOGY

GENERAL DESCRIPTION: HUMAN PHYSIOLOGY/FUNCTIONAL ANATOMY

This course explains normal physiology of the human body (with emphasis on cellular mechanisms), and gives a general review of systemic human anatomy (with clinical applications). The goal of this course 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
- Causes of AIDS
- Problems with tissue transplants

Cardiovascular System

The structure and contractile properties of the heart

Mechanical forces regulating blood pressure

Hormonal and neural regulating mechanisms

Interactions of commonly used drugs with the cardiovascular system

TOPICS OF STUDY: HUMAN PHYSIOLOGY contd.

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
- Basal ganglia disorders such as Parkinson's and Huntington's Chorea

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 contd.

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- clinical anatomy

Autonomic Nervous System
Centres of control; sympathetic and parasympathetic systems;
neurotransmitters

Organs of Special Sense

Eye, Ear, Olfaction, Taste

TOPICS OF STUDY: FUNCTIONAL ANATOMY contd.

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

Gross anatomy; functional significance; clinical aspects

The Lymphatic System

Significance

Gross anatomy and histology of lymphatic tissue

Lymphatic vessels; lymph node

Spleen, thymus, appendix

IMMUNOLOGY

GENERAL DESCRIPTION: IMMUNOLOGY

In this course, an overview is presented of the immune system, immune responses, defence mechanisms against infectious disease and treatment applications. 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 Histocompatability 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 (eg: OKT3 and HA-1A)

See also: Section under **Biotechnology and Pharmacogenetics**

GENERAL DESCRIPTION: PATHOPHYSIOLOGY AND PATHOLOGY

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

TOPICS OF STUDY: PATHOPHYSIOLOGY AND PATHOLOGY

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: anaphylactic, cytotoxic, immune complex, delayed

Autoimmune diseases

TOPICS OF STUDY: PATHOPHYSIOLOGY AND PATHOLOGY contd.

FOR THE FOLLOWING DISEASES, PLEASE REVIEW THE: ETIOLOGY, PATHOGENESIS, CLINICAL PRESENTATION AND LAB INVESTIGATION

Obstructive Lung Disease

Asthma

Chronic Obstructive Pulmonary Diseases (COPD)
- Chronic bronchitis
- Emphysema

Gastrointestinal Diseases (Non- Neoplastic)

Reflux esophagitis (GERD)

Peptic ulcer disease / Dyspepsia

Gastritis
- Acute haemorrhagic/erosive gastritis
- Chronic non-erosive gastritis
- Infectious gastritis (i.e. *Helicobacter pylori*)

Inflammatory Bowel Disease
- Crohn's disease
- Ulcerative colitis

Zollinger-Ellison syndrome

Liver Disease

Cholestasis

Hepatitis (A, B, C)

Cirrhosis

Drug-induced hepatotoxicity

Tumours

Liver biochemistry (see Clinical Biochemistry section)

Renal Disease

Acute renal insufficiency

Chronic renal insufficiency

Lab investigation (see Clinical Biochemistry section)

TOPICS OF STUDY: PATHOPHYSIOLOGY AND PATHOLOGY contd.

Endocrinology

Thyroid Disorders
- Hyperthyroidism
- Hypothyroidism

Adrenal Disorders
- Cushing's Syndrome
- Addison's Disease
- Pheochromocytoma

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

Congestive 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. vit B_{12} deficiency and folic acid deficiency)

Haemostatic disorders

TOPICS OF STUDY: PATHOPHYSIOLOGY AND PATHOLOGY contd.

Neurology

Neurodegenerative diseases
Alzheimer's Disease and dementias Parkinson's Disease

Pain and headache
- Acute or chronic
- Migraine
- Nociceptive or neuropathic

Seizure disorders

Stroke

Psychiatry

Anorexia, bulimia and eating disorders

Anxiety and agitation disorders

Attention Deficit Hyperactivity Disorder (ADHD)

Bipolar disorder

Depression (ajor depression)

Insomnia

Schizophrenia

Carcinogenesis and Neoplasia

Genetic basis of carcinoma

Sites
- Lung and gastrointestinal neoplasms
- Gynecologic neoplasms
- Urinary tract neoplasms
- Hematology (i.e. leukemia and lymphoma)
- Skin NeoplasmsMalignant melanoma and others
- Cancer of the bone, brain, breast, prostate

COURSE DESCRIPTION: MEDICAL MICROBIOLOGY

This course of study includes the general biology of micro organisms 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, prostheses

Skin and Wound infections
- Cellulitis, Impetego, wounds

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

Infections of the eye
- Conjunctivitis

Infections of the Urogenital Tract
- Urinary tract infections
- Sexually transmitted infections

Infections of the CNS
- Meningitis
- Abcesses

TOPICS OF STUDY: MEDICAL MICROBIOLOGY contd.

Infections of the respiratory tract
- Otitis, pharyngitis, sinusitis
- Tuberculosis
- Pneumonia, bronchitis, pleurisy, croup
- Mycoplasma, Legionella, Chlamydia

Antimicrobial Agents

β-Lactams, Cephalosporins

Quinolones

Macrolides, Ketolides, Clindamycin, Tetracyclines

Aminoglycosides, Vancomycin

Sulfonamides and Trimethoprim

Metronidazole, Chloramphenicol

Viral Infections

Properties, structure, replication, and transmission

Viral pathogenesis, host response and principles of diagnostic virology

Sites of viral infections
- Respiratory tract
- CNS
- Prion diseases
- Gastrointestinal tract
- HIV and AIDS
- Herpes viruses
- Viral hepatitis
- Measles, mumps, rubella
- Chickenpox and shingles
- Infections in the fetus and newborn
- Skin, mucous membranes
- Childhood Fevers

Antiviral Agents

TOPICS OF STUDY: MEDICAL MICROBIOLOGY contd.

Parasitology

Protazoal Diseases
- Protazoas and Helminths

Malaria

Ectoparasites
- Lice, Scabies, Ticks

Mycology

Properties, structure, replication, and transmission

Systemic Mycoses
- Candida
- Aspergillus
- Histoplasmosis
- Blastomycosis
- Coccidiodomycosis
- Cryptococcosis

Superficial Mycoses
- Dermatophytes

Antifungal Agents

Sterilization and Disinfection

Hospital epidemiology

Infection control methods (Clean room, Laminar Flow Hood)

Immunoprophylaxis and Vaccines

PHARMACEUTICAL SCIENCES

Pharmaceutics and Drug Delivery Systems

Phamacokinetics and Biopharmaceutics

Medicinal Chemistry

Pharmacology

Toxicology and Clinical Toxicology

Pharmaceutical Analysis

Biotechnology and Pharmacogenetics

GENERAL DESCRIPTION: PHARMACEUTICS AND DRUG DELIVERY SYSTEMS

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 study includes the role of biopharmaceutics, preformulation 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, H bonding, 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 contd.

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 solution
- 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 Contd.

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

Intrapulmonary 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 Contd.

Dermal 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 Contd.

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

COURSE DESCRIPTION: PHARMACOKINETICS & BIOPHARMACEUTICS

This course 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 contd.

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 contd.

Therapeutic Drug Monitoring
- Drugs in renal failure: Aminoglycosides; Cyclosporine A
- Drugs with saturable kinetics: Phenytoin; Salicylates
- Drugs with linear kinetics: Theophylline; Digoxin; Procainamide

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
- From urinary excretion data for one compartment open model

Looking at drug concentration vs. time curves
- Determining what model the drug follows

Clearance rates

Loading doses and time to reach steady state

GENERAL DESCRIPTION: MEDICINAL CHEMISTRY

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.

Nomenclature of organic chemistry

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
- Alkyl halides: halothane, isoflurane, etc.
- Nitrates, nitrites, and nitroglycerin
- Antioxidants in pharmaceutical preparations

Fundamental Concepts of Medicinal Chemistry:

Structure-activity relationships

Ionization and pK_a 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 contd.

Biological properties: absorption, distribution, metabolism, excretion, pharmacological activity

Nomenclature that is specific to medicinal chemistry

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

History of Selected Anti-infective Agents

Dihydropteroate synthetase inhibitors and bacteriostatic agents

Sulfanilamides and sulfones compared with p-aminobenzoic acid

Avoiding crystalluria through ionization

Dihydrofolate reductase inhibitors and related biochemical pathways

Review of Ion Channels (Sodium, Potassium And Calcium)

State dependent interactions of voltage-gated ion channels

Resting state and use-dependent blocking

Local anaesthetics and anti-arrhythmic agents

Ion channel-related adverse effects of drugs

Therapeutic Applications of Steroids

Cholesterol regulation and atherosclerosis: e.g., HMG-CoA reductase inhibitors

Steroid and thyroid hormone receptors

Steroids and gonadotropins.

Estrogens and progestin, including selective estrogen receptor modulators

Corticosteroids

Carbonic Anhydrase and Angiotensin Converting Enzyme

Carbonic anhydrase inhibitors: therapeutic applications

ACE inhibitors and angiotensin II receptor antagonists

TOPICS OF STUDY: MEDICINAL CHEMISTRY contd.

Comparison with diuretics in antihypertensive applications

Nicotinic Receptors

Applications in the peripheral and central nervous systems

Muscarinic Receptors

Importance in the heart and smooth muscles

General importance in the autonomic nervous system

Atropine: discussion of structures of anticholinergics

Acetylcholinesterase inhibitors: indirect-acting cholinergic agonists

Adrenergic Receptors

General importance of the adrenergic or sympathetic nervous system

Agonists as vasoconstrictors, presynaptic $alpha_2$ receptors

Beta-blockers and treatment of hypertension

Treatment of asthma and $beta_2$-selective agonists

Amphetamines and MAO Inhibitors

Review of the structure of the blood-brain barrier

Discussion of amphetamines: CNS stimulants and anorectic agents

Selected MAO-A and MAO-B inhibitor structural classes

Dopamine Receptors

L-dopa therapy in the treatment of Parkinsonism: decarboxylase inhibitors

Antipsychotic therapy by neuroleptic agents: important structural classes

Serotonin Receptors

General importance in the central nervous system

Reuptake inhibitors and antidepressants

Some antiemetic and migraine therapeutic agents

TOPICS OF STUDY: MEDICINAL CHEMISTRY contd.

Histamine Receptors

Histamine and its role as a local hormone

Antihistamines (H_1 antagonists) and treatment of allergies

H_2 antagonists: development of these agents

Acid suppression by other mechanisms: proton pump inhibitors

GABA Receptors

General importance in the central nervous system

Review of barbiturates and benzodiazepines

GABA deficiencies and certain diseases of the central nervous system

DNA Intercalating Agents (anticancer and antibacterial applications)

Review of the DNA structure

Essential molecular characteristics of intercalating agents

Review of important antitumour antibiotics as well as antibacterial agents

Opioid Analgesics

Morphine: structural link with the enkephalins

Enkephalins and endorphins

Codeine, heroin and meperidine and others related to morphine

Eicosanoids

Endogenous compounds: prostanoids and leukotrienes

COX-1 and COX-2 inhibition (NSAIDs)

Leukotriene receptor antagonists and eicosanoid enzyme inhibitors.

Platelet activating factor, membrane lipids, and antiplatelet agents

Antibiotics

Agents acting as protein synthesis inhibitors in bacteria

Agents acting on cell membranes, including antibacterial and antifungal applications

TOPICS OF STUDY: MEDICINAL CHEMISTRY contd.

Mechanisms and structures of agents with narrow and broad spectrum profiles

Microtubules (anticancer, antifungal, antibacterial applications)

Paclitaxel, docetaxel, and vinca alkaloids as antitumor agents

Griseofulvin: antifungal therapies

Colchicine in gout and selected anthelmintic agents

Diabetes Mellitus

Insulin and glucagon

Hypoglycemic agents

Selected agents for treating insulin resistance

Amino Acids, Proteins, Enzymes & Peptide Hormones

Important hormones such as thyroid hormones

Peptidomimetics and peptide synthesis: e.g., hormones of hypothalamic origin such as gonadotropin-releasing hormone (superagonists)

PHARMACOLOGY

GENERAL DESCRIPTION: PHARMACOLOGY

The study of basic pharmacological principles is applied to representative clinically important drugs having their primary actions on various organ systems of the body. The course includes a 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 (Autonomic Nervous System)

Drugs and catecholamine metabolism

Sympathomimetics

Adrenoceptor blockade

Cholinomimetics

Anticholinesterases

Muscarinic blockade

Ganglionic blockade

Neuromuscular blockade

Anaesthetics

Local anaesthetics

General anaesthetics

TOPICS OF STUDY: PHARMACOLOGY contd.

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

Immunosuppressants

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

Central Nervous System Pharmacology

Pain and opioid analgesics

Anxiolytic drugs

Hypnotic drugs

Neuroleptic drugs

Antidepressants

Psychostimulants

Anti-Parkinson drugs

Antiseizure drugs

Anti-Alzheimer's drugs

Drugs Affecting the Haematopoietic System

Iron, folic acid, vitamin B12, erythropoietin

Immunosuppressants used for heart transplantation

TOPICS OF STUDY: PHARMACOLOGY contd.

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

Anti-platelet drugs

Fibrinolytics and anti-fibrinolytic drugs

Antihyperlipidemic Drugs

Diuretics

Cancer Chemotherapy

Alkylating agents, antimetabolites, cytotoxic antibiotics, plant alkaloids, hormones,

Adjunctive agents including antiemetics

TOPICS OF STUDY: PHARMACOLOGY contd.

Gastro-Intestinal Pharmacology

Drugs affecting GI motility

Drugs affecting gastric secretion

Drugs for eating disorders

Anti-obesity drugs

Endocrine Pharmacology

Insulin and oral hypoglycemics

Corticosteroids

Thyroid and anti-thyroid drugs

Androgens and anabolic steroids

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

Vasopressin

Oxytocin

Bone mineral homeostasis

Anti-Microbial Agents

Antibacterial drugs

Beta-lactam antibiotics, cephalosporins, sulphonamides, trimethoprim, tetracyclines, chloramphenicol, aminoglycosides, erythromycin, macrolides, ketolides, lincosamides, fluoroquinolones, vancomycin, polymyxin, bacitracin, metronidazole, nitrofurantoin, antimycobacterial agents

Antiviral drugs

Antifungal drugs

Antiprotozoal drugs

Anthelmintic drugs

TOPICS OF STUDY: PHARMACOLOGY contd.

Drugs of Abuse

Ethanol, amphetamines, barbiturates, benzodiazepines (including flunitrazepam), nicotine, cannabis, GHB, cocaine/crack, heroin, ketamine, methadone, nitrites, solvents, hallucinogens: ecstasy, PCP, LSD, mescaline

TOXICOLOGY AND CLINICAL TOXICOLOGY

GENERAL DESCRIPTION: TOXICOLOGY & CLINICAL TOXICOLOGY

Concerned primarily with drug-induced diseases, this course 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

Neurodegenerative Disease

Hepatic Toxicology

Mechanisms and clinical consequences

TOPICS OF STUDY: TOXICOLOGY & CLINICAL TOXICOLOGY contd.

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

Venoms

GENERAL DESCRIPTION: PHARMACEUTICAL ANALYSIS

The following study material should provide a thorough understanding of all those analytical processes involved in the qualitative and quantitative measurement of drugs and their metabolites. This would include specific analytical procedures and instrumentation, as well as the fundamental basis on which these procedures are based. Students should also be able to evaluate data obtained by these methods in terms of reliability and significance.

TOPICS OF STUDY: PHARMACEUTICAL ANALYSIS

Fundamental Basis for Sample Preparation and the Analysis of Drugs and/or Drug Metabolites

Recognition of the origins of acidity and basicity of drug molecules

Prediction of pKa by inspection of molecular structure

Prediction of pH of an aqueous solution of drug and estimation of % charged or uncharged at any given pH

Impact of plasma proteins in drug analysis

Internal versus external standards

Choice of internal standard

Extraction methods, liquid/liquid and solid phase extraction

Partition coefficients and choice of extraction solvents

Standard curves and their use

Pharmacopoeia and in-house standards

Analytical validation and good laboratory practice

TOPICS OF STUDY: PHARMACEUTICAL ANALYSIS contd.

Methods in Drug Analysis

Chromatographic Separation Methods
- Thin Layer and Paper Chromatography
- High Pressure Liquid Chromatography **(HPLC has a major emphasis)**
- Gas Liquid Chromatography (GLC)
- For each:
  - Principles of the technique
  - Limitations, qualitative versus quantitative
  - Choice of stationary and mobile phases
  - Specialized reagents (spray reagents, derivatization reagents and chiral analyses) and detection systems

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

Biological Extraction and immunoassay methods
- Immobilized enzymes and cells
- Immunoassays, radioimmunoassay and EIA
- Radioreceptor assays
- Microbial assays

Statistical methods in analysis of data
- Regression
- Correlation
- Confidence intervals

Pharmaceutical Applications
- Standards for new drugs
- Quality control of drug products
- Stability testing (expiry, storage)
- Assays for therapeutic drug monitoring
- Assays for drug abuse or overdose
- Innovations in biotechnology assays

BIOTECHNOLOGY AND PHARMACOGENETICS

GENERAL DESCRIPTION: BIOTECHNOLOGY AND PHARMACOGENETICS

In this course, 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 contd.

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 and factor VIII
- Follicle stimulating hormone
- 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 contd.

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
    ADA in immunodeficiency and IL-2 in cancer

Future prospects

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 contd.

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
- (e.g.: OKT3 and HA-1A)

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 contd.

Erythropoietin

Thrombolytic Agents

Comparison of t-PA, streptokinase, and urokinase

Formulation of Protein and Peptide Drugs

Problems: stability, bioavailability and routes of administration

Recent approaches in protein and peptide drug delivery

PHARMACY PRACTICE

Therapeutics (including Non-Prescription Medication)

Professional Practice Skills

THERAPEUTICS (INCLUDING NONPRESCRIPTION MEDICATIONS)

GENERAL DESCRIPTION: THERAPEUTICS

This course 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 (over-the-counter) 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 pharmaceutical 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 pharmaceutical 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: THERAPEUTICS

FOR THE FOLLOWING DISEASES, THERAPEUTICS CONSIDERATIONS SHOULD INCLUDE PRESCRIPTION MEDICATION, SELF-CARE (OVER-THE-COUNTER) TREATMENTS, NON-PHARMACEUTICAL APPROACHES AS WELL AS ALTERNATIVE (COMPLEMENTARY) TREATMENTS.

Respiratory Diseases

Asthma
Chronic obstructive pulmonary diseases (COPD)
Croup
Smoking cessation

TOPICS OF STUDY: THERAPEUTICS contd.

Dermatology

Acne
Acne Rosacea
Allergic 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
Pharyngitis
Teething
Viral upper respiratory tract infections

Gastroenterology

Cirrhosis
Constipation
Crohn's disease
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’s disease and Ulcerative colitis
Irritable Bowel Syndrome
Nausea and vomiting
Pseudomembranous colitis

TOPICS OF STUDY: THERAPEUTICS contd.

Cardiovascular diseases

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

Urology

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

Musculo-skeletal diseases

Chronic pain
Multiple sclerosis (MS)
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)
Sexually transmitted infections
Vaginal candidiasis

TOPICS OF STUDY: THERAPEUTICS contd.

Infectious Diseases

Bone and joint infection (osteomyelitis)
Central nervous system infection
Infections of the traveller
Endocarditis
Fungal infections
Gastrointestinal infections
HIV and AIDS (including opportunistic infections)
Intra-abdominal infections
Malaria prevention
Meningitis
Pneumonia (community acquired pneumonia and nosocomial)
Respiratory tract infections (lower and upper)
Sepsis and septic shock
Skin and soft tissue infections
Surgical prophylaxis
Tuberculosis
Urinary tract infections (UTIs)

Neurology

Alzheimer's disease and other dementias
Headaches (migraine, tension headache, rebound headache)
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 (manic-depressive psychosis)
Depression
Drug withdrawal syndromes
Insomnia and sleep disorders
Panic disorder
Personality disorders
Schizophrenia

TOPICS OF STUDY: THERAPEUTICS contd.

Nephrology

Chronic renal dysfunction
Nephrotoxicity
Renal transplantation

Other

Anemias
Chemotherapy and related toxicities
Dehydration
Fluid and electrolyte disorders
Obesity

GENERAL DESCRIPTION: PROFESSIONAL PRACTICE SKILLS

Courses covering the broad subject area of Pharmacy professional practice skills encompass the study of:

- pharmaceutical care
- client records
- prescription processing and dispensing
- communications, patient counselling and education
- safety issues and incident prevention
- drug information and evidence-based decision-making
- jurisprudence: federal law, prescriptive authority and regulatory issues
- health promotion, disease prevention and social issues

TOPICS OF STUDY: PROFESSIONAL PRACTICE SKILLS

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

Document clinical status and any changes in pharmacotherapy that are required

Assess patient for any new drug therapy problems

Schedule the next follow-up evaluation

Client Records

Application of privacy legislation and ethical considerations

Preparation and maintenance of patient records (includes profiles, charts, etc)

TOPICS OF STUDY: PROFESSIONAL PRACTICE SKILLS contd.

Prescription Processing and Dispensing

Accurate interpretation of prescription orders

Accurate calculations

Application of legislative requirements (federal legislation) see Jurisprudence section also

Extemporaneous compounding

Sterile preparations and pharmaceutical biohazards

Safe storage, handling and disposal of Drugs
- Cold chain management

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

Communications, Patient Counselling and Education

Pharmacist Interactions in the workplace
- Effective dialogue with clients, 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
- Compliance issues (adherence) and missed doses
- When to seek medical attention and follow-up
- Non-pharmacological and lifestyle measures

TOPICS OF STUDY: PROFESSIONAL PRACTICE SKILLS contd.

Communications, Patient Counselling and Education contd.

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

Patient counselling and education on non-prescription 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

Professional collaboration and teamwork
- Work collaboratively with other health care professionals to optimize patient outcomes
- Refer to other health care providers when required
- Promote health and wellness in the community

TOPICS OF STUDY: PROFESSIONAL PRACTICE SKILLS contd.

Safety Issues and Incident Prevention

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

Canada Vigilance Program - adverse drug reaction monitoring
Development of actions and strategies and actions to prevent incidents
- Error-prone abbreviations and dosage designations
- Look-alike and sound-alike drug names

Identification, management, and documentation of medication incidents (errors) – National System for Incident Reporting (NSIR)

Institute for Safe Medication Practices (ISMP)

Health Canada MedEffect: advisories, warnings and recalls

Medication reconciliation

Canadian Patient Safety Institute (CPSI) – Safer Healthcare Now!

Drug Information and Evidence-Based Decision-Making

Selection of Suitable References and Information Databases
- Cochrane Collaborative Library
- Medline
- Primary, secondary, tertiary references

Evaluation of Drug Literature and Scientific Information
- Clinical Trials
- Evidence-based medicine
- Clinical Practice guidelines

Response to Drug Information Requests

TOPICS OF STUDY: PROFESSIONAL PRACTICE SKILLS contd.

Jurisprudence

Provincial Regulatory Authorities (PRAs)

NAPRA

Federal law, prescriptive authority and regulatory issues

Food and Drugs Act and Regulations

Controlled Drugs and Substances Act
- Precursor Control Reulations
- Benzodiazepines and other Targeted Substances Regulations

Narcotic Control Regulations

Marijuana medical access

Methadone
- Maintenance treatment
- For pain management

Privacy legislation

Health promotion, disease prevention and social issues

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

BEHAVIOURAL, SOCIAL AND ADMINISTRATIVE PHARMACY SCIENCES

Pharmacy Administration: Management / Health Care Systems
Pharmacoeconomics

Biostatistics/Pharmacoepidemiology

Bioethics

PHARMACY ADMINISTRATION

GENERAL DESCRIPTION: PHARMACY ADMINISTRATION

The course of study of the social, behavioural and administrative pharmacy sciences encompasses a number of broad areas including:

- Canadian health care systems (including society and the profession of pharmacy)
- Pharmacy management
- Pharmacoeconomics

TOPICS OF STUDY: CANADIAN HEALTH CARE SYSTEMS

Governance and Standards

About Health Canada (see Health Canada website also)
- 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 (to drugs) Program
- 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

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

PIPEDA- Personal Information Protection and Electronic Documents Act
- www.privcom.gc.ca – look for print version link

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)
- Non-prescription Drug Manufacturers Association of Canada (NDMAC)

Canadian Agency for Drugs and Technologies in Health (CADTH)
- Healthcare technology assessment
- Common Drug Review directorate

Patented Medicines Prices Review Board (PMPRB)

Institute for Safe Medication Practices
www.ismp.org click on "Medication Safety Tools and Resources" section

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

- Financing and the cost of health care services
- Health expenditures and trends
- 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)

TOPICS OF STUDY: CANADIAN HEALTH CARE SYSTEMS contd.

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

Financing and the cost of health care services
Access to Privately funded (market driven) health care providers and facilities
Telehealth services
Human resources (shortages of health care personnel and scopes of practice)

TOPICS OF STUDY: SOCIETY AND THE PROFESSION OF PHARMACY

History of Pharmacy as a Profession

Evolution of pharmacy as a distinct profession
Historical transition from a primary interest of pharmacy with the preparation of dosage forms, to the distribution of drug products, and now to the safe and effective use of drugs in patient care
Voluntary pharmacy organizations, advocacy groups and political action by pharmacists

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

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

TOPICS OF STUDY: PHARMACY MANAGEMENT

Basic Responsibilities of Management

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

Entrepreneurship
Risk and innovation

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

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 and styles of management
Trade unions, contracts and collective bargaining
Employee motivation, performance appraisal, discipline
Recruitment and retention of staff
Increasing role of pharmacy technicians

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

TOPICS OF STUDY: PHARMACY MANAGEMENT contd.

Community Pharmacy Management

Forms of Legal Ownership
- Sole proprietorship, partnership, corporation, cooperative

Pharmacy Ownership Structures
- Independents, chain, franchise, food store, mass merchandise, specialty, mail order, banner groups, central fill facilities

Hospital Pharmacy Management

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

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, medication counselling, drug use review, continuous quality improvement

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
- Markups, rebates and discounts
- Cognitive fees

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

TOPICS OF STUDY: PHARMACOECONOMICS contd.

Drug Use Management Strategies
- Drug Use Review agencies
- Academic detailing
- 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

PHARMACOEPIDEMIOLOGY AND BIOSTATISTICS

GENERAL DESCRIPTION: PHARMACOEPIDEMIOLOGY AND BIOSTATISTICS

In these courses of study, knowledge of biostatistics theory and the methods used in epidemiological research are necessary to critically evaluate the scientific literature and make evidence-based decisions in the practice of pharmacy.

BASIC PRINCIPLES: PHARMACOEPIDEMIOLOGY AND BIOSTATISTICS

I Use of acquired knowledge in epidemiology and biostatistics to solve problems related to individual or collective health problems.

II Use of acquired knowledge in epidemiology and biostatistics to evaluate drug utilization trends or draw conclusions about drug efficacy or effectiveness.

III Use of acquired knowledge in epidemiology and biostatistics to critically evaluate scientific literature.

TOPICS OF STUDY: PHARMACOEPIDEMIOLOGY AND BIOSTATISTICS

Pharmacoepidemiology

Measures of frequency, prevalence, incidence, cumulative incidence

Population types, life expectancy, risk

Research Methods:

Experimental, causal-comparative, correlational, descriptive, historical

Randomized, case control, cohort, case reports, anecdotal, population studies

Study designs: placebo controlled, cross-over, washout, factorial, N of 1, parallel

Critical Appraisal of Research:

Relative risk reduction or benefit, absolute risk reduction or benefit, odds ratio, number needed to treat

Conflict of interest, publication bias, research funding source, research ethics, institutional review boards (IRB), Cochrane Collaboration and similar agencies

TOPICS OF STUDY: PHARMACOEPIDEMIOLOGY AND BIOSTATISTICS contd.

Biostatistics

The Definition of Population

Sample, sampling, sample size, clusters, stratified

Sample error, sampling bias, representativeness

Inclusion criteria, exclusion criteria

The 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

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

BIOETHICS

GENERAL DESCRIPTION: BIOETHICS

The study of bioethics encompasses consideration of basic ethical principles and values that form the ethical foundations for the provision of care by the health professions including Pharmacy practice.

TOPICS OF STUDY: BIOETHICS

Dominant (normative) moral views in health care ethics

Utilitarianism/consequentialism

Deontology

Bioethical principles

Beneficence, Nonmaleficence, Autonomy, Justice, Veracity, Fidelity

TOPICS OF STUDY: PHARMACY ETHICS

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

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
- Palliative care, pain management, and end-of-life care

Pharmacist conscience clause

Other Issues in Pharmacy and Health Care Ethics
- Clinical drug trials research and the place of pharmaceuticals in advancing health
- Health reform and allocation of limited resources
- Interdisciplinary decision-making
- Ethics committees
- Conflict of interest (gifts from patients and the pharmaceutical industry)
- Access to health care and pharmaceuticals in underdeveloped countries

Professionalism
- Trust, integrity, competence, respect, virtues, compassion, collegiality