Pharmacology Review

**Chapter 1:**

* **Role of FDA**
  + 1988- FDA was made official agency for US Department of Health and Human Services.
  + Protects Public Safety
  + Branches of FDA

**CDER**- Center for Drug Evaluation & Research

* Decides what drugs are prescription or OTC

**CBER**- Center for Biologics Evaluation & Research

* Regulates the use of Biologics including serums, vaccines & blood product

**CFSAN**- Center for Food Safety & Applied Nutrition

* Oversees herbal and dietary products
* **Stages of Approval**
  + Preclinical Investigation
    - First Stage
      * Extensive lab research on human and microbial cells
      * Examine the drug’s effectiveness at different doses
      * Look for adverse effects
      * Testing on cultured cells and in animals essential for predicting if drug will cause harm to humans
      * Always inconclusive due to lack of human response
    - FDA’s Critical Path Initiative
      * Enhance use of bio-information to improve safety, effectiveness, and manufacturability of candidate medical products
  + Clinical Investigation
    - Second Stage
      * Longest part of drug approval process
      * For every 5,000 chemicals that enter pre-clinical testing, only 5 make it to human testing. Of the 5 potential drugs only 1 is approved
      * Three different stages (clinical phase trials)
      * Pharmacologists first perform tests on healthy volunteers
        + Determine proper dosage
        + Assess for adverse effects
      * Phase I Clinical trials
        + Takes about 1 year
        + Involves 20 to 80 normal, healthy volunteers
        + If drug shows significant therapeutic benefits and is reasonably safe for initial use in humans (HIV patients) then a IND may be submitted for Phase I
      * Phase II
        + Takes about 2 years
        + Involves 100 to 300 volunteer patients with the disease
      * Phase III
        + Takes about 3 years
        + Involves 1000 to 3000 patients in hospitals and clinic agencies
    - If drug appears effective and w/o serious SE approval for marketing may be accelerated, or drug may be used immediately in special cases
  + New Drug Application (NDA)
    - Third Stage
      * Drug Brand Name finalized
      * Clinical phase III may continue depending on results
      * By law FDA has 6 months to review application
      * May be approved to final stage, or rejected and suspended until concerns are addressed by Pharm Company.
      * Average review time 17-24 months
  + Post-marketing Surveillance
    - Final Stage
      * Purpose is to survey for harmful drug effects in larger populations
        + IE. diabetes drug troglitazone (Rezulin), banned in Britain and recalled by FDA for liver and heart failure
      * Nurses have the most frequent opportunities to participate in the drug approval process, and the reporting of adverse effects
* **Key Concepts**
  + Pharmacology is the study of medicines and how drugs are admin and how the body responds
  + Pharmacology and therapeutics are closes connected
  + Pharmacotherapy is the application of drugs to prevent disease and ease suffering
  + Therapeutic agents may be classified as traditional drugs, biologics, or alternative therapies
* **Key Terms**
  + Biologics
    - Substances that produce biologic responses within the body; they are synthesized by cells of the human body, animal cells or microorganisms
  + Complementary and alternative therapies
    - Treatments considered outside the realm of conventional Western medicine
  + Drug
    - General term for any substance capable of producing biologic responses in the body
  + Formulary
    - List of drugs and drug recipes commonly used by pharmacists
  + Medication
    - A drug after it has been administered
  + Pharmacopoeia
    - Medical reference indicating standards of drug purity, strength, and directions for synthesis

**Chapter 2:**

* **Therapeutic and Pharmacologic Classifications of Drugs**
* Therapeutic Classification
  + Method of organizing drugs based on therapeutic usefulness in treating particular diseases
  + Clearly states what a drug does clinically
    - Ie. anti-coagulants, anti-hyperlipidemics, anti-hypertensives, anti-dysrhythmics, anti-anginals
* Pharmacologic Classification
  + Addresses a drug’s mechanism of action
    - How a drug produces its effect in the body
      * Diuretic – treats hypertension by lowering plasma volume
      * Calcium channel blocker- treats hypertension by decreasing cardiac contractibility
    - More specific than therapeutic classification
    - Requires an understanding of biochemistry and physiology
* Prototype Drug
  + Well understood drug model with which other drugs in its representative class are compared
* **Drug Names:**
* Chemical Name
* Chosen by IUPAC
* A drug only has (1) chemical name
* Used by chemists and pharmacists
* Generic Name (Official Name)
  + - * Assigned by the US Adopted Name Council
      * Less complicated then chemical name
      * Easier to remember
      * One generic name per drug
      * Cheaper
      * Usually lower case lettering
* Trade Name (Copyrighted, Proprietary or Brand)
  + - * Assigned by the company marketing the drug
      * Usually short and easy to remember
      * Is on market for 17 years before generics may be made
      * Usually CAPITALIZED
  + Generic VS Trade
    - Cheaper
    - Unclear whether there is any difference in actions
    - May have different inert ingredients
      * Ie. tablet form the ingredients may be more tightly compressed in one of them
    - May have a difference in bioavailability
    - Negative formulary list – trade name drugs that may not be substituted with generic drugs
* **Drug Schedules:**
* Addiction
  + - Overwhelming feeling that drives someone to use a drug repeatedly.
* Dependence
  + - A physiologic or psychological need for a substance.
    - Physical dependence: Altered physical condition caused by the adaptation of the nervous system to repeated drug use.
      * Physical discomfort/withdraw
    - Psychological
      * Few signs of physical distress when drug is withdrawn
      * Feelings of intense compelling desire to continue drug use
* Schedule I, II, III, IV, V
  + - I- Highest potential for abuse, high potential for dependence
      * Heroin, LSD, marijuana, methaqualone
    - II- High potential for abuse, and dependence
      * Morphine, PCP, cocaine, methadone, methamphetamine
      * Special order form must be used to obtain
      * Telephone orders not permitted
      * No refills w/o dr. visit
    - III- Moderate potential for abuse, high potential for dependence
      * Anabolic steroids, codeine, hydrocodone w/asa or Tylenol, some barbiturates
    - IV- Lower potential for abuse and dependence
      * Dextropropoxyphene, pentazocine, meprobamate, diazepam, alprazolam
    - V- Lowest potential for abuse and dependence
      * OTC cough medicine w/codeine, diphenoxylate w/atropine
* Monitored by the DEA
* FDA responsible for standards
* **Key Terms**
  + Bioavailability
    - Ability of a drug to reach the blood stream and its target tissues
  + Combination drug
    - Drug product with more than one active generic ingredient
  + Controlled substance
    - In the US, a drug whose use is restricted by the Comprehensive Drug Abuse Prevention and Control Act
  + Dependence
    - Strong physiological or psychological need for a substance
  + Mechanism of action
    - The way in which a drug exerts its effects
  + Withdrawal
    - Physical signs of discomfort associated with the discontinuation of an abused substance

**Chapter 3:**

* **Medication Knowledge/Responsibilities of the Nurse**
  + What drug is ordered
    - Drug name and drug classification
    - Intended or proposed use
    - Effects on the body
    - Contraindications
    - Special considerations
      * Age, weight, body fat distribution, pathophysiologic states affect pharmacotherapeutic response
    - Side effects
  + Why the medication has been prescribed for this particular patient
  + How the medication is supplied by the pharmacy
  + How the medication is to be administered, including dose ranges
  + What nursing process considerations related to the medication apply to this patient
* **Allergic reaction**
  + Acquired hyper-response of body defenses to a foreign substance (allergen)
  + Signs
    - Skin rash with or w/o itching
    - Edema (swelling caused by fluid in body’s tissue)
    - Runny nose
    - Reddened eyes w/tearing
  + Nurse required to
    - Alert all personnel by documenting the allergy
    - Appropriately labeling patient med rec and MAR
    - Agency-approved bracelet should be placed to alert all caregivers to the specific drug allergy
    - Inform physician and pharmacist
* **Anaphylaxis**
  + Severe type of allergic reaction
  + Massive, systemic release of histamine and other chemical mediators of inflammation that can lead to life threatening shock
  + S&S
    - Acute dyspnea (shortness of breath)
    - Sudden appearance of hypotension or tachycardia
    - Must receive immediate treatment
* **Toxic Epidermal Necrolysis (TEN)**
  + Severe and deadly drug-induced allergic reaction
  + Occurs when the liver fails to properly break down a drug, which then cannot be excreted normally
    - Associated w/ use of some anti-convulsants (phenytoin (Dilantin), carbamazepine (Tegretol), antibiotic trimethoprim/sulfamethoxazole (Bactrim, Septra), and other drugs, but can occur with the use of any prescription or OTC preparation, including ibuprofen (Advil, Motrin)
  + Widespread epidermal sloughing, caused by disintegration of keratinocytes
  + Severe epidermal detachment involving the top layer of the skin and mucous membranes
  + Multi-system organ involvement and death if the reaction is not recognized and diagnosed
  + Risk of death decreases if the offending drug is quickly withdrawn and supportive care is maintained
* **Stevens-Johnson Syndrome (SJS)**
  + Usually promoted by the same or similar drugs as TEN
  + Begins within 1 to 14 days of pharmacotherapy
  + Start of SJS usually signaled by nonspecific upper respiratory infection (URI) with chills, fever, and malaise
  + Generalized blister-like lesions follow within a few days
  + Skin sloughing of 10% of the body
* **The (5) Rights of Drug Administration: (Safe delivery of medication)**
* Right Patient (2 identifiers)
* Right Medication
* Right Dose
* Right route of administration
* Right time of delivery
* Right of Refusal
* Right to Education
* Right Preparation
* Right Documentation
  + - Check for allergies
* **Three Checks of Drug Administration:**
* Check drug w/MAR when removing from drawer, refrigerator, or locker.
* Check drug when preparing (pouring, container, connecting IV)
* Check drug label before administering to patient
* **Five most common causes of medication errors are:**
  + Incomplete patient information
    - Unaware of allergies, other medications, previous diagnoses, or lab results)
  + Unavailable drug information
    - Current warnings issued by the FDA
  + Miscommunication of drug orders
    - Illegible handwritten orders
    - Confusion between drugs w/similar names
    - Misuse of zeroes and decimal points
    - Unclear abbreviations
  + Lack of appropriate labeling when a drug is prepared and repackaged into smaller units
  + Environment factors
    - Noise or interruptions that distract the nurse as she prepares to administer the meds
* **Compliance**
  + Taking a medication in the manner prescribed by the health care provider, or in the case of OTC drugs, following instructions on label.
  + Patient non-compliance ranges from not taking meds at all to taking at wrong time or wrong manner due to:
    - Being too expensive
    - Not approved by pt’s health insurance
    - Forgetfulness
    - Discontinue due to annoying side effects
    - Adverse effects such as headache, dizziness, nausea, diarrhea, or impotence
    - Self-adjusting their own dose
* **Drug Orders and Time Schedules**
  + STAT- Time between writing the order and administering the drug should be 5 minutes or less
  + ASAP – Within 30 minutes of the written order
  + Single Order – A drug to be given only once
  + PRN – as required by pt’s condition
  + Narcotic orders and other schedule drugs are often automatically discontinued after 72 hrs, unless reordered by physician
  + Some medications must be taken at specific times
    - Upset stomach – drug will be admin w/meals to prevent epigastric pain, N/V
    - Food may interfere w/absorption – meds should be admin between meals
    - Drugs that cause drowsiness – CNS Drugs and anti-hypertensive drugs are best admin at bedtime
    - Sildenafil (Viagra) – admin 30 to 60 minutes prior to expected sexual intercourse
  + Documentation is completed only after the medications have been administered
    - Include drug name, dosage, time administered, and assessments and nurse signature
* **Routes of Drug Administration**
  + Enteral Route
    - Oral
    - Nasogastic
    - Gastrostomy tubes
    - Most common route
    - Most convenient
    - Least costly
    - Safest route
      * Skin barrier in not compromised
      * Vomit if overdose
    - Available in cap, tab, liqid
    - Vast absorptive surfaces
      * Oral mucosa
      * Stomach
      * Small intestine
    - Tablet/Capsule
      * Most common
      * Preferred by patients
      * May become inactive by first pass metabolism
    - Sublingual
      * Medication placed under tongue
      * Dissolves slowly
      * Rapid onset of action due to rich blood supply
      * Administer after oral meds
      * Avoids first pass metabolism (liver)/enzymatic process of stomach/small intestine
    - Buccal
      * Medication placed between gum and cheek
      * Slower absorption then sublingual
      * Preferred over subq for sustained release/greater mucosal surface
      * Avoids first pass metabolism (liver)/enzymatic process of stomach/small intestine
    - NG
      * Soft, flexible tube
      * Inserted in nasopharynx
      * Tip lies in stomach
      * Used for short-term treatment
      * Medications administered directly into tube
        + Usually liquid
        + Pills can be crushed, but may clog tube
        + No sustained release drugs
    - Gastrostomy tube
      * Surgically placed directly into stomach
      * Long term care
      * Medications administered directly into tube
        + Usually liquid
        + Pills can be crushed, but may clog tube
        + No sustained release drugs
  + Topical Route
    - Produce local affect
      * Ie. antibiotic cream to treat infected skin
      * Ie. antineoplastic put into bladder to treat tumors
      * Ie. corticosteroids sprayed into nostrils to reduce inflammation
    - Produces fewer side effects
    - Absorbed very slowly
    - Reaching general circulation minimal
    - Some drugs provide slow release and absorption
      * Administered for SYSTEMIC EFFECTS
        + Ie. nitroglycerin patch for CAD
        + Ie. prochlorperazine (Compazine) suppositories (rectal) to alleviate nausea
        + Absorption is essential for therapeutic action
    - Transdermal delivery system
      * Patches (nitro, scopolamine)
      * Avoid first pass metabolism/digestive enzymes
    - Ophthalmic
      * Treat local conditions of the eye/surrounding structures
        + Excessive dryness
        + Infections
        + Glaucoma
        + Dilation of pupil during exam
      * Eye irrigations
      * Drops
      * Ointments
      * Medicated disks
    - Otic
      * Treat local conditions of ear
        + Infections
        + Soft blockages
      * Eardrops
      * Irrigation
    - Nasal
      * Local and systemic drug admin
      * Nasal mucosa provides excellent absorptive surface
      * Ease of use
      * Avoid first pass metabolism/digestive enzymes
      * Potential for damage to cilia
      * Mucosa irritation common
      * Local effect
        + Drops or sprays
    - Vaginal
      * Treating local infections and to relieve vaginal pain and itching
      * Application – suppositories, creams, jellies, or foams
      * Instructions
        + Empty bladder
        + Offer pad following admin
        + Supine position w/ knees bent and separated
        + Expose vaginal orifice by separating labia w/non-dominant hand
    - Rectal
      * Local or systemic
      * Safe and effective means of drug delivery to pt’s who are comatose or who are experiencing N/V
      * Generally Suppository form, may be enema
      * Slower absorption, but steady and reliable
      * First pass effect is avoided
      * Digestive enzymes of upper GI tract avoided
      * Instruction
        + Lie patient on left side (Sims’ position)
        + Tell pt to retain suppository for at least 30 mins, unless admin for defecation
  + Parenteral Route

**Chapter 4:**

* **Pharmacokinetics:**
* Drug movement throughout the body
* How body deals with medications
* Travels through active or passive transport

**Active Transport**

* Requires ATP
* Large molecules
* Ionized drugs
* Water soluble agents

**Diffusion or Passive Transport**

* Does not require ATP
* Movement of a chemical from high to low concentration
* Small molecules
* Non-ionized drugs
* Lipid soluble
* Four Categories/Processes

**Absorption**

* + - Movement of substance from site of admin, across membranes to circulating fluids
    - Syrups absorb faster than pills
    - IM takes longer to absorb than IV
    - Factors for absorption
      * Digestive motility (movement)
      * Blood flow
      * Exposure to enzymes in digestive tract

**Distribution**

* Movement through vascular system
* Amount of blood flow to tissues
* Blood-brain barrier
* Fetal-placental barrier
* Tissue’s ability to accumulate and store
* Heart, liver, kidneys and brain receive most blood flow
* Skin, bone and adipose tissue receive lower supply

**Metabolism**

* A.K.A. Biotransformation
* Chemically converts drug to form for easier excretion
* Liver is primary site of drug metabolism
* Kidneys and cells of intestinal tract have high metabolic rate
* Hepatic microsomal enzyme system (P-450)
  + Named after cytochrome (key component)
  + Used to inactivate drugs
  + Accelerate drugs excretion
* First pass effect
* Factors affecting metabolism
  + Liver health
  + Age
  + Nutrition
  + Competition of drugs

**Excretion**

* Removal of drugs
* Primary organ for excretion are the kidneys
* Biliary excretion: bile to feces
* Small molecules, water soluble agents, electrolytes easily filtered by glomerulus.
* Factors affecting excretion
  + Kidney health (kidney disease = less excretion)
  + Ph of filtrate (weak = faster excretion)
  + Age
* Laboratory indicators: CR, BUN, Creatinine clearance
* **Drug Plasma Concentration and Therapeutic Response**
  + - * Therapeutic response of most drugs is directly related to level in the plasma
      * Minimum effective concentration
        + Amount of drug required to produce a therapeutic effect
      * Toxic concentration
        + Level of drug that will result in serious adverse effects
      * Therapeutic range
        + Plasma drug concentration between the minimum effective concentration and the toxic concentration
* **Plasma half-life and Duration of Drug action**
  + - * Length of time required for the plasma concentration of a medication to decrease by ½ after admin.
      * The greater the ½ life the longer it takes a medication to be excreted
* **Loading Doses and Maintenance Doses**
  + - * Loading Doses- Higher amount of drug, often given only once or twice to prime the bloodstream with a sufficient level of drug
        + Important for drugs with prolonged half-lives and for situations in which it is critical to raise drug plasma

**Chapter 6**

* The Nursing Process
  + - * Assessment of the patient

Systemic collection, organization, validation, and documentation of patient data.

Ongoing process that begins with the nurses initial contact with the pt and continues with every interaction thereafter

Health history and physical assessment

Baseline Data

Subjective Date

Objective Data

Nurse must access key components by asking:

History of drug allergy

Past medical history

Medications currently used

Personal and social history including the use of alcohol

Use of tobacco

Use of caffeine

Street drugs

Pregnancy status

**Chapter 13**

* **Autonomic Nervous System (ANS)**
* Sympathetic
  + Fight or Flight
  + Catecholamine Class
    - Norepinephrine
    - Epinephrine (adrenaline)
    - Dopamine
    - Synthetic
      * Isoproterenao
      * Dobutamine
* Noncatecholamine drugs
  + Different chemical structure same targeted tissues
* Adrenergic- receptors at ends of postganglionic sympathetic neurons
  + Two basic types
    - Alpha receptors
      * Alpha1
        + All organs except heart
        + Constriction of blood vessels
        + Dilation of pupils
        + Treatment of nasal congestion
        + Treatment of Hypotension
  + Alpha2
    - Presynaptic adrenergic nerve terminals
    - Inhibition of release of norepinephrine
    - Treatment of hypertension
* Beta Receptors
  + Beta1
    - Heart and kidneys
    - Increased heart rate and force of contraction
    - Release of renin
    - Treatment of cardiac arrest
    - Treatment of heart failure
    - Treatment of shock
  + Beta2
    - All organs except heart
    - Inhibition of smooth muscle
    - Treatment of asthma
    - Treatment of premature labor contractions
* Sympathomimetics (adrenergic agonist)
* Phenylephrine (Neo-Synephrine)
  + Therapeutic Class: Nasal decongestant, mydriatic agent, anti-hypotensive
  + Pharmacologic Class: adrenergic agent
  + Alpha agonist
  + Adverse effects: Insomnia, nervousness, hypertension
* Sympatholytics (adrenergic antagonist)
  + Minipress
    - Therapeutic class: Anti-hypertensive
    - Pharmacologic class: adrenergic-blocking agent
    - Alpha1
    - Adverse reactions
      * Tachycardia
      * Edema
      * Heart failure
* Parasympathetic
  + Rest and Digest
  + Cholinergic nerves
    - Release acetylcholine (Ach)
    - Two types
      * Nicotinic receptors
        + Postganglionic neurons

Stimulation of smooth muscle and gland secretions

* Muscarinic receptors
  + Heart
    - Decreased heart rate and force of contraction
* Organs other than heart
  + Stimulation of smooth muscle and gland secretions
* Parasympathomimetics (Cholinergic Agent)
  + Nursing Considerations
    - Direct acting
      * Monitor I&O
      * Monitor for blurred vision
      * Monitor for orthostatic hypotention
    - Indirect acting
      * Monitor for muscle strength and neuro status
      * Evaluate chewing and swallowing ability
      * Schedule meds on empty stomach
  + Bethanechol (Duvoid, Urecholine)
    - Therapeutic class: non-obstructive urinary retention agent
    - Pharmacologic class: Muscarinic cholinergic receptor agonist
    - Stimulates smooth muscle contraction
    - Elderly need to be assessed frequently for dizziness
    - Renal failure will occur if pt doesn’t void after surgery
* Parasympatholytic (Cholinergic blocking agents/anti-cholinergic)
  + Atropine (Atro-pen, Atropair, Atropisol)
    - Therapeutic class: Antidote for anticholinerase poisoning
    - Pharmacologic class: Muscarinic cholinergic receptor antagonist
    - Increased heart rate, bronchodilator
  + Uses
    - PUD
    - Bradycardia
    - IBS
* KEY TERMS
  + Acetylcholine (ACH) – Primary neurotransmitter of the parasympathetic nervous system; also present at somatic neuromuscular junctions and at sympathetic preganglionic nerves.
  + Acetylcholinesterase (AchE) – Enzyme that degrades acetylcholine within the synaptic cleft, enhancing effects of the neurotransmitter
  + Adrenergic – Relating to nerves that release norepinephrine or epinephrine
  + Adrenergic antagonist – Drug that blocks the actions of the sympathetic nervous system
  + Anticholinergic – Drug that blocks the actions of the parasympathetic nervous system
  + Autonomic nervous system (ANS) – Portion of the peripheral nervous system that governs involuntary actions of the smooth muscle, cardiac muscle, and glands.
  + Catecholamines – Class of agents secreted in response to stress that include epinephrine, norepinephrine, and dopamine
  + Central nervous system (CNS) – Division of the nervous system consisting of the brain and spinal cord
  + Cholinergic – Relating to nerves that release acetylcholine
  + Fight or flight response – Characteristic set of signs and symptons produced when the sympathetic nervous system is activated
  + Ganglionic synapse – The juncture between two multipolar neurons located outside of the central nervous system, where axon terminals from the first neuron make contact with cell bodies and extensions of the second neuron
  + Monoamine oxidase (MAO) – Enzyme that destroys norepinephrine in the nerve terminal
  + Muscarinic – Type of cholinergic receptor found in smooth muscle, cardiac muscle, and glands
  + Myasthenia gravis – Motor disorder caused by a destruction of nicotinic receptors on skeletal muscles and characterized by profound muscular fatigue
  + Nicotinic – Type of cholinergic receptor found in ganglia of both the sympathetic and parasympathetic nervous systems
  + Norepinephrine (NE) – Primary neurotransmitter in the sympathetic nervous system
  + Parasympathetic nervous system – Portion of the autonomic nervous system that is active during periods of rest and that results in the rest or relaxation response
  + Para-sympathomimetic – Drug that mimics the actions of the parasympathetic nervous system
  + Peripheral nervous system – Division of the nervous system containing all nervous tissue outside the CNS, including the autonomic nervous system
  + Postganglionic neuron – Autonomic nerve after the ganglionic synapse transmitting impulses to the target tissue
  + Preganglionic neuron – Autonomic nerve before the ganglionic synapse carrying impulses from the spinal cord
  + Rest and digest response – Signs and symptoms produced when the parasympathetic nervous system is activated
  + Somatic nervous system – Nerve division that provides voluntary control over skeletal muscle
  + Sympathetic nervous system – Portion of the autonomic system that is active during periods of stress and results in the fight or flight response
  + Sympatholytic – A drug that blocks the actions of the sympathetic nervous system
  + Sympathomimetic – A drug that stimulates or mimics that sympathetic nervous system
  + Synapse – Junction between two neurons consisting of a presynaptic nerve, a synaptic cleft, and a postsynaptic nerve
  + Synaptic transmission – Process by which a neurotransmitter reaches receptros to regenerate the action potential

**Chapter 44**

**Diabetes Mellitus Type 1**

* A.K.A insulin-dependent diabetes mellitus
* Most common disease of childhood
* On insulin for life
* Autoimmune destruction of pancreatic beta cells
  + Lack of insulin production
* Alpha cell – Glucagon secreting cell
* Beta cell- insulin secreting cell
* S&S
  + Hyperglycemia
    - FBS >126 (2x’s)
  + Three P’s
    - Polyuria- excessive urination
    - Polyphagia- increased hunger
    - Polydipsia- increased thirst
* Glucosuria- High levels of glucose in urine
* Weight loss
* Fatigue
* Ketoacids can give breath an acetone-like, fruity odor
* DKA- diabetic ketoacidosis
* Progress to coma/death if untreated
* Hypertension
* Heart disease
* Blindness
* Renal failure
* Neuropathy
* Amputations
* Impotence
* Stroke
* Goal is to balance glucose and insulin
* Treatment
  + Too much insulin causes hypoglycemia <50mg/dl
    - Eat crackers/drink juice
    - Severe hypoglycemia
      * Give IV glucose in a dextrose solution (D-50)
      * IV, IM or subq glucagon (1mg)
* Not enough insulin causes hyperglycemia
  + Regular insulin
    - Humulin R, Novolin R
    - Short acting (30-60 min)
    - Most frequently uses
    - Subq or IV
    - May be mixed w/NPH (cloudy)
      * Clear before cloudy
* Rapid Acting
  + Insulin lispro (Humalog)
    - Subq 5-10min before meal
    - 10-20 min onset
    - May be mixed w/NPH (draw lispro first)
* Suspension
  + Isophane (NPH, Humulin N)
    - Intermediate
    - Onset 1-2hrs
    - Do not mix w/glargine
    - Subq/mix

**Chapter 44**

**Diabetes Mellitus Type II**

* More common form of DM
* Insulin resistance due to defect
  + Pancreas produces sufficient amounts of insulin but target cells do not recognize it.
  + Exercise and diet have shown to reverse insulin resistance
* Obesity
* Suffer same complications as pt’s with type 1 if regimen not followed
* Treatment
  + Oral hypoglycemic
    - Prescribed after diet and exercise fail
    - Sulfonylureas
      * Glipizide (Glucotrol)
* Biguanides
  + Metformin
    - Lactic acidosis
* Alpha-glucosidase inhibitor
  + Acarbose (Precose)
    - Take with meals
* Thiazolidinediones
  + Piotroglitazone (Avandia)
    - Contraindicated for persons w/heart conditions

**Chapter 45**

* **Female Reproductive System**
  + Regulated by the hypothalamus and pituitary gland and ovary
    - Hypothalamus secretes
      * Gonadotropin releasing hormone (GnRH)
        + Travels to pituitary and stimulates secretion:

Follicle-stimulating hormone (FSH) and LH

Both FSH and LH act on ovary to mature ovarian follicles

* + - Ovarian and Uterine Cycle
      * Ovulation
        + 14th day of ovarian cycle (1st half-**FSH)**
        + Surge of **LH** causes one follicle to expel its oocyte (2nd half)
        + Last half the corpus luteum secretes progestin

Progesterone with estrogen promotes breast development and regulates the monthly changes of the uterine cycle

* + - Estrogen and Progesterone
      * Used as drugs
        + Prevent pregnancy
        + Treat dysfunctional uterine bleeding
        + Severe symptoms of menopause
        + Certain neoplasms
* Oral Contraceptives (Ortho-Novum)

Begin on Day 5 and continues for 21 days

7 days are placebo

Estrogen/Progesterone

Act by preventing ovulation

Accomplished by providing negative feedback

Make uterine endometrium less favorable to receive an embryo

Also prescribed to regulate monthly cycle

Reduce incidence of dysmenorrhea

Side Effects

Breast milk reduction (begin 6 weeks postpartum)

Cancer (HPV positive) cervical cancer

Glucose elevation (monitor diabetics)

Hypertension increased with age, dose and length of therapy

Lupus exacerbation (use progestin only OC)

Menstrual irregularities (May need to increase progestin)

Migraines (estrogen may increase or decrease)

Nausea, edema, breast tenderness (caused by high amounts of estrogen)

Teratogenicity (Estrogen is pregnancy X)

Thromboembolic disorders (Estrogen promotes clotting)

* + - * Drug to Drug interactions
        + Reduce effectiveness of Warfarin, insulin
    - Provera
      * Progestin
      * medroxpyprogesterone
      * Primary target – endometrium
      * Inhibits effect of estrogen on uterus
      * Pregnancy X
      * Give PO with meals to avoid gastric distress
      * Treatment of:
        + Dysfunctional uterine bleeding
        + Secondary amenorrhea
        + May be given IM for palliation of metastatic uterine or renal carcinoma
        + Contraception – sustained release (Depo-Provera)
  + Labor and Breast Feeding
    - Oxytocic (Pitocin)
      * Stimulate uterine contractions to promote induction of labor.
      * Natural hormone
      * Secreted from the posterior pituitary gland
      * Target organs oar uterus and breast
      * Postpartum – oxytocin released in response to suckling
        + Causes milk to be ejected from mammary glands
    - Tocolytics
      * Uterine relaxants to suppress preterm labor contractions
  + Female Fertility
    - Three primary causes
      * Pelvic infections
      * Obstruction of the uterine tubes
      * Lack of ovulation
        + Clomiphene (Clomid

Preferred Drug

Stimulates release of LH

If not effected, chorionic gonadotropin (HCG) may be added to regimen

* + - Endometriosis
      * Common cause of infertility
      * Characterized by presence of endometrial tissue on outside of uterus.
      * May be treated with estrogen-progestin oral contraceptives

**Chapter 47**

**Bone and Joint**

**Role of Calcium:**

* Primary mineral
* Bone formation
* Regulated by parathyroid hormone
  + - Sustain nervous, muscular and cardiovascular systems
    - Homeostasis
    - PTH stimulates bone cells (osteoclasts)
      * Accelerate bone reabsorption
* Osteoblasts
  + Removes calcium from blood and deposits to bone
  + Bone deposition or bone building
  + Stimulated by calcitonin hormone
* Hypocalcemia
  + - Chronic kidney disease (loss in urine)
    - Decreased secretion of PTH
    - Blood transfusions
    - Anticonvulsants (phenytoin)
    - Overtreatment of Lasix, corticosteroids
    - S&S
      * Muscle twitching, tremor
      * Abdominal cramping w/hyperactive bowel sounds
      * Numbness, tingling
* Hypercalcemia
  + - Kidney stones and fractured bones may occur
    - S&S
      * Anorexia
      * Vomiting
      * Thirst
      * Fatigue
* Osteomalacia (Rickets in children)
  + - Softening of bones due to demineralization
    - Cause: deficiency of Vitamin D and Calcium
    - Most prevalent in older adults, premature babies, and vegetarians
    - S&S
      * Hypocalcemia
      * Muscle weakness
      * Muscle spasms
      * Diffuse bone pain in hip
* S&S of Rickets
  + Bowlegged
  + Pigeon chest
  + Slight fever
  + Restless at night
* Osteoporosis
  + - Brittle bones
    - Most common bone disorder
    - Asymptomatic until fracture
    - Greatest risk factor is onset of menopause
      * Estrogen decreases and bones become weak and fragile
* Other risk factors
  + Excessive alcohol use
  + Excessive caffeine use
  + Anorexia nervosa
  + Tobacco
  + Physical activity
  + Testosterone deficiency in older men
  + Inadequate Vitamin D or calcium in diet
  + Corticosteroids, anticonvulsants and immunosuppressant’s
* Treatment for Osteoporosis and Osteomalacia
  + HRT – To reduce fractures
    - Calcitonin (nasal or subq)
      * Secreted by thyroid gland
* Raloxifene (Evista)
  + - ERT – Treat osteoporosis
* SERM (Selective Estrogen Receptor Module
  + Increase mass of bone
    - Increased estrogen may cause blood clots, cancer and stroke
  + Calcium Supplements
    - Calcium carbonate (Rolaids, Tums)
    - Calcium chloride
    - Calcium citrate
    - Calcium gluconate
* Vitamin D Supplements
  + Calcitriol (Rocaltrol)
* Biphosphonates
  + Alendronate (Fosamax) Osteoporosis/Pagets
  + Ibandronate (Boniva)
  + Entidronate (Didronel)
* **Nursing**
* Assessment
  + Obtain bone density studies
  + Note amount of soda intake
  + Note sunscreen use/amount of sun exposure
  + Lab values throughout admin
    - Ca
    - PO4
    - Mag
* Adverse effects
  + N/V
  + Abdominal pain
  + Esophageal pain
  + Constipation/Diarrhea
  + Electrolyte imbalance
  + Report immediately any GI irritation or pain
* Implementation
  + Intervention
    - Bisphosphonates
      * Prior to starting correct any deficiencies
      * Take on empty stomach w/full glass of water
      * Sit upright for 30-60 minutes
      * Take calcium 2 hrs after/before
    - Encourage pt to get 15-20 minutes sun exposure daily w/o sunscreen
    - Calcium/Vitamin D w/meals or within (1) hr after meals
    - Increase fluid intake to 2L per day
    - Therapeutic response
      * 1-3 months
      * Effects continue after med is discontinued

**Arthritis**

* Inflammation of a joint
* Osteoarthritis
  + Most common type of arthritis
  + Progressive, degenerative joint disease
  + Caused by the breakdown of articular cartilage
  + Frequently affected areas
    - Knee
    - Spine
    - Hip
* S&S
  + Localized pain
  + Stiffness
  + Joint & bone enlargement
  + Limitations in movement
* Not accompanied by a severe degree of inflammation
* Goal is to reduce pain and inflammation
* Treatment
  + Initial – acetaminophen
    - Inexpensive
    - Relatively safe
* NSAIDS (Naproxen, ibuprofen like)
  + Used when acetaminophen doesn’t work
* Anti-Inflammatory
  + Tramadol (Ultram)
    - Opoid w/o abuse potential
* Glucocorticoids
  + Intra-articular
  + Temporary for acute cases
* Hyaluronate (Hyaglan)
  + Injected directly into joint
  + (1) injection per week for 3-5 weeks
* Rheumatoid Arthritis (RA)
  + Disfigurement and inflammation of multiple joints
  + Occurs at earlier age
  + May produce systemic manifestations
    - Infections
    - Pulmonary disease
    - Pericarditis
* Goal
  + Control inflammation
  + Reduce pain
  + Minimize physical disability
* Treatment
  + NSAID’s (initial treatment) increased doses
  + Glucocorticoids
    - Flare up’s (short term)
* Disease modifying anti-rheumatic drug (DMARD)
  + Reduced mortality
  + Administer after other meds fail
  + Maximum therapeutic effects take several months
  + Hydroxychoroquine (Plaquenil)
  + Methotrexate (Rheumatrex, Trexall)
  + Sulfasalazine (Azulfidine)
* Gout
  + Acute Arthritis
  + Caused by accumulation of uric acid (urate) crystals in joints and other body tissues, causing inflammation
  + Reduced excretion of uric acid by the kidneys
  + May be asymptomatic
  + Primary
    - Caused by hereditary defect in uric acid metabolism
  + Secondary
    - Caused by disease or drugs that increase metabolic turnover of nucleic acids
    - Drugs that cause gout
      * Thiazide diuretics
      * Aspirin
      * Cyclosporine
      * Chronic alcohol abuse
* Diseases that may cause gout
  + Diabetic ketoacidosis
  + Kidney failure
  + Leukemia
* Acute Gouty arthritis
  + Occurs when needle shaped uric acid crystals accumulate in joints
  + Extreme pain
  + Red, inflamed tissue
  + Sudden onset often at night
  + May be triggered by alcohol, dehydration, stress/injury to joint, fever
  + Mostly occurs in big toe, heels, ankles, wrists, fingers knees, elbows
  + After age 30
  + May cause kidney stones
  + Goal:
    - Terminate acute attacks
    - Prevention of future episodes
* Treatment
  + NSAID
    - Indomethacin (Indocin)
    - Naproxen (Naprosyn)
    - May affect stomach leading to bleeding ulcers
* Glucocorticoids
  + May be used for exacerbation
  + Intra-articularly
* Uric Acid Inhibitors
  + No foods high in purine
  + Used in combination therapy w/anti-gout
  + Colchicine
    - Take on empty stomach
    - May cause diarrhea
* Anti-gout
  + Probenecid (Benemid)
  + Allopurinol (Zyloprim)
* Nursing
  + Avoid foods high in purine
    - Salmon, sardines
    - Organ meat
    - Mushrooms, legumes, oatmeal
    - Alcohol
* Avoid large doses of Vitamin C
  + May acidify urine (stones)
* Increase fluid 2-4L daily

**Glaucoma**

* Eye disease caused by damage to optic nerve
* Results in gradual loss of vision
* Increased intraocular pressure
* Occurs without cause in elderly (>60)
* Could be caused by genetic factors
* Congenital
* Can occur in young children
* Leading cause of preventable blindness
* Two types
  + Open-angle glaucoma
    - Most common type
    - Cause unknown
    - Many pt’s asymptomatic
    - Bilateral
    - Iris does not cover the trabecular meshwork, remains open.
    - Can be successfully treated with medication
* Closed-angle glaucoma
  + A.K.A narrow-angle
  + Incidence higher in older adults
  + Asian descent
  + Unilateral (one side)
  + May be caused by stress, injury, meds
  + Normal thickening of the lens
  + Angle of the iris and anterior chamber narrows, obstructing the outflow of aqueous humor
  + Trabecular meshwork and canal of Schlemm blocked
  + Treatment
    - Prostaglandin
      * Most effective
      * Long duration of action
      * Less side effects
      * Administered just before bedtime
      * Latanoprost (xalatan)
        + Eye drop solution
        + Adverse effects

Increased length and thickness of eyelash

Darkening of iris

Sensation of foreign body in eye

Systemic respiratory infection, angina

* + - Beta-adrenergic blockers
      * Open-angle glaucoma
      * Because of possible systemic effects caution is used with asthma and heart failure patients
      * Timolol (Betimol, Istalol, Timoptic)
        + Adverse effects

Local burning

Stining

Blurred vision

Double vision

Headache

Angina

Anxiety

Bronchoconstriction

Hypertension

Dysrhythmias

* + - Carbonic Anhydrase Inhibitors
      * Topically or systemic
      * Open-angle
      * Well tolerated topically
      * Acetazolamide (Diamox)
        + Oral qd
        + Can reduce IOP quickly
        + Serum electrolytes should be monitored
        + Adverse effects

Diuresis

Electrolyte imbalance

Blood dyscrasias

Flaccid paralysis

Hepatic impairment

* + - Osmotic Diuretics
      * Used postoperatively
      * Emergency treatment for acute closed-angle attacks
      * Ability to quickly reduce blood volume
      * Mannitol (Osmitrol)
        + IV or solution
        + Adverse effects

Orthostatic hypotension

Facial flushing

Headache

Palpitations

Anxiety

Nausea

Electrolyte imbalance

Edema

**Eye Exams**

* Mydriatic drugs
  + Sympathomimetic
    - Phenylephrine (Mydfrin, New-Synephrine)
  + Dilates pupil for better assessment
  + Cause intense photophobia and pain in response to bright light
  + Can worsen glaucoma
  + Effects can last from 3hrs to several days
  + Must wear sunglasses
* Cycloplegic drugs
  + Anti-cholinergic
    - Atropine
  + Dilate pupil
  + Paralyze ciliary muscle to prevent lens from moving
  + Cause severe blurred vision
  + Cause loss of near vision
  + Effects can last from 3hrs to several days
  + Must wear sunglasses

**Anti-anxiety, Sedative, Hypnotics**

* Lorazepam (Ativan)
  + Benzodiazepine
  + Therapeutic class: sedative-hypnotic, anxiolytic, anesthetic adjunct
  + Pharmacologic class: GABA receptor agonist
  + Most potent benzodiazepine
  + Used as a pre-anesthetic med to provide sedation
  + Used to manage status epilepticus
  + May be given IV (potential respiratory depression, monitor q 5-15 min)
  + Adverse effects
    - Drowsiness
    - Sedation
  + Contraindications
    - Do not use if acute narrow angle glaucoma is present
    - Depressive disorder
    - Psychosis
  + Overdose
    - Antidote: flumazenil (Romazicon)
* Escitalopram Oxaltate (Lexapro)
  + Therapeutic class: Antidepressant, anxiolytic
  + Pharmacologic Class: SSRI
  + Generalized anxiety
  + Depression
  + Panic disorders
  + Administer 14 days after MAOI drugs have been stopped
  + Adverse effects
    - Dizziness
    - Nausea
    - Insomnia
    - Somnolence
    - Confusion
    - O/D = seizures
  + Contraindications:
    - Patients who are breastfeeding
* Zolpidem (Ambien)
  + Therapeutic class: Sedative-Hypnotic
  + Pharmacologic class: Non-benzo, non-barb, GABA agonist, CNS depressant
  + Preserves stages III and IV of sleep
  + Short term insomnia
  + Give immediately before bedtime (7-27 min onset)
  + Adverse effects
    - Daytime sedation
    - Confusion
    - Amnesia
    - Dizziness
    - Depression
    - Nausea
    - Vomiting
  + Contraindications
    - Lactating women should not take
  + OD treatment
    - IV Fluids
    - Flumazenil (Romazicon) may help
* Phenobarbital (Luminal)
  + Therapeutic class: Anti-seizure, sedative
  + Pharmacologic class: Barbiturate, GABA agonist
  + Long acting
  + Used for a variety of seizures
  + Used to promote sleep
  + Schedule IV drug
  + Adverse effects
    - May cause dependence
    - Drowsiness
    - Vitamin deficiency (D, folate, B9, B12)
    - Laryngospasms
    - OD, severe respiratory depression
* Phenytoin (Dilantin)
  + Therapeutic class: anti-seizure, anti-dysrhythmic
  + Pharmacologic class: Hydantoin, sodium influx-suppressing drug
  + Effective against most types of seizures
  + Unlabeled use for digitalis-induced dysrhythmias
  + Adverse effects:
    - Dysrhythmias (bradycardia, v-fib)
    - Severe hypotension
    - Hyperglycemia
    - Headache
    - Nystagmus (involuntary eye movement)
    - Ataxia (lack of muscle coordination)
    - Confusion
    - Slurred speech
    - Paradoxical nervousness
  + Contraindications
    - Seizures due to hypoglycemia
    - Bradycardia
    - Heart block