

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 (β_1 and/or β_2)
 - Mimic the action of epinephrine/norepinephrine
- Physiologic effects:
 - β_2 stimulation $\rightarrow$ bronchodilation
 - β_1 stimulation $\rightarrow$ $\uparrow$ HR, $\uparrow$ contractility
 - Smooth muscle relaxation (in lungs, uterus, etc.)

Beta-Blockers (metoprolol)

- What they do:
 - Block beta-adrenergic receptors (β_1 and/or β_2)
 - 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

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

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
 - $\text{Conc.} = \text{dose}/V_d$ OR $V_d = \text{dose}/\text{conc}$

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

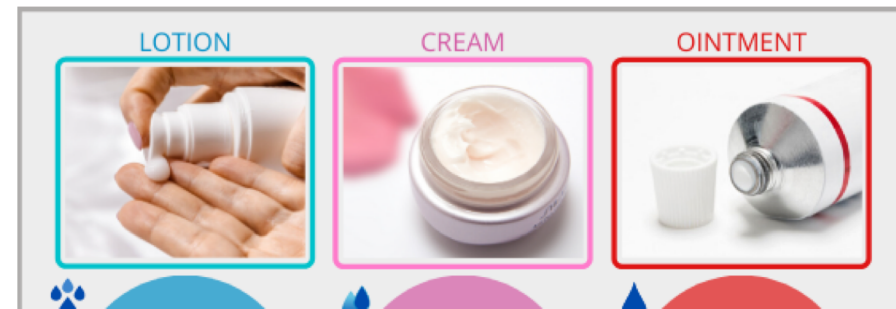
- Tablet
- Capsule
- Cream
- Ointment
- Lotion
- Solution
- Suspensions
- Suppository
- Transdermal patch
- Nasal Spray
- Injection
- Aerosol HFA

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

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



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



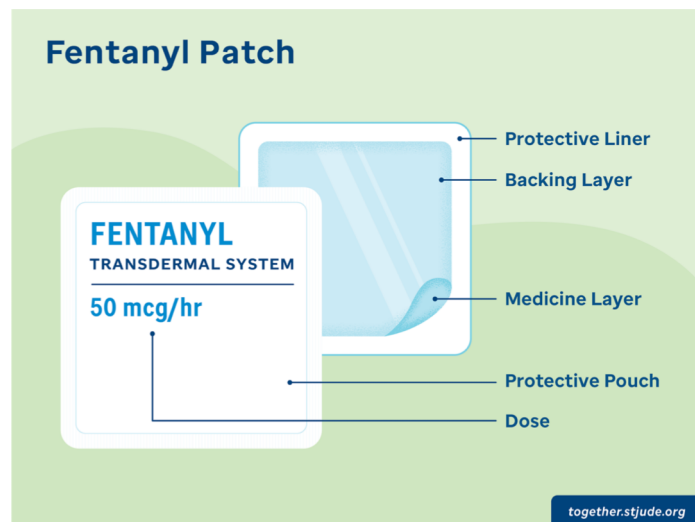
Suppository

- 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



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



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.

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

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 exhibits 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 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
$\frac{1}{8}$	0.125	12%
$\frac{1}{4}$	0.25	25%
$\frac{1}{3}$	0.33	33%
$\frac{1}{2}$	0.5	50%
$\frac{2}{3}$	0.66	66%
$\frac{3}{4}$	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: $\frac{25 \text{ g}}{100 \text{ mL}} = \frac{X \text{ g}}{5 \text{ mL}}$
- Cross multiply: $\frac{25 \text{ g}}{100 \text{ mL}} \times \frac{X \text{ g}}{5 \text{ mL}}$
- Solve for X: $25 \text{ g} * 5 \text{ mL} = 100 \text{ mL} * X \text{ g}$
- $X = \frac{25 \text{ g} * 5 \text{ mL}}{100 \text{ mL}} = 1.25 \text{ g Drug A}$

Dispensing calculations

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

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





Day supply calculations

Amount dispensed/daily use

- Tablets/capsules:

- $\frac{14 \text{ capsules}}{2 \text{ capsules daily}} = 7 \text{ day supply}$

- Oral Liquids:

- $\frac{500 \text{ mL}}{20 \text{ mL}} = 25 \text{ day supply}$

Daily supply calculations (cont...)

Inhaler/nasal sprays:

- Based off how many metered doses in package

- $$\frac{200 \text{ metered doses}}{2 \text{ puffs q4h}} = \frac{200 \text{ metered doses}}{2 \times 6} = \frac{200}{12} \approx 17 \text{ day supply}$$

Eye/Ear Drops:

- Based of how many mL in bottle, 1 mL = 20 drops

- $$2.5 \text{ mL} * \frac{20 \text{ drops}}{\text{mL}} = 50 \text{ drops per bottle} \times \frac{\text{per day}}{4 \text{ drops}} = 12.5 \text{ day supply}$$

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?
 - $100 \text{ lb} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} = 45.45 \text{ kg} \times \frac{5 \text{ mg}}{\text{kg/day}} = 227.27 \text{ mg/day}$
 - $\frac{227.27 \text{ mg}}{\text{day}} \times \frac{1 \text{ day}}{2 \text{ doses}} \approx 114 \text{ mg per dose}$

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

$$1 \text{ fl oz} = 2 \text{ tbsp}$$

$$1 \text{ oz} = 30 \text{ g}$$

$$1 \text{ kg} = 2.2 \text{ lbs}$$

$$1 \text{ lb} = 16 \text{ oz}$$

$$1 \text{ tsp} = 5 \text{ mL}$$

$$1 \text{ tbsp} = 15 \text{ mL} = 3 \text{ tsp}$$

$$8 \text{ fl oz} = 1 \text{ cup}$$

$$1 \text{ mL} = 20 \text{ drops}$$

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

$$1 \text{ kg} = 1000 \text{ g}$$

$$1 \text{ g} = 1000 \text{ mg}$$

$$1 \text{ mg} = 1000 \text{ mcg}$$

Temperature Conversion

Fahrenheit to Celsius:

- $C = (F - 32) \times \left(\frac{5}{9}\right)$

Celsius to Fahrenheit:

- $F = (C \times \frac{9}{5}) + 32$

- Example: Convert 75° F to Celsius

- $(75^{\circ} F - 32) \times \left(\frac{5}{9}\right) = 43 \times \left(\frac{5}{9}\right) \approx 24^{\circ} C$



Temperature (cont...)

Common Temperatures

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

length conversions

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

$$1 \text{ in} = 2.54 \text{ cm}$$

$$1 \text{ m} = 100 \text{ cm}$$

$$12 \text{ in} = 1 \text{ ft}$$

Concentration

- The amount of drug, or active ingredient, in a given weight/volume
- $\text{Concentration} = \frac{\text{active ingredient amount}}{\text{total weight/volume}}$
- 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?
 - $\frac{250 \text{ mg}}{5 \text{ mL}} = \frac{X \text{ mg}}{100 \text{ mL}}$
 - 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*

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



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: $\frac{0.9 \text{ g}}{100 \text{ mL}} = \frac{x \text{ g}}{1000 \text{ mL}}$
- 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?
 - $\frac{1000 \text{ mL}}{8 \text{ hour}} \times \frac{1 \text{ hour}}{60 \text{ mins}} = 2.08 \text{ mL/min}$
 - $2.08 \text{ mL/min} \times 30 \text{ mins} = 62.5 \text{ mL every 30 mins}$
- Example: What is the flow rate in drops per minute of 1000 mL NS infused over 8 hours and set to 60 gtts/mL?
 - $\frac{1000 \text{ mL}}{8 \text{ h}} \times \frac{1 \text{ h}}{60 \text{ min}} \times \frac{60 \text{ gtts}}{1 \text{ mL}} = 125 \text{ gtts/min}$





IV duration

- How long an IV solution will take to administer
- $\frac{\text{Volume}}{\text{Rate}} = \text{Time}$
- 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??
 - $250 \text{ mL} \times \frac{1 \text{ min}}{2.5 \text{ mL}} \times \frac{1 \text{ hour}}{60 \text{ min}} = 1.67 \text{ hours}$