Nurses’ Role in Medication Management

Patient Assessment

- Review medical history and allergies
- Assess vital signs, labs, and symptoms before giving meds
- Identify contraindications or potential interactions
- Evaluate pain level, mental status, and functional status
- Determine if the patient can safely self-administer

Medication Administration

- Follow the 5(+) rights of medication administration
- Prepare and administer medications via appropriate routes (oral, IV, IM, SQ, transdermal, inhaled, ophthalmic, etc.)
- Use aseptic technique
- Double-check high-alert medications
- Verify controlled substance counts and documentation
- Hold medications when clinically necessary (e.g., low HR for beta-blockers)

Medication Administration Rights

- **Core Rights**
  - **Right Patient** – Verify using two identifiers (name, DOB, MRN)
  - **Right Medication** – Confirm the drug matches the order
  - **Right Dose** – Ensure the dose is appropriate and correctly calculated
  - **Right Route** – Administer via the ordered route (oral, IV, IM, etc.)
  - **Right Time** – Give at the correct time/frequency based on policy

Medication Administration Rights

- **Expanded Rights**
- **Right Documentation**
  - Record medication administration immediately and accurately—drug, dose, route, time, site, and patient response.
- **Right Reason**
  - Verify the medication makes sense for the patient's diagnosis or condition (e.g., giving metoprolol for rate control vs. hypertension).
- **Right Response**
  - Monitor the patient to ensure the medication is working as intended; watch for adverse reactions.
- **Right Education**
  - Teach the patient what the medication is for, how it works, and possible side effects.
- **Right to Refuse**
  - Respect the patient's autonomy—patients have the right to decline a medication. Nurses must document refusal and notify the provider when appropriate.

Monitor and Evaluate

- Assess therapeutic effects
- Watch for adverse effects or allergic reactions
- Monitor lab results related to drug therapy (e.g., INR, peak/trough, electrolytes)
- Track fluid status, vital signs, mental status
- Evaluate pain control and functional outcomes
- Report unexpected or severe reactions immediately

Educate

- Explain medication purpose, dose, route, timing
- Discuss potential side effects and when to seek help
- Teach adherence strategies
- Demonstrate device use (inhalers, pens, patches)
- Provide discharge instructions and written materials
- Promote lifestyle changes that complement medication therapy

Teamwork and Communication

- Clarify unclear or unsafe orders
- Communicate significant changes in condition
- Collaborate with pharmacists and prescribers
- Participate in interdisciplinary rounds
- Use SBAR or similar tools for structured communication
- Advocate for adjustments when needed (dose changes, drug alternatives)

Medication Reconciliation

- Collect complete medication histories
- Compare home meds with admission/transfer/discharge orders
- Identify duplications, omissions, and interactions
- Update records and report discrepancies

Documentation

- Document all medications given (or held), time, dose, route
- Record patient response
- Document teaching and understanding
- Note any adverse events or interventions
- Report and record medication errors per protocol

Error Reporting and Prevention

- Follow safety protocols (barcoding, double-checking)
- Report near-misses and actual medication errors
- Engage in root cause analysis discussions
- Promote a culture of safety
- Use clinical decision support tools correctly

Ethical Considerations

Patient Autonomy

- Respecting a patient’s right to refuse medications
- Ensuring medication decisions are voluntary and informed
- Managing situations where a patient refuses a medication that is clinically important

Informed Consent & Education

- Ensuring patients understand why they’re receiving a medication
- Balancing limited time with the ethical requirement to educate
- Addressing language barriers, health literacy, or cognitive impairment

Justice & Fairness

- Providing equitable pain management without bias
- Ensuring vulnerable populations receive the same quality of medication care
- Avoiding stereotyping (e.g., assumptions about “drug-seeking behavior”)

Confidentiality

- Protecting medication information, particularly sensitive meds (HIV therapy, psychiatric meds, contraceptives)
- Avoiding disclosure in public spaces or in front of visitors without permission

Ethical Challenges With High-Risk Medications

- Handling opioids responsibly—balancing pain relief with risk of addiction
- Navigating sedation, restraints, or end-of-life medications

Beneficence and Nonmaleficence

- Giving medications only when benefits outweigh risks
- Identifying potential harm (interactions, allergies, contraindications)
- Advocating to stop or modify therapy that appears unsafe

Following Orders vs. Advocacy

- Addressing unsafe or unclear orders
- Knowing when to challenge or clarify a prescription
- Reporting concerns even when it feels uncomfortable

Pharmacodynamics and Pharmacokinetics

Pharmacodynamic Terminology

- Agonist
  - Stimulates/activates receptor
- Antagonist (Blocker)
  - Blocks receptor, preventing physiologic function
- Partial agonist
  - Provides some level of stimulation, but also limits full agonist effects

Beta-Agonist (albuterol)

- What they do:
  - Stimulate beta-adrenergic receptors (β1 and/or β2)
  - Mimic the action of epinephrine/norepinephrine
- Physiologic effects:
  - β2 stimulation → bronchodilation
  - β1 stimulation → ↑ HR, ↑ contractility
  - Smooth muscle relaxation (in lungs, uterus, etc.)

Beta-Blockers (metoprolol)

- What they do:
  - Block beta-adrenergic receptors (β1 and/or β2)
  - Reduce effects of epinephrine and norepinephrine
- Physiologic effects:
  - ↓ Heart rate (negative chronotropy)
  - ↓ Contractility (negative inotropy)
  - ↓ Blood pressure
  - ↓ Myocardial oxygen demand
  - May cause bronchoconstriction (especially nonselective agents)

Partial Agonist

- Mechanism of action: Partial agonist at the alpha-4, beta-2 nicotinic acetylcholine receptors in the brain
  - Provides moderate, controlled stimulation of these receptors
  - Blocks nicotine from binding to the same receptors (acts as a functional antagonist)
- How this helps with smoking cessation:
  - Reduces cravings by partially stimulating nicotine receptors
  - Decreases withdrawal symptoms because the receptors aren’t completely deprived of stimulation
  - Prevents the “reward” from cigarettes because nicotine cannot strongly activate the receptor when Chantix is bound
  - Makes smoking less satisfying if the patient slips and smokes

Terminology

- Potency: amount needed for effect (lower dose required, more potent)
- Efficacy: maximum effect a drug can produce
- Therapeutic index
  - Ideally want large therapeutic window
  - Narrow therapeutic index medications – fine line between efficacy and toxicity
  - Warfarin, levothyroxine, lithium, phenytoin
  - Often need to draw levels for narrow therapeutic index window medications

Receptor Affinity

- Higher affinity
  - Doesn’t allow other drugs to bind/displace
  - Naloxone
- Lower affinity
  - Impacts potency
- Receptor subtypes
  - H1 vs. H2
  - Alpha subtypes
    - Prostate vs. HTN

ADME

- Absorption
- Distribution
- Metabolism
- Elimination (excretion)

Half- Life

- Factors affecting half-life
  - Formulation
  - Elimination/Metabolism
    - Greatest specific variation
  - Absorption rate
  - Distribution
  - Drug interactions
- Affects dosing
  - BID versus QID, versus weekly

Elimination

- Creatinine is a waste product generated from normal muscle metabolism (from creatine phosphate)
- It is produced at a relatively constant rate, depending on muscle mass
- Creatinine is primarily filtered by the kidneys and excreted in urine
- Small amounts may be secreted by renal tubules, but most elimination is via glomerular filtration

Elimination

Cockcroft-Gault Formula for Estimating Creatinine Clearance

$$\textbf{CrCl (mL/min)} = \frac{(140\text{-age}) \times \text{Lean Body Weight (kg)}}{\text{Serum Creatinine (mg/dL)} \times 72} \quad (\times 0.85 \text{ if female})$$

Metabolism

- Drug metabolism is the biochemical modification of medications by the body, primarily to facilitate elimination.
- Most drug metabolism occurs in the liver through enzymatic processes, especially the cytochrome P450 (CYP450) system.
- Phase I reactions include oxidation, reduction, and hydrolysis, which generally introduce or expose functional groups on the drug molecule.
- Phase II reactions involve conjugation, where the drug is linked to a large, water-soluble molecule (such as glucuronic acid or sulfate) to enhance excretion.
- Metabolism typically transforms lipid-soluble drugs into more water-soluble compounds that can be excreted by the kidneys.

Metabolism

- **Genetic** variations in CYP450 enzymes can alter metabolism rates, impacting drug effectiveness and risk of toxicity.
- Certain drugs can **induce** CYP450 enzymes, increasing metabolism of themselves or other drugs and reducing therapeutic effect.
- Other drugs can **inhibit** CYP450 enzymes, slowing metabolism and increasing the potential for adverse effects.
- **Liver** disease can significantly reduce metabolic capacity, requiring dosage adjustments to prevent toxicity.
- Age influences metabolism: neonates and older adults often have reduced metabolic activity.
- **First-pass metabolism** occurs when oral drugs are extensively metabolized in the liver before reaching systemic circulation, reducing bioavailability.
- Metabolic pathways can produce active (prodrug), inactive, or toxic metabolites, which influence clinical outcomes and side-effect profiles.

Volume of Distribution

- Theoretical volume of fluid that would be necessary to keep the drug at the same concentration in the plasma
- V_d = Volume of distribution
- Simple compartment model
  - Conc. = dose/Vd OR Vd = dose/conc

Drug Interaction Mechanisms

- Enzyme inhibition – increased concentrations
  - 3A4, 2D6
- Enzyme inhibition – reduced concentrations
  - Prodrugs (codeine, tamoxifen, clopidogrel)
- Alteration of renal elimination
  - Lithium, digoxin
- Absorption alterations
  - Cholestyramine, sucralfate, calcium, iron
  - Reduced concentrations

Absorption alterations

- Drug interactions
- Alteration of GI
  - Gastric bypass – reduced extent of absorption
  - Slow motility - increased
- Gut transporter saturation
  - Gabapentin

Onset of Action

- Delivery method of drug
  - IV
  - Oral
  - Transdermal
- Intrinsic property of drug or delivery system
- Lipophilic
  - Cross blood brain barrier, quicker onset for CNS purposes
    - ICU sedation

Drug Delivery Systems

- **Intravenous** (IV): immediate onset; drug enters bloodstream directly
- Inhalation: very rapid onset; large surface area and rich blood supply in lungs
- Sublingual/buccal: rapid onset; bypasses first-pass metabolism
- Intramuscular (IM): moderate onset; absorption depends on muscle perfusion
- Subcutaneous (SQ): slower than IM but faster than oral in many cases
- **Oral** (PO): slower onset; affected by stomach emptying, food, GI absorption
- Rectal: variable onset; partially bypasses first-pass metabolism
- Transdermal patches: very slow onset; designed for long, steady absorption
- Topical (skin/eye/ear): local effects with minimal systemic onset
- Intranasal: relatively fast due to mucosal absorption
- Intrathecal/epidural: fast and targeted onset within CNS
- Implantable devices (e.g., hormone implants): slow, sustained release over weeks to months

What Impacts Bioavailability

- Drug itself
- Delivery route
  - IV = 100%
- First pass metabolism
  - Budesonide (Crohn's)
- Drug/food interactions
- Physiology, GI tract

Nursing Responsibilities

- Monitor for therapeutic and adverse effects
- Evaluate patient response to drug therapy within the expected timeline
- Educate patient on expected outcomes of medications
- Educate patients about toxicity and recognize possible signs of toxicity
- Recognize that changes in drug therapy could lead to drug interactions
- Identify patients who’ve had changes in renal or liver function

Dosage Forms

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Objectives

- Know the different dosage forms of medications
- Know the different routes of administration
- Distinguish benefits and pitfalls of the different dosage forms and routes of administration

Common Dosage forms

- Tablet
- Capsule
- Cream
- Ointment
- Lotion
- Solution
- Suspensions
- Suppository
- Transdermal patch
- Nasal Spray
- Injection
- Aerosol HFA

Tablet, capsule

- Tablet: hard compressed medication
  - Advantages: coated tablets may provide masking of taste, chewable formulations, may crush/split
  - Disadvantages: some tablets may have unpleasant taste, requires consciousness for oral consumption, may be large
  - Examples: sertraline tablets, potassium chloride tablets
- Capsule: medication in a gelatin container (hard or soft shelled)
  - Advantage: masks taste, may open/sprinkle most
  - Disadvantages: some may be hard to swallow, requires consciousness
  - Examples: duloxetine capsules, dilt-XR capsules

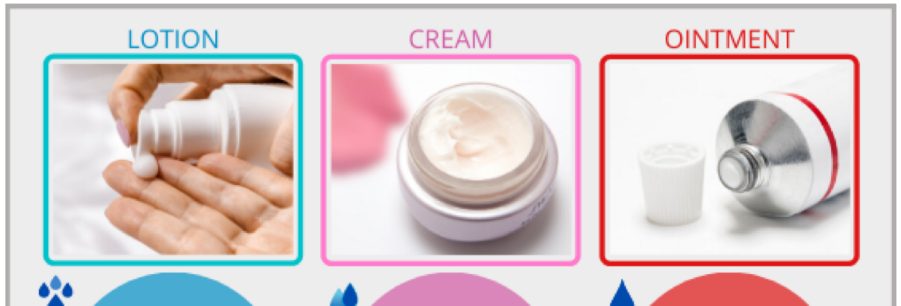
https://www.msdmanuals.com/home/drugs/administration-and-kinetics-of-drugs/drug-absorption

Ointment, cream, lotion

- Ointment: semi-solid, greasy preparations for use on skin, rectum, nose, eye
  - Examples: pimecrolimus 1% ointment, lidocaine ointment

- Creams: semi-solid mixture of drug with oil and water
  - Examples: tretinoin cream, hydrocortisone cream
  - Oil (O/W) in water v. water in oil (W/O)

- Lotion: aqueous preparation for external application
  - Examples: calamine lotion



https://www.eaticc.com/?category_id=2550836

Solutions / Suspensions

- Solutions: liquid preparations dissolved and evenly dispersed
  - Advantages: systemic and localized effect, easier to administer v. oral tablets/capsules, oral can use flavoring agents
  - Disadvantages: risk of contamination and degradation
- Suspension: liquid preparations in which drug is readily dispersed upon shaking
  - Advantages: easier to administer v. oral tablets/capsules, oral can use flavoring agents
  - Disadvantages: must remember to shake before use
  - Examples: paracetamol suspension

https://www.shopmedvet.com/product/amoxicillin-clavulanic-acid-suspension-400-57mg-100ml/Pharmaceuticals-Prescription

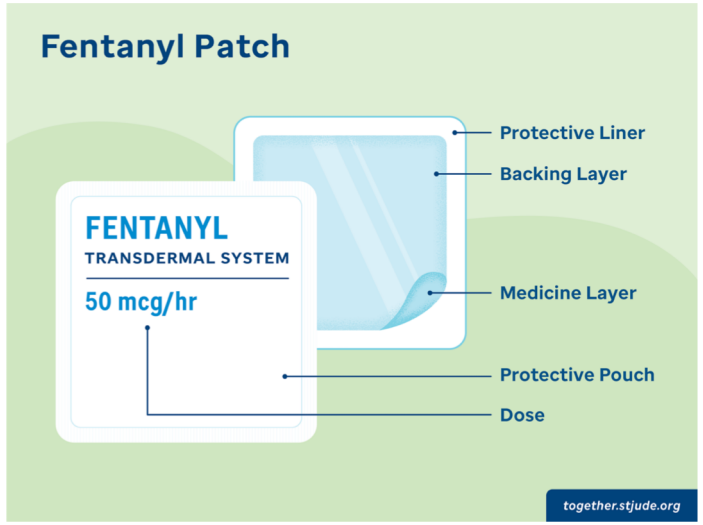
Suppository

- Suppository: small solid medicated mass, usually cone-shaped to be inserted into the rectum or vagina
  - Advantages: localized onset, can be administered to unconscious/intubated patients
  - Disadvantages: uncomfortable
  - Examples: hydrocortisone suppository, Dulcolax suppository

https://www.dulcolax.com/en-us/products/fast-relief/laxative-suppositories

Transdermal Patch

- Transdermal patch: medicated adhesive patch that is placed on the skin to deliver drug through the skin and into the bloodstream
  - Advantages: continuous round-the-clock drug delivery; may be local or systemic
  - Disadvantages: concentration may vary (exercise, hot baths), irritation to skin



Injection

- Injection: infusion method of putting liquid into the body (needle and syringe)
  - Advantages: rapid onset
  - Disadvantages: painful, no taking it back
  - Example: cyanocobalamin injection, insulin pens

Nasal Spray

- Nasal Spray: solution containing medication for administration into the nose with the aid of patient force (inhalation)
  - Advantages: localized effect, can absorb through nasal mucosa for systemic effect
  - Disadvantages: uncomfortable, contamination of the bottle tip
  - Example: fluticasone saline spray, naloxone

Aerosol HFA

- Usually inhalers; drugs with a mixture of propellants held under pressure in an aerosol dispenser
  - Advantages: localized effect, rapid onset
  - Disadvantages: poor hand-breath coordination
  - Examples: Albuterol HFA

https://www.wellrx.com/albuterol%20sulfate%20hfa/drug-information/

Less common dosage forms

- Enema
  - Liquid preparation for rectal use
  - Fleet enema
- Lozenge/gum
  - Medicated gum or lozenge for oral use
  - Nicorette lozenge and gum (not to be swallowed)
- Powder
  - Medication in powder form, for oral or topical use
  - Nystatin powder, cholestyramine packets
- Shampoo
  - Medicated shampoo for topical use (scalp, skin)
  - Ketoconazole shampoo
- Tincture
  - Medication in a solution of alcohol
  - CBD Tincture (OTC)
- Film
  - Medicated films for buccal, sublingual use
  - Suboxone
- Chewable tablets
  - Tablets for oral use that can be chewed without losing its medical properties or inducing unwanted effects
  - Lamotrigine chewable tablets, Motrin chewable tablets

Routes of Administration

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Routes of administration

- Routes of administration refer to the different pathways in which a drug can enter the body
- Examples we will go over in depth include:
  - Oral
  - Buccal
  - Sublingual
  - Rectal
  - Vaginal
  - Intravenous
  - Intramuscular
  - Subcutaneous
  - Transdermal
  - Topical
  - Inhalation
  - Ophthalmic
  - Intranasal

Oral

- Denoted as ‘PO’
- Oral ingestion (swallowing) is the most common medication route
  - Powders, tablets, capsules, suspensions, solutions, syrups
  - Examples: Augmentin suspension, metoprolol tartrate tablets, duloxetine capsules
- Absorption occurs as early as in the mouth; most drugs are absorbed by the stomach or small intestine
- Oral drugs will usually experience ‘first pass metabolism’ → the breakdown of oral medications in the liver (and less commonly, other locations of the body) that occurs before systemic circulation
  - Medications experiencing first-pass metabolism result in a reduced concentration and effect of the drug

  Advantages: convenient, self- administration, safe, cheap
- Potentially poor candidates for oral administration: young children, elderly, patient experiencing seizures, intubated patients, unconscious
  - Example of a poor drug candidate: insulin cannot be administered orally due to the gastric acid in the stomach destroying this drug. This is why insulin is usually injected subcutaneously.

https://ptcbtestprep.com/routes-of-administration/

Buccal

Drug is given between the gums and cheek

- Denoted as ‘BUC’
- Directly enters bloodstream via diffusion through oral mucosa/tissue
- Due to lack of first-pass effect → may have better bioavailability +/- more rapid onset
- Potential candidates that would benefit from buccal administration: Rapid onset of action, poor compliance
- Potentially poor candidates for buccal administration: unconscious, nauseated, patients experiencing dysphagia
- Examples: nicotine gum

Sublingual

Drug is placed under the tongue

- Denoted as ‘SL’
  - Often films, ODT
- Directly enters bloodstream via diffusion of tissues located under the tongue
- Relation with first-pass effect, ideal candidates, and poor candidates are similar to BUC administration
- Examples: nitroglycerin tablets, buprenorphine film

https://www.msdmanuals.com/home/drugs/administration-and-kinetics-of-drugs/drug-administration#:~:text=Oral%20route&text=For%20drugs%20administered%20orally%2C%20absorption,bloodstream%20to%20its%20target%20site.

Parental: (subcutaneous, intramuscular, intravenous)

- Parental administration will provide bioavailability closest to 100%. Dependent of area of administration, these medications undergo varied distribution, metabolism, and excretion
- Subcutaneous: injecting into the layer of skin below the dermis and epidermis
  - SC or SubQ
  - Examples: insulin, heparin
- Intramuscular: injection into a muscle
  - IM
  - Examples: Vaccinations, Vitamin B12 injections
- Intravenous: injection directly into bloodstream: bloodstream administration via a vein
  - IV
  - Examples: TPN, D5, NS, antibiotics
- Advantages: rapid onset, ability for titration, emergency medicine, avoids first-pass, usually high bioavailability
- Disadvantages: higher cost (compared to oral), rapid accumulation, infection via contamination to skin/bloodstream, pain at application site, cannot self-administer, painful, less stable than oral (shorter shelf life)

Less common parental routes of administration

- Intracardial → into the heart
- Intraosseous → into the bone marrow
- Intradermal → into the skin
- Intravitreal → through the eye
- Intraocular → into the eye
- Intravesical → into the bladder
- Intrathecal → into the spinal cord
- Intraarticular → into a joint space

Topical

- Topical applications are used when a local effect of a drug is desired in the form of a lotion, solution, cream, ointment preparation
  - Examples: clotrimazole cream
- Absorbed through the skin, distributed through the skin tissue, metabolized in the skin and then circulates systemically
- Advantages: self-controlled, non-invasive, avoids first-pass
- Disadvantages: mainly for localized effect, can transfer to other patients (testosterone gel)

Rectal

Uses the rectum as a route of administration; absorbed by the rectum's blood vessels

- Rectal administration bypasses portal circulation by up to 50%, thus metabolism via liver is not significant. Medication may flow into body’s circulatory system which distributes systemically
- Advantages: localized and systemic, unconscious/intubated administration, safer in hepatically impaired
- Disadvantages: uncomfortable, slower and more erratic absorption, irritation of rectum
- Ointment, suppository, enema
- Examples: fleet enema, hydrocortisone suppository

Vaginal

Delivery of medication within the vaginal cavity

- Avoids first-pass
- Advantages: localized effect, can use in unconscious/intubated
- Disadvantages: sometimes systemic effect, more complicated to administer
- Gel, cream, enema,
- Examples: metronidazole vaginal gel, estradiol vaginal tablets, fluconazole tablets

Transdermal

- Drug is delivered throughout the entire body (systemically) through the skin's absorption via a patch
  - Examples: fentanyl patches, scopolamine patch, Vivelle-Dot
- Absorbed and metabolized by the skin, distributed systemically, avoids first-pass
- Potential candidates that would benefit from transdermal administration: patients requiring continuous drug delivery for several hours/days, patients with lack of GI usage
- Potentially poor candidates for transdermal administration: allergy/sensitivity to adhesive, patients only needed acute relief/care

Intranasal

- Solutions, sprays, inhalations that are insufflated through the nose
- Absorbed into venous circulation,
  - Examples: fluticasone spray, Narcan
- Advantages: bypasses BBB and first-pass, rapid delivery of drugs
- Disadvantages: irritating to nose, difficult in young children/elderly, cannot administer to unconscious/intubated

Inhalation

- Atomized drug or fine powdered drugs administered through the windpipe and reached the lungs
  - Examples: Advair Diskus, Ventolin HFA
- Minimal systemic absorption (localized to lungs)
- Advantages: localized effect, treats many lung diseases
- Disadvantages: requires hand-mouth coordination,

Ophthalmic

Administration of a drug to the eyes

- Absorbed through the cornea, conjunctiva, and nasal mucosa, and exbibits local effects. Medications administered via the ophthalmic route have systemic effects to a degree. However, a majority of drug is lost in the precorneal area
  - Examples: Restasis, bimatoprost solution
- Metabolism occurs via outflow of blinking mechanisms, and the nasolacrimal route
- Advantages: localized (infection, dry eyes)
- Disadvantages: difficult to administer, variable drop sizes, reliance on proper patient technique

Otic

Administration of a drug into the ears

- Absorbed through the inner ear, blood-labyrinth barriers, and other routes, and distributes variably in the ear's open fluid spaces and tissue compartments.
  - Examples: acetic acid solution, ciprofloxacin solution
- Elimination occurs through the pharynx, vascular system, lymphatic system, and een CSF
- Advantages: localized infection (acute otitis media)
- Disadvantages: difficult to administer, variable drop sizes, reliance on proper patient technique

Calculations

Percentage, Decimals, and Fractions

- Fraction is a part of a whole amount written with a division symbol
- Dividing the fraction in a calculator gives us the decimal value
- % to decimal by dividing by 100 (moving decimal left two places)
- Decimal to % by multiplying by 100 (moving decimal right two places)

Fractions	Decimals	Percentage
1/8	0.125	12%
1/4	0.25	25%
1/3	0.33	33%
1/2	0.5	50%
2/3	0.66	66%
3/4	0.75	75%

Ratios and proportions

Ratio:

- The relation between two amounts shown using either a colon or a fraction
- 1:100 or $\frac{1}{100}$ meaning “1 per 100”

Proportion:

- Two ratios that are equivalent
- Example: $\frac{2}{5} = \frac{4}{10}$

Ratios and proportions (cont…)

- Can use this to solve certain pharmacy calculations
- Example: How many grams of Drug A is present in 5 mL of a solution with 25 g Drug A in 100 mL of solution?
  - Set up problem: $\frac{25\ \text{g}}{100\ \text{mL}} = \frac{\text{X g}}{5\ \text{mL}}$
  - Cross multiply: $\frac{25\ \text{g}}{100\ \text{mL}} \times \frac{\text{X g}}{5\ \text{mL}}$
  - Solve for X: $25\ \text{g} * 5\ \text{mL} = 100\ \text{mL} * \text{X g}$
  - X = $\frac{25\ \text{g} * 5\ \text{mL}}{100\ \text{mL}}$ = 1.25 g Drug A

Dispensing calculations

Amount of medication used in a day x number of days taking medication

- <u>Tablets/Capsules:</u>
  - 3 tablets per day $*$ 30 days = 90 tablets needed
- <u>Oral Liquids:</u>
  - 2.5 mL twice daily $*$ 30 days = 2(2.5) $*$ 30 = 150 mL needed

Day supply calculations

Amount dispensed/daily use

- <u>Tablets/capsules:</u>
  - $\frac{\text{14 capsules}}{\text{2 capsules daily}}$ = 7 day supply
- <u>Oral Liquids:</u>
  - $\frac{\text{500 mL}}{\text{20 mL}}$ = 25 day supply

Daily supply calculations (cont…)

Inhaler/nasal sprays:

- Based off how many metered doses in package
  - $\frac{200\ metered\ doses}{2\ puffs\ q4h} = \frac{200\ metered\ doses}{2\ x\ 6} = \frac{200}{12} \approx$ 17 day supply

Eye/Ear Drops:

- Based of how many mL in bottle, 1 mL = 20 drops
  - 2.5 mL $* \frac{20\ drops}{mL}$ = 50 drops per bottle x $\frac{per\ day}{4\ drops}$ = 12.5 day supply

Weight based calculations

- Certain medications have weight-based dosing associated with its use
- Medications for children are also often weight based
- Usually written as mg/kg or mg/kg/day
- Example: 100 lb patient with instructions to give 5 mg/kg/day BID, what would one dose be in mg?
  - 100 lb x $\frac{1\ \text{kg}}{2.2\ \text{lb}}$ = 45.45 kg x $\frac{5\ \text{mg}}{\text{kg/day}}$ = 227.27 mg/day
  - $\frac{227.27\ \text{mg}}{\text{day}}$ *x* $\frac{1\ day}{2\ doses}$ ≈ *114 mg per dose*

Common Weight Conversions

- Example: What is 105 lbs in kgs?
  - $105 \text{ lbs} * \frac{1 \text{ kg}}{2.2 \text{ lbs}} = 47.73 \text{ kgs}$

Weight Equivalents
1 fl oz = 2 tbsp
1 oz = 30 g
1 kg = 2.2 lbs
1 lb = 16 oz
1 tsp = 5 mL
1 tbsp = 15 mL = 3 tsp
8 fl oz = 1 cup
1 mL = 20 drops

Metric conversion

- Metric system is based off multiples of 10
- Example: How many grams are in 1.5 kgs?
  - $1.5\ \text{kg} * \frac{1000\ \text{g}}{1\ \text{kg}} = 1500\ \text{g}$

IMPORTANT CONVERSIONS
1 kg = 1000 g
1 g = 1000 mg
1 mg = 1000 mcg

Temperature Conversion

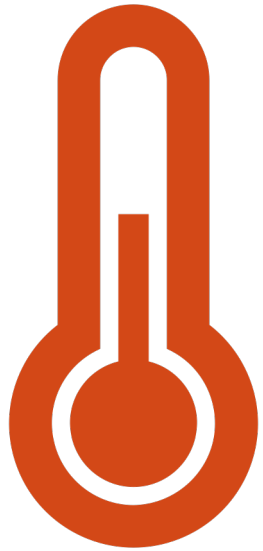
<u>Fahrenheit to Celsius:</u>

- $C = (F - 32) \times (^{5}/_{9})$

<u>Celsius to Fahrenheit:</u>

- $F = (C \times {}^{9}/_{5}) + 32$

- Example: Convert 75º F to Celsius
    - $(75º\ F - 32) \times (^{5}/_{9}) = 43 \times (^{5}/_{9}) \approx 24º\ C$



Temperature (cont...)

Common Temperatures

0ºC	32º F	Water freezing temp
100ºC	212º F	Water boiling temp
20-25ºC	68-77ºF	Controlled room temperature
2-8ºC	36-46ºF	Controlled fridge temperature
-25 to -10ºC	-13 to -14ºF	Controlled freezer temperature

length conversions

Common Conversions
1 in = 2.54 cm
1 m = 100 cm
12 in = 1 ft

Concentration

- The amount of drug, or active ingredient, in a given weight/volume
- Concentration = $\frac{\text{active ingredient amount}}{\text{total weight/volume}}$
- Can be written as a strength, a percentage, or a ratio and expressed in different units of measure (mg/mL, g/mL, unit/g, etc.)
- Example: how many mg of amoxicillin is in 100 mL of a 250 mg/5 mL suspension?
    - $\frac{250\ \text{mg}}{5\ \text{mL}} = \frac{\text{X mg}}{100\ \text{mL}}$
    - Solve for X = 5,000 mg of amoxicillin

Insulin calculations

For U100 insulin, 1 mL = 100 units *always double check that 100 unit/mL vial/pens*

- <u>Vial</u>
    - 10 mL vial $*\frac{100\ \text{units}}{1\ \text{mL}}$ = 1,000 units $*\frac{\text{per day}}{20\ \text{units}}$ = 50 day supply (may expire before)
- <u>Pen (add 2 unit priming to each dose)</u>
    - 3 mL per pen $*\frac{100\ \text{units}}{1\ \text{mL}}$ = 300 units
    - 300 units $*\frac{\text{per day}}{20\ \text{units}+2\ \text{priming units}}$ ≈ 14 day supply

IV concentrations

- Example: how many g of NaCl is in 1 L of NS
  - Remember: $0.9\%\ \text{NaCl} = \frac{0.9\ \text{NaCl}}{100\ \text{mL}}$
  - Set up equation: $\frac{0.9\ \text{g}}{100\ \text{mL}} = \frac{\text{x g}}{1000\ \text{mL}}$
  - Solve for x = 9 g NaCl

Common Abbreviations		
D5W	Dextrose 5%	5 g dextrose in 100 mL water
NS	0.9% NaCl	0.9 g NaCl in 100 mL water
½ NS	0.45% NaCl	0.45 g of NaCl in 100 mL water

Infusion rate

- The rate that an IV medication is delivered to a patient, can also be known as a flow rate or drip rate
- Always double check units (mins vs hrs, mL vs gtt)
- Infusion rate = $\frac{\text{Volume}}{\text{Time}}$

Infusion rate (cont…)

- Example: what is the infusion rate of a 1000 mL NS bag every min if infused over an 8-hour period? What about every 30 mins?
  - $\frac{1000\ \text{mL}}{8\ \text{hour}} \times \frac{1\ \text{hour}}{60\ \text{mins}} = 2.08$ mL/min
  - 2.08 mL/min x 30 mins = 62.5 mL every 30 mins
- Example: What is the flow rate in drops per minute of 1000 mL NS infused over 8 hours and set to 60 gtts/mL?
  - $\frac{1000\ \text{mL}}{8\ \text{h}} \times \frac{1\ \text{h}}{60\ \text{min}} \times \frac{60\ \text{gtts}}{1\ \text{mL}} = 125$ gtts/min

IV duration

- How long an IV solution will take to administer
- $\frac{\text{Volume}}{\text{Rate}}$ = Time
- Example: an 250 mL of an antibiotic is administered at rate of 2.5 mL/min rate, how long will this medication take to be administered in hours??
  - 250 mL x $\frac{1\ \text{min}}{2.5\ \text{mL}}$ x $\frac{1\ \text{hour}}{60\ \text{min}}$ = 1.67 hours