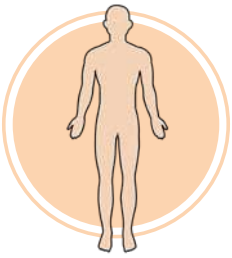
Fundamentals Review



HEAD-TO-TOE ASSESSMENT

HEAD-TO-TOE ASSESSMENT

1. INSPECT
2. PALPATE
3. PERCUSS
4. AUSCULTATE

Introduction

- Knock
- Introduce yourself
- Wash hands
- Provide privacy
- Verify client ID and DOB
- Explain what you are doing (using non-medical language)

Orientation

- What is your name?
- Do you know where you are?
- Do you know what month it is?
- Who is the current U.S. president?
- What are you doing here?
- **A&O X4** = Oriented to Person, Place, Time, and Situation

"Normal" Vital Signs

- **PULSE:** 60-100 bpm
- **BLOOD PRESSURE:** 120/80 mmHg
- **O_2 SATURATION:** 95-100%
- **TEMPERATURE:** 97.8-99.1°F
- **RESPIRATIONS:** 12-20 breaths per min

PULSE SCALE

0	PULSE IS ABSENT
1+	DIMINISHED
2+	NORMAL
3+	FULL
4+	BOUNDING, STRONG

Assessing the strength of the pulse

Head & Face

HEAD

- Inspect head/scalp/hair
- Palpate head/scalp/hair

FACE

- Inspect
- Check for symmetry
- To assess **CRANIAL NERVE 7**, check....

VII: FACIAL

- Raise eyebrows
- Smile
- Frown
- Show teeth
- Puff out cheeks
- Tightly close eyes

EYES

- Inspects external eye structures
- Inspect color of conjunctiva and sclera
- **PERRLA**
  - **P**upils **E**qual, **R**ound, **R**eactive to **L**ight, & **A**ccommodation

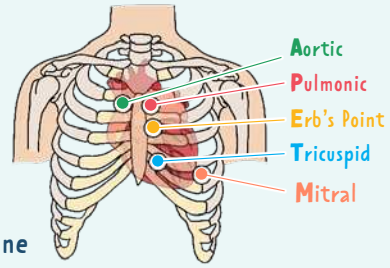
ASSESS THE DEPTH OF THE RESPIRATIONS

EFFORT	note if it's **LABORED** or **UNLABORED**
RHYTHM	note if it's **REGULAR** or **IRREGULAR**

5 AREAS FOR LISTENING TO THE HEART

MNEMONIC

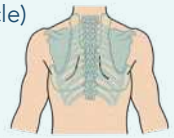
All
People
Enjoy
Time
Magazine



Neck, Chest (Lungs) & Heart

NECK

- Inspect and palpate
- Palpate carotid pulse
- Check skin turgor (under clavicle)



POSTERIOR CHEST

- Inspect
- Auscultate lung sounds in posterior and lateral chest
  - Note any crackles or diminished breath sounds

ANTERIOR CHEST

- Inspect:
  - Use of accessory muscles
  - AP to transverse diameter
  - Sternum configuration
- Palpate: symmetric expansion
- Auscultate lung sounds → anterior and lateral
  - Note any crackles or diminished breath sounds

HEART

- Auscultate heart sounds (**A**, **P**, **E**, **T**, **M**) with diaphragm and bell
  - Note any murmurs, whooshing, bruits, or muffled heart sounds

HEAD-TO-TOE ASSESSMENT

Peripherals

UPPER EXTREMITIES

- Inspect and palpate
- Note any texture, lesions, temperature, moisture, tenderness, & swelling
- Palpate radial pulses bilaterally

0	PULSE IS ABSENT
1+	DIMINISHED
2+	NORMAL
3+	FULL
4+	BOUNDING, STRONG

SHOULDER

- Inspect, palpate, and assess

ELBOWS

- Inspect, palpate, and assess

HANDS AND FINGERS

- Inspect hands/fingers/nails
- Palpate hands and finger joints
- Check muscle strength of hands bilaterally
  - Does each hand grip evenly?

Spine

- Have the client stand up (if able)
- Inspect the skin on the back
- Inspect: spinal curvature (cervical/thoracic/lumbar)
- Palpate spine
- Note any lesions, lumps, or abnormalities

If we were to percuss + palpate before listening (auscultating), we would alter the bowel sounds. This would lead to inaccurate results.

Lower Extremities (hips, knees, ankles)

LOWER EXTREMITIES

- Inspect:
  - Overall skin coloration
  - Lesions
  - Hair distribution
  - Varicosities
  - Edema
- Palpate: Check for edema (pitting or non-pitting)
- Check capillary refill bilaterally

CAPILLARY REFILL TIME (CRT)
Time taken for capillary bed to regain its color after pressure has been applied

NORMAL <2-3 SECONDS

HIPS

- Inspect and palpate

KNEES

- Inspect and palpate

ANKLES

- Inspect and palpate
- Posterior pulse
- Dorsal pedis pulse bilaterally
  - Check strength bilaterally
    - Dorsiflexion flexion against resistance

0	PULSE IS ABSENT
1+	DIMINISHED
2+	NORMAL
3+	FULL
4+	BOUNDING, STRONG

Abdomen

Assess in different order:

1. INSPECT
2. AUSCULTATE
3. PERCUSS
4. PALPATE

- Inspect:
  - Skin color
  - Contour
  - Scars
  - Aortic pulsations
- Auscultate bowel sounds: all 4 quadrants (start in RLQ and go clockwise)
- Light palpation: all 4 quadrants

ABSENT: Must listen for at least 5 minutes to chart absent bowel sounds

HYPOACTIVE: One bowel sound every 3-5 minutes

NORMOACTIVE: Gurgles 5-30 times per minute

HYPERACTIVE: Can sometimes be heard without a stethoscope. Constant bowel sounds (> 30 sounds per minute)

OVERALL

- Positions and drapes client appropriately during exam (gave client privacy)
- Gave client feedback/instructions
- Exhibits professional manner during exam, treated client with respect and dignity
- Organized: exam followed a logical sequence (order of exam "made sense")

DOSAGE CALCULATION

ABBREVIATIONS

TIMES OF MEDICATIONS

ac	before meals
pc	after meals
daily	every day
bid	two times a day
tid	three times a day
qid	four times a day
qh	every hour
ad lib	as desired
stat	immediately
q2h	every 2 hours
q4h	every 4 hours
q6h	every 6 hours
prn	as needed
hs	at bedtime

EXAMPLE

QUESTION: A patient is receiving 1 mg tid.
How many mg will they receive in one day?

Remember: tid = 3X a day

ANSWER: If they are receiving 1 mg for 3X a day, that's 1 mg x 3 = 3 mg per day

ROUTES OF ADMINISTRATION

PO	by mouth
IM	intramuscularly
PR	per rectum
SubQ	subcutaneously
SL	sublingual
ID	intradermal
GT	gastrostomy tube
IV	intravenous
IVP	intravenous push
IVPB	intravenous piggyback
NG	nasogastric tube

DRUG PREPARATION

tab, tabs	tablet
cap, caps	capsule
gtt	drop
EC	enteric coated
CR	controlled release
susp	suspension
el, elix	elixir
sup, supp	suppository
SR	sustained release

METRIC

g (gm, Gm)	gram
mg	milligram
mcg	microgram
kg (Kg)	kilogram
L	liter
mL	milliliter
mEq	milliequivalent

APOTHECARY & HOUSEHOLD

gtt	drop
min, m, mx	minim
tsp	teaspoon
pt	pint
gal	gallon
dr	dram
oz	ounce
T, tbs, tbsp	tablespoon
qt	quart

CONVERSIONS

BASED ON VOLUME

1 mg = 1,000 mcg
1 g = 1,000 mg
1 oz = 30 mL
8 oz = 1 cup
1 tsp = 5 mL
1 dram = 5 mL
1 tbsp = 15 mL
1 tbsp = 3 tsp
1 L = 1,000 mL

THE METRIC SYSTEM

LARGE unit to **SMALL** unit → move decimal to the **RIGHT**

SMALL unit to **LARGE** unit → move decimal to the **LEFT**

MOVING TO A LARGER UNIT?
Move the decimal place to the Left
(Ex: mcg → mg)

MEMORY TRICK

Larger unit think Left

EXAMPLE

1500 mcg = _____mg

A **mg** is **larger** than a **mcg**
Therefore you move decimal 3 places to the Left

1500. mcg = 1.500 mg (1.5 mg)

BASED ON WEIGHT

1 kg = 2.2 lbs
1 lb = 16 oz

lb → kg
DIVIDE by **2.2**

EXAMPLE 120 **lbs** = _____ **kg**

120 **lbs** / **2.2** = 54.545 **kg**

kg → lb
MULTIPLY by **2.2**

EXAMPLE 45.6 **kg** = _____ **lbs**

45.6 **kg** x **2.2** = 100.32 **lbs**

DOSAGE CALC RULES

Medication error kills, prevention is crucial!

1. Show ALL your work.

2. Leading zeros must be placed before any decimal point.
   The decimal point may be missed without the zero

   EXAMPLE **.2** mg should be **0.2** mg
   WHY? **.2** could appear to be **2**
   (0.2 mg of morphine is VERY different than 2 mg of morphine!)

3. No trailing zeros.

   EXAMPLE **0.7** mL *NOT* **0.70** mL
   1 mg *NOT* **1.0** mg
   WHY? **1.0** could appear to be **10**!

4. Do not round until you have the final anwser!

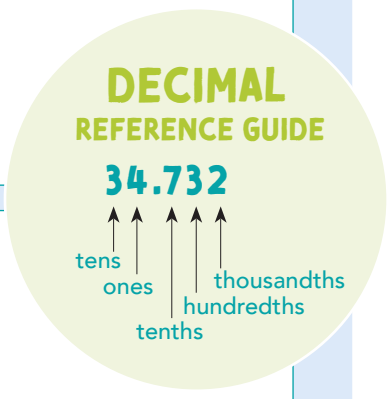
HOW TO ROUND YOUR FINAL ANSWER

If the number in the thousands place is **5 OR GREATER** → The # in the hundredth place is rounded up

EXAMPLES **1.995** mg is rounded to **2** mg
1.985 mg is rounded to **1.99** mg

If the number in the thousands place is **4 OR LESS** → The # is dropped

EXAMPLES **0.992** mg is rounded to **0.99** mg



5. Most nursing schools, if not all, do not give partial credit.
   This means every step must be done correctly!

FORMULA METHOD

For Volume-Related Dosage Orders

$$\frac{D}{H} \times V = A$$

D = Desired

EXAMPLE: "The physician orders **120 mg**..."

Some medications like heparin and insulin are prescribed in **units/hour**

H = Dosage of medication available

EXAMPLE: "The medication is supplied as **100 mg**/5 mL"

V = Volume the medication is available in

EXAMPLE: "The medication is supplied as 100 mg/**5 mL**"

A = Amount of Medication required for administration

YOUR ANSWER

You should assume that all questions are asked "**per dose**" unless the question gives a timeframe (example: "how many tablets will you give in 24 hours?")

EXAMPLE 1

Ordered: Drug C 150 mg
Available: Drug C 300 mg/tab
How many tablets should be given?

$$\frac{D}{H} \times V = A$$

What's our desired? Drug C 150mg PO
What do we have? Drug C 300mg/tab
What's our quantity/volume? tablets

150 ~~mg~~ ÷ 300 ~~mg~~ x 1 tab = 0.5 tabs

150 ÷ 300 = 0.5 x 1 = 0.5 tabs

FINAL ANSWER: 0.5 tabs

EXAMPLE 2

Ordered: Drug C 10,000 units SubQ
Available: Drug C 5,000 units/mL
How many mL should be given?

$$\frac{D}{H} \times V = A$$

What's our desired? Drug C 10,000 SubQ
What do we have? Drug C 5,000 units
What's our quantity/volume? 1 mL

10,000 ~~units~~ ÷ 5,000 ~~units~~ x 1 mL = 2 mL

10,000 ÷ 5,000 = 2 x 1 = 2 mL

FINAL ANSWER: 2 mL

IV FLOW RATES

mL / hour

$$\frac{\text{mL of solution}}{\text{total hours}} = \text{mL/hr}$$

What if the question is given in MINUTES?

Since there are 60 minutes in one hour, use this formula:

$$\frac{\text{mL of solution}}{\text{min}} \times 60_{\text{(minutes)}} = \text{mL/hr}$$

If the question is asking for flow rate and you're given units of mL, you need to write the answers in **mL/hr!**

mL/hr is always rounded to the nearest **WHOLE** number!

EXAMPLE #1

ORDERED: 1000 mL D5W to infuse over 3 hours. What will the flow rate be?

$$\frac{1000 \text{ mL}}{3 \text{ hr}} = 333.333 \text{ mL/hr}$$

ANSWER: 333 mL/hr

(rounded to the nearest whole number)

EXAMPLE #2

ORDERED: Infuse 3 grams of Penicillin in 50 mL normal saline over 30 minutes.

$$\frac{50 \text{ mL}}{30 \cancel{\text{min}}} \times 60 \cancel{\text{min}} = 100 \text{ mL/hr}$$

ANSWER: 100 mL/hr

gtt / min

$$\frac{\text{mL of solution}}{\text{total minutes}} \times \text{drop factor} = \text{gtt/min}$$

What if the question is given in HOURS?

Since there are 60 minutes in one hour, use this formula:

Convert hours to minutes!

EXAMPLES:

1 hour = 60 minutes

2.5 hours = 150 minutes

If a drop factor is included, the question is asking for flow rate in gtt/min.

You need to write the answers in **gtt/minute**!

REMEMBER OUR ABBREVIATIONS:

gtt means "drop"!

EXAMPLE #1

ORDERED: 1000 mL of Lactated Ringer's to infuse at 50 mL/hr. Drop factor for tubing is a 5 gtt/mL. *(Convert: 1 hour = 60 min)*

$$\frac{50 \cancel{\text{mL}}}{60 \text{ min}} \times 5 \text{ gtt}/\cancel{\text{mL}} = 4 \text{ gtt/min}$$

50 ÷ 60 = 0.833 x 5 = 4.166

Round to the nearest whole number → 4

FINAL ANSWER: 4 gtt/min

REMEMBER RULE #4 Don't round till the end!

EXAMPLE #2

ORDERED: 100 mL of Metronidazole to infuse over 45 minutes. The tubing you are using has a drop factor of 10 gtt/mL.

$$\frac{100 \cancel{\text{mL}}}{45 \text{ min}} \times 10 \text{ gtt}/\cancel{\text{mL}} = 22 \text{ gtt/min}$$

100 ÷ 45 = 2.222 x 10 = 22.222

Round to the nearest whole number → 22

FINAL ANSWER: 22 gtt/min

REMEMBER RULE #4 Don't round till the end!

PRACTICE QUESTIONS

Do all 10 questions without looking at the correct answers on the following pages. Don't forget to show all your work. After you are done, walk through each question…even the questions you got correct!

1. **ORDERED:** Rosuvastatin 3000 mcg PO ac
AVAILABLE: Rosuvastatin 2 mg tablet (scored)
How many tabs will you administer in 24 hours?

2. **ORDERED:** Tylenol supp 2 g PR q6h
AVAILABLE: Tylenol supp 700 mg
How many supp will you administer? Round to nearest tenth.

3. **ORDERED:** Potassium chloride 0.525 mEq/lb PO dissolved in 6 oz of juice at 0930
AVAILABLE: Potassium cholride 12 mEq/mL
How many mL of potassium chloride will you add to the juice for a 66.75 kg patient? Round to nearest tenth.

4. **1000 mL D5W to infuse over 4 hours.**

5. **150 mL Cipro 250 mcg to infuse over 45 minutes.**

6. **250 mL normal saline over 5 hours. Tubing drop factor of 10 gtt/mL.**

7. **Humulin R 200 units in 100 mL of normal saline to infuse at 4 units/hr.**

8. **Dopamine 600 mg in 200 mL of normal saline to infuse at 10mcg/kg/min. Pt weight = 190 lbs.**

9. **2.5 L normal saline to infuse over 48 hours.**

10. **ORDERED:** Morphine 100 mg IM q12h prn pain
AVAILABLE: Morphine 150 mg/2.6 mL
How many mL will you administer? Round to nearest hundredth.

COMPREHENSIVE REVIEW

1

ORDERED: Rosuvastatin 3000 mcg PO ac
AVAILABLE: Rosuvastatin 2 mg tablet (scored)

How many tabs will you administer in 24 hours?

STEP 1: CONVERT DATA

mcg → mg

3000 mcg = 3 mg

REMEMBER **SMALL TO BIG:** move the decimal point 3 to the left
unit is getting Larger think Left

STEP 2: READY TO USE DATA

ORDERED: 3 mg
AVAILABLE: 2 mg
VOLUME: 1 tab
ADMINISTERED AC: before each meal
QUESTION IS ASKING: dosage in 24 hours

STEP 3: IRRELEVANT DATA

N/A

STEP 4: FORMULA USED

$$\frac{D}{H} \times V = A$$

SHOW YOUR WORK

$\frac{3\ \cancel{mg}}{2\ \cancel{mg}} = 1.5$

1.5 x 1 tab = 1.5

1.5 x 3 = 4.5 tabs per day

ROUND: *No rounding necessary*

DON'T FORGET TO CHECK TIMES OF MEDICATION!

The medication is ordered to be given AC, which means before each meal. Since there are 3 meals in a day (24 hours), the answer must be multiplied by 3.

FINAL ANSWER: 4.5 tabs

2

ORDERED: Tylenol supp 2 g PR q6h
AVAILABLE: Tylenol supp 700 mg

How many supp will you administer? Round to nearest tenth.

STEP 1: CONVERT DATA

g → mg

2g = 2000 mg

REMEMBER **BIG TO SMALL:** move the decimal point 3 to the right

STEP 2: READY TO USE DATA

ORDERED: 2000 mg
AVAILABLE: 700 mg
VOLUME: 1 supp

STEP 3: IRRELEVANT DATA

N/A

STEP 4: FORMULA USED

$$\frac{D}{H} \times V = A$$

SHOW YOUR WORK

$\frac{2000\ \cancel{mg}}{700\ \cancel{mg}} = 2.857$

REMEMBER RULE #4
Don't round till the end!

2.857 x 1 supp = 2.857 supp

ROUND: *Nearest tenth*

2.857 supp → 2.9 supp

FINAL ANSWER: 2.9 supp

COMPREHENSIVE REVIEW

3

ORDERED: Potassium chloride 0.525 mEq/lb PO dissolved in 6 oz of juice at 0930
AVAILABLE: Potassium chloride 12 mEq/mL
How many mL of potassium chloride will you add to the juice for a 66.75 kg patient? Round to nearest tenth.

STEP 1: CONVERT DATA

kg → lb

66.75 ~~kg~~ x 2.2 (lb/~~kg~~) = 146.85 lb

! In this case, ordered amount depends on patient weight

mEq/lb → mEq

(0.525 mEq/~~lb~~ x 146.85 ~~lb~~ = 77.096 mEq)

STEP 2: READY TO USE DATA

ORDERED: 77.096 mEq
AVAILABLE: 12 mEq
VOLUME: 1 mL

STEP 3: IRRELEVANT DATA

Dissolved in 12 oz of juice at 0930

! Question asked for "per dose" because no timeframe was given

STEP 4: FORMULA USED

$$\frac{D}{H} \times V = A$$

SHOW YOUR WORK

$$\frac{77.096\ \text{mEq}}{12\ \text{mEq}} = 6.424$$

! **REMEMBER RULE #4** Don't round till the end!

6.424 X 1 mL = 6.424 mL

ROUND: *Nearest tenth*

6.424 mL → 6.4 mL

FINAL ANSWER: 6.4 mL

4

1000 mL D5W to infuse over 4 hours.

STEP 1: CONVERT DATA

N/A

STEP 2: READY TO USE DATA

1000 mL
4 hr

STEP 3: IRRELEVANT DATA

N/A

STEP 4: FORMULA USED

$$\frac{\text{mL of solution}}{\text{total hours}} = \text{mL/hr}$$

SHOW YOUR WORK

$$\frac{1000\ \text{mL}}{4\ \text{hr}} = 250\ \text{mL/hr}$$

! **mL/hr** is always rounded to the nearest **WHOLE** number!

ROUND: *No rounding necessary*

FINAL ANSWER: 250 mL/hr

COMPREHENSIVE REVIEW

5

150 mL Cipro 250 mcg to infuse over 45 minutes.

If the question is asking for flow rate ("to infuse") and you're given mL of solution, you need to write the answer in **mL/hours!**

STEP 1: CONVERT DATA

N/A

STEP 2: READY TO USE DATA

ML OF SOLUTION: 150 mL
TOTAL HOURS: 45 min

STEP 3: IRRELEVANT DATA

Cipro 250 mcg

IMPORTANT: don't let this information lead you to use the wrong formula. In this example, we're asked for a flow rate which requires mL of solution and total time.

STEP 4: FORMULA USED

$$\frac{\text{mL of solution}}{\text{total minutes}} \times 60 = \text{mL/hr}$$

SHOW YOUR WORK

$$\frac{150 \text{ mL}}{45 \text{ min}} = 3.333 \times 60 = 200 \text{ mL/hr}$$

REMEMBER RULE #4
Don't round till the end!

mL/hr is always rounded to the nearest **WHOLE** number!

ROUND: *No rounding necessary*

FINAL ANSWER: 200mL/hr

6

250 mL normal saline over 5 hours. Tubing drop factor of 10 gtt/mL.

STEP 1: CONVERT DATA

hr → min

1 hour = 60 minutes

$$5 \text{ hr} \times \frac{60 \text{ min}}{1 \text{ hr}} = 300 \text{ min}$$

STEP 2: READY TO USE DATA

ML OF SOLUTION: 250 mL
TOTAL MINUTES: 300 min
DROP FACTOR: 10 gtt/mL

STEP 3: IRRELEVANT DATA

N/A

STEP 4: FORMULA USED

$$\frac{\text{mL of IV solution}}{\text{time in minutes}} \times \text{drop factor} = \text{gtt/min}$$

SHOW YOUR WORK

$$\frac{250 \text{ mL}}{300 \text{ min}} = 0.8333 \text{ mL/min}$$

REMEMBER RULE #4
Don't round till the end!

$$0.8333 \text{ mL/min} \times 10 \text{ gtt/mL} = 8.3333 \text{ gtt/min}$$

ROUND: *gtt/mL is always rounded to the nearest whole number!*

8.3333 gtt/min → 8 gtt/min

The question may not specify to round the final answer to a whole number; you are expected to know this with gtt/min units.

FINAL ANSWER: 8 gtt/min

COMPREHENSIVE REVIEW

7

Humulin R 200 units in 100 mL of normal saline to infuse at 4 units/hr.

STEP 1: CONVERT DATA

N/A

STEP 2: READY TO USE DATA

DESIRED: 4 units/hr
AVAILABLE: 200 units
VOLUME: 100 mL

STEP 3: IRRELEVANT DATA

N/A

STEP 4: FORMULA USED

$$\frac{D}{H} \times V = A$$

SHOW YOUR WORK

$$\frac{4 \text{ units/hr}}{200 \text{ units}} = 0.02 \text{ /hr}$$

0.02 /hr x 100 mL = 2 mL/hr

mL/hr is always rounded to the nearest **WHOLE** number!

ROUND: *No rounding necessary*

FINAL ANSWER: 2 mL/hr

8

Dopamine 600 mg in 200 mL of normal saline to infuse at 10 mcg/kg/min.
Pt weight = 190 lbs.

If the question is asking for flow rate ("to infuse") and you're given mL of solution, you need to write the answer in **mL/hours!**

STEP 1: CONVERT DATA

mcg → mg

10 mcg = 0.010 mg

lb → kg

190 lb / 2.2 = 86.363 kg

$$\frac{mg/kg}{min} \rightarrow \frac{mg}{min}$$

In this case, ordered amount depends on patient weight

0.010 mg/kg/min x 86.363 kg = 0.863 mg/min

REMEMBER

SMALL TO BIG:
move the decimal point 3 to the left
unit is getting Larger think Left

STEP 2: READY TO USE DATA

DESIRED: 0.863 mg/min
AVAILABLE: 600 mg
VOLUME: 200 mL

STEP 3: IRRELEVANT DATA

N/A

STEP 4: FORMULA USED

$$\frac{D}{H} \times V = A$$

SHOW YOUR WORK

$$\frac{0.863 \text{ mg/min}}{600 \text{ mg}} = 0.00143 \text{ /min}$$

0.00143 /min x 200 mL = 0.2878 mL/min

0.2878 mL/min x 60 min = 17.2727 mL/hr

WAIT!
This is in mL/min ... we need units of mL/hr!

ROUND: *mL/hr is always rounded to nearest whole number!*

17.2727 mL/hr → 17 mL/hr

FINAL ANSWER: 17 mL/hr

COMPREHENSIVE REVIEW

9

2.5 L normal saline to infuse over 48 hours.

If the question is asking for flow rate ("to infuse") and you're given mL of solution, you need to write the answer in **mL/hours!**

STEP 1: CONVERT DATA

L → mL

REMEMBER **BIG TO SMALL:** move the decimal point 3 to the right

2.5 L = 2500 mL

STEP 2: READY TO USE DATA

ML OF SOLUTION: 2500 mL
TOTAL HOURS: 48 hr

STEP 3: IRRELEVANT DATA

N/A

STEP 4: FORMULA USED

$$\frac{\text{mL of solution}}{\text{total hours}} = \text{mL/hr}$$

SHOW YOUR WORK

$$\frac{2500 \text{ mL}}{48 \text{ hours}} = 52.0833 \text{ mL/hr}$$

ROUND: *mL/hr is always rounded to nearest whole number!*

52.0833 mL/hr → 52 mL/hr

FINAL ANSWER: 52 mL/hr

10

ORDERED: Morphine 100 mg IM q12h prn pain
AVAILABLE: Morphine 150 mg/2.6 mL
How many mL will you administer? Round to nearest hundredth.

STEP 1: CONVERT DATA

N/A

STEP 2: READY TO USE DATA

ORDERED: 100 mg
AVAILABLE: 150 mg
VOLUME: 2.6 mL

STEP 3: IRRELEVANT DATA

IM q12h prn pain

Question asked for "per dose" because no timeframe was given

STEP 4: FORMULA USED

$$\frac{D}{H} \times V = A$$

SHOW YOUR WORK

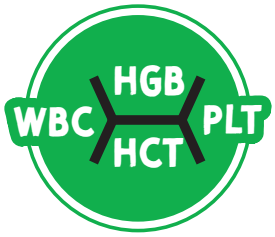
$$\frac{100 \text{ mg}}{150 \text{ mg}} = 0.6666$$

0.6666 x 2.6 mL = 1.7333 mL

ROUND: *nearest hundredth*

1.7333 mL → 1.73 mL

FINAL ANSWER: 1.73 mL



LAB VALUE CHEAT SHEET

WITH MEMORY TRICKS

LAB VALUE CHEAT SHEET

VITAL SIGNS

BLOOD PRESSURE	SYSTOLIC	120 mmHg
	DIASTOLIC	80 mmHg
HEART RATE	60 – 100 bpm	
RESPIRATIONS	12 – 20 breaths/min	
TEMPERATURE	97.8 – 99°F (36.5 - 37.2°C)	
OXYGEN	95 – 100%	
OXYGEN IN COPD PT.	as low as 88%	

COPD pts are expected to have low O_2 levels

RENAL

CALCIUM	9 - 11 mg/dL
MAGNESIUM	1.5 - 2.5 mg/dL
PHOSPHORUS	2.5 - 4.5 mg/dL
SPECIFIC GRAVITY	1.010 - 1.030
GFR	90 - 120 mL/min/1.73 m^2
BUN	7 - 20 mg/dL
CREATININE	0.6 – 1.2 mg/dL

PANCREAS

AMYLASE	30 - 110 U/L
LIPASE	0 - 150 U/L

COMPLETE BLOOD COUNT (CBC)

WBCs	4,500 - 11,000 /µL
RBCs	4.5 - 5.5 X10^6 /µL
PLTs	150,000 - 450,000 /µL
HEMOGLOBIN (HGB)	FEMALE: 12 - 16 g/dL
	MALE: 13 - 18 g/dL
HEMATOCRIT (HCT)	FEMALE: 36% - 48%
	MALE: 39% - 54%

BASIC METABOLIC PANEL (BMP)

SODIUM	135 – 145 mEq/L
POTASSIUM	3.5 – 5.0 mEq/L
CHLORIDE	95 - 105 mEq/L
CALCIUM	9 - 11 mg/dL
BUN	7 - 20 mg/dL
CREATININE	0.6 – 1.2 mg/dL
ALBUMIN	3.4 - 5.4 g/dL
TOTAL PROTEIN	6.2 - 8.2 g/dL

HBA1C

NON-DIABETIC	4 - 5.6%
PRE-DIABETIC	5.7 - 6.4%
DIABETIC	> 6.5%
Goal for diabetic:	< 7%

LIVER FUNCTION TEST (LFT)

ALT	7 - 56 U/L
AST	5 - 40 U/L
ALP	40 - 120 U/L
BILIRUBIN	0.1 - 1.2 mg/dL

COAGs

PT	10 - 13 sec
PTT	25 - 35 sec
aPTT	NOT ON HEPARIN: 30-40 secs
	ON HEPARIN: 47-70 secs
INR	NOT ON WARFARIN: < 1 sec
	ON WARFARIN: 2 - 3 sec

BMI

UNDERWEIGHT	<18.5
HEALTHY WEIGHT	18.5 - 24.9
OVERWEIGHT	25.0 - 29.9
OBESITY	> 30.0

ABGs

PH	7.35 - 7.45
$PaCO_2$	35 - 45 mmHg
PaO_2	80 - 100 mmHg
HCO_3	22 - 26 mEq/L

LIPID PANEL

TOTAL CHOLESTEROL	<200 mg/dL
TRIGLYCERIDE	<150 mg/dL
LDL	<100 mg/dL
HDL	>60 mg/dL

LDL bad cholesterol - we want LOW levels

HDL Happy cholesterol - we want HIGH levels

OTHER

MAP (mean arterial pressure)	70 - 100 mmHg
ICP (intracranial pressure)	5 - 15 mmHg
GLASGOW COMA SCALE	BEST = 15

MILD: 13-15 MODERATE: 9-12 SEVERE: 3-8

LAB VALUE MEMORY TRICKS

ELECTROLYTES

SODIUM: 135 - 145

*Commit to memory!

POTASSIUM: 3.5 - 5

BANANAS:
There are about 3-5 in every bunch & you want them half ripe (½)

So, think 3.5 - 5.0

PHOSPHORUS: 2.5 - 4.5

PHOR: 4

US: 2 (me + you = 2)

*don't forget the .5

CALCIUM: 9 - 11

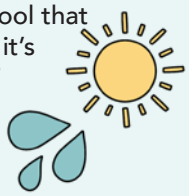
CALL 911

MAGNESIUM: 1.5 - 2.5

MAGnifying glass you see 1.5 - 2.5 bigger than normal

CHLORIDE: 95 -105

Think of a chlorinated pool that you want to go in when it's SUPER HOT: 95 - 105 °F



COMPLETE BLOOD COUNT (CBC)

- Hemoglobin (Hgb)
  Female: 12 - 16 g/dL
  Male: 13 - 18 g/dL
- Hematocrit (HCT)
  Female: 36% - 48%
  Male: 39% - 54%

To remember HCT, multiply Hgb by 3

12 X 3 = 36
16 X 3 = 48 *(Female)*

13 X 3 = 39
18 X 3 = 54 *(Male)*

BASAL METABOLIC PANEL (BMP)

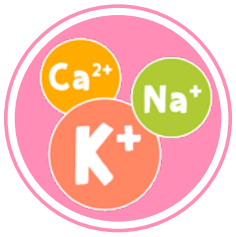
BUN: 7 - 20 mg/dL

Think hamburger **BUN**s...
Hamburgers can cost anywhere from $7 - $20 dollars

CREATININE: 0.6 – 1.2 mg/dL

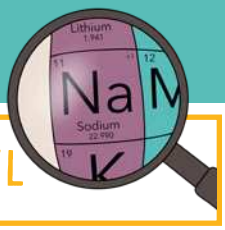
This is the same value as **LITHIUM**'s therapeutic range (0.6 - 1.2 mmol/L)

Lithium is excreted almost solely by the kidneys...
And creatinine is a value that tests how well your kidneys filter



ELECTROLYTE IMBALANCES

SODIUM (Na+) IMBALANCE



SODIUM is a major ELECTROLYTE found in ECF.
Essential for acid-base, fluid balance, active & passive transport mechanism, irritability & CONDUCTION of nerve-muscle tissue

135 - 145 mEq/L

SIGNS & SYMPTOMS

↑ > 145 mEq/L = HYPERNATREMIA

BIG & BLOATED

MNEMONIC **"FRIED SALT"**

- **F** Flushed skin
- **R** Restless, anxious, confused, irritable
- **I** Increased BP & fluid retention
- **E** Edema (pitting)
- **D** Decreased urine output
- **S** Skin flushed & dry
- **A** Agitation
- **L** Low-grade fever
- **T** Thirst (dry mucous membranes)

↓ < 135 mEq/L = HYPONATREMIA

HYPOVOLEMIC HYPONATREMIA:
↓ of fluid & sodium

HYPERVOLEMIC HYPONATREMIA:
↑ body water that is greater than Na+

MNEMONIC **"SALT LOSS"**

- **S** Stupor/coma
- **A** Anorexia (nausea/vomiting)
- **L** Lethargy (weakness/fatigue
- **T** Tachycardia (thready pulse)
- **L** Limp muscles (muscle weakness)
- **O** Orthostatic hypotension
- **S** Seizures/headache
- **S** Stomach cramping (hyperactive bowels)

RISK FACTORS

- Increased sodium intake
  - Excess oral sodium ingestion
  - Excess administration of IV fluids w/ sodium
  - Hypertonic IV fluids
- LOSS OF FLUIDS!
  - Fever
  - Watery diarrhea
  - Diabetes insipidus
  - Excessive diaphoresis
  - Infection
- Decreased sodium excretion
  - Kidney problems

HEMOCONCENTRATION = INCREASED SODIUM!

- Increased sodium excretion
  - **D**iaphoresis (ex: high fever)
  - **D**iarrhea & vomiting
  - **D**rains (NGT suction)
  - **D**iuretics (thiazide & loop diuretics)

4 D's

- SIADH
- Adrenal insufficiency (adrenal crisis)
- Inadequate sodium intake
  - Fasting, NPO, Low-salt diet
- Kidney disease
- Heart failure

MANAGEMENT

- If due to fluid loss:
  - Administer IV infusions
- If the cause is inadequate renal excretion of sodium:
  - Give diuretics that promote sodium loss
- Restrict sodium & fluid intake as prescribed

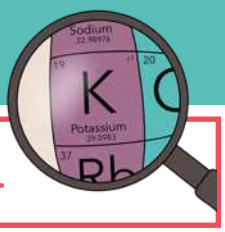
MNEMONIC **"ADD SALT"**

- **A** **ADMINISTER** IV sodium chloride infusions (only if due to hypovolemia)
- **D** **DIURETICS** (If due to hypervolemia) Hyponatremia → high fluids & low salt = hemodilution
- **D** **DAILY WEIGHTS** Where sodium goes, water FLOWS
- **S** **SAFETY** (orthostatic hypotension AKA risk for falls)
- **A** **AIRWAY PROTECTION** (NPO) Don't give food to a lethargic, confused client (Increased Risk For Aspiration)
- **L** **LIMIT WATER INTAKE** Hypervolemic hyponatremia (high fluid & low salt)
- **T** **TEACH** about foods high in sodium (canned food, packaged/processed meats, etc.)

POTASSIUM & SODIUM = OPPOSITES

EXAMPLE: ↑ NA = ↓ K+

POTASSIUM (K) IMBALANCE



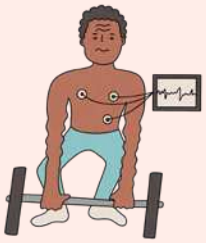
POTASSIUM imbalance plays a vital role in cell **METABOLISM**, and **TRANSITION** of nerve impulses, the functioning of cardiac, lung, muscle tissues, & acid-base balance.

3.5 - 5 mEq/L

SIGNS & SYMPTOMS

> 5 meq/L = HYPERKALEMIA

- **Muscles contract for TOO long = Tight & Contracted**



MNEMONIC **"MURDER"**

- **M** **M**uscle cramps & weakness
- **U** **U**rine abnormalities
- **R** **R**espiratory distress
- **D** **D**ecreased cardiac contractility (↓HR, ↓BP)
- **E** **E**CG changes
  - Tall peaked T waves
  - Flat P waves
  - Widened QRS complexes
  - Prolonged PR intervals
- **R** **R**eflexes (↑ DTR)

< 3.5 meq/L = HYPOKALEMIA

- **Not enough contraction = Weak**
- Thready, weak, irregular pulse
- Orthostatic hypotension
- Shallow respirations
- Anxiety, lethargy, confusion, coma
- Paresthesias
- Hyporeflexia
- Hypoactive bowel sounds (constipation)
- Nausea, vomiting, abdominal distention
- ECG changes
  - ST depression
  - Shallow or inverted T wave
  - Prominent U wave

RISK FACTORS

- Medication
  - Potassium-sparing diuretics (Spironolactone)
  - Ace inhibitors
  - NSAIDs
- Excessive potassium intake
  (*Example:* rapid infusion of potassium-containing IV solutions)
- Kidney disease or those on Dialysis
  - Decreased potassium excretion
- Adrenal insufficiency (Addison's disease)
- Tissue damage
- Acidosis
- Hyperuricemia
- Hypercatabolism

Potassium imbalance can cause **CARDIAC DYSRHYTHMIAS** that can be **LIFE-THREATENING!**

- Actual total body potassium loss
- Inadequate potassium intake
  - Fasting, NPO
- Movement of potassium from the extracellular fluid to the intracellular fluid
  - Alkalosis
  - Hyperinsulinism
- Dilution of serum potassium
  - Water intoxication
  - IV therapy with potassium-deficient solutions

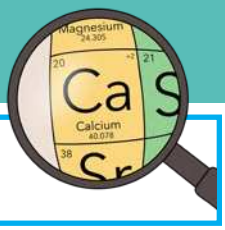
MANAGEMENT

- Monitor EKG
- Discontinue IV & PO potassium
- Initiate a potassium-restricted diet
- Potassium-excreting diuretics
- Prepare the client for dialysis
- Prepare for administration:
  - IV calcium gluconate & IV sodium bicarb
- Avoid the use of salt substitutes or other potassium-containing substances

- Oral potassium supplements
- Liquid potassium chloride
- Potassium-retaining diuretic
- Potassium is **NEVER** administered by IV push, IM, or subQ routes
  - IV potassium is always diluted & administered using an infusion device!

POTASSIUM & SODIUM = OPPOSITES EXAMPLE: ↑ NA = ↓ K+

CALCIUM (Ca+) IMBALANCE



CALCIUM is found in the body's cells, bones, and teeth. Needed for proper functioning of the CARDIOVASCULAR, NEUROMUSCULAR, ENDOCRINE systems, blood clotting & teeth formation

9 - 11 mg/dL

SIGNS & SYMPTOMS

> 11 mg/dL = HYPERCALCEMIA

MNEMONIC **"BACKME"**

- **B** Bone pain
- **A** Arrhythmias
- **C** Cardiac arrest (bounding pulses)
- **K** Kidney stones
- **M** Muscle weakness ↓ (DTR)
- **E** Excessive urination

< 9 mg/dL = HYPOCALCEMIA

MNEMONIC **"CATS GO NUMB"**

- **C** Convulsions
- **A** Arrhythmias
- **T** Tetany
- **S** Spasms & stridor
- **GO NUMB** Numbness in fingers, face, limbs

POSITIVE TROUSSEAU'S: Carpal spasm caused by inflating a blood pressure cuff

CHVOSTEK'S SIGNS: Contraction of facial muscles w/ light tap over the facial nerve.

MEMORY TRICK Think "C" for Cheesy smile

RISK FACTORS

- Increased calcium absorption
- Decreased calcium excretion
- Kidney disease
- Thiazide diuretics
- Increased bone resorption of calcium
  - Hyperparathyroidism / Hyperthyroidism
  - Malignancy (bone destruction from metastatic tumors)
- Hemoconcentration

- Inhibition of calcium absorption from the GI tract
- Increased calcium excretion
  - Kidney disease, diuretic phase
  - Diarrhea & steatorrhea
  - Wound drainage
- Conditions that decrease the ionized fraction of calcium

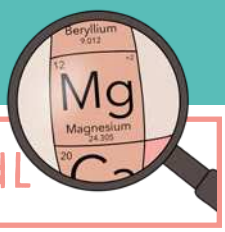
MANAGEMENT

- D/C IV or PO calcium
- D/C Thiazide diuretics
- Administer phosphorus, calcitonin, bisphosphonates, & prostaglandin synthesis inhibitors (NSAIDs)
- Avoid foods high in calcium

- Adm. calcium PO or IV
  - For IV, warm before & adm. slowly
- Adm. aluminum hydroxide & Vit D
- Initiate seizure precautions
- 10% calcium (acute calcium deficit)
- Consume foods high in calcium

CALCIUM & PHOSPHATE = INVERSE EXAMPLE: ↑ Ca^{+} = ↓ PO_4

MAGNESIUM (Mg) IMBALANCE



Most of the MAGNESIUM found in the body is found in the BONES. Regulates BP, blood sugar, muscle contraction & nerve function.

1.5 - 2.5 mg/dL

SIGNS & SYMPTOMS

> 2.5 mg/dL = HYPERMAGNESEMIA

MEMORY TRICK: Magnesium is a **SEDATIVE!**

LOW (↓) everything, AKA SEDATED

- ↓ energy (drowsiness / coma)
- ↓ HR (bradycardia)
- ↓ BP (hypotension)
- ↓ RR (bradypnea)
- ↓ Respirations (shallow)
- ↓ Bowel sounds
- ↓ DTRs (deep tendon reflex)

< 1.5 mg/dL = HYPOMAGNESEMIA

HIGH (↑) everything, AKA NOT SEDATED

- ↑ HR (tachycardia)
- ↑ BP (hypertension)
- ↑ deep tendon reflex (hyperreflexia)
- Shallow respirations
- Twitches, paresthesias
- Tetany & seizures
- Irritability & confusion

REMEMBER: Also seen in hypocalcemia. Ca & Mg rise and fall together!

POSITIVE TROUSSEAU'S: Carpal spasm caused by inflating a blood pressure cuff

CHVOSTEK'S SIGNS: Contraction of facial muscles w/ light tap over the facial nerve.

MEMORY TRICK: Think "C" for Cheesy smile

RISK FACTORS

- Increased magnesium intake
  - Magnesium-containing antacids (TUMS) & laxatives
  - Excessive adm. of magnesium IV
- Renal insufficiency
  - ↓ renal excretion of Mg = ↑ Mg in the blood
- DKA (Diabetic Ketoacidosis)

- Insufficient magnesium intake
  - Malnutrition/vomiting/diarrhea
  - Malabsorption syndrome
  - Celiac & Crohn's disease
- Increased magnesium excretion
  - Diuretics or chronic alcoholism
- Intracellular movement of magnesium
  - Hyperglycemia & Insulin adm.
  - Sepsis

MANAGEMENT

- Diuretics
- IV adm. calcium chloride or calcium gluconate
- Restrict dietary intake of Mg containing foods
- Avoid the use of laxatives & antacids containing magnesium
- Hemodialysis

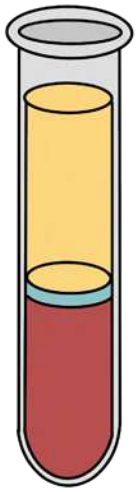
- Magnesium sulfate IV or PO
- Seizure precautions
- Instruct the client to increase magnesium-containing foods

MAGNESIUM & CALCIUM = SAME — **EXAMPLE: ↑ MG = ↑ CA+**

FUNDAMENTALS

BLOOD TYPES

Before a blood transfusion happens, a patient's blood should be sent to the lab to be typed & cross-matched.
If a patient receives blood that is not a compatible type, it can lead to a transfusion reaction and potentially death.



Plasma
55% of total blood

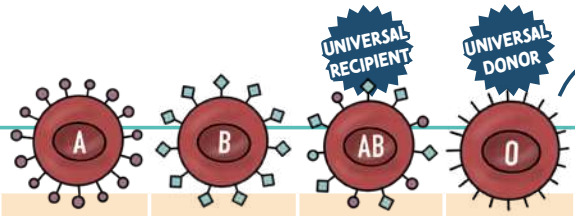
Water
Ions
Proteins
Nutrients
Waste
Gases

White Blood Cells & Platelets
> 1% of total blood

Erythrocytes
45% of total blood

CENTRIFUGE

A device that uses force to separate components of fluids. It separates fluids of different densities. This is how labs separate blood.



UNIVERSAL RECIPIENT

UNIVERSAL DONOR

MEMORY TRICK — O think universal dOnOr

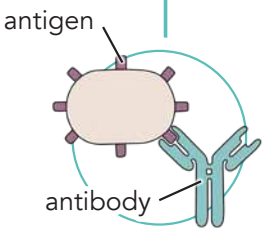
ANTIGEN	A	B	A&B	NONE
ANTIBODIES	B	A	NONE	A&B
RECIPIENT	A, O	B, O	ALL	O
DONOR	A, AB	B, AB	AB	ALL

A person who can receive blood of any type

Compatible with any blood type

ANTIGENS
- Proteins that elicit immune responses
- Identifies the cell

PLASMA ANTIBODIES
- Protects body from "invaders" (think ANTI)
- Opposite of the type of antigen that is found on the RBC



RH FACTOR

Rhesus (Rh) factor is an inherited protein found on the surface of red blood cells.

If your blood has the protein, you're Rh **positive**.

If your blood lacks the protein, you're Rh **negative**.

HAS Rh on surface. **CAN RECEIVE** + −

DOES NOT HAVE Rh on surface. **CAN RECEIVE** −

DONOR BLOOD TYPES

RECIPIENT BLOOD TYPES	O−	O+	A−	A+	B−	B+	AB−	AB+
O−	♥							
O+	♥	♥						
A−	♥		♥					
A+	♥	♥	♥	♥				
B−	♥				♥			
B+	♥	♥			♥	♥		
AB−	♥		♥		♥		♥	
AB+	♥	♥	♥	♥	♥	♥	♥	♥

Always check with your hospital's protocol about blood product administration

ABBREVIATIONS

AAA Abdominal Aortic Aneurysm
Abd Abdomen
Ac Before Meals
ACLS Advanced Cardiac Life Support
AD Admitting Diagnosis
A&D Admission and Discharge
Ad lib As Desired
ALL Acute Lymphocytic Leukemia
ADL Activities of Daily Living
Adm. Admission
Amb Ambulation
AKA Above-the-Knee Amputation
AV Atrioventricular
AP or **A.P.** Appendectomy
Bid Twice a Day
BLS Basic Life Support
BM Bowel Movement
BP Blood Pressure
BKA Below-the-Knee Amputation
BUN Blood Urea Nitrogen
BPH Benign Prostatic Hyperplasia
BX Biopsy
CABG Coronary Artery Bypass Graft
C/O Complaining Of
CAD Coronary Artery Disease
CBC Complete Blood Count
CCU Cardiac Care Unit / Coronary Care Unit
C&S Culture & Sensitivity
CF Cystic Fibrosis
CHF Congestive Heart Failure
CKD Chronic Kidney Disease
CPR Cardiopulmonary Resuscitation
COPD Chronic Obstructive Pulmonary Disease
CVA Cerebrovascular Accident (stroke)
CVC Central Venous Catheter
D/C Discontinue or Discharge
D&C Dilatation and Curettage
DI Diabetes Insipidus
DIC Disseminated Intravascular Coagulation
DKA Diabetic Ketoacidosis
DM Diabetes Mellitus
DVT Deep Vein Thrombosis
DX Diagnosis
ECG or **EKG** Electrocardiogram
ED Emergency Department
EENT Eye, Ears, Nose and Throat
ETT Endotracheal Tube
FBS Fasting Blood Sugar
Fx Fracture
Gtt or **G.T.T.** Glucose Tolerance Test
HOB Head of Bed
HS Bedtime
Hx History
ICU Intensive Care Unit
LMP Last Menstrual Period
LOC Level of Consciousness
LES Lower Esophageal Sphincter
LP Lumbar Puncture
I&O Intake and Output
MAP Mean Arterial Pressure
MRI Magnetic Resonance Imaging
MVA Motor Vehicle Accident
NGT Nasogastric Tube
NPO Nothing by Mouth
NKA No Known Allergies
O_2 Oxygen
OB Obstetrics
OOB Out of Bed
OR Operating Room
OA Osteoarthritis
Ortho Orthopedics
OT Occupational Therapist
Pc After Meals
Prn or **p.r.n.** As Needed
Pre op Before Surgery
PFT Pulmonary Function Test
PLT Platelets
PTCA Percutaneous Transluminal Coronary Angioplasty
PRBC Packed Red Blood Cells
PVC Premature Ventricular Contraction
Rom/R.O.M. Range of Motion
RBC Red Blood Cell
RT Respiratory Therapist
RA Rheumatoid Arthritis
SOB Shortness of Breath
SBAR Situation, Background, Assessment, Recommendation
SSE or **S.S.E.** Soap Suds Enema
Stat At Once, Immediately
SLE Systemic Lupus Erythematosus
STD Sexually Transmitted Disease
SIADH Syndrome of Inappropriate Antidiuretic Hormone Secretion
Tid Three Times a Day
T&S Type and Screen
TPN Total Parenteral Nutrition
TIA Transient Ischemic Attack
TB Tuberculosis
TURP Transurethral Resection of the Prostate
UA Urinalysis
UTI Urinary Tract Infection
US Ultrasound
VS Vital Signs
WBC White Blood Count
WNL Within Normal Limits

DO NOT USE	POTENTIAL PROBLEM	INSTEAD, WRITE:
U	Mistaken for "0" (zero) or "cc"	unit
IU	Mistaken for IV (intravenous) or the number 10 (ten)	"international unit"
Q.D., QD, q.d., qd, Q.O.D.,QOD, q.o.d, qod	Mistaken for each other	"daily" or "every other day"
Trailing zero (X.0 mg) Lack of leading zero (.X mg)	Decimal point is missed	"X mg" "0.X mg"
MS, MSO4, MgSO4	Can mean morphine sulfate or magnesium sulfate	"morphine sulfate" "magnesium sulfate"
@	Mistaken for the number "2" (two)	"at"
cc	Mistaken for U (units) when poorly written	"mL" or "milliliters"

THE NURSING PROCESS

SUBJECTIVE DATA
What the client tells the nurse

OBJECTIVE DATA
Data the nurse obtains through their assessment & observation

Set SMART Goals
MNEMONIC
- **S**pecific
- **M**easurable
- **A**chievable
- **R**elevant
- **T**ime frame

MNEMONIC "A DELICIOUS PIE"

ASSESS
- Gather information
- Verify the information collected is clear & accurate

DIAGNOSE
- **Interpret the information collected**
- Identify & prioritize the problem through a nursing diagnosis (be sure it's NANDA approved)

PLAN
- **Set goals to solve the problem**
- Prioritize the outcomes of care

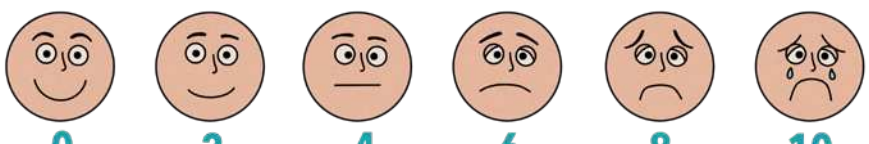
IMPLEMENT
- Reaching those goals through performing the nursing actions
- "Implementing" the goals set above in the planning stage

EVALUATE
- Determine the outcome of goals
- Evaluate client's compliance
- Document client's response to pain
- Modify & assess for needed changes

VITAL SIGNS

 **BLOOD PRESSURE (BP)**	**SYSTOLIC** **120** mmHg **DIASTOLIC** **80** mmHg	Hypotension = low blood pressure Hypertension = high blood pressure
 **HEART RATE (HR)**	**60 – 100** bpm	Bradycardia = **<60** bpm Tachycardia = **>100** bpm
 **RESPIRATION RATE (RR)**	**12 – 20** breaths/min	Bradypnea = **<12** breaths/min Tachypnea = **>20** breaths/min
 **TEMPERATURE (T)**	**97.8 – 99°F** **(36.5 - 37.2°C)**	Hypothermia = **<95 °F (<35 °C)** Hyperthermia = **>104 °F (>40 °C)**
 **OXYGEN (O_2)**	**95 – 100%**	Low oxygen levels = hypoxemia
PAIN	Pain is subjective data given to you by the patient	Can be measured in various ways: The numerical scale, Wong-Baker Faces®, or verbal rating scale

Wong-Baker FACES® Pain Rating Scale



PRIORITY QUESTIONS

You know you are being asked a **PRIORITY QUESTION** when the question asks:

- What is the **most important** ?
- What is the **initial response** ?
- Which action should the nurse take **first** ?

When you see these questions, you should immediately think of **MASLOW'S HIERARCHY OF NEEDS** and **ABCs**!

ABCs

A Airway

#1 Patent Airway

Patent means "open"; the airway is clear!

ASK YOURSELF:

Can they successfully breathe oxygen in and breathe CO_2 out?

B Breathing

#2 Breathing

Gas exchange taking place inside the lungs

ASK YOURSELF:

Can gas exchange successfully happen in their lungs?

C Circulation

#3 Circulation

Can they circulate blood through their body and are their organs being perfused?

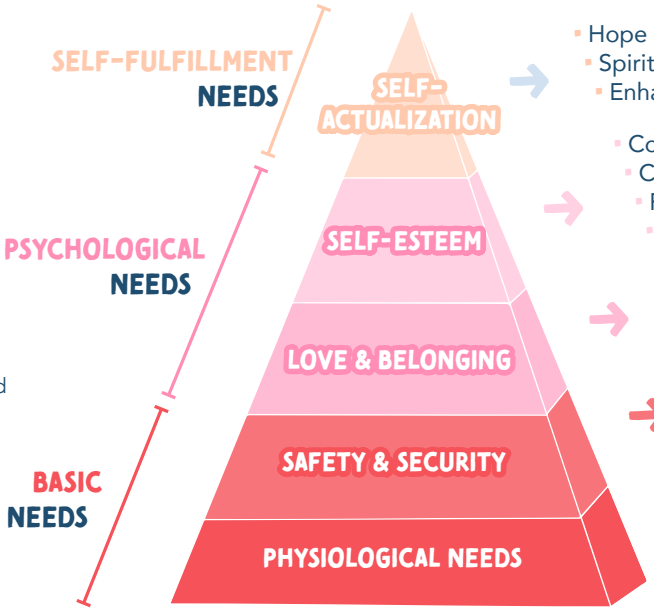
ASK YOURSELF:

Is there a reason that the blood isn't pumping/circulating in the body?

(Example: The heart is working to pump the blood to the vital organs)

MASLOW'S HIERARCHY OF BASIC NEEDS

This shows the **5** levels of human needs, **PHYSIOLOGICAL NEEDS** being the most important (oxygen, fluids, nutrition, shelter). **ABCs** fall into Maslow's **PHYSIOLOGICAL** need!



- Hope
- Spiritual well-being
- Enhanced growth

- Control
- Competence
- Positive regard
- Acceptance/worthiness

- Maintain support systems
- Protect from isolation

- Protection from injury
- Promote feeling of security
- Trust in nurse-client relationship

- Airway
- Respiratory effort
- Heart rate, rhythm, and strength of contraction
- Nutrition
- Elimination

NCLEX TIP

Pain is considered "**psychological**" meaning it does not take priority. *Pain rarely kills people

NURSING ETHICS & LAW

ETHICAL PRINCIPLES

AUTONOMY
Respect for an individual's right to make their own decisions

NONMALEFICENCE
Obligation to do & cause no harm to others

BENEFICENCE
Duty to do good to others

JUSTICE
Distribution of benefits & services fairly

VERACITY
Obligation to tell the truth

FIDELITY
Following through with a promise

HIPAA

THE HEALTH INSURANCE PORTABILITY & ACCOUNTABILITY ACT

- Clients records are private & they have the right to ensure the medical information is not shared without permission
- All health care professionals must inform the client how their health information is used
- The client has the right to obtain a copy of their personal health information

PATIENT RIGHTS

THE RIGHT TO...

- Privacy
- Considerate & respectful care
- Be informed
- Know the names & roles of the persons who are involved in care
- Consent or refuse treatment
- Have an advance directive
- Obtain their own medical records & results

CONSENT

TYPES OF CONSENT:

- Admission agreement
- Immunization consent
- Blood transfusion consent
- Surgical consent
- Research consent
- Special consents

- Treatment can not be done without a client's consent
- In the case of an emergency when a client cannot give consent, then consent is implied through emergency laws
- Minors (under 18), consent must be obtained from a parent or legal guardian

! Before signing the consent, the client must be informed of the following: risks & benefits of surgery, treatments, procedures, & plan of care in layman's terms so the client understands clearly what is being done.

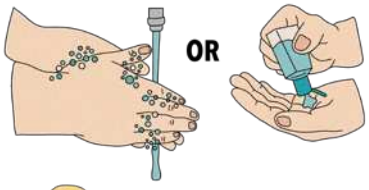
INFECTION CONTROL

PPE → PERSONAL PROTECTIVE EQUIPMENT

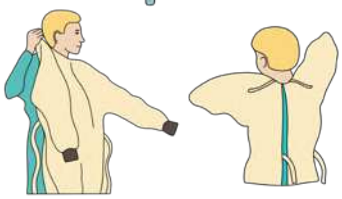
DONNING
Putting on PPE

- Put on PPE before entering the client's room
- Do not touch your face while wearing PPE
- Minimize contact with items in the client's room

1. **HAND HYGIENE**



2. **GOWN**



3. **MASK / RESPIRATOR**

4. **GOGGLES / FACE SHIELD**

5. **GLOVES**

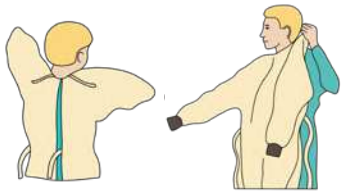
DOFFING
Removing PPE

- Remove PPE at the client's doorway or outside the room
- If hands become soiled while removing PPE, stop & perform hand hygiene
- After hand hygiene, continue with PPE removal

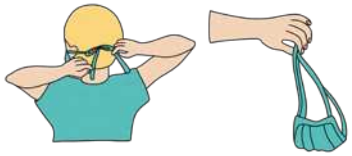
1. **REMOVE GLOVES**

2. **REMOVE PROTECTIVE EYEWEAR**

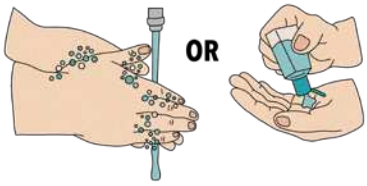
3. **REMOVE GOWN**



4. **REMOVE & DISCARD RESPIRATOR**



5. **PERFORM HAND HYGIENE**

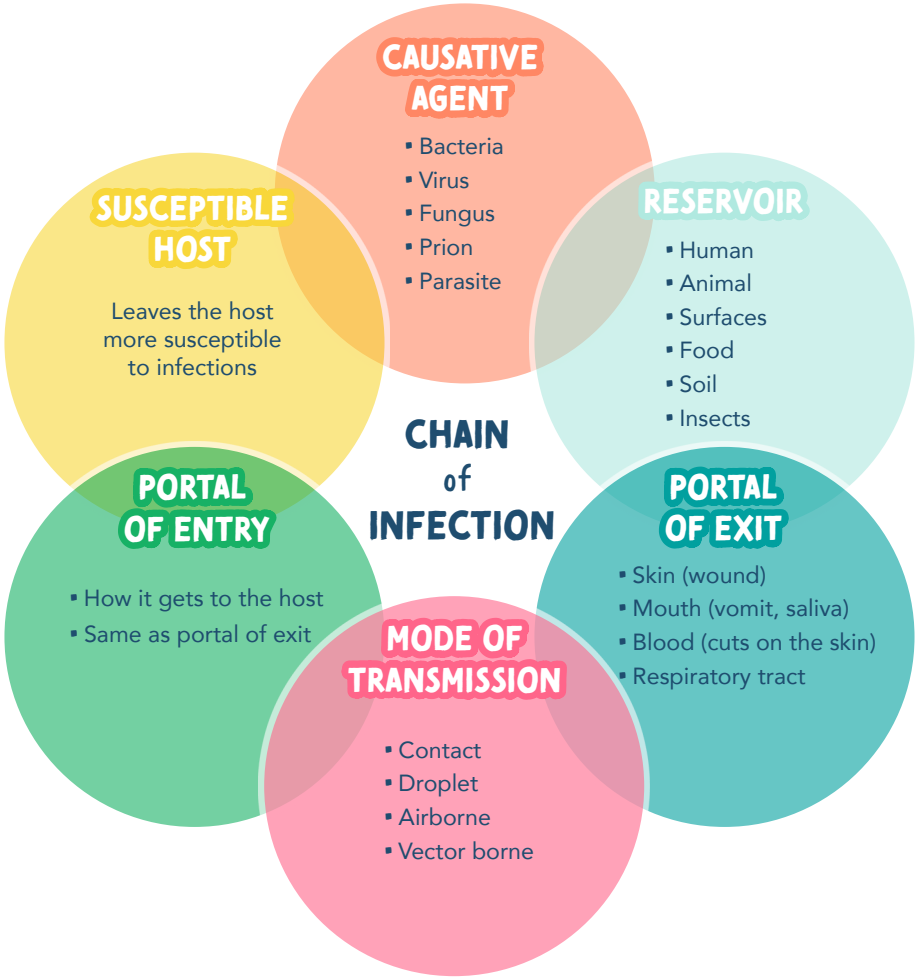


HOSPITAL-ASSOCIATED INFECTIONS (HAIs)

CAUTI..... Catheter-associated urinary tract infection
SSI ..... Surgical site infection
CLABSI..... Central line-associated blood infection
VAP ..... Ventilator-associated pneumonia

Meticulous hand hygiene practices and use of chlorhexidine washes helps in preventing HAIs

INFECTION CONTROL



STAGES OF INFECTION

INCUBATION
Interval between the pathogen entering the body & the presentation of the first symptom

PRODROMAL STAGE
Onset of general symptoms to more distant symptoms; the pathogen is multiplying

ILLNESS STAGE
Symptoms specific to the infection appear

CONVALESCENCE
Acute symptoms disappear and total recovery could take days to months

TRANSMISSION BASED PRECAUTIONS

AIRBORNE
- Single room under negative pressure
- Door remains closed
- Health care workers wear a respiratory mask (N95 or higher level)

MNEMONIC: Think "MTV"

Measles
Tuberculosis
Varicella (Chickenpox) & Disseminated herpes-zoster (Shingles)

*Airborne precaution is no longer needed when all lesions have crusted over

DROPLET
- Private room or a client whose body cultures contain the same organism
- Wear a surgical mask
- Place a mask on the client whenever they leave the room

- **Adenovirus**
- **Diphtheria (pharyngeal)**
- **Epiglottitis**
- **Influenza (flu)**
- **Meningitis**
- **Mumps**
- **Parvovirus B19**
- **Pertussis**
- **Pneumonia**
- **Rubella**
- **Scarlet fever**
- **Streptococcal pharyngitis**

CONTACT
- Private room or cohort client
- Use gloves & a gown whenever entering the client's room

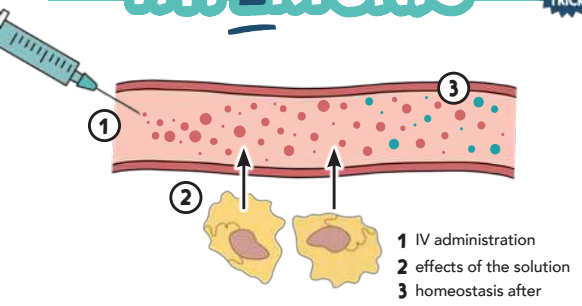
- **Colonization or infection with a multidrug-resistant organism**
- **Enteric infections** (Clostridium difficile)
- **Respiratory infections** (RSV, Influenza)
- **Wound & skin infections** (cutaneous diphtheria, herpes simplex, impetigo, pediculosis, scabies, staphylococci, & varicella-zoster)
- **Eye infections** (conjunctivitis)

When in contact with C. Diff, patient's hands must be washed with *soap & water* when performing hand hygiene

IV THERAPY: TYPES OF IV SOLUTIONS

HYPERTONIC

MEMORY TRICK "ENTER THE VESSEL FROM THE CELLS"



MORE **SALT** in the solution,
LESS **WATER** in the solution. The vessel becomes MORE concentrated than the cell.
Water then **LEAVES** the cell.
Therefore, the cells will **SHRINK**.

EXAMPLES:

5% saline
3% saline
5% dextrose in 0.9% saline (D5NS)
5% dextrose in 0.45% saline (D5 ½ NS)
5% dextrose in LR (D5LR)
10% dextrose in water (D10W)

USED FOR:

Cerebral edema
Hyponatremia
(low levels of sodium)
Metabolic alkalosis
Maintenance fluid
Hypovolemia

MONITOR FOR:

Fluid Volume Overload

MEMORY TRICK
HYPERtonic think HIGH numbers

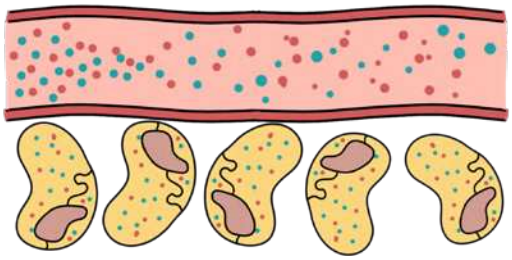
*The only exception to this memory trick is **5% DEXTROSE IN WATER (D5W)** → **5% DEXTROSE IN WATER (D5W)** starts as ISOTONIC and then changes to HYPOTONIC when the dextrose is metabolized.

ISOTONIC

ISO means EQUAL

MEMORY TRICK "STAYS WHERE I PUT IT"

EXPANDS intravascular fluid volume & replaces fluid loss



Same osmolality as body fluids
(Equal water & particle ratio)

EXAMPLES:

0.9% sodium chloride (NS) (normal saline)
5% dextrose in water (D5W)*
Lactated Ringers (LR)

Use with **BLOOD PRODUCTS**

USED FOR:

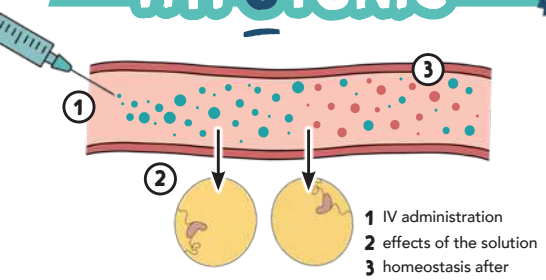
Blood loss
(hemorrhage, burns, surgery)
Dehydration
(vomiting & diarrhea)
Fluid maintenance

NORMAL SALINE

is the only solution compatible to use with blood or blood products

HYPOTONIC

MEMORY TRICK "GO OUT OF THE VESSEL" + INTO THE CELL



LESS **SALT** in the solution, MORE **WATER** in the solution.
The vessel becomes LESS concentrated than the cell.
Water then **ENTERS** the cell. Therefore, the cells will **SWELL**.

EXAMPLES:

0.45% saline (1/2 NS)
0.33% saline (1/3 NS)
0.225 saline (1/4 NS)
5% dextrose in water (D5W)*

USED FOR:

Diabetic ketoacidosis (DKA)
Helps kidneys excrete excess fluids
Hypernatremia
(high levels of sodium)

In DKA, there is so much glucose in the cells, they need water!

DO NOT GIVE WITH:

↑ ICP
Burns
Trauma

IV THERAPY: BASICS

Fluid in our body is found in **2** places:

INTRACELLULAR (ICF)

fluid INSIDE the cell

(Millions of these cells in our body)

& EXTRACELLULAR (ECF)

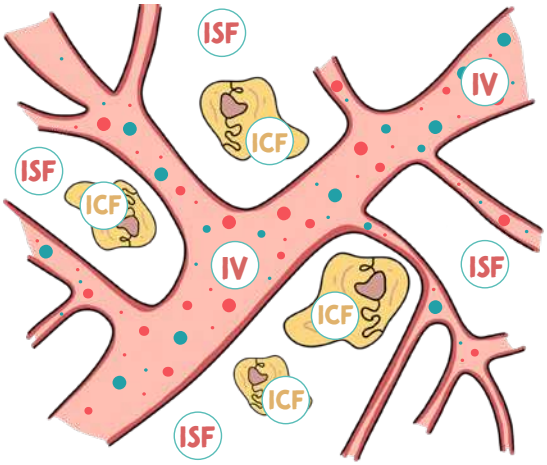
fluid OUTSIDE the cell

INTERSTITIAL FLUID (ISF)

fluid that surrounds the cell
AKA fluid in the tissues

INTRAVASCULAR (IV)

plasma/fluid in
the blood vessels



THE CELLS & HOMEOSTASIS

The cells love to have everything equal (homeostasis). But when fluids/solutes shift, **DIFFUSION/OSMOSIS** occurs to get back to homeostasis again.

DIFFUSION

the movement of a **SOLUTE** from a

HIGHER

concentration

to a

LOWER

concentration

(until there is equal concentration)

TIP

Sodium is a solute!

OSMOSIS

the movement of **WATER** through a semipermeable membrane from a

LOWER

solute concentration

to a

HIGHER

solute concentration

(until there is equal concentration)

said another way...

from a

HIGHER

water concentration

to a

LOWER

water concentration

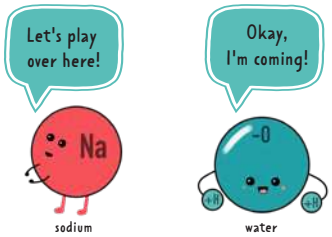
(until there is equal concentration)

SODIUM & WATER

MEMORY TRICK

WHERE SODIUM **GOES** WATER **FLOWS!**

Sodium is the cool kid,
so water wants to be his friend.



EXAMPLE: *If sodium shifts into the cell (intracellular space) water will follow and leave the extracellular space (the vessel)*

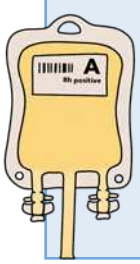
COLLOIDS & CRYSTALLOIDS

COLLOIDS

PLASMA EXPANDERS!

Large molecules

Colloids have **LARGE** molecules making it more efficient at increasing fluid volume in the blood.



EXAMPLES:

Albumin

Fresh frozen plasma (FFP)

USED FOR:

Shock

Pancreatitis

Burns

Excessive bleeding

CRYSTALLOIDS

Small molecules

Crystalloids have **SMALL** molecules. They are less expensive than colloids and provide immediate fluid resuscitation.

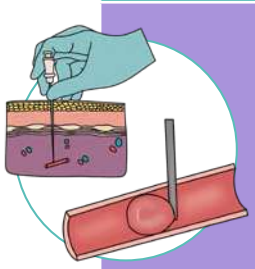
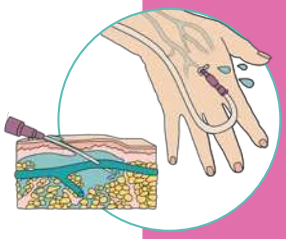
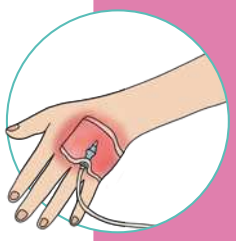
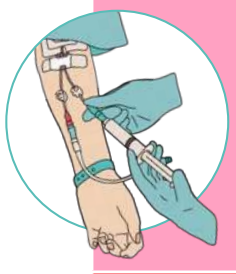
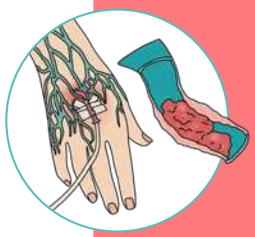
EXAMPLES:

Hypertonic solution

Isotonic solution

Hypotonic solution

IV THERAPY: COMPLICATIONS

	PATHOLOGY	SYMPTOMS	TREATMENT
 **AIR EMBOLISM**	Air enters the vein through the IV tubing	▪ Tachycardia ▪ Chest pain ▪ Hypotension ▪ ↓ LOC ▪ Cyanosis	▪ Clamp the tubing ▪ Turn client on the left side & place in Trendelenburg position ▪ Notify the HCP
 **INFILTRATION**	IV fluid leaks into surrounding tissue	AT THE SITE: ▪ Pain ▪ Swelling ▪ Coolness ▪ Numbness ▪ No blood return	▪ Remove the IV ▪ Elevate the extremity ▪ Apply a warm or cool compress ▪ Do not rub the area
 **INFECTION**	Entry of microorganism into the body via IV	▪ Tachycardia ▪ Redness ▪ Swelling ▪ Chills & fever ▪ Malaise ▪ Nausea & vomiting	▪ Remove the IV ▪ Obtain cultures ▪ Possible antibiotic administration
 **CIRCULATORY OVERLOAD**	Administration of fluids too rapidly (Fluid Volume Overload)	▪ ↑ blood pressure ▪ Distended neck veins ▪ Dyspnea ▪ Wet cough & crackles	▪ ↓ flow rate (keep-vein-open rate) ▪ Elevate the head of the bed ▪ Keep the client warm ▪ Notify the HCP
 **PHLEBITIS**	Inflammation of the vein Can lead to a **clot** (thrombophlebitis) 	AT THE SITE: ▪ Heat ▪ Redness ▪ Tenderness ▪ ↓ flow of IV	▪ Remove the IV ▪ Notify the HCP ▪ Restart the IV on the opposite side
 **HEMATOMA**	Collection of blood in the tissues	AT THE SITE: ▪ Blood ▪ Hard & painful lump ▪ Ecchymosis	▪ **ELEVATE** the extremity ▪ Apply pressure & ice

BLOOD TRANSFUSIONS

ADMINISTRATION OF BLOOD TRANSFUSION

1. Insert an IV line using a 16g*, 18g, or 20g IV needle
   **commonly used for trauma patients*
2. Run it with normal saline 0.9% (keep-vein-open-rate)
   Blood is transfused with a special Y-tubing with an inline-filter
3. Begin the transfusion slowly
   - A. The first 15 min are the **MOST CRITICAL,** the RN must stay at bedside
   - B. Vital signs are monitored every 30 min - 1 hr
   - C. After 15 min, the flow can be increased (unless a transfusion reaction has occurred)
4. Dispose the bag into a red biohazard bag
5. Document the patient's tolerance to the administration of the blood product

If you use too small of a needle (i.e. 24 gauge needle) when administering blood products, it can cause the blood to **LYSIS**.

FACTS ABOUT BLOOD TRANSFUSIONS

- Administered by the RN
- Only normal saline (NS) can be used in conjunction with blood
- Type & screen and a cross match are good for **72 HOURS**

Blood must be hung (started) within **30 MINUTES** from the time the blood is picked up from the blood bank

All blood must be transfused within **4 HOURS** of the time the blood was hung (started)

STOP the transfusion if you suspect a **TRANSFUSION REACTION**

TRANSFUSION REACTION

A transfusion reaction is an adverse reaction that happens as a result of receiving blood transfusions

IMMEDIATE TRANSFUSION REACTION

Chills, diaphoresis, aches, chest pain, rash, hives, itching, swelling, dyspnea, cough, wheezing, or rapid, thready pulse

CIRCULATORY OVERLOAD

Infusion of blood too rapid for the client to tolerate
Cough, dyspnea, chest pain, headache, hypertension, tachycardia, bounding pulse, distended neck vein, wheezing

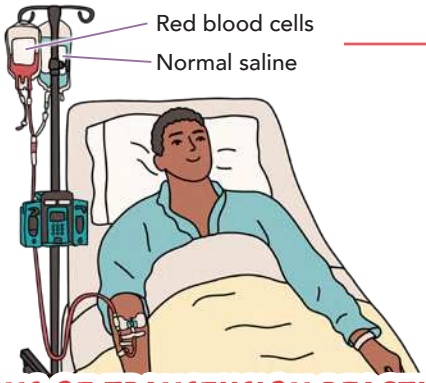
SEPTICEMIA

Blood that is contaminated with microorganisms
Rapid onset of chills, high fever, vomiting, diarrhea, hypotension & shock

IRON OVERLOAD

Complication that occurs in client's who receive multiple blood transfusions
Vomiting, diarrhea, hypotension, altered hematological values

**Always check with your hospital's protocol about IV and blood product administration*



SIGNS OF TRANSFUSION REACTIONS

- Fast heart rate
- Itching/urticaria/skin rash
- Wheezing/dyspnea/tachypnea
- Anxiety
- Flushing/fever
- Back pain

NURSING ACTIONS:

1. **STOP** the transfusion
2. Change the IV tubing down to the IV site
3. Keep the IV open w/ normal saline
4. Notify the HCP & blood bank
5. Do not leave the patient alone (monitor the patient's vital signs & continue to assess)

MEDICATION ADMINISTRATION

6 RIGHTS OF MED ADMIN

- RIGHT **CLIENT**
- RIGHT **TIME**
- RIGHT **DOSE**
- RIGHT **MED**
- RIGHT **ROUTE**
- RIGHT **DOCUMENTATION**

TYPES OF ORDERS

ROUTINE
Given on a regular schedule with or without a termination date.

SINGLE "ONE-TIME"
Used for a single case.
Not a routine medication.

STAT
Only for administration once and given immediately.

PRN
"As needed" must have an indication for use such as pain, nausea & vomiting.

⚠ COMMON MEDICATION ERRORS ⚠

Medication error kills, prevention is crucial!

- ✘ **Wrong medication**
- ✘ **Incorrect dose**
- ✘ **Wrong...**
  - Client
  - Route
  - Time
- ✘ **Administer a medication the client is allergic to**
- ✘ **Incorrect D/C of Medication**
- ✘ **Inaccurate prescribing**

SCOPE OF PRACTICE

RN

- Post-op assessment
- Initial client teaching
- Starting blood products
- Sterile procedures
- IVs & IV medications
- Discharge education
- Clinical assessment

NOTE:

When a registered nurse delegates tasks to others, responsibility is transferred but accountability for patient care is not transferred. The RN is still responsible!

LPN/LVN

- Stable client
- Monitor RN's findings & gather data
- Specific assessments
- Reinforce teaching
- Routine procedures (catheterization, ostomy care, wound care)
- Monitors IVFs & blood products
- Administer injections & narcotics (not IVs meds & 1st IV bag)
- Tube potency & enteral feedings
- Sterile procedures

SPECIFIC ASSESSMENTS

Lung sounds, bowel sounds, & neurovascular checks

UAP

- Routine, stable vital signs
- Documenting input and output
- Can get blood from the blood bank
- Activities of daily living (ADLs)

ADLS

- **Feeding** (not with aspiration risk)
- **Positioning**
- **Ambulation**
- **Cleaning**
- **Linen change**
- **Hygiene care**

RN = Registered Nurse **LPN** = Licensed Practical Nurse **LVN** = Licensed Vocational Nurse **UAP** = Unlicensed Assistive Personnel

PHARMACOKINETICS

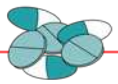
MEMORY TRICK "ADME" some medications

PHARMACOKINETICS:
The study of how drugs are moved throughout the body

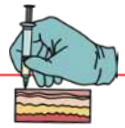
A ABSORPTION

Medication going from the location of administration to the bloodstream

ORAL
Takes the longest to absorb



SUBQ & IM
Depends on the site of blood perfusion.
More blood perfusion = rapid absorption



IV
Quickest absorption time

D DISTRIBUTION

Transportation by bodily fluids of the medication to where it needs to go

INFLUENCING FACTORS:

- Circulation
- Permeability of the cell membrane
- Plasma protein binding

M METABOLISM

How is the medication going to be broken down?

MOST COMMON SITE: Liver

INFLUENCING FACTORS:

- **Age** (Infants & elderly have a limited med-metabolizing capacity)
- **Medication type**
- **First-pass effect**
  A drug given orally gets metabolized and its effects are greatly reduced before it reaches the systemic circulation. It's generally related to the liver or gut. It may need to be administered via parenteral route (subQ, IM, or IV) because this route bypasses the liver and gut.
- **Nutritional status**

E EXCRETION

How is the medication going to be eliminated from the body?

MOST COMMONLY DONE BY: Kidneys

INFLUENCING FACTORS:

- **Kidney dysfunction**
  Leads to an increase in the duration and intensity of a medication response

If the kidneys aren't working/excreting waste, the medication will stay in the body which leads to toxic levels

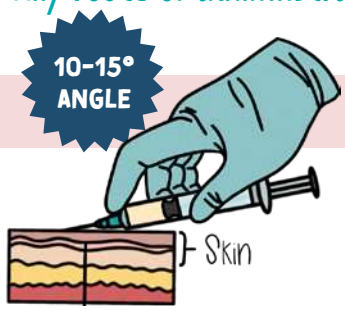
PARENTERAL ADMINISTRATION

Any route of administration that does not involve drug absorption through the GI tract

SLOWEST ABSORPTION

QUICKEST ABSORPTION

INTRADERMAL (ID)



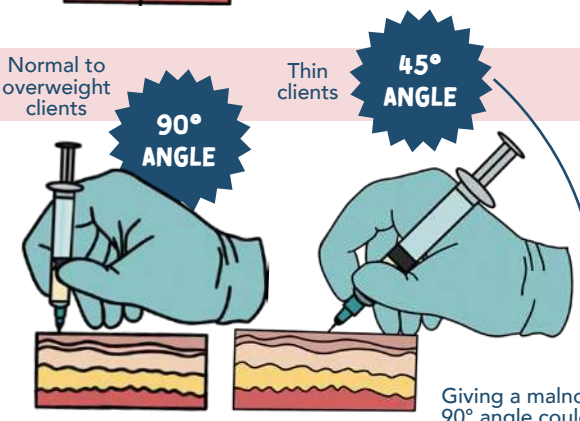
Should form a "BLEB"

USES:
- TB testing
- Allergy sensitivities

NEEDLE SIZE:
25 - 27 gauge

USUAL SITE:
Inner forearm

SUBCUTANEOUS (SUBQ)



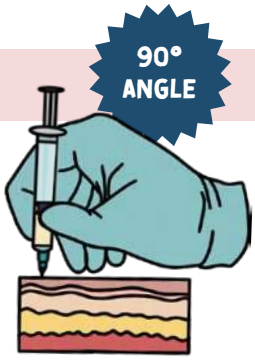
Giving a malnourished/thin client a medication at a 90° angle could lead to accidental intramuscular injury!

USES:
non-irritating, water-soluble medication (insulin & heparin)

NEEDLE SIZE:
23 - 25 gauge

USUAL SITE:
- Abdomen
- Posterior upper arm
- Thigh

INTRAMUSCULAR (IM)



Use the Z TRACK METHOD

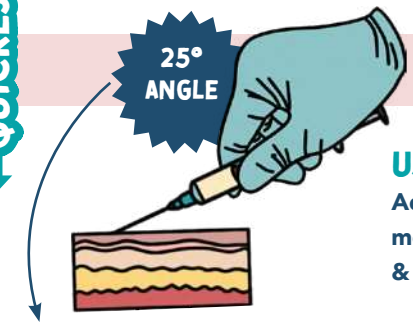
Do not inject more than 3 mL (2 mL for the deltoid)
Divide larger volumes into two syringes & use two different sites

USES:
Irritating, solutions in oils, and aqueous suspensions

NEEDLE SIZE:
22 - 25 gauge

USUAL SITE:
- Deltoid
- Vastus lateralis
- Ventrogluteal

INTRAVENOUS (IV)



25° angle used when starting an IV

USES:
Administering medications, fluids, & blood products

NEEDLE SIZE:
16 gauge:
clients who have trauma
18 gauge:
surgery & blood administration
22 - 24 gauge:
children, older adults, & clients who have medical issues or are stable post-op

USUAL SITE:
- Hand
- Wrist
- Cubital fossa
- Foot
- Scalp

The smaller the gauge number, the larger the IV bore

GAUGES & IV USES

16 G	18 G	20 G*	22 G	24 G
Trauma, surgery, rapid fluid administration (bolus)	Administering blood, rapid infusions (bolus), CT scans with IV dye	Medications, routine therapies, IV fluids	IV fluids, medications	Pediatric patients, elderly patients, very fragile/small veins

LARGEST ← → SMALLEST

Some hospitals allow blood to be administered with 20 G

Always check with your hospital's protocol about IV and blood product administration

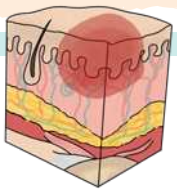
PRESSURE INJURIES (ULCERS)

"Decubitus Ulcer" "Bed Sores"

WHAT IS A PRESSURE INJURY?

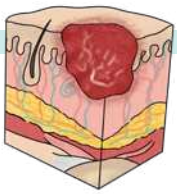
The break down of skin integrity due to unrelieved pressure

Most commonly seen in bedridden and/or incontinent patients



TYPE 1

- Skin is intact (unbroken)
- Nonblanchable redness
- Swollen tissue
- Darker skin → may appear blue / purple

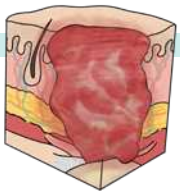


TYPE 2

- Skin is NOT intact
- Partial thickness loss
- No fatty tissue is visible
- Superficial ulcer

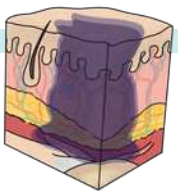
TYPE 3

- Skin is NOT intact
- Full thickness SKIN loss
  - → Damage to or necrosis of subQ tissue
  - → No bone, muscle, or tendon exposed
- Ulcer extend down to the underlying fascia, but not through it
- Deep crater with or without tunneling



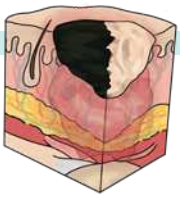
TYPE 4

- Skin is NOT intact
- Full thickness TISSUE loss
  - → Destruction of tissue
  - → Bone, muscle, or tendon exposed
- Deep pockets of infection & tunneling



DEEP TISSUE INJURY (DTI)

- Skin is intact (unbroken)
- Tissue beneath the surface is damaged
- Appears purple or dark red



UNSTAGEABLE

Stage cannot be determined due to eschar or slough covering the visibility of the wound

RISK FACTORS

MNEMONIC "AVOIDS PRESS"

- **A** Aging skin
- **V** Vascular disorders
- **O** Obesity
- **I** Immobility & incontinence
- **D** Diabetes
- **S** Skin friction
- **P** Poor nutrition
- **R** Reduced RBCs (anemia)
- **E** Edema
- **S** Sensory deficits
- **S** Sedation

BRADEN SCALE

Asses your client's skin **EVERY** shift for pressure injuries using the Braden Scale!

Looks at **6** categories

- **SENSORY PERCEPTION**
- **MOISTURE**
- **ACTIVITY**
- **MOBILITY**
- **NUTRITION**
- **FRICTION & SHEAR**

Interpretation

LOW RISK: 22 - 23
LESS RISK: 19 - 21
HIGH RISK: <18

NURSING CONSIDERATIONS

As a nurse, it's important to **PREVENT** pressure injuries while in the hospital!

RELIEVE PRESSURE

- Apply pressure relieving devices (overlays, specialty beds, air cushions, foam-padded seat cushions, etc.)
- Do not use donut-type devices or synthetic sheepskins

PROPER NUTRITION

- ↑ protein intake
- Adequate hydration
- Possible enteral nutrition

Protein promotes wound healing

SKIN HYGIENE

- Clean skin with mild soap
- Clean incontinent patients
- Do not scrub or rub bony prominences
- Barrier for incontinence
- Moisturizer for hydration

REPOSITIONING

Turn/reposition patient every 2 hours while in the bed

- LIFT, don't PULL
  - Pulling could cause shearing & friction from force

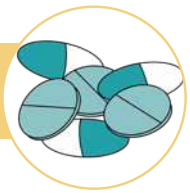
MONITOR:

- Size & color of the wound
- Braden Scale (tool for anticipating the risk of pressure ulcers)

NONPARENTERAL ADMINISTRATION

Absorbed into the system through the digestive tract

ORAL OR ENTERAL



- CONTRAINDICATIONS: vomiting, aspiration precautions/absence of a gag reflex, decreased LOC, difficulty swallowing
- Have client sit at 90 angle to help with swallowing
- NEVER crush enteric-coated or time-release medications
- Break or cut scored tablets only!

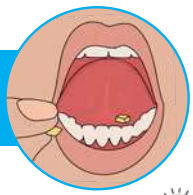
TRANSDERMAL

- Place the patch on a dry and clean area of skin (free of hair)
- Rotate the sites of the patch to prevent skin irritation
- Always take off the old patch before placing a new one on

INHALATION

- Rinse mouth after the use of steroids
- 20 - 30 seconds between puffs
- 2 - 5 minutes between different medications
- Use a spacer if possible to prevent thrush

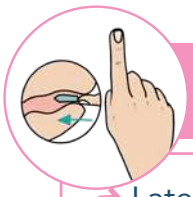
SUBLINGUAL & BUCCAL



SUBLINGUAL: Under the tongue
BUCCAL: Between the cheek & the gum

Do not swallow!

Keep the medication under the tongue (sublingual) or in between the cheek and gum (buccal) until it has completely absorbed



SUPPOSITORIES

RECTAL

- Lateral or sims' position
- Use lubrication
- Insert beyond the internal sphincter
- Leave it in for 5 minutes

VAGINAL

- Supine with knees bent & feet flat on the bed, close to hips
- Insert the suppository along the posterior wall of the vagina (3 - 4 inches deep)
- Stay supine for at least 5 minutes

INSTALLATION (DROPS, OINTMENTS, SPRAYS)

EYES

- If there is dried section use a moisten sterile gauze and wipe from inner to outer canthus to prevent bacterial from entering the eye
- Have the client tilt their head back slightly
- Pull lower eye lid down gently to expose the conjunctival sac
- Hold the dropper 1 - 2 cm above the conjunctiva sac & drop medication directly into the sac
- Close eye lid & apply gentle pressure on the nasolacrimal duct for 30 - 60 seconds

EARS

- Have client tilt their head
- Warm the solution before adm. to prevent vertigo & dizziness
- **ADULTS**: pull ear **UP**ward & outward
- **< 3 YEARS OF AGE**: pull ear **DOWN** & back

MEMORY TRICK
ADULT UP
CHILD DOWN

NOSE

- Have client lie supine
- Do not blow nose for 5 min after drop instillation

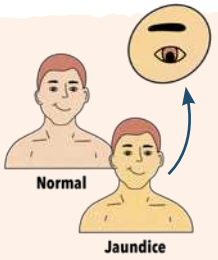
INTEGUMENTARY (SKIN) OVERVIEW

INSPECTION OF THE SKIN

Color changes are more difficult to notice in clients with darker skin

	DESCRIPTION	INDICATION	LOCATIONS
PALLOR	Loss of color	Lack of blood flow, anemia, shock	Face, conjunctiva, nail beds, palm, lips, mucous membranes
ERYTHEMA	Redness *can be blanchable or non-blanchable*	Inflammation, localized vasodilation, sun exposure, rash, hyperthermia	Skin (areas of trauma or pressure)
JAUNDICE	Yellow to orange	Liver-dysfunction	Skin, sclera, mucous membranes
CYANOSIS	Bluish	Hypoxia (not enough oxygen) or impaired venous return	Lips, mucous membranes, nail beds, skin

The best way to assess for **JAUNDICE** is to press gently on the forehead or nose. If the skin looks yellow where you applied pressure, it indicates jaundice.



PERIPHERAL CYANOSIS

Cyanosis of the peripherals (fingertips, palms, toes)

Rarely a life-threatening medical emergency

CENTRAL CYANOSIS

Cyanosis around the mouth, tongue or mucous membranes

⚠ Medical emergency!

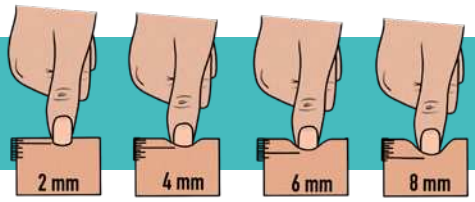
EDEMA is accumulation of excess fluid in the body's tissues that causes swelling of the skin

EDEMA CAN BE:

- → Non-pitting
- → Pitting

WEEPING EDEMA Areas that have pitting edema can leak fluid out directly from the skin

GRADING PITTING EDEMA



PITTING is when you press the edematous area for a few seconds and it dimples or pits

TYPES OF WOUND DRAINAGE

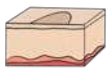
SEROUS	Clear, watery plasma.
SANGUINEOUS	Bright red blood.
SEROSANGUINEOUS	Pale, pink, watery. Mixture of clear and red fluid.
PURULENT	Thick, yellowish-green. Foul odor.

Indicates active bleeding

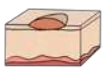
May indicate infection

PRIMARY LESION

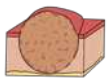
Develops as a result of a disease process



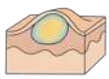
MACULE
Flat discoloration of the skin <1 cm
Example: freckles



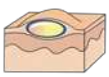
PAPULE
Solid, slightly elevated lesion <1cm
Example: moles



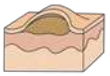
NODULE
Solid & elevated lesion >1cm
Example: lipomas



PUSTULE
Enclosed pus-filled cavity
Example: acne



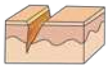
WHEAL
Superficial, raised lesion
Example: allergic reactions



VESICLE
Elevated cavity containing clear fluid
Example: chickenpox, shingles

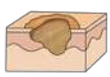
SECONDARY LESION

Results from a primary lesion or due to a client's actions (scratching, picking)

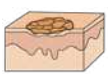


FISSURE
Linear crack/tear with abrupt edge
Example: anal fissures, athletes foot

SCAR
Normal tissue is lost & replaced with connective tissue causing a scar
Example: healed area after surgery/injury



EROSION
Scooped-out, shallow depression
Example: severe pressure injuries



SCALE
Compact, flaky skin (silvery or white)
Example: psoriasis

HYPOVOLEMIA VS. HYPERVOLEMIA

SCAN FOR HYPO VS. HYPERVOLEMIA VIDEO

HYPOVOLEMIA

"LOW" "VOLUME" "IN THE BLOOD"

ALSO CALLED: Dehydration • Fluid volume deficit (FVD) • Hypovolemic shock

HYPERVOLEMIA

"HIGH" "VOLUME" "IN THE BLOOD"

ALSO CALLED: Over-hydration • Fluid volume excess

CAUSES

Hypovolemia

- Loss of fluid from ANYWHERE
  - Thoracentesis
  - Paracentesis
  - Hemorrhage
  - NG tube
  - Trauma
  - GI losses
    - Vomiting
    - Diarrhea
- Third spacing
  - Burns
  - Ascites
- Polyuria (peeing a lot)
  - Diabetes
  - Diuretics
  - Diabetes insipidus

THIRD SPACING shifts the fluids from the **INTRAVASCULAR SPACE** (the vein) into the **INTERSTITIAL SPACE** (third space). This causes a drop in the circulating blood volume

Hypervolemia

- Heart failure
- Kidney dysfunction
  - Can't filter the blood = back up of fluids
- Cirrhosis
- ↑ Sodium intake

MEMORY TRICK: **WHERE SODIUM GOES WATER FLOWS!** Sodium is the cool kid, so water wants to be his friend.

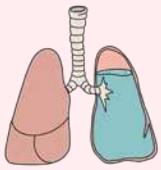
SIGNS & SYMPTOMS

Hypovolemia

- Flat neck veins
- ↑ HR (weak & thready)
- ↑ Respirations
- ↑ Urine specific gravity
- ↓ BP → LESS VOLUME = LESS PRESSURE
- ↓ CVP
- ↓ Weight
- ↓ Skin turgor
- ↓ Urine output
- Dry mucous membranes
- Thirst

Hypervolemia

- Distended neck vein (JVD)
- ↑ HR (bounding)
- ↑ BP → MORE VOLUME = MORE PRESSURE
- ↑ Weight
- ↑ CVP
- Wet lung sounds
  - Crackles / dyspnea
  - Due to back flow of fluid from the heart
- Edema
- Polyuria
  - Kidneys are trying to get rid of the excess fluid



LABS

MEMORY TRICK: **CONCENTRATED (DEHYDRATED) MAKES THE # GO UP**

- ↑ Urine specific gravity
- ↑ Hematocrit (%)
- ↑ Serum sodium
- ↑ BUN

MEMORY TRICK: **DILUTED (OVER-HYDRATED) MAKES THE # GO DOWN**

- ↓ Urine specific gravity
- ↓ Hematocrit (%)
- ↓ Serum sodium
- ↓ BUN

NURSING CONSIDERATIONS / TREATMENT

Hypovolemia

- Fluid replacement
  - Fluids (PO or IV)
- Safety precautions
  - Risk for fall due to orthostatic hypotension
- Daily I&O + weights

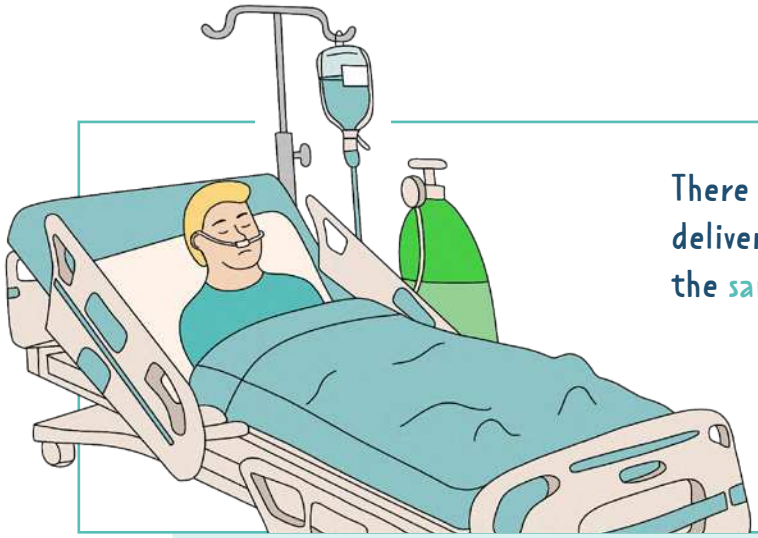
monitor for fluid volume overload

Hypervolemia

- Low sodium diet
- Daily I&O + weights
- Diuretics
- High-Fowler's or Semi-Fowler's position
  - Easier to breathe

MEMORY TRICK: **WHERE SODIUM GOES WATER FLOWS!**

OXYGEN DELIVERY SYSTEM



There are many types of oxygen delivery systems, but they all have the same goal:

They are used to **ADMINISTER, REGULATE,** and **SUPPLEMENT OXYGEN.**

MASK TYPE	FLOW RATE	FiO_2	DESCRIPTION
 Nasal cannula	**2 - 6** L/min	**24 - 44%**	**Low-flow device** Used for non-acute situations
 Simple masks	**6 - 10** L/min	**40 - 60%**	**Low-flow device** Used for non-acute situations
 Non-rebreather mask	**10 - 15** L/min	**80 - 90%**	**Low-flow device** Used for acutely ill patients
 High-flow oxygen therapy	Up to **60** L/min	**21 - 100%**	**High-flow oxygen** Often a high flow nasal cannula
 Venturi mask	**2 - 15** L/min	**24 - 50%**	**High-flow device** Best for patients with chronic lung disease
 Face tent	at least **10** L/min	**24 - 100%**	**High-flow device** Great for those who don't tolerate masks well

Can be given as humidified air to ↓ nasal irritation/dryness

Most precise O_2 delivery without intubation

MEMORY TRICK

Venturi mask think **V**ery accurate O_2

MED-SURG

KIDNEY OVERVIEW

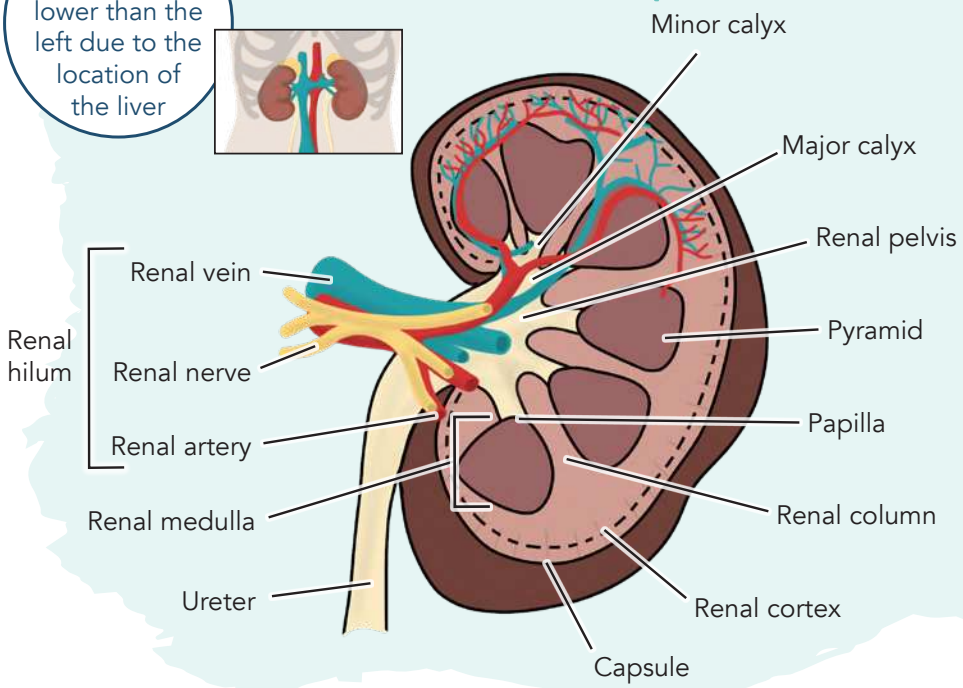
FUNCTIONS of the kidneys

MNEMONIC "A WET BED"

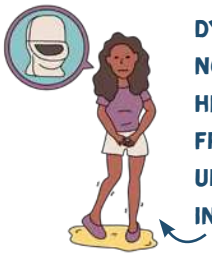
- **A** **A**cid-base balance
- **W** **W**ater balance
- **E** **E**lectrolyte balance
- **T** **T**oxin removal
- **B** **B**lood pressure control
- **E** **E**rythropoietin
- vitamin **D** metabolism

FUN FACT: The right kidney sits lower than the left due to the location of the liver

ANATOMY of the kidney



TERMS TO KNOW



- **DYSURIA** ..... Pain while urinating
- **NOCTURIA** ..... Excessive urination at night
- **HEMATURIA** ..... Bloody urine
- **FREQUENCY** ..... Voiding more than every 3 hours
- **URGENCY** ..... Strong desire to void
- **INCONTINENCE** ..... Involuntary voiding
- **ENURESIS** ..... Involuntary voiding during sleep
- **PROTEINURIA** ..... Abnormal amounts of protein in the urine
- **OLIGURIA** ..... Urine output: <400 mL/day
- **ANURIA** ..... Urine output: <50 mL/day
- **MICTURITION** ..... Voiding

URINE FORMATION

1 GLOMERULAR FILTRATION

Blood flows into the kidneys: **120 mL/min**

Filters water, electrolytes, & small molecules **into the glomerulus** (Large molecules stay in the bloodstream)

2 TUBULAR REABSORPTION

Fluid moves **from renal tubules into the capillaries**. They reabsorb fluid into the venous circulation.

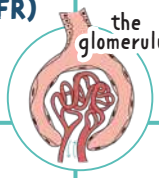
3 TUBULAR SECRETION

Fluid moves **from the capillaries into the renal tubules** to get eliminated/excreted.

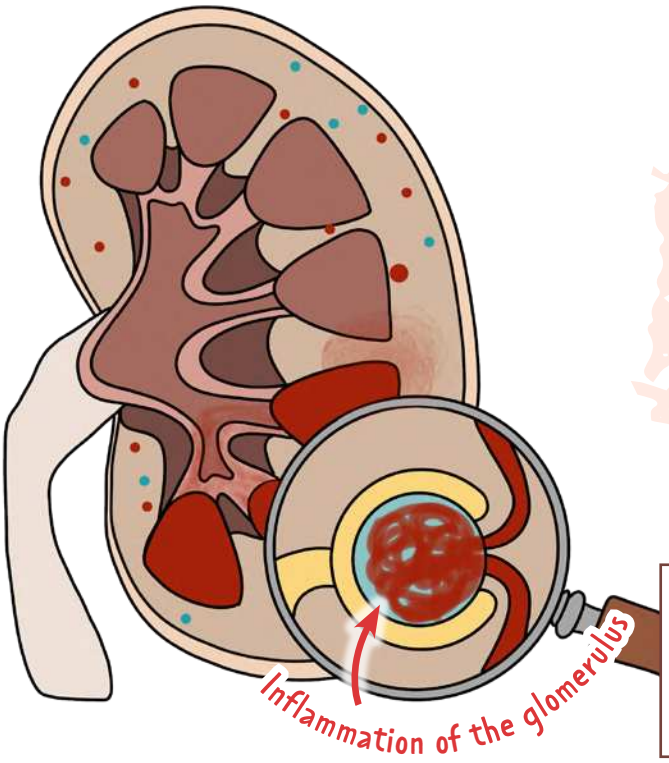
4 URINE EXCRETION

Adults should void 1-2 L/day
No less than 30mL/hr

LAB VALUES RELATED TO THE KIDNEYS

	DESCRIPTION	EXPECTED RANGE	↓	↑
GLOMERULAR FILTRATION RATE (GFR) 	Rate of blood flow through the kidneys	**90 - 120** mL/min	**POSSIBLE CAUSES:** Kidney dysfunction *(such as chronic kidney disease)*	-
CREATININE *Creatinine is a better indicator of kidney function than BUN*	End product of muscle metabolism; solely filtered from the blood via glomerulus	**0.6 - 1.2** mg/dL  **RHYME**: Creatinine over 1.3 = think bad kidney	▪ Muscle mass is low ▪ Hyperthyroidism ▪ Starvation ▪ Liver disease	▪ Acute or chronic kidney disease ▪ Congestive heart failure ▪ Dehydration ▪ Certain drugs 
BLOOD UREA NITROGEN (BUN)	Normal waste product resulting from the breakdown of proteins. ↑ levels can indicate a kidney problem & be toxic in the body	**7 - 20** mg/dL  Think hamburger BUNs... Hamburgers can cost anywhere from $7 - $20	▪ Liver damage ▪ Malabsorption ▪ Poor diet ▪ Low nitrogen diet	Can be due to PRErenal failure, POSTrenal failure, or INTRArenal failure *See "ACUTE KIDNEY INJURY (AKI)" page*
URINE SPECIFIC GRAVITY	Measures the kidney's ability to excrete or conserve water	**1.010 - 1.030**	▪ Too much fluid intake ▪ Diabetes Insipidus 	▪ Dehydration ▪ Syndrome of inappropriate antidiuretic hormone secretion (SIADH) 
URINE OUTPUT	The amount of urine a person excretes from their bladder via the urethra	Urine output: **AT LEAST 30** mL/hr Average adult: **1500** mL/day 	▪ Shock ▪ Hypotension ▪ Trauma ▪ Infection ▪ Chronic kidney injury	▪ Diabetes mellitus ▪ Diabetes insipidus ▪ Too much diuretics
NORMAL FINDINGS	Free from glucose, ketones, blood, protein, bilirubin, nitrates or leukocyte esterase in the urine			

ACUTE GLOMERULONEPHRITIS (POSTSTREPTOCOCCAL)



PATHOLOGY

1. Untreated strep
2. Immune system response by creating **antigen-antibody complexes** (14 days after infection)
3. These antibodies get "lodged" in the glomeruli
4. Inflammation & scarring
5. ↓ GFR

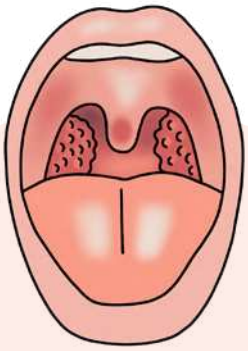
It's not the strep that causes the inflammation of the kidneys.

It's the **antigen-antibody complexes** that form due to the strep that causes the inflammation & damage to the glomeruli

SIGNS & SYMPTOMS

- Hematuria — Blood in the urine
- Azotemia — Excessive nitrogenous waste in the blood
- Malaise
- Headache
- Proteinuria (mild)
- Hypoalbuminemia
- ↓ GFR = Oliguria
- Edema
  - Swelling in the face/eyes
- ↑ Blood pressure
- Retaining sodium
- ↑ Urine specific gravity
- ↑ BUN & creatinine
- (+) ASO (Antistreptolysin) Titer

Tea colored urine (cola color)



MAIN CAUSE:

Recent group A beta-hemolytic streptococcal infection

INTERVENTIONS

- Fix the cause! (strep)
- Diet modifications
  - Fluid restriction
  - Sodium restriction
  - ↓ Protein
  - Provide a lot of carbohydrates

Carbohydrates provide energy & stop the breakdown of protein

- Monitor
  - Daily intake & output
  - Daily weight

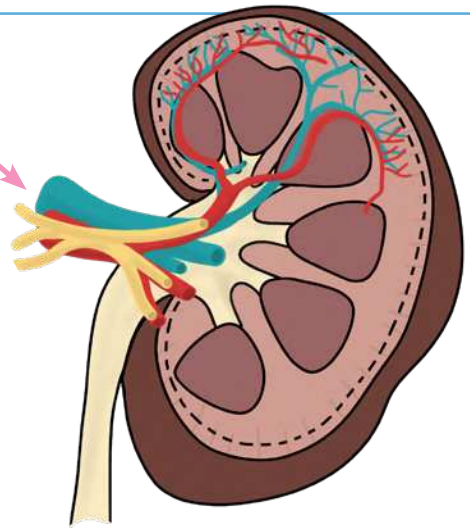
A weight gain of 1 kg is equal to 1,000 mL of retained fluid

- Bed rest
- Monitor blood pressure
  - Antihypertensives
  - Diuretics

ACUTE KIDNEY INJURY (AKI)

WHAT IS IT?

Sudden renal damage! Causes a build-up of waste, fluid, and electrolyte imbalance.
It can be reversible. Formerly called *Acute Renal Failure*.



PRERENAL FAILURE

Damage **BEFORE** the kidneys

↓ VOLUME/PERFUSION TO THE KIDNEYS

- **Cardiac damage**
  - ↓ or impaired cardiac output
  - *Example:* MI
- **Vasodilation**
- **Hemorrhage** (hypovolemia)
- **Burns**
- **GI losses** (vomiting/diarrhea)

INTRARENAL FAILURE

Damage **IN** the kidneys

PROLONGED ISCHEMIA

- **Myoglobinuria**
- **Hemoglobinuria**
- **Rhabdomyolysis**
- **Nephrotoxic drugs**
  - *Examples:* NSAIDs, antibiotics (aminoglycosides), chemo drugs, contrast dyes
- **Infections**
  - *Examples:* Glomerulonephritis

POSTRENAL FAILURE

Damage **AFTER** the kidneys

OBSTRUCTION/BLOCKAGE IN THE URINARY TRACT

- **Renal calculi (stones)** - **Blood clots**
- **Benign prostatic hyperplasia (BPH)** - **Tumors** - **Neuro damage (stroke)**

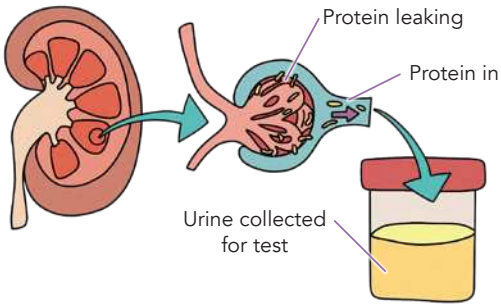
MEMORY TRICK "OH OH DARN RENAL"

	OH ONSET/INITIATION	OH OLIGURIA	DARN DIURETIC	RENAL RECOVERY
PHASES	Triggering event *(Prerenal, intrarenal or postrenal failure)*	↓ Urine output < 400 mL/24 hrs Glomerulus decreases the ability to filter blood (↓ GFR)	Cause of AKI is corrected Gradual ↑ in urinary output	↑ in kidney function May take up to 6 - 12 months
TREATMENT	Correct & identify the underlying cause to prevent long term damage to nephrons!	**DIET MODIFICATIONS:** - Low protein diet - Limit fluid intake - Strict I&O + daily weights **MONITOR** EKG & labs - *Watch for HYPERkalemia > 5.0* - ↑ *BUN & creatinine* - Dialysis may be needed until kidney function returns	Large amount of diluted urine with electrolytes **MONITOR** the patient for dehydration & hypokalemia	Some patients may never recover and may develop chronic kidney disease (CKD)

NEPHROTIC SYNDROME

PATHOLOGY

Inflammatory response in the glomerulus
↓
Damage to membrane
↓
Loss of protein (albumin)
Albumin regulates oncotic pressure
↓
HYPOALBUMINEMIA
Low albumin levels



- Causes synthesis of cholesterol & triglycerides → Hyperlipidemia
- Fluid shift → Generalized edema
- Albumin is a protein which prevents clot formation → Possible blood clots (thrombosis)
- Can lose protein that helps fight infections (immunoglobulins) → Risk for infection

CAUSES

- Bacteria or viral infection
- Cancer
- Genetic predispositions
- Systemic disease (lupus or diabetes)
- NSAIDs

SIGNS & SYMPTOMS

- **Hypoalbuminemia**
  - Edema
  - Fatigue & loss of appetite
  - Hyperlipidemia
- **Proteinuria (> 3 g/day)**
  - Large amounts of protein in the urine

INTERVENTIONS

- **Monitor fluid status**
  - Daily weights & I&O's
  - Swelling & abdominal girth
- **Diet modifications**
  - ↓ Cholesterol & saturated fats
  - ↓ Na+ intake
  - Moderate protein intake
- **Medications**
  - Diuretics
  - Statins (lipid-lowering drugs)
  - Prednisone to ↓ inflammation
  - Antineoplastic agent
  - Immunosuppressant
- **Monitor signs of...**
  - Infection
  - Blood clots

CHRONIC KIDNEY DISEASE (CKD)

PATHOLOGY

- Progressive & irreversible loss of kidney function
- Occurs over a long period of time

CAUSES

- Untreated acute kidney injury (AKI)
- Diabetes mellitus
- Hypertension
- Family history
- Recurrent infections
- Autoimmune disorders

STAGES

Stages are based on the GFR rate
AS CKD WORSENS... GFR DECREASES ↓

	GFR
STAGE 1	> 90
STAGE 2	60 - 89
STAGE 3	A: 45 - 59 B: 30 - 44
STAGE 4	15 - 29
STAGE 5	< 15 END STAGE RENAL DISEASE

TREATMENT

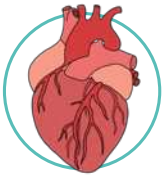
- Dialysis
- Kidney transplant

SIGNS & SYMPTOMS

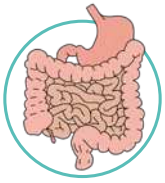
In the end stages of CKD,
ALMOST EVERY BODY SYSTEM is negativity affected

- ↓ Urinary output (UOP)
  - Oliguria = <400 mL/day
  - Anuria = <100 mL/day
- Proteinuria & hematuria

- Lethargy
- Altered LOC/confusion
- Seizures



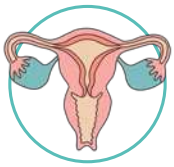
- Hypertension
- Fluid volume excess (hypervolemia)
- Heart failure



- Anorexia
- Nausea/vomiting
- Uremic fetor (ammonia breath)
- Metallic taste

- Impaired immune & inflammatory response

- Anemia (↓ erythropoietin [EPO])
- ↑ Risk for bleeding
- Prolonged bleeding time



- Amenorrhea
- Erectile dysfunction
- ↓ Libido

- Uremic frost
- Pruritus

LABS

- ↑ BUN
- ↑ Creatinine
- ↑ K+
- ↑ Magnesium
- ↓ Calcium
- ↑ Phosphate

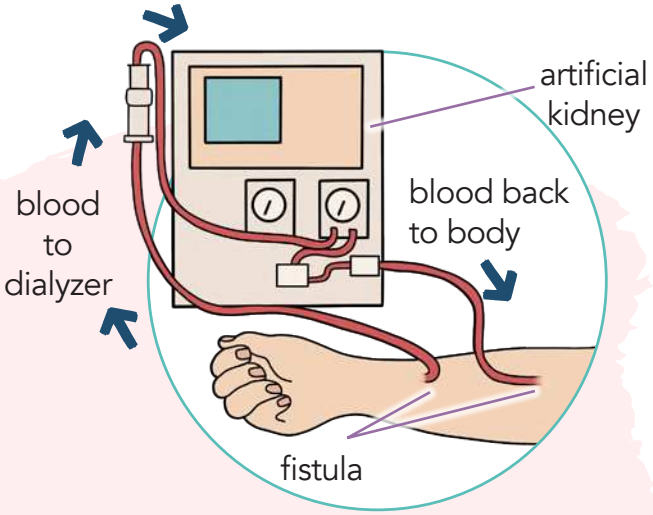
TYPES OF DIALYSIS: HEMODIALYSIS

DIALYSIS is a way to remove waste products from the blood in those with kidney dysfunction. In a healthy body, the kidneys are able to filter waste products. But if the kidneys are not functioning properly and are injured, they need help removing excess waste from the blood. Otherwise, waste accumulates and becomes toxic/harmful to the body.

MOST COMMON METHOD OF DIALYSIS

HEMODIALYSIS

uses a dialyzer (an artificial kidney) to remove excess fluids and toxins.



THE PROCESS

OUTSIDE THE BODY

THE DIALYZER
(Artificial kidney)

↓

Brings blood to the dialyzer

↓

Filters out toxins/waste products

↓

Brings clean blood back to the body

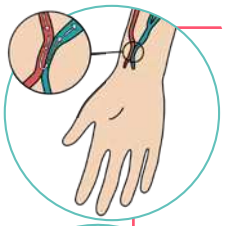
3X a week
(3 - 5 hours per treatment)

Typically done in the hospital or in a dialysis clinic

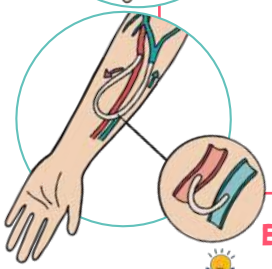
ACCESS

VASCULAR ACCESS

BOTH REQUIRE SURGERY



FISTULA
Joining an artery to a vein



GRAFT
Inserting synthetic graft material between an artery and a vein

Increased risk for infection due to the synthetic material insertion

EVALUATION OF PATENCY:

MEMORY TRICK

- ✔ **Feel the thrill** (palpating the fistula)
- ✔ **Hear the bruit** (heard during auscultation)

COMPLICATIONS

- Hypotension
- Disequilibrium syndrome
- Hemorrhage
- Air embolus
- Electrolyte imbalances

PATIENT EDUCATION

On the arm that has vascular access, you need to **AVOID:**

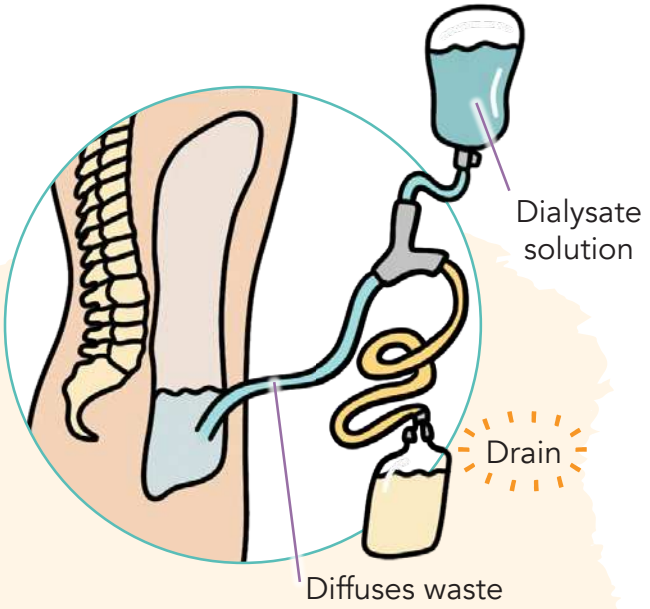
- ✘ Compression
- ✘ Blood draws
- ✘ Blood pressure readings
- ✘ Tight clothing
- ✘ Carrying bags
- ✘ Sleeping on that arm

TYPES OF DIALYSIS: PERITONEAL DIALYSIS

DIALYSIS is a way to remove waste products from the blood in those with kidney dysfunction. In a healthy body, the kidneys are able to filter waste products. But if the kidneys are not functioning properly and are injured, they need help removing excess waste from the blood. Otherwise, waste accumulates and becomes toxic/harmful to the body.

PERITONEAL DIALYSIS

Uses a peritoneum to remove excess fluids and toxins



THE PROCESS

INSIDE THE BODY

Warm the solution!
↓
Dialysate is infused into the peritoneal cavity by gravity
↓
Close the clamp on the infusion line
↓
Dialysate dwells for a set amount of time (dwell time)
↓
The drainage tube is unclamped
↓
Fluid drains from the peritoneal cavity by gravity
↓
A new container of dialysate is infused as soon as drainage is complete
↓
REPEAT!

7X a week
(multiple exchanges per day)

Typically done at home

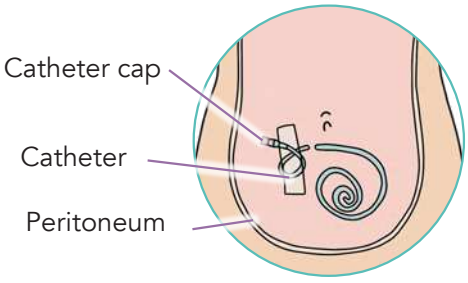
COMPLICATIONS

This procedure is commonly done at home and has an **increased risk for infection** in the peritoneum.

PERITONITIS (INFECTION)

- Cloudy or bloody drainage
- Fever
- Abdominal pain
- Malaise

ACCESS



PERITONEAL CATHETER
performed at the bedside or in the operating room

PATIENT EDUCATION

How to **AVOID** infections:

- ✔ Good hand hygiene before and after dialysis
- ✔ Clean site of catheter daily
- ✔ Keep supplies in a clean, dry place

URINARY TRACT INFECTION

PATHO

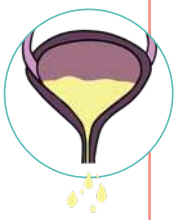
Infection within the urinary system caused by either a **BACTERIA**, **VIRAL**, or **FUNGUS**.

BACTERIA IS THE MOST COMMON
Specifically E. Coli

CAUSES

- Most common in women (shorter urethra & urethra is close to the rectum)
- Overuse of antibiotics
- Indwelling catheters
- Hormone changes (pregnancy changes)
- Diabetes
- Lifestyle
  - Baths, scented tampons, perfumes, etc.

EDUCATION



- Take entire antibiotics course
- Wipe from front to back
- Void after intercourse
- Avoid caffeine & ETOH
- Void frequently
- Avoid bubble baths, perfumes, or sprays!
- Wear non-tight cotton underwear

NURSING CONSIDERATIONS

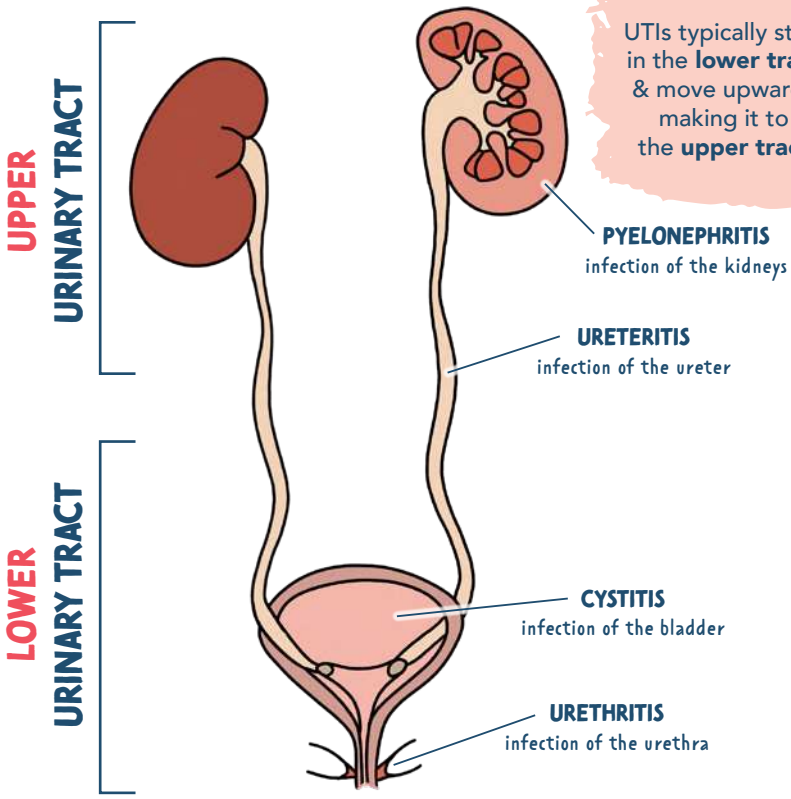
- Maintain fluid status
  - 2 - 3 L per day
  - Remove the catheter ASAP (per HCP order)

"flushing" out the urinary tract

- Medications
  - Antibiotics
  - Analgesia (control pain)
  - Phenazopyridine (Pyridium)

Take urine culture BEFORE giving first dose of antibiotics

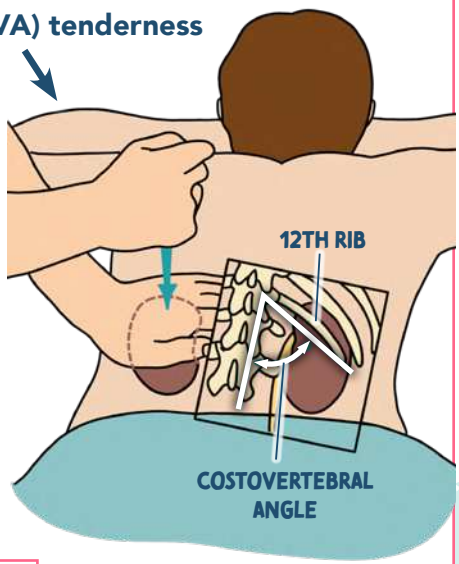
Analgesic to ↓ pain
May turn urine orange



UTIs typically start in the **lower tract** & move upwards making it to the **upper tract**

SIGNS & SYMPTOMS

- Smelly urine
- Chills & fever
- **Costovertebral angle (CVA) tenderness**
- Nausea & vomiting
- Headache/malaise
- Painful urination (dysuria)
- Burning on urination
- Frequency & urgency
- Nocturia
- Incontinence
- Hematuria
- Fever
- WBCs in the urine



Elderly patients may show atypical symptoms:

- Confusion
- Lethargy
- New incontinence

RENAL CALCULI

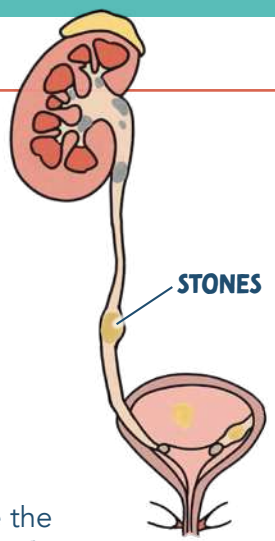
PATHO

Stones (calculi) found in the urinary tract & kidney!

NEPHROLITHIASIS:
stones in the **kidneys**

URETEROLITHIASIS:
stones in the **ureter**

- Stones can be very large *or* very small
- They can be found inside the **KIDNEYS**, **URETERS**, or the **BLADDER**



TREATMENT

Most commonly, the stone will pass on it's own!

- Medications to control the *PAIN*
  - NSAIDs → **↓ Pain & inflammation** *(makes the stone easier to pass)*
  - Opioid analgesics
- Strain the urine
  - keep any stones & send them to the lab to evaluate the type of stone

- Get them moving or frequently turning them!
- ↑ Fluids!

Push stone forward & out! Decreases risk of infection

- Diet:
  - Limit protein, Na+ foods, & calcium
- Procedures:

NONINVASIVE Extracorporeal Shock Wave Lithotripsy (ESWL)
Sends shock waves to break up the stone!

INVASIVE! Percutaneous Nephrolithotomy
Stone removed by an incision made on the back where the kidneys are located.

SIGNS & SYMPTOMS

- **PAIN!**
- Discomfort
- Hematuria → (RBCs)
- Pyuria → (WBCs)
- Nausea & vomiting

DIAGNOSIS

- KUB: X-ray of kidneys, ureters, bladder
- IVP: intravenous pyelogram
- Ultrasound or CT scan
- Urine test

What is URIC ACID? Uric acid is a waste products of the breakdown of **purines**

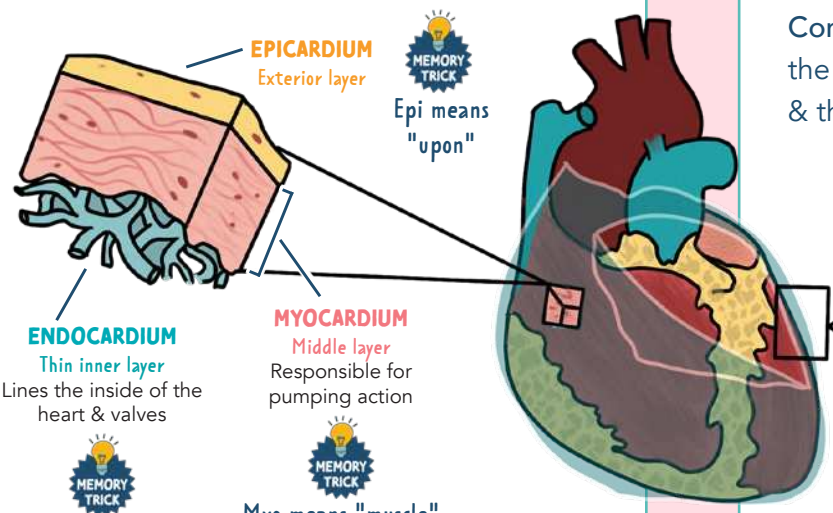



	CALCIUM (MOST COMMON!)	URIC ACID	STRUVITE	CYSTINE
STONE TYPE	Forms due to ↑ amounts of calcium & oxalate in the urine	Too much uric acid in the urine (acidic urine)	Persistent alkaline environment that is ammonia-rich urine Due to a **bacteria**	Rare, genetic, inherited disorder that affects renal absorption of cystine
CAUSES	▪ Hypercalcemia ▪ Hypercalciuria ▪ Hyperparathyroidism ▪ ↑ intake of Na+ ▪ Dehydration ▪ GI disorders ▪ ↑ intake of calcium supplements with vitamin D	▪ Gout ▪ Foods high in purine or animal proteins ▪ Dehydration ▪ Metabolic issues (diabetes)	▪ Chronic urinary tract infections (UTIs) ▪ Foreign bodies ▪ Neurogenic bladder	

CARDIAC OVERVIEW

LAYERS OF THE HEART

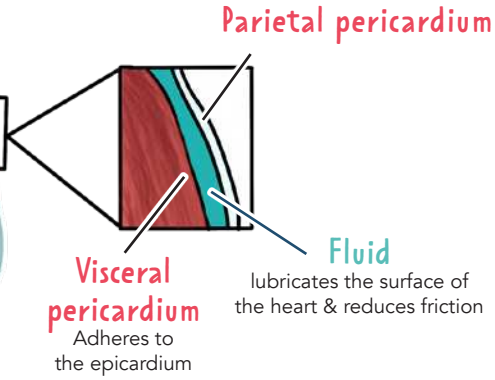
There are three layers of the heart:
EPICARDIUM, **MYOCARDIUM**, and **ENDOCARDIUM**



PERICARDIUM

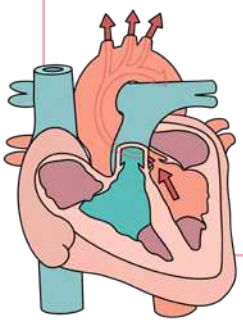
Thin sac that encases the heart.

Composed of two layers:
the Parietal pericardium
& the Visceral pericardium.



CARDIAC TERMS

CARDIAC OUTPUT



Total volume of blood ejected (pumped) by the heart per minute.

It's the amount of blood reaching the tissues.

FORMULA

HR x SV = CO

Heart Rate *Stroke Volume* *Cardiac Output*

HR = The # of times the heart contracts each minute (normal **60 - 100** bpm)

SV = Amount of blood ejected from the left ventricle with each heartbeat

NORMAL:
4 - 8 L/min

INTERPRETATION

↓ **CO** = **LESS** volume
(↓ perfusion to the vital organs)

↑ **CO** = **MORE** volume
(could be due to hypervolemia, etc.)

STROKE VOLUME

Amount of blood pumped out of the ventricle with each beat or contraction

CONTRACTILITY

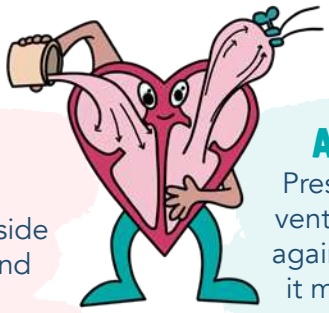
Force / strength of contraction of the heart muscle

EJECTION FRACTION (EF)

% of blood expelled from the left ventricle with every contraction

NORMAL EF: 50 - 70%

EXAMPLE:
If the EF is 55%, the heart is pumping out 55% of what's inside of the left ventricle



PRELOAD

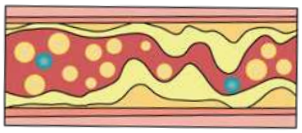
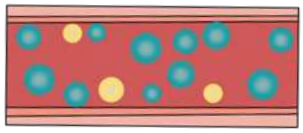
Amount of blood returned to the right side of the heart at the end of diastole

AFTERLOAD

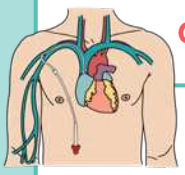
Pressure that the left ventricle has to pump against (the resistance it must overcome to circulate blood)

Clinically measured by systolic blood pressure!

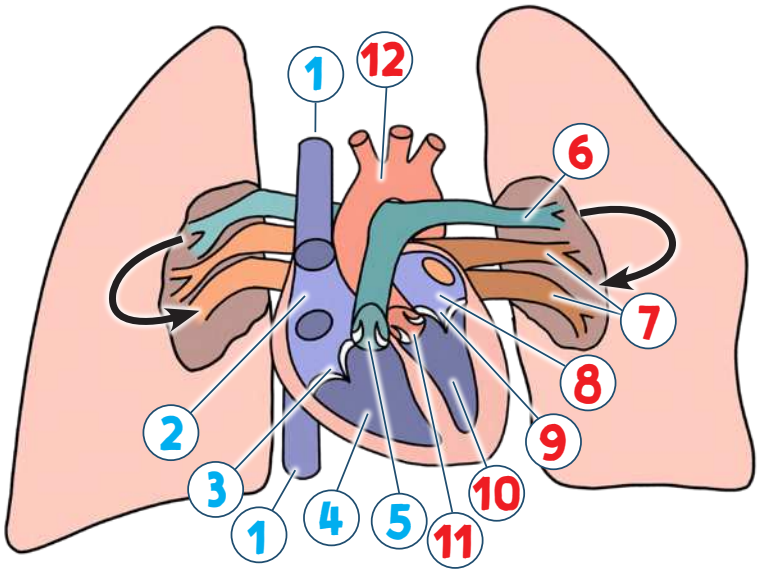
LAB VALUES RELATED TO THE CARDIAC SYSTEM

	EXPECTED RANGE	DESCRIPTION	↓	↑
TOTAL CHOLESTEROL	< 200 mg/dL	Measurement of the total amount of cholesterol in your blood	Indicates a lower risk for cardiovascular disease	Increases the risk for heart disease and stroke
TRIGLYCERIDES	< 150 mg/dL	Most common type of fat in the body. Takes the food you eat and stores it as excess energy		
LOW DENSITY LIPOPROTEINS (LDL)	< 100 mg/dL	 LDL bad MEMORY TRICK LDL think: we want Low levels "bad fat"		
HIGH DENSITY LIPOPROTEINS (HDL)	F > 40 mg/dL M > 55 mg/dL	 HDL good MEMORY TRICK HDL think: we want High levels, because it's a Happy cholesterol	Increases the risk for heart disease and stroke	Indicates a lower risk for cardiovascular disease
D-DIMER	< 0.5 mcg/mL	D-dimers are fragments of fibrin that are in the blood when a clot dissolves or is broken down. **D-dimer helps to determine if a clot is present somewhere in the body**	Normal/low Levels ▪ Blood clot is ruled out	Elevated/high levels (positive result) **POSSIBLE CAUSES:** ▪ Blood clot may be present in the body ▪ Disseminated intravascular coagulation (DIC)
BNP	< 100 pg/mL	BNP is a peptide released when the ventricle is filled with too much fluid and stretches	Helps to indicate heart failure is not present	Congestive heart failure (HF)

HEMODYNAMIC PARAMETERS

CARDIAC OUTPUT (CO)	**4 – 8** L/min	Total volume pumped per minute
 **CARDIAC INDEX (CI)**	**2.5 – 4.0** L/min/m^2	Cardiac output per body surface area $CI = \frac{CO}{\text{surface area}}$
CENTRAL VENOUS PRESSURE (CVP)	**2 – 8** mmHg	Pressure in the superior vena cava. Shows how much pressure from the blood is returned to the right atrium from the superior vena cava
MEAN ARTERIAL PRESSURE (MAP)	**70 – 100** mmHg *At least 60 mmHg is required to adequately perfuse the vital organs*	Average pressure in the systemic circulation *(your body)* through the cardiac cycle
SYSTEMIC VASCULAR RESISTANCE (SVR)	**800 – 1200** dynes/sec/cm	The **resistance** it takes to push blood through the circulatory system to create blood flow

FLOW OF BLOOD THROUGH THE HEART



RIGHT
Deoxygenated Blood

1. Superior Vena Cava / Inferior Vena Cava
2. Right Atrium (RA)
3. Tricuspid Valve (TV)
4. Right Ventricle (RV)
5. Pulmonary Valve (PV)
6. Pulmonary Artery*

carries DEOXYGENATED blood to the LUNGS

LEFT
Oxygenated Blood

7. Pulmonary Vein*
8. Left Atrium
9. Bicuspid/Mitral Valve
10. Left Ventricle
11. Aortic Valve
12. Aorta

carries OXYGENATED blood to the TISSUES/BODY

OVERVIEW OF BLOOD VESSELS

ARTERIES
Carry oxygenated blood to tissues

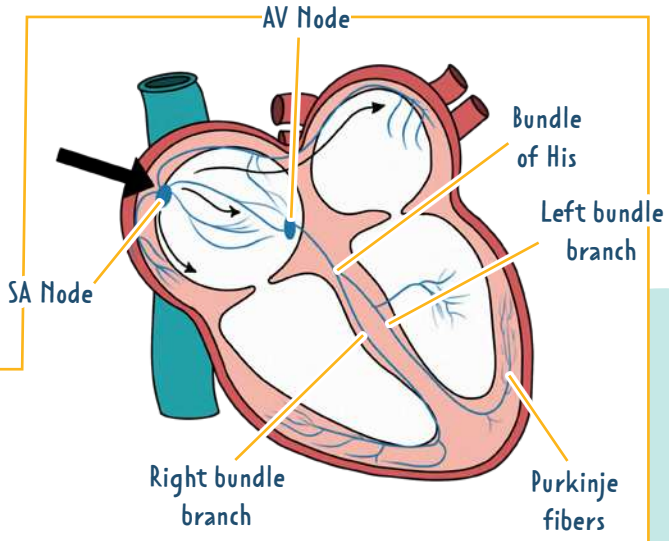
VEINS
Carry deoxygenated blood back to the heart

MEMORY TRICK: **A**rteries think **A**way from the heart

*** EXCEPTIONS**

The only exception to this is the **PULMONARY ARTERY** and **PULMONARY VEIN**

- **PULMONARY ARTERY** ↓ brings deoxygenated blood from the heart to the lungs
- **PULMONARY VEIN** ↓ carries oxygenated blood from the lungs to the heart



ELECTRICAL CONDUCTION OF THE HEART

CARDIAC CONDUCTION SYSTEM:
Generates & transmits **ELECTRICAL IMPULSES** which stimulates contractions of the atria and then the ventricles.

MNEMONIC

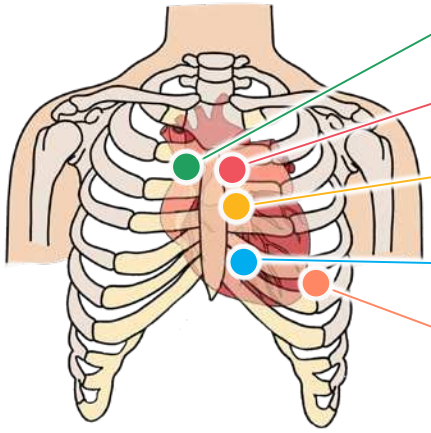
STEPS IN THE HEART'S CONDUCTION SYSTEM

SEND	**S**A node (**S**ino**A**trial node) → Primary pacemaker of the heart. Creates electrical impulses of **60 - 100 bpm**
A	**A**V node (**A**trio**V**entricular) → Secondary pacemaker of the heart "backup pacemaker." If the SA node malfunctions, the AV node takes over at a rate of **40 - 60 bpm**
BIG	**B**undle of His
BOUNDING	**B**undle branches (right & left)
PULSE	**P**urkinje fibers → If the SA & the AV nodes fail, the Purkinje fibers can fire at a rate of **30 - 40 bpm**

NOTE: This is a normal heart rate

AUSCULTATING HEART SOUNDS

5 AREAS FOR LISTENING TO THE HEART



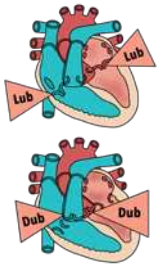
MNEMONIC

All **P**eople **E**njoy **T**ime **M**agazine

- **A**ortic Right 2nd intercostal space
- **P**ulmonic Left 2nd intercostal Space
- **E**RB's Point (S1, S2) Left 3rd intercostal space
- **T**ricuspid Lower left sternal border 4th intercostal
- **M**itral Left 5th intercostal, medial to midclavicular line

MEMORY TRICK: Think **M** for **M**idclavicular

NORMAL



S1 *LUB* — Tricuspid & mitral valve closure

↓

S2 *DUB* — Aortic & pulmonic valve closure

CLOSING OF THE VALVES
Valve opening does not normally produce a sound

ABNORMAL

S3 **EARLY DIASTOLE** in rapid ventricle filling

↓

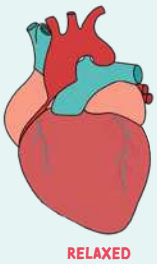
S4 **LATE DIASTOLE** & high atrial pressure (forcing blood into a stiff ventricle)

ABNORMAL VENTRICULAR FILLING
Extra ♥ sounds

CONTRACTED

SYSTOLIC

Ventricle pump / ejection = **LUB (S1)**



RELAXED

DIASTOLIC

Ventricle relax / filling = **DUB (S2)**

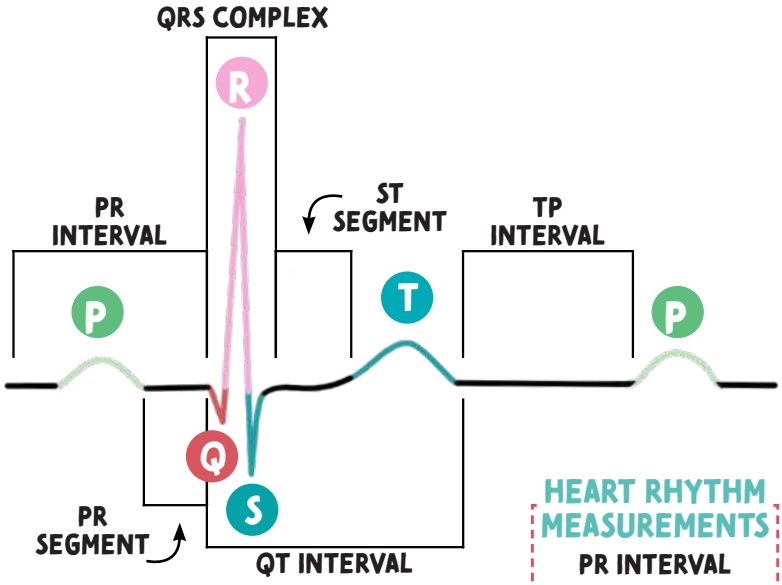
LUB (S1) ⇄ **DUB (S2)**

MEMORY TRICK

"COZY RED"

CO *(contract)* **ZY** *(systole)*
RE *(relax)* **D** *(diastole)*

EKG WAVEFORMS



P WAVE ..... Atrial contraction (**DE**polarization)

PR SEGMENT ..... Movement of electrical activity from atria to ventricles

QRS COMPLEX... Ventricle contraction (**DE**polarization)

ST SEGMENT ..... Time between ventricular depolarization & repolarization

T WAVE ..... Ventricle relaxing (**RE**polarization)

TP INTERVAL ..... Ventricle relaxing & filling

MEMORY TRICK
DEpolarization think...
DEcompressing

MEMORY TRICK
REpolarization think...
RElaxing
REpolarizing
REfilling with blood

BASIC RHYTHMS

NORMAL SINUS	60 - 100 bpm
SINUS TACHYCARDIA	> 100 bpm
SINUS BRADYCARDIA	< 60 bpm

HEART RHYTHM MEASUREMENTS

PR INTERVAL
0.12 - 0.20

QRS COMPLEX
0.06 - 0.12

QT INTERVAL
< 0.40 seconds

PR INTERVAL

Movement of electrical activity from atria to ventricles

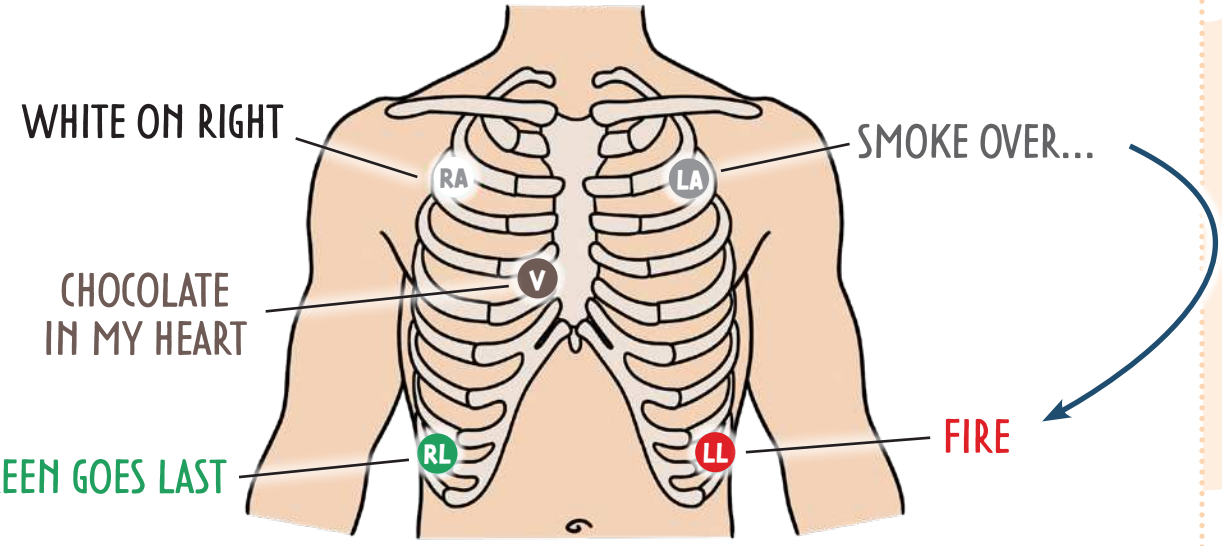
ST SEGMENT

Time between ventricular de-polarization and repolarization *(ventricular contraction)*

QT INTERVAL

Time it takes for ventricles to depolarize and repolarize (to contract and relax)

5-LEAD PLACEMENT



MED-SURG
CARDIAC

6 STEPS TO INTERPRETING EKGs

#1 P-WAVE

Identify & examine the P-waves

- Should be present & upright
- Comes before QRS complex
- One P-wave for every QRS complex

#2 PR INTERVAL

Measure PR interval

NORMAL PR INTERVAL:
0.12 - 0.20 seconds

#3 QRS COMPLEX

Is every P-wave followed by a QRS complex?

NORMAL QRS COMPLEX:
0.06 - 0.12 seconds

- Should not be widened or shortened – this may indicate a problem!

Widened is often seen in PVCs, Electrolyte imbalances & drug toxicity!

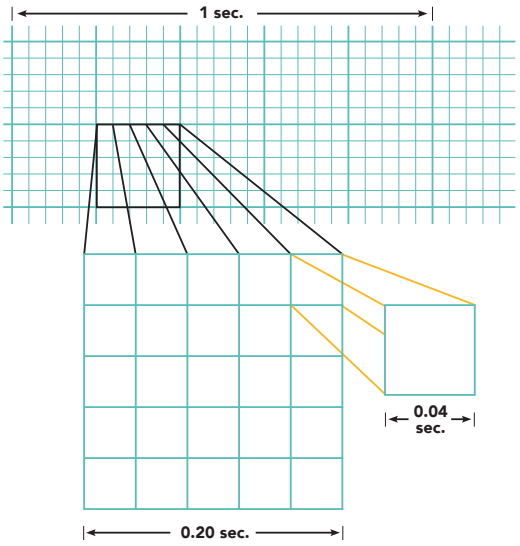
#4 R-R

Are the R-R intervals consistent?

- Regular or irregular?

BASIC RHYTHMS

SINUS TACHYCARDIA	> 100 bpm
NORMAL SINUS	60 - 100 bpm
SINUS BRADYCARDIA	< 60 bpm



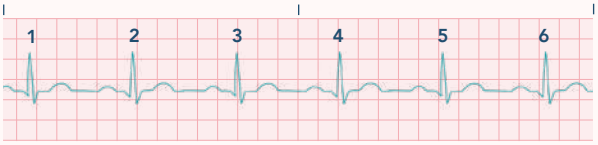
1 large box = 0.20 seconds
5 large boxes = 1 second
1 small box = 0.04 seconds

#5 DETERMINE THE HEART RATE

6 SECOND METHOD

Count the number of R's in between the 6 second strips & multiply by 10

Be sure and check that the strip is 6 seconds! Count the boxes



6 R's X 10 = 60 beats per minutes

BIG BOX METHOD

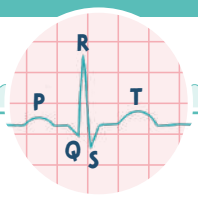
300 divided by the number of big boxes between 2 R's

300 / 5 = 60 BPM

#6 IDENTIFY THE EKG FINDING!

EKGs

NORMAL SINUS RHYTHM



RATE	60 - 100 bpm
RHYTHM	Regular
P-WAVE	Upright & uniform before each QRS
PR INTERVAL	Normal
QRS COMPLEX	Normal

SINUS BRADY

KEY The sinus node creates an impulse at a ***slower***-than-normal rate

RATE	< 60 bpm
RHYTHM	Regular
P-WAVE	Upright & uniform before each QRS
PR INTERVAL	Normal
QRS COMPLEX	Normal

CAUSES

- Lower metabolic needs
  - Sleep
  - Athletic training
  - Hypothyroidism
- Vagal stimulation
- Medications
  - Calcium channel blockers, beta blockers, Amiodarone

THIS IS NORMAL: Athletes have a low RESTING heart rate. This is because the heart is strong and pumps more efficiently with each heartbeat

TREATMENT

- Correct the underlying cause!
- ↑ the heart rate to normal

SINUS TACHY

KEY The sinus node creates an impulse at a ***faster***-than-normal rate

RATE	> 100 bpm
RHYTHM	Regular
P WAVE	Upright & uniform before each QRS
PR INTERVAL	Normal
QRS COMPLEX	Normal

CAUSES

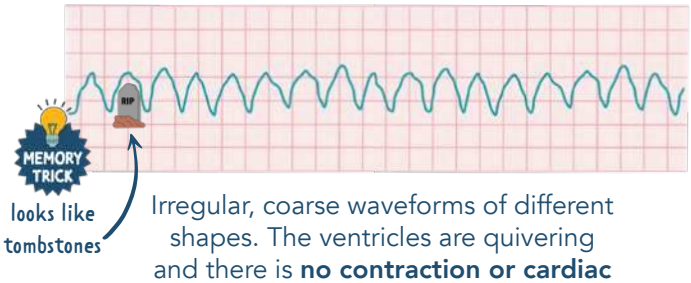
- Physiologic or psychological stress
  - Blood loss, fever, exercise, dehydration, infection, sepsis
- Certain medications
  - **Stimulants**: caffeine, nicotine
  - **Illicit drugs**: cocaine, amphetamines
  - **Stimulate sympathetic response**: epinephrine
  - **Beta-2 agonists**
- Heart failure
- Cardiac tamponade
- Hyperthyroidism

TREATMENT

- Identify the underlying cause!
- ↓ the heart rate to normal

EKGs

VENTRICULAR TACHYCARDIA (VT)



Irregular, coarse waveforms of different shapes. The ventricles are quivering and there is **no contraction or cardiac output** which may be **fatal**!

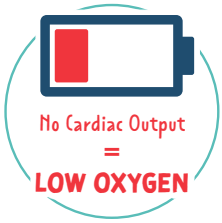
RATE	100 - 250 bpm
RHYTHM	Regular
P-WAVE	Not visible
PR INTERVAL	None
QRS COMPLEX	Wide (like tombstones) > 0.12 seconds

CAUSES

- Myocardial ischemia / infarction
- Electrolyte imbalances
- Digoxin toxicity
- Stimulants: caffeine & methamphetamine

MANIFESTATIONS

- Patient is usually awake (unlike V-fib)
- Chest pain
- Lethargy
- Anxiety
- Syncope
- Palpitations



TREATMENT

STABLE CLIENT WITH A PULSE

- Oxygen
- Antiarrhythmics (ex. Amiodarone...stabilizes the rhythm)
- Synchronized Cardioversion
  - Synchronized administration of shock (delivery in sync with the QRS wave).
  - Cardioversion is NOT defibrillation! (defibrillation is only given with deadly rhythms!)

UNSTABLE CLIENTS WITHOUT A PULSE

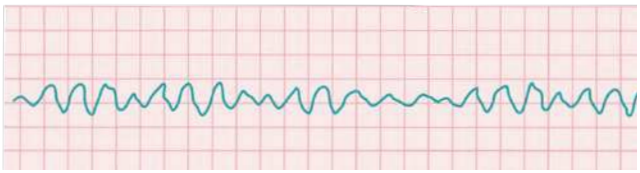
Also called **PULSELESS V-TACH**

- CPR
- Follow ACLS protocol for defibrillation
- Possible intubation
- Drug therapy
  - Epinephrine, vasopressin, amiodarone

UNTREATED VT can lead to → **VENTRICULAR FIBRILLATION** → **DEATH**

EKGs

VENTRICULAR FIBRILLATION (V-FIB)



Rapid, disorganized pattern of electrical activity in the ventricle in which electrical impulses arise from many different foci!

RATE	Unknown
RHYTHM	Chaotic & irregular
P-WAVE	Not visible
PR INTERVAL	Not visible
QRS COMPLEX	Not visible

CAUSES

- Cardiac injury
- Medication toxicity
- Electrolyte imbalances
- Untreated ventricular tachycardia

MANIFESTATIONS

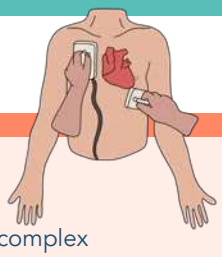
- Loss of consciousness
- May not have a pulse or blood pressure
- Respirations may stop
- **Cardiac arrest**

No Cardiac Output = No blood or oxygen to the body

TREATMENT

- CPR
- Oxygen
- Defib ⚡ MEMORY TRICK "Defib the Vfib"
  (follow ACLS protocol for defibrillation)
- Possible intubation
- Drug Therapy
  - Epinephrine (causes vasoconstriction)
  - Antiarrhythmics: Amiodarone, lidocaine
  - Possibly magnesium

CARDIOVERSION VS. DEFIBRILLATION



CARDIOVERSION

- **SYNCHRONIZED SHOCK**
  Synced shock delivered only during the R wave of the QRS complex
  If the shock is accidentally delivered during the T-wave, it can cause **R-ON-T PHENOMENON** ☠
- **LOWER** amount of joules (energy) used
- Not done with CPR
- Stable patients (must have a QRS complex)

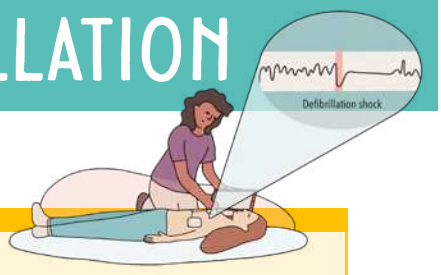
Synchronizer switch must be turned on!

EXAMPLE:

- **A-fib**
  Patients are sedated for this outpatient procedure. It does not require a hospital stay.

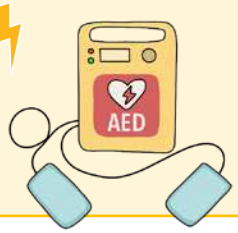
MEMORY TRICK Think: Cardioversions are Carefully planned

VS



DEFIBRILLATION

- **ASYNCHRONOUS**
  Done with an automated external defibrillator (AED)
- **HIGHER** amount of joules (energy) used
- Resume CPR after shock ⚡⚡
- Unstable patients ⚠



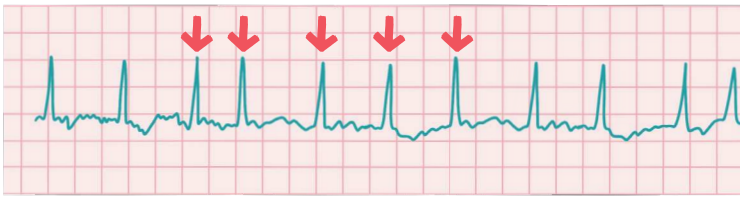
EXAMPLE:

- **Pulseless ventricular tachycardia (VT)**
  or
- **Ventricular fibrillation (VF)**

EKGs

ATRIAL FIBRILLATION (A-FIB)

IRREGULAR R-R INTERVALS



Uncoordinated electrical activity in the atria that causes rapid & disorganized "fibbing" of the muscles in the atrium.

RATE	Usually over 100 bpm
RHYTHM	Irregular
P-WAVE	None. They are irregular (fibrillary waves)
PR INTERVAL	Visible
QRS COMPLEX	Narrow & irregularly irregular

THE ATRIA IS QUIVERING!

CAUSES

- Open heart surgery
- Heart failure
- COPD
- Hypertension
- Ischemic heart disease

MANIFESTATIONS

- Most commonly asymptomatic
- Fatigue
- Malaise
- Dizziness
- Shortness of breath
- Tachycardia
- Anxiety
- Palpitations

All due to Low O_2

TREATMENT

STABLE PT.

- Oxygen
- Drug therapy!
  - Beta blockers
  - Calcium channel blockers
  - Digoxin
  - Amiodarone
  - Anticoagulant therapy to prevent clots

UNSTABLE PT.

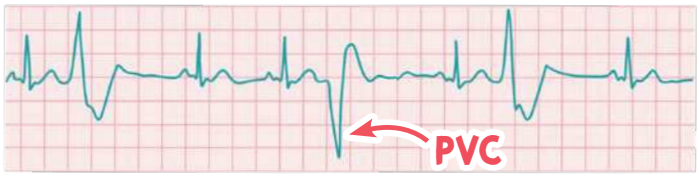
- Oxygen
- Cardioversion
  - Synchronized administration of shock (delivery in sync with the QRS wave).
  - Cardioversion is NOT defibrillation!

DEFIBRILLATION
Defibrillation is only given with deadly rhythms!

RISK FOR CLOTS
The atria quiver causes pooling of blood in the heart which increases the risk for clots = increased risk for MI, PE, CVA, & DVTs!

EKGs

PREMATURE VENTRICULAR CONTRACTIONS (PVCs)



Early or premature conduction of a QRS complex

RATE	Depends on the underlying rhythm
RHYTHM	Regular but interrupted due to early P-waves
P-WAVE	Visible but depends on timing of PVC (may be hidden)
PR INTERVAL	Slower than normal but still 0.12 - 0.20 seconds
QRS COMPLEX	Sharp, bizarre, and abnormal during the PVC

CAUSES

- Heart failure
- Cardiomyopathy
- Electrolyte imbalance
- Myocardial ischemia / infarction
- Drug toxicity
- Caffeine, tobacco, alcohol
- Stress or pain
- ↑ workload on the heart
  - Exercise
  - Fever
  - Hypervolemia
  - Heart failure
  - Tachycardia

BIGEMINY: every **other** beat
TRIGEMINY: every **3rd** beat
QUADRIGEMINY: every **4th** beat

R-ON-T PHENOMENON: PVC arises spontaneously from the repolarization gradient (T-wave) may precipitate V-fib

TREATMENT

Treatment based on underlying cause

- May not be harmful if the client has a healthy heart
- Oxygen
- ↓ caffeine intake
- Correct the electrolyte imbalances
- D/C or adjust the drug causing toxicity
- ↓ stress or pain

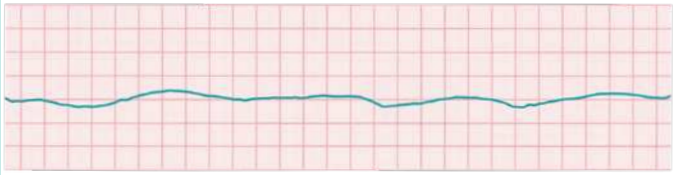
MANIFESTATIONS

- May be asymptomatic
- Feels like your heart...
  - skipped a beat
  - is pounding
- Chest pain

CHEST PAIN

Notify the healthcare provider if the client complains of chest pain, if the PVCs increase in frequency or if the PVCs occur on the T-wave (R-on-T phenomenon).

ASYSTOLE



~~RATE~~
~~RHYTHM~~
~~P-WAVE~~
~~PR INTERVAL~~
~~QRS COMPLEX~~

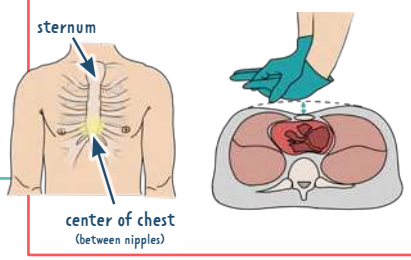
FLATLINE

CAUSES

- Myocardial ischemia/infarction
- Heart failure
- Electrolyte imbalances
  (common: hypo/hyperkalemia)
- Severe acidosis
- Cardiac tamponade
- Cocaine overdose

TREATMENT

HIGH QUALITY CPR



- Heel of hand on center of the chest
- Arms straight
- Shoulders aligned over hands
- Compress at 2-2.4 inches at a rate of 100-120/min
- 30 compressions to 2 rescue breaths
- Minimal interruptions

EKGs

ATRIAL FLUTTER

SAWTOOTH

Similar to A-fib, but the heart's electrical signals spread through the atria. The heart's upper chambers (atria) beat too quickly but at a regular rhythm.

RATE	75-150 bpm
RHYTHM	Usually regular
P-WAVE	"**Sawtooth**" P-wave configuration shaped flutter waves
PR INTERVAL	Unable to measure
QRS COMPLEX	Usually normal & upright

CAUSES

- Coronary artery disease (CAD)
- Hypertension
- Heart failure
- Valvular disease
- Hyperthyroidism
- Chronic lung disease
- Pulmonary embolism
- Cardiomyopathy

MANIFESTATIONS

- May be asymptomatic
- Fatigue / syncope
- Chest pain
- Shortness of breath
- Low blood pressure
- Palpitations
- Dizziness

TREATMENT

STABLE PT.

- Drug therapy!
  - Calcium channel blockers
  - Antiarrhythmics
  - Anticoagulants

RISK FOR CLOTS
Atrial flutter causes pooling of blood in the atria = risk for clots

UNSTABLE PT.

- Cardioversion
  - Synchronized administration of shock (delivery in sync with the QRS wave).
  - Cardioversion is NOT defibrillation!

DEFIBRILLATION
Defibrillation is only given with deadly rhythms!

HEART FAILURE

Can also be referred to as ***congestive heart failure***

PATHOLOGY

Cardiac disorder that **impairs the ability of the ventricles to fill or eject properly.** The heart muscle can't pump enough blood to meet the body's needs.

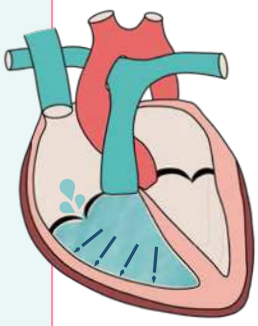
RISK FACTORS

- Uncontrolled hypertension
- Congenital heart defect
- Arrhythmias
- Coronary artery disease
- Faulty heart valves
- Damage or inflammation of the heart muscle

DIAGNOSTIC

- ↑ B-type natriuretic peptides (BNP)
- Chest x-ray (enlarged heart & pulmonary infiltrate)
- Echocardiogram (measures ejection fraction)
- Cardiac stress test

BNP is a peptide released when the ventricle is filled with too much fluid and stretches. It's a marker for **CONGESTIVE HEART FAILURE (HF)**.



BNP	<100 pg/mL	Expected Range
BNP	100 - 300 pg/mL	HF is suspected
BNP	> 300 pg/mL	Mild HF
BNP	> 600 pg/mL	Moderate HF
BNP	> 900 pg/mL	Severe HF

PATIENT EDUCATION

- **REPORT** S&S of fluid retention (edema, weight gain)
- Elevate HOB (Semi or High-Fowler's position)
- Balance periods of activity & rest

DIET MODIFICATIONS:

- **Fluid restrictions**
- ↓ Sodium
- ↓ Fat
- ↓ Cholesterol

Spread fluids out during the day + suck on hard candy to ↓ thirst

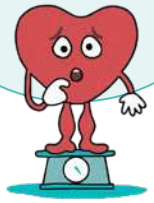
NURSING CONSIDERATIONS

MONITOR:

- I&Os
- Daily weights
- For edema & pulmonary edema

Daily weights are the best way to monitor HF

Monitor for weight gain over a short period of time (2-3 lbs)



MEDICATIONS

- **Diuretics**
- **Ace inhibitors**
- **Beta blockers**
- **Digoxin**

POTASSIUM SPARING
(Spironolactone)

POTASSIUM WASTING
(Loop & thiazide)

MEMORY TRICK

DIURESIS THE BODY
Diuretics = Diuresis = Dry inside

- **MONITOR** potassium levels

NORMAL K+:
3.5 - 5.0 mEq/L

HEART FAILURE CONTINUED

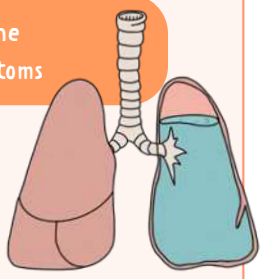
LEFT-SIDED HEART FAILURE

MOST COMMON

Also called ***left ventricular (LV) heart failure***

	Description	Ejection fraction
SYSTOLIC HF	**Weakened heart muscle** The ventricle does not **EJECT (squeeze)** properly	Ejection fraction reduced Also called heart failure with reduced ejection fraction (HFrEF)
DIASTOLIC HF	**Stiff & non-compliant heart muscle** This is not an issue with the ejection fraction (the heart ejects properly). The issue is that the ventricles do not **FILL** properly	Normal ejection fraction Also called heart failure with preserved ejection fraction (HFpEF)

Fluid is backing up into the **LUNGS** = pulmonary symptoms



MEMORY TRICK

Left side think Lungs

RIGHT-SIDED HEART FAILURE

Also called ***right ventricular (RV) heart failure***

Typically occurs as a result of **LEFT-SIDED HF**

When the **LEFT** ventricle fails, pressure from fluid builds up and causes a back flow of fluids into the **RIGHT** side of the heart

This causes damage to the **RIGHT** side of the heart

Fluid is backing up into the **VENOUS SYSTEM**

MEMORY TRICK

Right = the Rest of the body

A PATIENT CAN HAVE BOTH!

SIGNS & SYMPTOMS

- **D** Dyspnea
- **R** Rales (crackles)
- **O** Orthopnea
- **W** Weakness/fatigue
- **N** Nocturnal paroxysmal dyspnea
- **I** Increased HR
- **N** Nagging cough *(frothy, blood tinged sputum)*
- **G** Gaining weight (2-3 lbs a day)

OTHER S&S
↑ UOP
Hypotension
S3 Gallop

CHRONIC HF may show **BOTH** of these signs & symptoms

- **S** Swelling of the legs & hands
- **W** Weight gain
- **E** Edema (pitting)
- **L** Large neck veins (JVD)
- **L** Lethargy/fatigue
- **I** Irregular heart rate
- **N** Nocturia
- **G** Girth (ascites)

OTHER S&S
Hepatomegaly
Splenomegaly
Anorexia

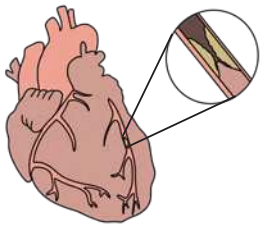
MED-SURG
CARDIAC

CORONARY ARTERY DISEASE (CAD)

PATHOLOGY

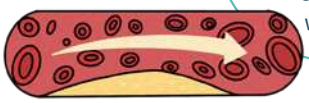
Damage in the coronary arteries due to **atherosclerosis**.

MOST COMMON TYPE OF CARDIOVASCULAR DISEASE



Atherosclerosis is plaque build-up that causes narrowing of the vessels and limits blood supply to the heart.

The plaque may rupture causing thrombi (clot) and may obstruct blood flow, leading to an acute MI.



Accumulation of fatty plaque that happens over time on the blood vessel walls

RISK FACTORS

NON-MODIFIABLE

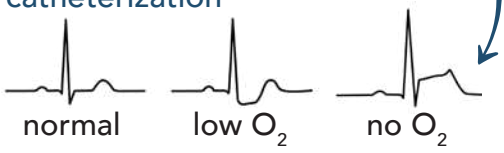
- Age
- Gender
- Race
- Family history

MODIFIABLE

- Diabetes
- Hypertension
- Smoking
- Obesity
- Physical inactivity
- High cholesterol
- Metabolic syndrome

DIAGNOSTIC

- Blood tests:
  LDL, HDL, total cholesterol, triglycerides
- EKG: assess for changes in ST segments
- Stress test
- Cardiac catheterization



CHOLESTEROL

LDL → Want LOW levels (<100 mg/dL)

Low Density Lipoprotein

BAD cholesterol

HDL → Want HIGH levels (>60 mg/dL)

High Density Lipoprotein

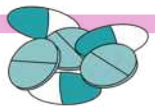
HAPPY cholesterol

SIGNS & SYMPTOMS

Usually **asymptomatic**

- Chest pain
  (stable angina which goes away with rest)
- Shortness of breath
- Epigastric distress (heartburn)
- Pain radiating to the jaw or left arm

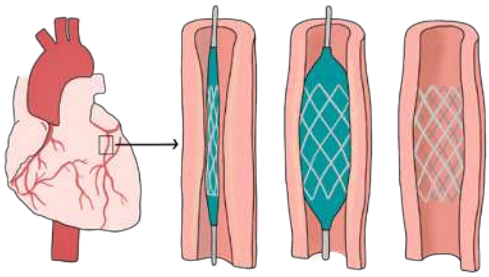
MEDICATIONS



- Antiplatelets
- Medications to normalize cholesterol levels
  (statins, bile acid sequestrants, fibric acids)

TREATMENT

- Percutaneous coronary intervention (PCI)



PATIENT EDUCATION

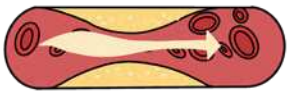
HEART HEALTHY DIET:

- ↓ in saturated fats
- ↑ in fiber

PREVENTATIVE MEASURES

- Check cholesterol levels
- Manage hypertension
- Control diabetes
- Smoking cessation
- Increase physical activity
- Weight loss if needed

ANGINA PECTORIS



Angina is chest pain associated with ischemia.
It's due to narrowing of at least one major coronary artery.

TYPES OF ANGINA

STABLE	"Predictable"	Occurs with **EXERTION** EXAMPLE Exercise or strenuous activity
UNSTABLE	"Preinfarction"	Occurs at **REST & MORE FREQUENTLY**
PRINZMETAL'S/ VARIANT	"Coronary artery vasospasm"	Pain at **REST** with reversible **ST-ELEVATION**

SIGNS & SYMPTOMS

- Chest pain (heavy sensation) may radiate to neck, jaw, or shoulders
- Unusual fatigue
- Weakness
- Shortness of breath
- Pallor
- Diaphoresis

INTERVENTIONS

- Reperfusion procedures

GOAL: ↓ oxygen demand

CABG — Coronary Artery Bypass Graft

PCI — Percutaneous Coronary Interventions

DRUG THERAPY

NITRATES	CALCIUM CHANNEL BLOCKERS	BETA BLOCKERS	ANTIPLATELET / ANTICOAGULANT
Vasodilators ↓ ischemia = ↓ pain Usually administered sublingual	Relaxes blood vessels ↑ oxygen supply to the heart ↓workload of heart	↓ myocardial oxygen consumption	Prevents platelet aggregation & thrombosis

PATIENT TEACHING

SUBLINGUAL NTG OR SPRAY

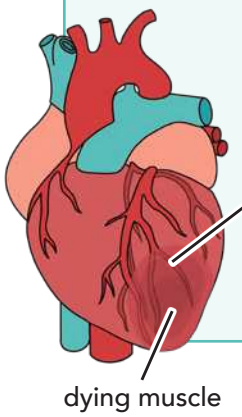
- **1** tab/spray sublingual every **5** minutes, up to **3** doses.
- If angina is not relieved or is worse 5 min after the first dose, call 911!

Keep in original container (dark, glass bottle) in a dry, cool place. Do not swallow or chew these tablets

MYOCARDIAL INFARCTION (MI)

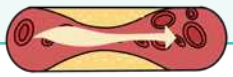
PATHO

Complete blockage in one or more arteries of the heart — EMERGENCY!

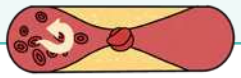


ATHEROSCLEROSIS
Coronary arteries become narrow due to plaque build-up

ANGINA
Due to ischemia (low O_2)



MYOCARDIAL INFARCTION (MI)
Plaque rupture become a blood clot that blocks arteries of the heart



SIGNS & SYMPTOMS

Sudden, crushing, radiating chest pain that continues despite rest & medications

- Shortness of breath
- Nausea & vomiting
- Sweating
- Pale & dusty skin

WOMEN PRESENT WITH DIFFERENT SYMPTOMS
- Fatigue
- Shoulder blade discomfort
- Shortness of breath

PAIN FELT IN THE... Left arm • Mid back/shoulder • Heartburn

DIAGNOSIS

- ECG
  - ST-elevation (no O_2)
  - ST-depression (low O_2)
  - T-wave inversion
- Troponin
- Stress tests
  - Chemical & exercise

TREATMENT

IMMEDIATE

MNEMONIC

- **M MORPHINE** — ↓workload of the heart & ↓ pain
- **O OXYGEN** — ↑O_2 to the heart
- **N NITROGLYCERIN** — opens up the vessels
- **A ASPIRIN** — Prevents platelets from sticking together

CATH LAB OR CLOT BUSTER

MEDICATIONS
- Thrombolytics (clot busters)
  - *Example: Streptokin***ase**

Suffixes: **-teplase** **-ase**

SURGERY
- PCI "Percutaneous Coronary Intervention"
- CABG
- Endarterectomy
  - Cut out the blockage

Any time you give a thrombolytic, watch for signs of bleeding!

PREVENTION & REST

PREVENT / STABILIZE CLOT
- Heparin IV

REST THE HEART WITH...
- Nitro
- Beta-blockers
- Calcium channel blockers

MED-SURG
CARDIAC

TEST YOUR KNOWLEDGE! NO CHEATING :)

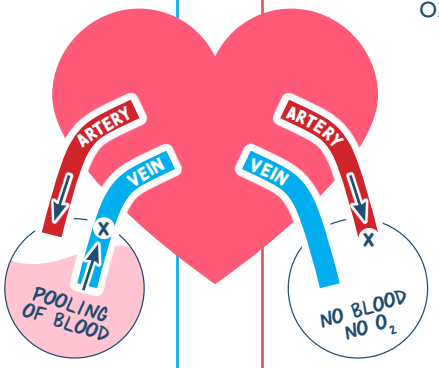
PERIPHERAL VASCULAR DISEASE WORKSHEET

is an umbrella term for...

PERIPHERAL VENOUS DISEASE (PVD)

Deoxygenated blood can't get back to the heart.

Pooling of oxygenated blood in the extremities.



PERIPHERAL ARTERIAL DISEASE (PAD)

Think "BAD"

Narrow artery (atherosclerosis) where oxygenated blood can't get to the distal extremities (hands & feet).

Ischemia & necrosis of the extremities

	PVD	PAD
PAIN ?		
PULSE ?		
EDEMA ?		
TEMP ?		
COLOR ?		
WOUNDS ?		
GANGRENE ?		
POSITIONING ?		

CAUSES OF BOTH

_____ • _____ • _____ • _____

DX: _____

TREAMENT

- **Position**

  _____

- **Medications**

  _____

  _____

- **Surgery**

  _____

  _____

  _____

TREAMENT

- **Position**

  _____

- **Perform** _____
- **Stop** _____
- **Avoid** _____
- **No** _____
- **Medications**

  _____

  _____

MED-SURG
CARDIAC

TEST YOUR KNOWLEDGE! NO CHEATING :)

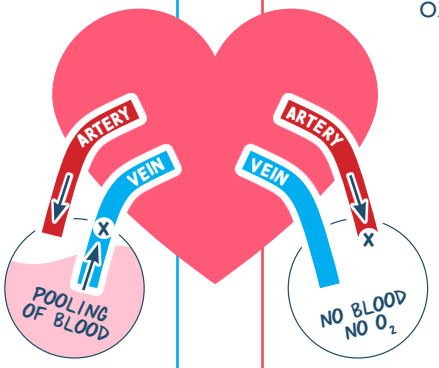
PERIPHERAL VASCULAR DISEASE WORKSHEET

is an umbrella term for...

PERIPHERAL VENOUS DISEASE (PVD)

Deoxygenated blood can't get back to the heart.

Pooling of oxygenated blood in the extremities.



PERIPHERAL ARTERIAL DISEASE (PAD)

Think "BAD"

Narrow artery (atherosclerosis) where oxygenated blood can't get to the distal extremities (hands & feet).

Ischemia & necrosis of the extremities

	PVD	PAD
PAIN ?		
PULSE ?		
EDEMA ?		
TEMP ?		
COLOR ?		
WOUNDS ?		
GANGRENE ?		
POSITIONING ?		

CAUSES OF BOTH

_____ • _____ • _____ • _____

DX: _____

TREAMENT

- **Position**

  _____

- **Medications**

  _____

  _____

- **Surgery**

  _____

  _____

  _____

TREAMENT

- **Position**

  _____

- **Perform** _____
- **Stop** _____
- **Avoid** _____
- **No** _____
- **Medications**

  _____

  _____

MED-SURG
CARDIAC

PERIPHERAL VASCULAR DISEASE

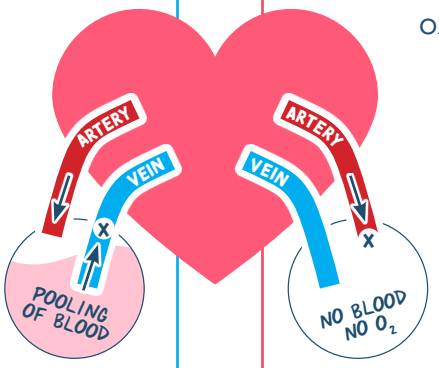
is an umbrella term for...

PERIPHERAL VENOUS DISEASE (PVD)

Deoxygenated blood can't get back to the heart.

Pooling of oxygenated blood in the extremities.

PAIN ?	✓	Dull, constant, achy pain!
PULSE ?	✓	May not be palpable due to edema
EDEMA ?	✓	Blood is POOLING in the leg
TEMP ?		Warm legs (Blood is warm)
COLOR ?		Stasis dermatitis (Brown/yellow)
WOUNDS ?		Venous STASIS ulcers, Irregular shaped wounds, shallow
GANGRENE ?	✗	We have too much blood! Gangrene is caused by insufficient amounts of blood.
POSITIONING ?		Elevate Veins — Positions that make it worse: dangling, sitting/standing for long periods of time



PERIPHERAL ARTERIAL DISEASE (PAD)

Think "BAD"

Narrow artery (atherosclerosis) where oxygenated blood can't get to the distal extremities (hands & feet).

Ischemia & necrosis of the extremities

PAIN ?	✓	Sharp pain: Gets worse at night "rest pain" Intermittent claudication
PULSE ?	✓	Very poor or even absent
EDEMA ?	✗	No blood in the extremities
TEMP ?		Cool — No blood = cool leg (blood is warm)
COLOR ?		Pale, hairless, dry, scaly, thin skin due to lack of nutrients (↓ O_2)
WOUNDS ?		Regular in shape, red sores round appearance "punched out"
GANGRENE ?	✓	Tissue death caused by a lack of blood supply
POSITIONING ?		Dangle arteries

CAUSES OF BOTH

Smoking • Diabetes • High cholesterol • Hypertension

DX: Doppler Ultrasound or Ankle Brachial Index (ABI)

TREATMENT — KEEP VEIN OPEN!

- **Elevate Veins**
- **Medications**
  - Aspirin or Clopidogrel
  - Cholesterol lowering drugs "statin"
- **Surgery**
  - Angioplasty
  - Bypass (CABG)
  - Endarterectomy

TREATMENT — GET BLOOD MOVING!

- **DAngle Arteries** (Dependent position)
- **Perform daily skin care with moisturizer**
- **Stop smoking**
- **Avoid tight clothing** (vasoconstriction)
- **No heating pads!**
- **Medications**
  - Vasodilators
  - Antiplatelets

CARDIAC BIOMARKERS

TROPONIN

EXPECTED RANGE
TROPONIN I < 0.03 ng/mL
TROPONIN T < 0.1 ng/mL

BEST indicator of an acute MI

Protein released in the blood stream when the heart muscle is damaged.

There are 3 isomers of troponin:

TROPONIN C:
Binds calcium to activate muscle contraction

TROPONIN I & T:
Specific for cardiac muscle

MEMORY TRICK

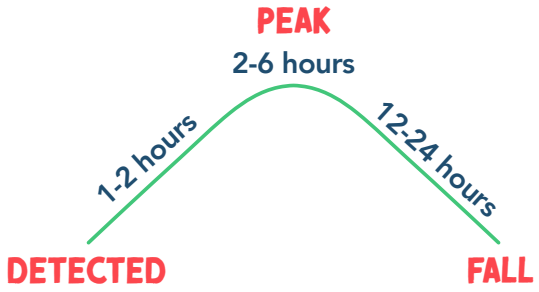
Troponin T think Two weeks
it can stay elevated

MYOGLOBIN

EXPECTED RANGE
5 - 70 ng/mL

Myoglobin is found in cardiac & skeletal muscle

NOT a specific indicator of an acute MI, but a (-) sign is good for ruling out an acute MI



MEMORY TRICK

Myoglobin think Muscle

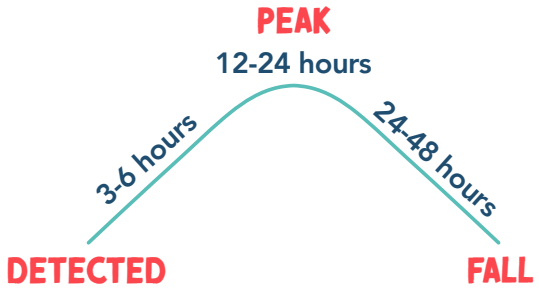
CK-MB

EXPECTED RANGE
0 - 5 ng/mL

CREATINE KINASE - MB

Cardiac-specific isoenzyme
BUT less reliable than Troponin

An enzyme released in the bloodstream when the heart, muscles or brains are damaged!



HYPERTENSION (HTN)

HYPERtension = **HIGH** BP

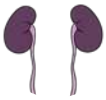
Most accurate diagnosis for HTN

CATEGORIES	SYSTOLIC (SQUEEZE)	DIASTOLIC (DECOMPRESS)
HYPOTENSION	< 100	< 60
NORMAL	< 120	< 80
PRE-HTN	120 - 139	80 - 89
STAGE 1 HTN	140 - 159	90 - 99
STAGE 2 HTN	> 160	> 100
⚠ HTN CRISIS	> 180	> 120

AFFECTED ORGANS

CONGESTIVE HEART FAILURE (CHF)
Overworking of the heart muscle (ventricle enlarges)

STROKE
Weak & narrow vessels could lead to rupture of vessels



RENAL FAILURE
Too much blood flowing to the kidneys at a fast rate & high pressure

VISUAL CHANGES
Damages blood vessels in the retina (blurred vision, can't focus on objects)

RISK FACTORS

PRIMARY HTN (MOST COMMON)

Also called **ESSENTIAL** or **IDIOPATHIC HTN**

- Cause is unknown
- Not curable, only controllable

- **R** Race (African Americans)
- **I** Intake of Na/ETOH
- **S** Smoking
- **K** Low **K**+ & vitamin D levels
- **F** Family HX
- **A** Advanced age
- **C** ↑ **C**holesterol
- **T** **T**oo much caffeine
- **O** **O**besity
- **R** **R**estricted activity
- **S** **S**leep apnea

SECONDARY HTN

Has a direct cause / preexisting condition

- Chronic kidney disease
- Diabetes
- Hypo/Hyperthyroidism
- Cushing syndrome
- Pregnancy
- Certain drugs (oral contraceptives)

SIGNS & SYMPTOMS

Usually ***asymptomatic!***

Commonly called the "SILENT KILLER"

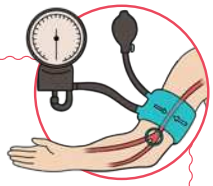
Symptoms *(if seen)*:

- Blurred vision
- Headache
- Chest pain
- Nose bleeds

EDUCATION

- Limit sodium intake
- Limit alcohol intake
- Smoking cessation
- Teach how to measure BP & keep a record
- Exercise programs for weight loss if needed

CHECKING BLOOD PRESSURE

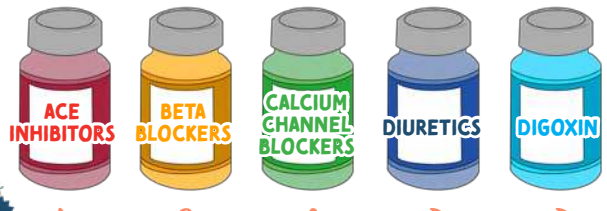


- ➜ Place stethoscope over brachial artery
- ➜ Patients should not smoke, exercise, etc. within 30 minutes of having their BP checked *(could lead to inflated BP)*
- ➜ Instruct the client to:
  - Sit in a chair with legs uncrossed
  - Arm at ♥ level
  - Correct size cuff
- ➜ No BPs should be auscultated in arms with:
  - Mastectomy
    - HX of AV shunt
    - Blood clots
    - PICC lines/central lines

Too small = false high BP

Too large = false low BP

ANTIHYPERTENSIVE MEDICATION OVERVIEW



SUFFIXES

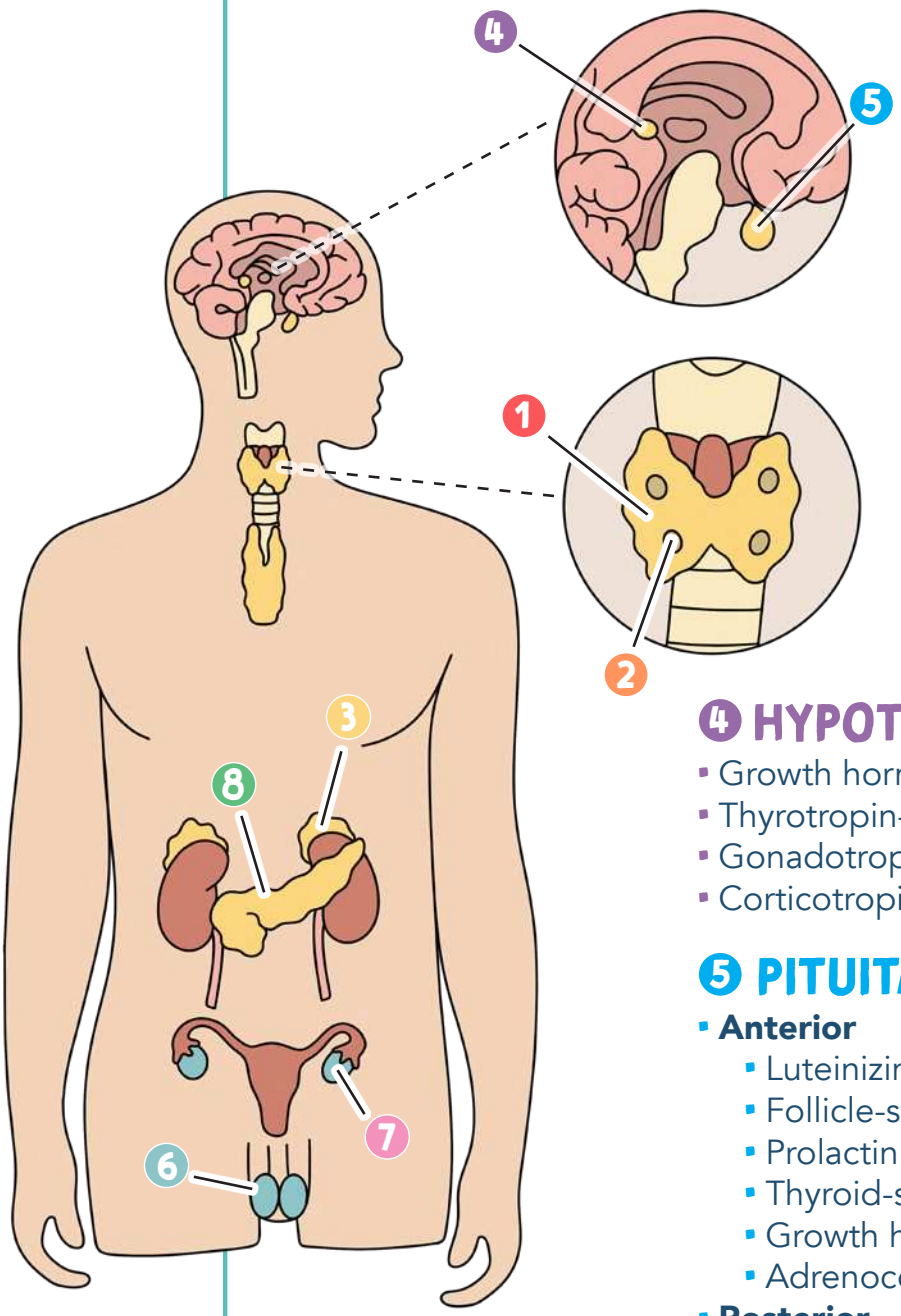
- **A** ACE inhibitors **-pril**
- **B** BETA Blockers **-olol**
- **C** Calcium Channel Blockers **-pine** **-amil**
- **D** Diuretics
- **D** Digoxin

ENDOCRINE SYSTEM OVERVIEW

FUNCTION OF THE ENDOCRINE SYSTEM:

The endocrine system is made up of glands & organs that release hormones (chemical messengers). These chemical messengers carry information & instructions from one cell to another.

HORMONES RELEASED by the endocrine organs/glands



1 THYROID GLAND

- Thyroxine (T4)
- Triiodothyronine (T3)
- Calcitonin

2 PARATHYROID GLAND

- Parathyroid hormone (PTH)

3 ADRENAL GLAND

- **Adrenal cortex**
  - Aldosterone
  - Cortisol
- **Adrenal medulla**
  - Epinephrine
  - Norepinephrine

4 HYPOTHALAMUS

- Growth hormone-releasing hormone (GHRH)
- Thyrotropin-releasing hormone (TRH)
- Gonadotropin-releasing hormone (GnRH)
- Corticotropin-releasing hormone (CRH)

5 PITUITARY GLAND

- **Anterior**
  - Luteinizing hormone (LH)
  - Follicle-stimulating hormone (FSH)
  - Prolactin
  - Thyroid-stimulating hormone (TSH)
  - Growth hormone (GH)
  - Adrenocorticotropic hormone (ACTH)
- **Posterior**
  - Antidiuretic hormone (ADH) (Vasopressin)
  - Oxytocin

6 TESTES

- Testosterone

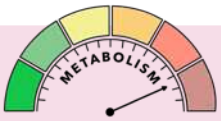
7 OVARIES

- Estrogen
- Progesterone

8 PANCREAS

- Insulin
- Glucagon

ENDOCRINE HORMONES

Thyroxine (T4) Triiodothyronine (T3)	These hormones are created and stored in the thyroid. Maintains body metabolism in a steady state. 
Calcitonin	Secreted by the thyroid gland. Regulates **calcium** in the body.  CALCitonin think CALCium
Thyroid-Stimulating Hormone (TSH)	TSH stimulates the thyroid, causing T3 & T4 to be released 
Oxytocin	Muscle contractions to help expel the baby
Prolactin	Stimulates milk production after childbirth
Insulin	Works to **DECREASE** blood glucose levels. Insulin puts sugar & potassium into the cells to be used later as energy 
Glucagon	Works to **INCREASE** blood glucose levels. Breaks down stored glucose (glycogen) in the liver 
Epinephrine & Norepinephrine	Stress hormones. They are catecholamines that are released when blood pressure drops. Helps in times of **ACUTE** stress
Cortisol	Glucocorticoid. Helps regulate metabolism, ↑ blood glucose levels, and has anti-inflammatory properties. Helps in times of **CHRONIC** stress
Antidiuretic Hormone (ADH)	Helps regulate the amount of water in your body 
Aldosterone	Mineralocorticoid that helps in fluid balance
Parathyroid Hormone (PTH)	Helps to increase serum calcium in the blood
Estrogen	Helps to regulate the menstrual cycle, uterus growth during pregnancy, maintains the pregnancy, and supports the fetus as it grows
Progesterone	Helps to regulate the menstrual cycle, stimulates growth of maternal tissues and fetal organs during pregnancy  Progesterone think Pregnancy hormone
Testosterone	Helps in the development of male sex organs and reproductive tissue, plays a vital role in sperm production, promotes secondary sex characteristics (↑ bone mass, ↑ muscle mass, ↑ growth of body hair)  TESTosterone think TESTes

LAB VALUES RELATED TO THE ENDOCRINE SYSTEM

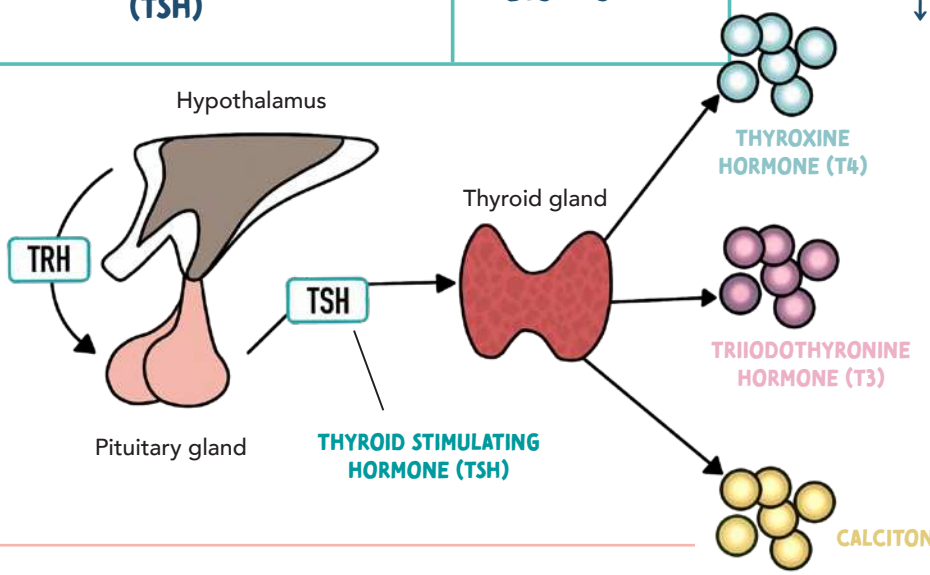
THYROID PANEL

	EXPECTED RANGE
T3 (TRIIODOTHYRONINE)	80 - 220 ng/dL
T4 (THYROXINE)	4 - 12 mcg/dL
THYROID STIMULATING HORMONE (TSH)	0.5 - 5 mU/L

T3 & T4 are always opposite of TSH (negative feedback mechanism)

HYPERTHYROIDISM:
↑ T3 & T4 ↓ TSH

HYPOTHYROIDISM:
↓ T3 & T4 ↑ TSH



BLOOD GLUCOSE

	EXPECTED RANGE	DESCRIPTION
BLOOD GLUCOSE GOAL	70 - 110 mg/dL	Any time of the day (doesn't matter when the last meal was)
FASTING BLOOD SUGAR (FBS)	< 100 mg/dL	No caloric intake for at least 8 hours
2-HR ORAL GLUCOSE TOLERANCE TEST	< 140 mg/dL	Drink a glucose drink (75g of glucose dissolved in water)
HBA1C	< 5.7%	Blood test that measures the average blood glucose (sugar) levels for the last 2-3 months

A finger stick blood sugar test is the most common way people with diabetes check their blood glucose levels

DIABETES TYPE 1 & 2

TYPE 1 DIABETES MELLITUS (T1DM)

TYPE 2 DIABETES MELLITUS (T2DM)

PATHOLOGY

NO INSULIN PRODUCTION

MEMORY TRICK
Type *ONE*
we have n*ONE*

- Caused by an autoimmune response
- The cells are starved of glucose since there is no insulin to bring glucose into the cells
- The cells break down protein and fat into energy, causing ketones to build up = **ACIDOSIS**!
- Usually diagnosed in **CHILDHOOD**

DOES NOT PRODUCE ENOUGH INSULIN, OR PRODUCES BAD INSULIN THAT DOES NOT WORK PROPERLY

- Insulin resistance
- Insulin receptors are worn out & not working properly!
- Usually diagnosed in **ADULTHOOD** (due to a poor diet, sedentary lifestyle, and obesity)

MEMORY TRICK
*T*errible *T*wos are BAD

MEMORY TRICK Easy to remember because **CHILDHOOD** comes **1ST** in life and **ADULTHOOD** comes **2ND**

RISK FACTORS

- Genetics
- Family history

- High blood sugar
- Hypertension
- Obesity
- Inactivity
- High cholesterol
- Family history
- Smoking

S&S

ONSET: ABRUPT

3 P's
Polyuria: excessive peeing
Polydipsia: excessive thirst
Polyphagia: excessive hunger

ONSET: GRADUAL

3 P's
Polyuria: excessive peeing
Polydipsia: excessive thirst
Polyphagia: excessive hunger

TREATMENT

Only has **1** treatment:
INSULIN

Oral hypoglycemic agents will not work for this pt.

Insulin dependent for life!

Has **2+** treatments:

1. **DIET & EXERCISE**
2. **ORAL HYPOGLYCEMIC AGENTS**
   Example: Metformin
3. **POSSIBLY INSULIN**

Insulin is not administered routinely in a type 2 diabetic patient. Only in times of stress, surgery, or sickness will insulin need to be administered.

DIAGNOSTIC CRITERIA

CASUAL
Any time of the day (doesn't matter when the last meal was)
> 200 mg/dL

FASTING BLOOD SUGAR (FBS)
No caloric intake for at least 8 hours
> 126 mg/dL

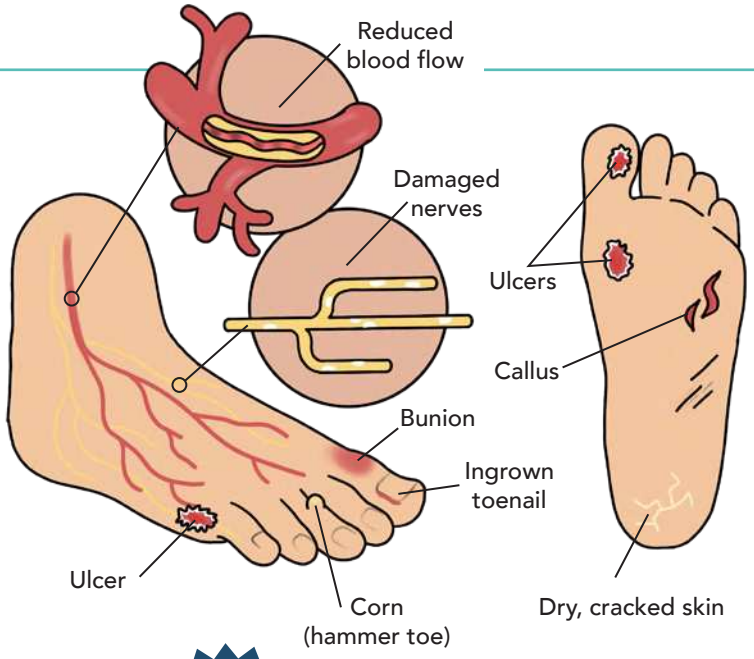
GLUCOSE TOLERANCE TEST
Drink a glucose drink (75g of glucose dissolved in water)
> 200 mg/dL

HBA1C
Blood test that measures the average blood glucose (sugar) levels for the last 2-3 months
> 6.5%

DIABETES TYPE 1 & 2 CONTINUED

DIABETIC FOOT CARE

- Wash feet daily
- Use warm water (test temperature beforehand) & mild soap
- Gently pat feet completely dry
- Inspect feet daily with a mirror (check for any cuts, blisters, or sores)
- Avoid over-the-counter products (callus remover, alcohol, etc)
- Cut toe nails straight across
- Do not cross legs
- Report symptoms of infection to the HCP



Keep feet clean, dry, & avoid irritation!

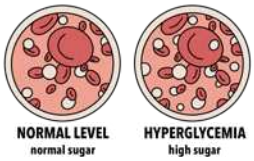
SICK DAY MANAGEMENT

MONITOR
- Blood glucose often
- Temperature often
- Urine for ketones

REPORT TO THE HCP IF:
- Ketones are present in urine
- If blood sugar is > 250 mg/dL
- If temperature is > 101°F

- Stay hydrated (avoid dehydration)

Do not skip insulin when you are feeling sick



DIABETES CAN NEGATIVELY AFFECT ALMOST EVERY ORGAN SYSTEM

This is because high levels of sugar in the blood damages the blood vessel walls and the nerves

ORGAN AFFECTED	KIDNEYS	NERVES	EYES	HEART	BRAIN
COMPLICATIONS	**NEPHROPATHY** Kidney damage Excessive blood glucose can damage the tiny blood vessels in the filtering system (glomeruli). **This causes kidney failure and even end-stage kidney disease.**	**PERIPHERAL NEUROPATHY** Damage to the nerves outside of the brain & spinal cord. Excessive blood glucose can injure the nerves. **This causes tingling, numbness, and eventually loss of sensation.** Nerve damage in the foot can cause serious complications such as major infections in cuts and blisters.	**DIABETIC RETINOPATHY** Eye damage Excessive blood glucose damages the blood vessels of the retina. **This causes blindness, cataracts, glaucoma.**	**CARDIOVASCULAR DISEASE** Damage to the heart & major coronary arteries Excessive blood glucose damages the blood vessels and nerves controlling the heart. **This causes coronary artery disease, hypertension, atherosclerosis.**	**STROKE** Excessive blood glucose damages the blood vessels and makes them stiff. It also can cause a build up of fatty deposits. **This may cause a blood clot that travels to the brain causing a stroke.**

All this sugar in the blood also causes delayed wound healing = risk for infection

DKA VS. HHNS

	DIABETIC KETOACIDOSIS (DKA)	HYPERGLYCEMIC HYPEROSMOLAR NONKETOTIC SYNDROME (HHNS)
PATHOLOGY	**HAPPENS MOSTLY IN TYPE 1 DIABETIC PATIENTS** Not enough insulin ↓ Body can't allow blood sugar into the cells for energy ↓ Blood sugar becomes VERY high ↓ Cells break down protein & fat into energy ↓ **KETONES** build up = **ACIDOSIS!** Ketones are a byproduct of metabolism	**HAPPENS MOSTLY IN TYPE 2 DIABETIC PATIENTS** NO acidosis present! Simply high amounts of glucose in the blood ~~ACIDOSIS~~ ~~KETONES~~
RISK FACTORS	4 S's ▪ **S**tress (surgery) ▪ **S**epsis (infection) ▪ **S**kipping insulin ▪ **S**tomach (stomach virus: nausea/vomiting) ▪ Undiagnosed diabetes	▪ Inadequate fluid intake ▪ ↓ kidney function ▪ Infection ▪ Stress ▪ Older adults
S&S	**ONSET: ABRUPT** ▪ **Hyperglycemia (300 - 500 mg/dL)** ▪ Ketosis & acidosis ▪ Dehydration ▪ Metabolic acidosis ▪ Kussmaul respirations (trying to blow off CO_2) ▪ Acid breath "fruity breath" REMEMBER: CO_2 is an acid 	**ONSET: GRADUAL** ▪ **Hyperglycemia (>600 mg/dL)** ▪ 3 **P**'s (**P**olyuria, **P**olydipsia, **P**olyphagia) ▪ Dehydration **(hypovolemia)** ▪ Neurovascular changes (confusion, ↓ LOC, headache) ~~NO METABOLIC ACIDOSIS~~

TREATMENT	▪ IV insulin with potassium (K+)
	▪ Fluid replacement
	▪ Correction of electrolyte imbalance
	▪ Administer bicarbonate for metabolic acidosis
	MEMORY TRICK: INsulin causes sugar & K+ to go IN the cells, causing hypokalemia unless we administer K+ with IV insulin
	MEMORY TRICK: DKA remember to monitor K levels
		NOTE FOR BOTH:
		Regular insulin is the only insulin given IV
		Regular goes Right into the vein
		▪ Fluid replacement
		▪ Correction of electrolyte imbalances
		▪ Administer insulin
		  ▪ IV insulin with potassium (K+)
		  ▪ SubQ insulin

MED-SURG
ENDOCRINE

HYPERGLYCEMIA VS. HYPOGLYCEMIA

HYPERGLYCEMIA

↑ BLOOD SUGAR

>200 mg/dL
Gradual (hours to days)

BLOOD GLUCOSE GOAL:
70 - 110 mg/dL

SIGNS & SYMPTOMS

3 P's MOST COMMON SYMPTOMS

- **P**olyuria
- **P**olydipsia
- **P**olyphagia
- Hot & dry skin
- Dry mouth (dehydration)
- Fruity breath
- Deep, rapid breaths (air hunger)
- Numbness & tingling
- Slow wound healing
- Vision changes

MEMORY TRICK: Hot & dry = Sugars high

CAUSES

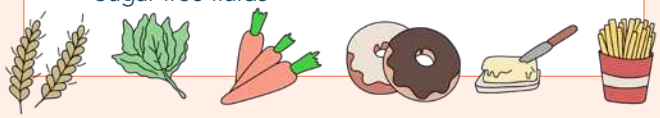
4 S's

- **S**epsis (infection)
- **S**tress
- **S**teroids
- **S**kipping insulin or oral diabetic medication
- Not eating a diabetic diet

DIABETIC DIET

✔
- Complex carbohydrates
- Fiber-rich foods
- Heart-healthy fish
- "Good fats"
- Sugar-free fluids

✘
- Saturated fats
- Trans fats
- Cholesterol
- Sodium



TREATMENT

- Administer insulin as needed
- Test urine for ketones

	RAPID	SHORT	INTERMEDIATE	LONG
GENERIC NAMES	Lispro Aspart Glulisine	regular	nph	Glargine Detemir
BRAND NAMES	Humalog Novolog Apidra	Humulin R Novolin R	Humulin N Novolin N	Lantus Levemir

HYPOGLYCEMIA

↓ BLOOD SUGAR

<70 mg/dL
Happens suddenly

THE BRAIN NEEDS GLUCOSE... NO GLUCOSE CAUSES BRAIN DEATH!

SIGNS & SYMPTOMS

- Cool & clammy skin
- Sweating (Diaphoresis)
- Palpitations
- Fatigue & weakness
- Confusion
- Headache
- Shakiness
- Inability to arouse from sleep
  - Can lead to coma ⚠

MEMORY TRICK: Cool & clammy needs some candy

CAUSES

- Exercise
  - Swimming, cycling, college athlete, etc.
- Alcohol
- Peak times of insulin → RAPID INSULIN has the highest risk for hypoglycemia

TREATMENT

CONSCIOUS PATIENTS

15 X 15 X 15

- Oral intake of **15 GRAMS** of carbohydrates
  Juices, soda, low fat milk. NOT peanut butter or high fat milk
- Recheck blood glucose in **15 MIN**
- Give another **15 GRAMS** of carbohydrates if needed

UNCONSCIOUS PATIENTS

Do not put anything in an unconscious client's mouth, they can **ASPIRATE**!

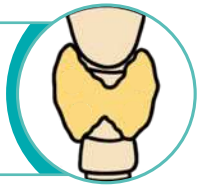
Administer IV 50% dextrose (D50)
OR Glucagon (IM, IV, SubQ)

⚠ **EMERGENCY** call a rapid response

THYROID DISORDERS

FUNCTION

- The thyroid gland produces 3 hormone (T3, T4, & Calcitonin)
  - You need **IODINE** to make these hormones
- Thyroid gives you **ENERGY**!



HYPERTHYROIDISM

PATHOLOGY

Excessive production of thyroid hormone

TOO MUCH ENERGY!

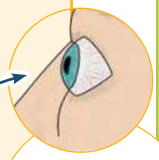
- Graves disease
- Too much iodine (helps makes T3 + T4)
- Toxic Nodular Goiter
- Thyroid replacement medication (Toxicity)

LAB VALUES

↑ T3 & T4 ↓ TSH

SIGNS & SYMPTOMS

- Hyper-excitable
- Nervous/tremors
- Irritable
- ↓ Attention span
- Increased appetite
- Weight loss
- Hair loss
- Goiter (enlarged thyroid)
- Hot
- **EXOPHTHALMOS**
- Increased:
  - Blood pressure
  - Pulse
  - GI function



Bulging eyes due to fluid accumulation behind the eyes

⚠ LIFE-THREATENING COMPLICATIONS ⚠

THYROID STORM!

⚠ **ACUTE / LIFE THREATENING EMERGENCY!**

TREATMENT

- Anti-Thyroid Medications
  - Methimazole or PTU
- Beta Blockers (↓ HR & BP)
- Iodine Compounds
- Radioactive Iodine Therapy
- Thyroidectomy

HYPOTHYROIDISM

PATHOLOGY

Low production of thyroid hormone

NOT ENOUGH ENERGY!

MOST COMMON

- Hashimoto's disease
- Not enough iodine
- Thyroidectomy
- Anti-thyroid medications
- Pituitary hormone
- Affects women more often then men

LAB VALUES

↓ T3 & T4 ↑ TSH

SIGNS & SYMPTOMS

- No energy
- Fatigue
- No expressions
- Weight gain
- Cold
- Amenorrhea
- Slurred speech
- Dry skin
- Coarse hair
- Decreased:
  - HR
  - GI function (constipation)
  - Blood sugar (Hypoglycemia)

⚠ LIFE-THREATENING COMPLICATIONS ⚠

MYXEDEMA COMA!

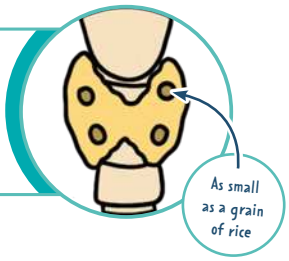
TREATMENT

- Hormone replacement (replacing levothyroxine)
  - Synthetic levothyroxine
    - Synthroid or Levothroid
  - *Will be on this medication forever*

PARATHYROID GLAND DISORDERS

FUNCTION

The parathyroid gland produces and secretes PTH (parathyroid hormone) which controls the levels of **CALCIUM** in the blood



↑ PTH
HYPERPARATHYROIDISM

↑ CALCIUM ↓ PHOSPHORUS

CAUSES

PRIMARY CAUSE:
Tumor or hyperplasia of the parathyroid

SECONDARY CAUSE:
Chronic kidney failure

SIGNS & SYMPTOMS

- **STONES:** Kidney stones (↑ calcium)
- **BONES:**
  - Skeletal pain
  - Pathological fractures from bone deformities

- Abdominal **MOANS**
  - Nausea, vomiting, and abdominal pain
  - Weight loss / anorexia
  - Constipation

- Psychic **GROANS**
  - Mental irritability
  - Confusion

MEMORY TRICK: STONES, BONES, MOANS, & GROANS

TREATMENT

- Parathyroidectomy
- Removal of more than one gland
- Administer:
  - Phosphates, calcitonin, & IV or oral bisphosphonates
- **DIET:** ↑ fiber & moderate calcium

↓ PTH
HYPOPARATHYROIDISM

↓ CALCIUM ↑ PHOSPHORUS

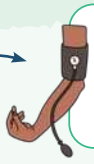
CAUSES

- Can occur due to accidental removal of the parathyroid
  - Thyroidectomy, parathyroidectomy, or radical neck dissection
- Genetic predisposition
- Exposure to radiation
- Magnesium depletion

SIGNS & SYMPTOMS

- Numbness & tingling
- Muscle cramps
- Tetany
- Hypotension
- Anxiety, irritability, & depression

Same S&S of hypocalcemia!



POSITIVE TROUSSEAU SIGN:
Carpal spasm caused by inflating a blood pressure cuff

CHVOSTEK'S SIGNS:
Contraction of facial muscles w/ light tap over the facial nerve
MEMORY TRICK: Think "C" for Cheesy smile

TREATMENT

- IV Calcium
- Phosphorus binding drugs
- **DIET:** ↑ Calcium ↓ Phosphorus

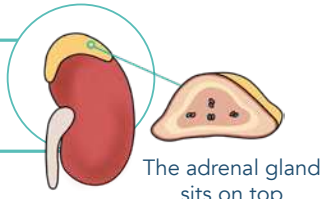
ADRENAL CORTEX DISORDERS

ADRENAL CORTEX HORMONES:

Glucocorticoids • Mineralocorticoids • Sex hormones

LOSES: K+

RETAINS: NA+ & H_2O



The adrenal gland sits on top of each kidney

CUSHING'S

Disorder of the adrenal cortex

TOO MANY STEROIDS

MEMORY TRICK They "have a CUSHION"

CAUSES

- Females
- Overuse of cortisol medications
- Tumor in the adrenal gland that secretes cortisol

SIGNS & SYMPTOMS

- Muscle wasting
- Moon face
- Buffalo hump
- Truncal obesity w/ thin extremities
- Supraclavicular fat pads
- Weight gain
- Hirsutism (masculine characteristics)
- ↑ Glucose ↑ NA+
- ↓ K+ ↓ CA+
- Hypertension

TREATMENT

- Adrenalectomy
  - Requires lifelong glucocorticoid replacement
- Avoid infection
- Adm. chemotherapeutic agents if adrenal tumor is present

ADDISON'S

Disorder of the adrenal cortex

NOT ENOUGH STEROIDS

MEMORY TRICK We need to "ADD" some

CAUSES

- Surgical removal of both adrenal glands
- Infection of the adrenal glands
- TB, cytomegalovirus, & bacterial infections

SIGNS & SYMPTOMS

- Fatigue
- Nausea / vomiting / diarrhea
- Anorexia
- Hypotension & Hypovolemia
- Confusion
- ↓ Blood sugar
- ↓ Na & H_20 ↑ K+
- Hyperpigmentation of the skin
- **Vitiligo**: white areas of depigmentation

⚠ ADDISONIAN CRISIS ⚠

SIGNS & SYMPTOMS
- Profound fatigue
- Dehydration
- Renal failure
- Rapid respiration
- Hyponatremia
- Hypokalemia
- Cyanosis
- Fever
- Nausea/vomiting

Think SHOCK!
- Hypotension
- Weak rapid pulse

TREATMENT: Fluid resuscitation & high-dose hydrocortisone

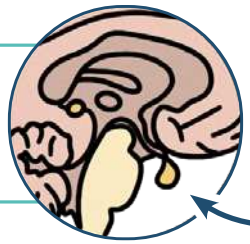
TREATMENT

- Adm. glucocorticoid and/or mineralocorticoid
- Diet: high in protein & carbs

PITUITARY GLAND DISORDERS

ANTIDIURETIC HORMONE (ADH):

ADH regulates & balances
the amount of water in your blood



ADH is found in the PITUITARY GLAND!

SYNDROME OF INAPPROPRIATE ANTIDIURETIC HORMONE (SIADH)

MEMORY TRICK SIADH think Soaked Inside

SIADH is often of non-endocrine origin

TOO MUCH ADH

RETAINS WATER

CAUSES

- Pulmonary disease
  - TB
  - Severe pneumonia
- Disorders of the CNS
  - Head injury
  - Brain surgery
  - Tumor
- HIV
- Medications
  - Vincristine
  - Phenothiazines
  - Antidepressants
  - Thiazide diuretics
  - Anticonvulsants
  - Antidiabetic drugs
  - Nicotine

SIGNS & SYMPTOMS

- Low urinary output of concentrated urine
- Fluid volume overload
- Weight gain without edema
- Hypertension
- Tachycardia
- Nausea & vomiting
- Hyponatremia

TREATMENT

- Implement seizure precautions
- Elevate HOB to promote venous return
- Restrict fluid intake
- Adm. loop diuretics
- Adm. vasopressin antagonists

INCREASED ICP
can lead to an ADH problem

DIABETES INSIPIDUS (DI)

MEMORY TRICK DI think Dry Inside

NOT ENOUGH ADH

LOSES WATER

CAUSES

- Head trauma, brain tumor
- Manipulation of the pituitary
  - Surgical ablation, craniotomy, sinus surgery, hypophysectomy
- Infections of the central nervous system (CNS)
  - Meningitis, encephalitis, or TB
- Failure of the renal tubules to respond to ADH

SIGNS & SYMPTOMS

- Excretes large amounts of diluted urine
- Polydipsia (increased thirst)
- Polyuria (increased urine output)
- Dehydration
- Decreased skin turgor
- Dry mucous membranes
- Muscle pain & weakness
- Headache
- **Postural hypotension**
- **Tachycardia**
- **Low urinary specific gravity**

Normal specific gravity
1.005 – 1.030

TREATMENT

- Adequate fluids
- IV hypotonic saline
- ADH replacement (replace the missing hormone!)
  - Vasopressin or desmopressin
- Monitor
  - Intake & output
  - Weight

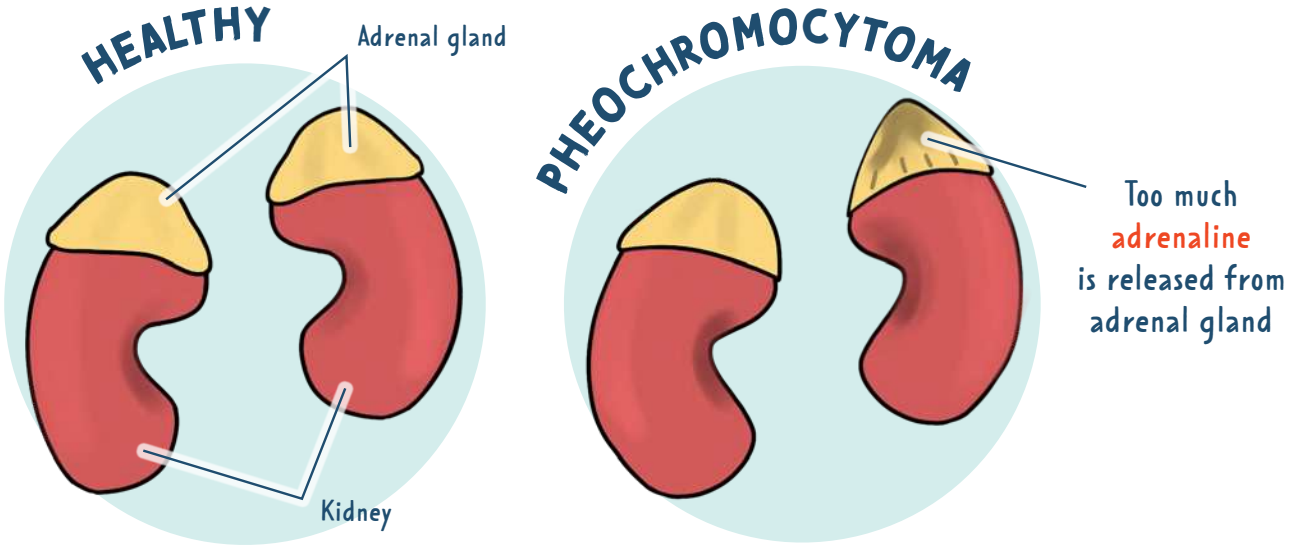
ADRENAL MEDULLA DISORDER

ADRENAL MEDULLA HORMONES:

Epinephrine ▪ Norepinephrine

PHEOCHROMOCYTOMA

RARE tumor on the adrenal gland that secretes excessive amounts of epinephrine & norepinephrine



CAUSES

- Family history that makes them prone to developing the tumor

SIGNS & SYMPTOMS

H's

- **H**ypertension (severe)
- **H**eadache
- **H**eat (excessive sweating)
- **H**ypermetabolism
- **H**yperglycemia

AVOID STIMULI!
It may cause a hypertensive crisis!

TREATMENT

- Adrenalectomy (if a tumor is present)
- Tell the client not to smoke, drink caffeine or change position suddenly
- Adm. anti-hypertensives
- Promote rest & calm environment
- **DIET:** high in calories, vitamins, & minerals

MED-SURG
RESPIRATORY

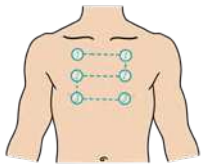
AUSCULTATING LUNG SOUNDS

TIPS FOR LISTENING

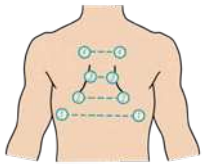
- Listen directly on the skin with the diaphragm
- Listening inside the **IN**tercostal spaces (**IN** *between the ribs*)
- Listen to the anterior & posterior chest
- Have the client sit upright (high fowler's), arms resting across the lap.
- Instruct client to take deep breaths
- Listen from top to bottom (comparing sides)

Listen for a
FULL INHALATION TO EXPIRATION
on each spot

ANTERIOR
Will hear
UPPER lobes well



POSTERIOR
Will hear
LOWER lobes well



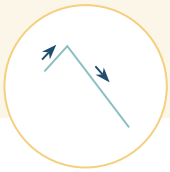
NORMAL SOUNDS

BRONCHIAL (TRACHEAL)

DESCRIPTION
High, loud & hollow tubular

LOCATION HEARD
Anteriorly only
(heard over trachea & larynx)

DURATION
Inspiration < expiration

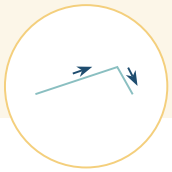


VESICULAR

DESCRIPTION
Soft, low pitched,
breezy / rushing sound

LOCATION HEARD
Heard anterior & posteriorly

DURATION
Inspiration > expiration

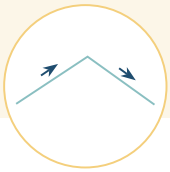


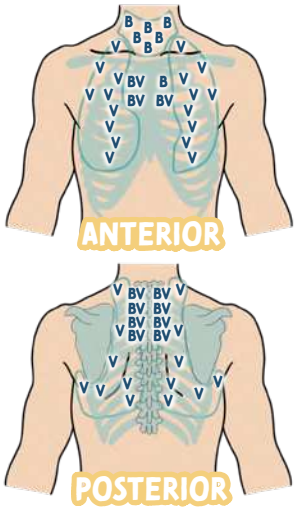
BRONCHOVESICULAR

DESCRIPTION
Medium pitched, hollow

LOCATION HEARD
Heard anterior & posteriorly

DURATION
Inspiration = expiration





ABNORMAL (ADVENTITIOUS) SOUNDS

DISCONTINUOUS SOUNDS
DISCRETE CRACKLING SOUNDS

FINE CRACKLES (RALES)
DESCRIPTION: High pitched, crackling sounds (Sound like fire crackling, or velcro coming part)
DUE TO: Previously deflated airways that are popping back open
EXAMPLE: Pulmonary edema, asthma, obstructive diseases

COARSE CRACKLES (RALES)
DESCRIPTION: Low pitched, wet bubbling sound
DUE TO: Inhaled air collides with secretion in the trachea or large bronchi
EXAMPLE: Pulmonary edema, pneumonia, depressed cough reflex

PLEURAL FRICTION RUB
DESCRIPTION: Low pitched, harsh / grating sounds
DUE TO: Pleura is inflamed and loses it's lubricant fluid. It's literally the surfaces rubbing together during respirations
EXAMPLE: Pleuritis

CONTINUOUS SOUNDS
CONNECTED MUSICAL SOUNDS

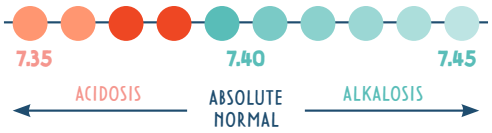
WHEEZES
DESCRIPTION: High-pitched musical instrument with more than one type of sound quality (polyphonic)
DUE TO: Air moving through a narrow airway
EXAMPLE: Asthma, bronchitis, chronic emphysema

STRIDOR
DESCRIPTION: High pitched whistling or gasping with harsh sound quality
DUE TO: Disturbed airflow in larynx or trachea
EXAMPLE: Croup, epiglottis, any airway obstruction

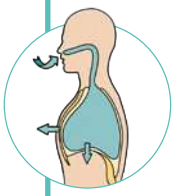
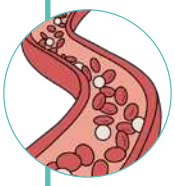
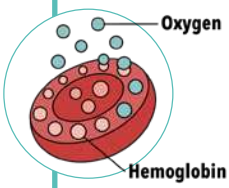
REQUIRES MEDICAL ATTENTION

LAB VALUES RELATED TO THE RESPIRATORY SYSTEM

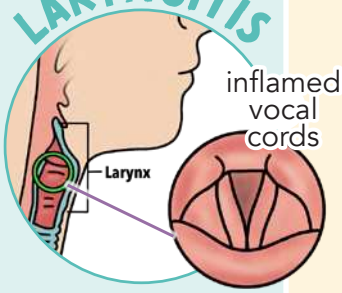
ABGs

	DEFINITION	EXPECTED RANGE	INTERPRETATION
PH	Measurement of how acidic or alkalotic your blood is	**7.35 - 7.45**	
$PaCO_2$	Measurement of carbon dioxide in the blood MEMORY TRICK CO_2 think aCid	**35 - 45**	CO_2 **>45** = Acidosis CO_2 **<35** = Alkalosis
HCO_3	Measurement of bicarbonate in the blood MEMORY TRICK Bicarbonate think Base	**22 - 26**	HCO_3 **>26** = Alkalosis HCO_3 **<22** = Acidosis
PaO_2	Measurement of oxygen in the blood	**80 - 100**	PaO_2 **<80** = Hypoxemia (the patient is not getting enough oxygen)
SaO_2	Percentage (%) of hemoglobin that is bound to oxygen	**95-100%**	SaO_2 **<95** = Hypoxemia (the patient is not getting enough oxygen) COPD pts are expected to have low O_2 levels (as low as 88%)

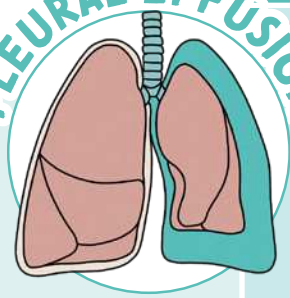
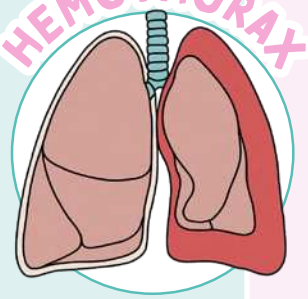
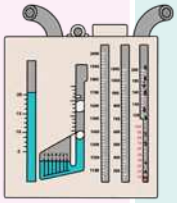
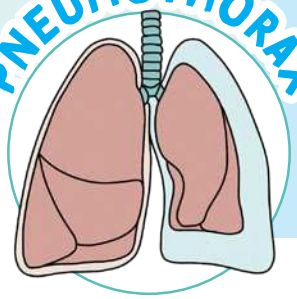
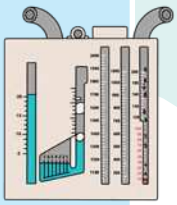
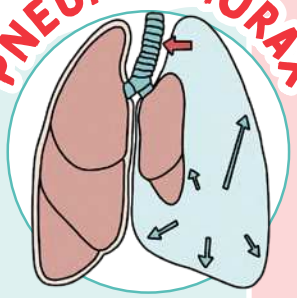
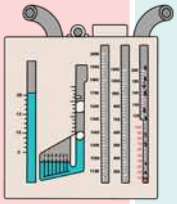
OXYGEN LEVELS EXPLAINED

	DEFINITION	EXPECTED RANGE	INTERPRETATION
FiO_2 	FiO_2 Fraction of inspired Oxygen (the air you breathe in)	Room air has **21%** oxygen	-
PaO_2 	The partial pressure of oxygen in the arterial blood MEMORY TRICK PaO_2 = arterial	**80 - 100** mmHg	**HYPOXEMIA** low oxygen in the blood Decreased oxygen in the **BLOOD** **HYPOXEMIA** usually leads to **HYPOXIA** **HYPOXIA** low oxygenation Decreased oxygen supply to the **TISSUES**
SaO_2 	Hemoglobin saturation percentage of hemoglobin that is bound to oxygen MEMORY TRICK SaO_2 = Saturation (%)	**95 - 100%** (measured with a pulse ox) 	

UPPER RESPIRATORY TRACT DISORDERS

	PATHOLOGY	SIGNS & SYMPTOMS	TREATMENT
RHINITIS 	Inflammation of the **mucous membrane in the nose** *Can be nonallergic or allergic*	▪ Runny nose ▪ Nasal congestion ▪ Nasal discharge ▪ Sneezing ▪ Headache	▪ Saline or steroid nasal sprays ▪ Antihistamines ▪ Decongestants
SINUSITIS 	Inflammation of the tissue lining the **sinuses** "sinus infection"	▪ Runny & stuffy nose ▪ Pressure & pain in the face ▪ Headache ▪ Post-nasal drip ▪ Mucus dripping down the throat ▪ Sore throat	▪ **VIRAL:** supportive measure ▪ **BACTERIAL:** antibiotics ▪ Nasal saline irrigation ▪ Corticosteroids ▪ Antihistamines
TONSILLITIS 	Inflammation of the **tonsils**	▪ Sore throat ▪ Fever ▪ Snoring ▪ Difficulty swallowing	▪ Fluids ▪ Salt water gargles ▪ Rest ▪ Humidified air ▪ Tonsillectomy (surgical removal of the tonsils)
LARYNGITIS 	Inflammation of the **larynx** (aka the "voice box")	▪ Hoarse voice ▪ Aphonia (loss of voice) ▪ Cough ▪ Dry sore throat ▪ Symptoms worsen with cold air or cold liquid	▪ Rest voice ▪ Avoid smoking & alcohol ▪ Avoid whispering and clearing throat (can irritate vocal cords) ▪ Humidified air & adequate hydration
PHARYNGITIS 	Inflammation of the **pharynx** (strep throat)	▪ Sore throat ▪ Red & swollen pharyngeal membrane & tonsils ▪ Lymph nodes ▪ White exudate ▪ Fever	▪ **VIRAL:** supportive measure ▪ **BACTERIAL:** antibiotics ▪ Rest ▪ Salt water gargles

HEMOTHORAX, PLEURAL EFFUSION, PNEUMOTHORAX, TENSION PNEUMOTHORAX

	PATHOLOGY	RISK FACTORS	TREATMENT
PLEURAL EFFUSION 	Lung collapse due to collection of **FLUID** in the pleural space	▪ Trauma ▪ Infection (pneumonia)	▪ Thoracentesis 
HEMOTHORAX 	Lung collapse due to a collection of **BLOOD** in the pleural space "Hemo" means blood	▪ A pneumothorax is often followed by a hemothorax	▪ Chest tube 
PNEUMOTHORAX 	Lung collapse due to a collection of **AIR** in the pleural space	▪ Trauma (blunt or penetrating) ▪ Medical procedure (central line placement) ▪ Gun shot or stab wound	▪ Chest tube 
TENSION PNEUMOTHORAX 	**MEDICAL EMERGENCY** Complications of a **PNEUMOTHORAX**. Occurs when the opening to the pleural space creates a one-way valve, then air collects in the lungs and can't escape (pressure builds up)	**Signs & symptoms:** ▪ Jugular vein distention (JVD) ▪ Compression on the heart (tachycardia, hypotension, chest pain) ▪ Compression on other lung (tachypnea, hypoxia) ▪ Tracheal shift	▪ Needle decompression (aspirate the air) ▪ Chest tube 

MED-SURG
RESPIRATORY

CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

PATHOLOGY

↓ O_2 & ↑ CO_2

Progressive pulmonary disease that causes chronic airflow obstruction. COPD causes the alveoli sacs to lose their elasticity (inability to fully exhale) leading to **AIR TRAPPING.**

Umbrella term for either

EMPHYSEMA or **CHRONIC BRONCHITIS**

RISK FACTORS

MOST COMMON

- Smoking
  - Breathing in harmful irritants
- Occupation exposure
- Infection
- Air pollution
- Genetic abnormalities
- Asthma
- Severe respiratory infection in childhood

Deficiency of Alpha1- antitrypsin (Protects the lining of the lungs)

DIAGNOSTIC

- Arterial blood gases (ABGs)
- Chest X-ray
- Pulmonary function test: **Spirometry**

Obstructive lung disease
FEV1 / **FVC** ratio of less than 70%

FEV1 =	FVC =
FORCED EXPIRATORY VOLUME	FORCED VITAL CAPACITY

PATIENT EDUCATION

- Smoking cessation
- Regular exercise
- Avoid inhaling irritations
  (Examples: smoke, mold, pollen, dust)
- Stay up to date on vaccines
- Influenza & pneumococcal vaccine to ↓ the incidence of pneumonia
- Teach proper breathing techniques:

DIET MODIFICATIONS:

- ↑ calories
- Small frequent meals
- ↑ protein
- Stay hydrated
- Thins mucous secretion

Patients with COPD (especially emphysema) are using a lot of their energy to breathe, therefore burning a lot of calories

PURSED LIPS Promotes carbon dioxide elimination

DIAPHRAGMATIC BREATHING We want to use the DIAPHRAGM rather than the accessory muscles to breathe

MEDICATIONS

- **Bronchodilators**
- Corticosteroids

End in suffixes: **-asone, -inide, -olone**

ORDER OF EVENTS:

1. **Bronchodilator:** Dilated airways
2. **Corticosteroids**: Now that airways are open, the steroids can do its job

NURSING CONSIDERATIONS

MONITOR RESPIRATORY SYSTEM:

- Lung sounds
- Sputum production
- Oxygen status

OXYGEN THERAPY

THOSE WITHOUT COPD	Healthy patients are stimulated to breath due to ↑ CO_2
★ **COPD PATIENTS**	COPD patients are stimulated to breathe due to ↓ O_2 (if you give too much O_2 ...they lose their "drive to breathe") Give oxygen with caution

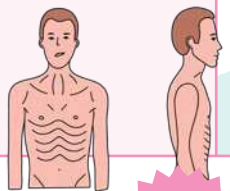
EMPHYSEMA VS CHRONIC BRONCHITIS

LIMITED AIR FLOW

↓ O_2 & ↑ CO_2

EMPHYSEMA

- Abnormal distention of airspaces
- Enlargement & destruction of airspace distal to the terminal bronchiole
- Hyperventilation (breathing fast)
- Trying to blow off CO_2



SIGNS & SYMPTOMS

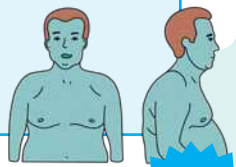
- Hyperinflation of the lungs (barrel chest)
- Thin - weight loss
- Shortness of breath
- Severe dyspnea

Burning a lot of calories from trying to breathe off the excess CO_2

PINK PUFFERS

CHRONIC BRONCHITIS

- Mucus secretion
- Airway obstruction (inflammation)
- Chronic productive cough & sputum production for >3 months (within 2 consecutive years)



SIGNS & SYMPTOMS

- Overweight
- Cyanotic (blue) - Hypoxemia
  - ↓ O_2 & ↑ CO_2
- Peripheral edema
- Rhonchi & wheezing
- Chronic cough

BLUE BLOATERS

CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

NURSING MANAGEMENT & EDUCATION

MONITOR RESPIRATORY SYSTEM

- Lung sounds
- Sputum production
- Oxygen status

LIFESTYLE MODIFICATIONS

- Smoking cessation
  - Determine readiness
  - Develop a plan
  - Discuss nicotine replacement

DIET MODIFICATIONS

- Promote nutrition
- Increase calories
- Small frequent meals
- Stay hydrated
  - Thins mucous secretions

TEACH PROPER BREATHING TECHNIQUES

- Pursed lips
- Diaphragmatic breathing

SURGERY

- Bullectomy
- LVRS: lung volume reduction surgery
- Lung transplant

STAY UP TO DATE ON VACCINES

- Influenza & pneumococcal vaccine
  ↓ the incidence of pneumonia

OXYGEN THERAPY

- COPD clients are stimulated to breathe due to ↓ O_2 (if you give too much O_2...they lose their "drive to breathe")
- Healthy clients are stimulated to breath due to ↑ CO_2

Adm. O_2 during exacerbations
or showing signs of respiratory distress

Adm. oxygen with caution to clients with **CHRONIC HYPERCAPNIA** (elevated $PaCO_2$ levels)
1 - 2 liters max

Clients with COPD (especially emphysema) are using a lot of their energy to breathe, therefore burning a lot of calories

small, frequent meals that are rich in **PROTEIN**

PROMOTES CARBON DIOXIDE ELIMINATION

Allows better expiration by ↑ airway pressure that keeps air passages open during exhalation!

We want to use the **DIAPHRAGM** rather than the *accessory muscles* to breathe!

➥ This strengthens the diaphragm and slows down breathing rate

MEDICATIONS

BRONCHODILATORS

- Relaxes smooth muscle of lung airways = better airflow
- Symbicort (steroid + long-acting bronchodilator)

CORTICOSTEROIDS

- ↓ inflammation (oral, IV, inhaled)
- *Example:* Prednisone, Solu-Medrol, Budesonide

SUFFIX:
"-asone"
"-inide"
"-olone"

BUPROPION (ANTI-DEPRESSANT)

**For more information about respiratory medications, see the Pharmacology Bundle*

ORDER OF EVENTS

1. **Bronchodilator**
   Dilated airways
2. **Corticosteroids**
   Airways are open; now the steroids can do their job

PNEUMONIA

PATHOLOGY

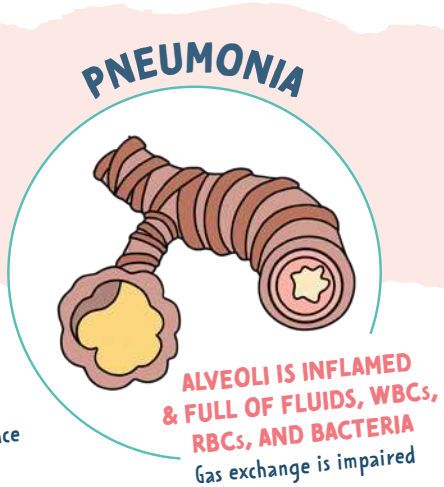
Lower respiratory tract infection that causes inflammation of **ALVEOLI SACS**!

TYPES

- **Community acquired pneumonia (CAP)**
- **Hospital acquired pneumonia (HAP)**
- **Healthcare associated pneumonia (HCAP)**
- **Ventilator-associated pneumonia (VAP)**
- **Aspiration pneumonia**

REMEMBER

gas exchange takes place in the alveoli... so pneumonia causes **impaired gas exchange.**



SYMPTOMS

MNEMONIC

- **P** **P**roductive cough (purulent sputum)
- **N** **N**euro changes (especially in the elderly)
- **E** **E**levated Lab (↑ PCO_2 & ↑ WBCs)
- **U** **U**nusual breath sounds (course crackles & rhonchi)
- **M** **Mild** to **high** fever

- **O** **O**xygen saturation low
- **N** **N**ausea & vomiting
- **I** **I**ncreased HR & BP
- **A** **A**chy (chills, fatigue)

RISK FACTORS

Can be **COMMUNITY-ACQUIRED** or **HOSPITAL-ACQUIRED**!

- Prior infection
- Immunocompromised
  - HIV, young/old, auto immune infections
- Postoperative
- Lung diseases
  - COPD
- Immobility
- Aspiration risk

DIAGNOSTIC

Chest X-ray ✸ ↑ White blood cells ✸ Sputum culture

- Chest X-ray → shows pulmonary infiltrates or pleural effusions
- ↑ White blood cells
- Sputum culture → can be **BACTERIAL, VIRAL, or FUNGAL**

INTERVENTIONS

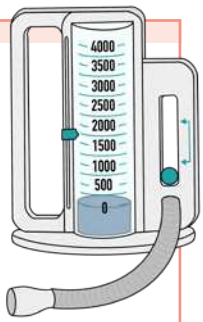
- Monitor...
  - Respiratory status
  - Vital signs: HR, temp, & pulse oximetry
  - Color, consistency & amount of sputum
- Diet
  - ↑ Calories
  - ↑ Protein
  - ↑ Fluids (oral or IV)
  - Small frequent meals

  (Thins secretions & compensates dehydration from fever)
- Medications
  - Antipyretics
  - **Antibiotics** *(only for bacteria)*
  - Antivirals

  (Always take blood cultures BEFORE administering **antibiotics**)
  - Bronchodilators
  - Cough suppressants
  - Mucolytic agents
- Semi Fowler's position (Helps lung expansion)

EDUCATE

- Use of Incentive Spirometer
  - Helps to pop open the alveoli sacs & get the air moving



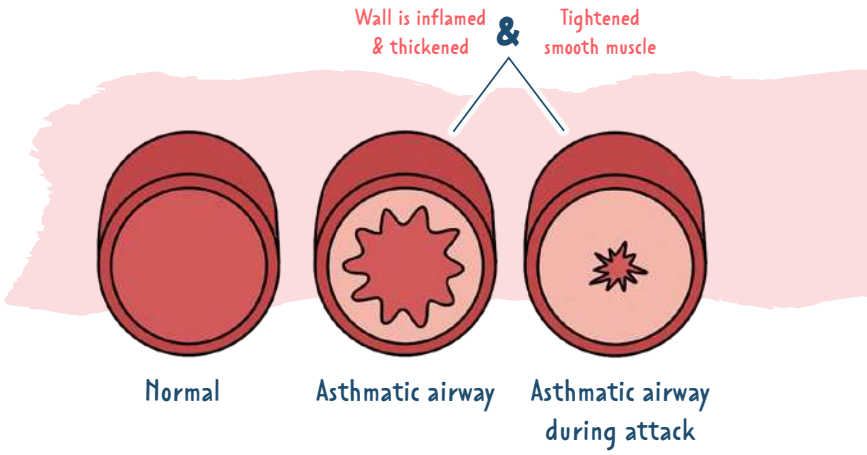
- Up-to-date vaccines
  - Annual flu shot
  - Pneumococcal vaccine

- Smoking cessation
- Hand washing & avoiding sick people

ASTHMA

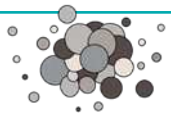
PATHOLOGY

Chronic lung disease that causes an inflamed, narrow, & swollen airway (bronchi & bronchioles)



CAUSES

NOT COMPLETELY KNOWN!



- Genetic
- Environmental
  - Smoke, pollen, perfumes, dust mites, pet dander, cold or dry air, etc.
- GERD
- Exercise-induced asthma
- Certain drugs
  - NSAIDS, aspirin

CLASSIFICATIONS:

Based on Symptoms

MILD INTERMITTENT
< 2 a week

MILD PERSISTENT
> 2 a week
Not daily

MODERATE PERSISTENT
Daily symptoms & exacerbations that happen 2x a week

SEVERE PERSISTENT
Continually showing symptoms with frequent exacerbations

SIGNS & SYMPTOMS

CHARACTERIZED BY FLARE-UPS
(meaning: it comes & goes)

- Dyspnea (shortness of breath)
- Tachypnea (fast respiratory rate)
- Chest tightness
- Anxiety
- Wheezing
- Coughing
- Mucus production
- Use of accessory muscles
- **AIR TRAPPING** → Air trapping causes the client to retain CO_2 which is **ACIDIC** = **RESPIRATORY ACIDOSIS**

⚠ STATUS ASTHMATICUS ⚠

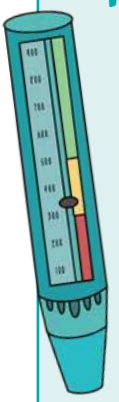
Medical emergency
Life-threatening asthma episode

oxygen
↓
hydration
↓
nebulization
↓
systemic corticosteroid

NURSING CARE

- Assess client's airway
- High Fowler's position
- Provide frequent rest periods
- Adm. oxygen therapy
  - Goal: keep the O_2 at 95 - 100%
- Maintain a calm environment to ↓ stress
- Asses **PEAK FLOW METER** reading
- Asses for cyanosis & retractions

PEAK FLOW METER



- Shows how controlled the asthma is & if it's getting worse
- Establish a baseline by performing a "personal best" reading
  - Client will exhale as hard as they can & get a reading

GREEN = GOOD
YELLOW = NOT TOO GOOD
RED = BAD

MEDICATIONS

- BronchoDILATORS
  - Short-acting (Albuterol) Rapid relief
  - Long-acting (Salmeterol) Prevents asthma attack
  - Methylxanthines (Theophylline)
- Corticosteroids Anti-inflammatory Agents
  - Suffix **-ASONE** & **-IDE**
  - *Ex: Beclometh**asone***
- Leukotriene Modifiers
- Anticholinergics

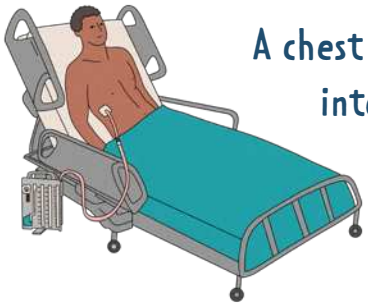
MNEMONIC

Certain medications are known to cause bronchospasms in patients with asthma. We want to "**BAN**" these medications from asthma patients.

- **B** Beta blockers
- **A** Aspirin
- **N** NSAIDs

*For more information about respiratory medications, see the Pharmacology Bundle

CHEST TUBES



A chest tube is a tube that is inserted into the pleural space to remove excess air, blood, or fluid. This helps re-expand the lungs.

WHY IS IT USED?

- After thoracic surgery
- During cardiac surgery (drain fluid from around the heart)
- Spontaneous pneumothorax
- Pneumothorax
- Hemothorax
- Pleural effusion
- Empyema (infection)

3 CHAMBERS:

DRAINAGE CHAMBER

This is where the fluid is collected from the patient

WATER-SEAL CHAMBER

Allows air to be removed from the pleural space WITHOUT outside air entering the lungs

Tidaling (rise & fall with each breath) = GOOD

Excessive continuous bubbling in the water seal chamber = BAD

If the water stops fluctuating, this could mean:
1. The lung has re-expand
2. The tubing is kinked

SUCTION-CONTROL CHAMBER (Two types)

WET SUCTION & DRY SUCTION

If the tube becomes DISLODGED:
Cover the insertion site with a sterile dressing

If the chamber becomes DAMAGED:
Place the tubing in sterile water while waiting for a new system

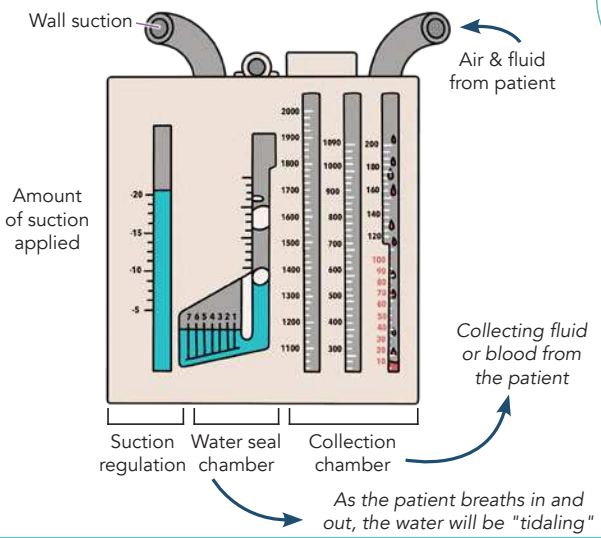
NURSING CONSIDERATIONS

- Always keep the drainage system BELOW the patient's chest
- **NEVER** strip the tubing
- **NEVER** clamp the tubing
- **EDUCATE** the patient to do **Valsalva maneuver** when the HCP is removing the chest tube
  - Deep breath, exhale, and bear down
- **MONITOR:**
  - Color & quantity of the drainage in the drainage collection chamber every hour
  - Lung sounds
  - Insertion site
- **REPORT** bright red blood (dark red is expected)

WET-SUCTION

Uses **WATER** to control the level of suction (actually filling the suction control chamber with water)

WILL HAVE GENTLE BUBBLING

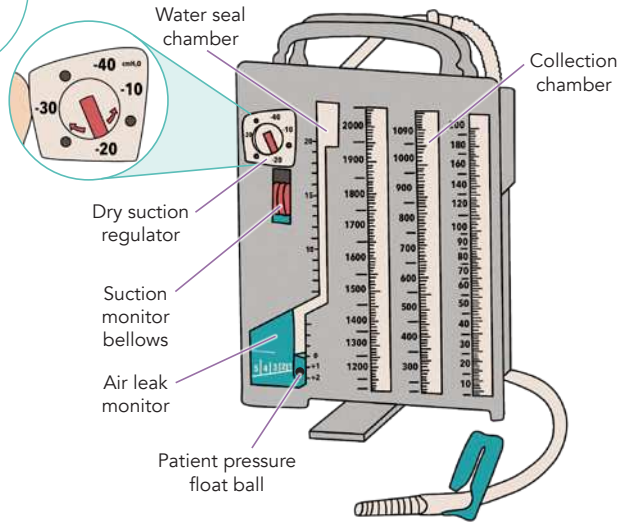


Both have a **collection chamber** and an **air leak monitor**

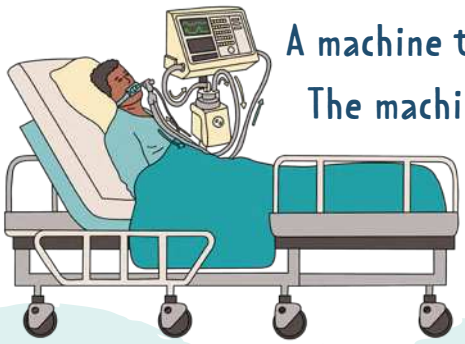
DRY-SUCTION

There is no water column (it's DRY). The suction is controlled by a suction monitor bellows that balances wall suction

THERE WILL BE NO BUBBLING



MECHANICAL VENTILATION



A machine that helps a person breathe. The machine pumps air into the lungs unlike normal breathing.

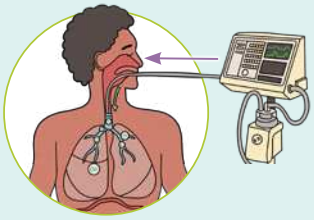
WHY IS IT USED?

- Control breathing during surgery
- Rest the respiratory muscles
- When a patient is unable to breathe on their own (respiratory failure such as ARDS)

POSITIVE PRESSURE VENTILATION*

THE AIR IS PUSHED INTO THE LUNGS

This forceful air entering into the lungs can cause **barotrauma**

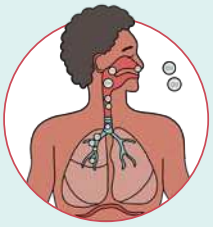


NEGATIVE PRESSURE VENTILATION*

NORMAL BREATHING

The diaphragm uses negative pressure to bring in oxygen

MEMORY TRICK: *N*egative think *N*ormal breathing



VENTILATOR SETTINGS

TIDAL VOLUME (VT)	Volume of gas delivered with each breath **500 - 800 mL**
RESPIRATORY RATE	# of breaths delivered to the patient **12 - 20 breaths per min**
FiO_2	Fraction of inspired oxygen (O_2 concentration of the air being delivered to the pt.) **21% - 100%**
POSITIVE END EXPIRATORY PRESSURE (PEEP)	The amount of pressure in the lungs after expiration (prevents collapse of the alveoli)

UNDERSTANDING ALARMS

HIGH PRESSURE ALARMS

MEMORY TRICK: *H*igh think *H*igh blockage of airflow

CAUSES:

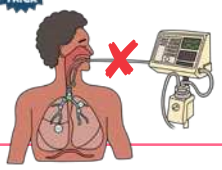
Excessive mucous or secretions, kinks, coughing, pulmonary edema, or pneumothorax, a patient "fighting" the ventilator

LOW PRESSURE ALARMS

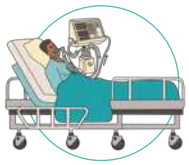
MEMORY TRICK: *L*ow think *L*eaks

CAUSES:

Disconnection, cuff leak, tube displacement



NURSING CONSIDERATIONS



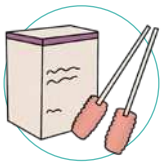
MONITOR:

- Level of consciousness
- Vital signs
- Lung sounds
- Arterial blood gases
- Symptoms of ventilator associated pneumonia
- The gastrointestinal system
- Nutritional status

SUCTIONING

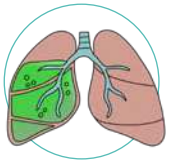
Suction secretions only when needed:

- Never suction when inserting a catheter into the airway
- Never suction for longer than 10 seconds
- Administered 100% oxygen before suctioning



ORAL CARE

- Clean the mouth with chlorhexidine every 2 hours



MOBILIZE SECRETIONS

- Turn/reposition the patient every 2 hours
- Keep the head of the bed >30°

GASTROINTESTINAL SYSTEM

- Administer PPIs & H2 blockers to prevent stress ulcers and decrease acid

Proton pump inhibitors (PPIs) end in -prazole

Histamine H2 antagonists (H2-blockers) end in -dine

MED-SURG
HEMATOLOGY

LAB VALUES RELATED TO THE HEMATOLOGICAL SYSTEM

COMPLETE BLOOD COUNT (CBC)

	EXPECTED RANGE	DESCRIPTION	↓	↑
RED BLOOD CELLS (RBCs)	F: 4.2 – 5.2 X 10^6 /uL M: 4.7 – 6.1 X 10^6 /uL	Red blood cells transport oxygen to the body's cells.	Fluid volume overload Hemorrhage Anemia Renal disease (lack of erythropoietin production) More volume dilutes the RBCs	Less volume concentrates the RBCs Dehydration/ fluid volume deficit Hyperactivity of the bone marrow
WHITE BLOOD CELLS (WBCs)	4,500 – 11,000 / uL	The white blood cells are a part of the immune system and help to fight infections and diseases.	**LEUKOPENIA** WBCs < 4,500 /uL Immunosuppression	**LEUKOCYTOSIS** WBCs > 11,000 /uL Current or recent INFECTION & inflammation
PLATELETS (PLT)	150,000 – 450,000 /uL	Platelets help clot the blood. Platelet aggregation is the clumping together of platelets that form a plug at the site of the injury.	**THROMBOCYTOPENIA** PLTs < 150,000 /uL ↓ Platelets think BLEEDING	**THROMBOCYTOSIS** PLTs > 450,000 /uL Certain cancers Infection
HEMOGLOBIN (HGB)	F: 12 – 16 g/dL M: 13 – 18 g/dL	Hemoglobin is an iron containing protein found in red blood cells. It transports oxygen from the lungs to the tissues. It also returns CO_2 from the tissues back to the lungs.	Fluid retention (hemodilution) Anemia Hemorrhage	Dehydration (hemoconcentration)
HEMATOCRIT (HCT)	F: 36% – 48% M: 39% – 54%	The percent of blood that is made up of red blood cells (expressed as a %).	Fluid retention (hemodilution) Anemia Hemorrhage	Dehydration (hemoconcentration) Low oxygen availability (smoking, pulmonary diseases (COPD), high altitudes)

TYPES OF COAGULATION TESTS

ACTIVATED PARTIAL THROMBOPLASTIN TIME (aPTT)	NORMAL (not on anticoagulants): 30 – 40 seconds ON HEPARIN THERAPY: 1.5 – 2.0 x the normal value	aPTT measures how long it takes for a blood clot to form. It's also used to monitor the effectiveness of the anticoagulant: **HEPARIN**.	MEMORY TRICK: Numbers are LOW = Clots will GROW	Heparin therapy MEMORY TRICK: Numbers are too HIGH = Patient will DIE (from increased bleeding)
PROTHROMBIN TIME (PT)	NORMAL (not on anticoagulants): 10 – 12 seconds ON HEPARIN THERAPY: 1.5 – 2.0 x the normal value	Prothrombin time measures the amount of time needed to form a clot. It's also used to monitor the effectiveness of the anticoagulant: **WARFARIN**.		Deficiency in vitamin K Deficiency in clotting factor Liver disease
INTERNATIONAL NORMALIZED RATIO (INR)	NORMAL (not on anticoagulants): < 1 ON HEPARIN THERAPY: INR 2.0 – 3.0 INR 2.5 – 3.5 (heart valve replacement)	INR is calculated from the prothrombin time and is used to monitor oral anticoagulants such as **WARFARIN**.		Warfarin therapy MEMORY TRICK: Numbers are too HIGH = Patient will DIE (from increased bleeding)
D-DIMER	< 0.5 mcg/mL	D-dimers are fragments of fibrin that are in the blood when a clot dissolves or is broken down. D-dimer helps to determine if a clot is present somewhere in the body	Blood clot is ruled out	Additional tests are needed to confirm and determine a specific diagnosis Blood clot may be present in the body

IRON DEFICIENCY ANEMIA

PATHOLOGY

TYPE OF ANEMIA CAUSED BY ↓ IRON LEVELS

There are many types of anemias (**iron deficiency**, vitamin B12 deficiency, folate deficiency, etc).

MOST COMMON TYPE OF ANEMIA

ANEMIA: the body doesn't have enough RBCs to carry oxygen to the tissues and the body.

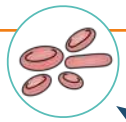
RED BLOOD CELLS ROLE

- Transports O_2 & removes CO_2 from the body with the help of hemoglobin (Hgb)

HEMOGLOBIN (HGB)

- Found in the RBCs
- It's a protein that contains IRON

Normal red blood cells



Iron deficiency anemia

Smaller in size & more pale
(because hemoglobin makes the blood bright red)

SIGNS & SYMPTOMS

SAME SYMPTOMS AS ANEMIA

- Pallor
- Weakness & fatigue
- Shortness of breath (from lack of oxygen)
- Tachycardia
- Microcytic (small) red blood cells

Anemia Normal

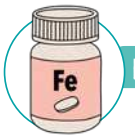
specific to iron deficiency anemia

SEVERE SYMPTOMS

- Smooth, red tongue
- Brittle & ridged nails

TREATMENT/MEDICATIONS

TREAT THE CAUSE: D/C any drugs causing the anemia.



IRON SUPPLEMENTS (oral or liquid)

MOST COMMON TREATMENT

Examples: ferrous sulfate, ferrous gluconate, ferrous fumarate

IV ADMINISTRATION OF IRON

If oral iron is poorly absorbed or poorly tolerated

RISK FACTORS

- Lack of iron (vegetarian diet)
- Blood loss (excessive menstruation, surgery or trauma)
- Pregnancy
- Iron malabsorption (due to bariatric surgery or Celiac disease)

DIAGNOSTIC

- Complete blood count (CBC)
  - ↓ **hemoglobin** & ↓ **hematocrit**
- Bone marrow aspiration
- Stool sample, colonoscopy, endoscopy (checking for blood)

NORMAL VALUES:

Hemoglobin (Hgb)
Female: 12 - 16 g/dL *Male:* 13 - 18 g/dL

Hematocrit (HCT)
Female: 36% - 48% *Male:* 39% - 54%

PATIENT EDUCATION

EDUCATE on administering iron supplements:

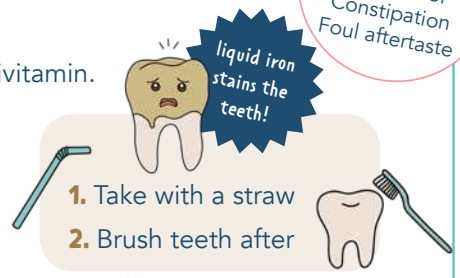
Side effects of iron supplements:
Black stool
Constipation
Foul aftertaste

↑ ABSORPTION

Vitamin C:
Take iron with fruit juice & multivitamin.
Take on an empty stomach

↓ ABSORPTION

Calcium:
Do not take iron with milk or antacids



EDUCATE on foods high in IRON: MNEMONIC **"EAT LOTS OF IRON"**

Egg yolks
Apricots
Tofu

Legumes
Oysters
Tuna
Seeds

P**O**tatoes
Fish

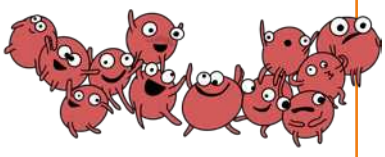
Iron-fortified cereals
Red meats
P**O**ultry
Nuts

THROMBOCYTOPENIA

PATHOLOGY

↓ PLATELETS

- Platelets help clot the blood
- **Platelet aggregation:** the clumping together of platelets that form a plug at the site of injury

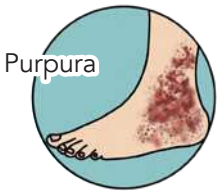


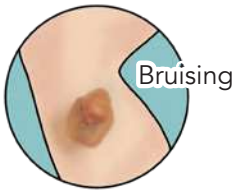
- ↓ Platelets = think bleeding

NORMAL PLATELET COUNT	THROMBOCYTOPENIA
150,000 - 450,000 /µL	< 150,000 /µL

SIGNS & SYMPTOMS

- Weakness, dizziness, tachycardia, hypotension
- Prolonged bleeding time
- Petechiae (pinpoint bleeding)
- Purpura
- Bruising
- Bleeding from the gums & nose
- Heavy menstrual cycles
- Blood in stool or urine





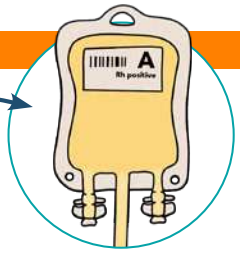
RISK FACTORS

MNEMONIC

- **P** Platelet disorders
- **L** Leukemia
- **A** Anemia
- **T** Trauma
- **E** Enlarged spleen
- **L** Liver disease
- **E** Ethanol (alcohol-induced)
- **T** Toxins (drug-induced)
- **S** Sepsis

TREATMENT

- Platelet transfusion



- Bone marrow transplant
  - Platelets are made in the bone marrow
- Splenectomy
  - For those unresponsive to medical therapy

DIAGNOSTIC

- ↑ Bleeding time
- ↑ INR & ↑ PT/PTT
- ↓ Hgb & Hct
- Bone marrow aspiration & biopsy

PATIENT EDUCATION

EDUCATE they will need to follow **BLEEDING PRECAUTIONS**:

- Use electric razors
- Use small needle gauges
- NO aspirin
- Decrease needle sticks
- Protect from injury

IMMUNE THROMBOCYTOPENIC PURPURA (ITP)

Type of thrombocytopenia, formerly called "**idiopathic thrombocytopenia purpura**"

"Purpura" is in the name because the body bruises easily & petechiae may occur in the trunk & extremities

PATHOLOGY

Autoimmune disease where the body produces antibodies against its own thrombocytes (platelets)

ITP
< 100,000 /µL

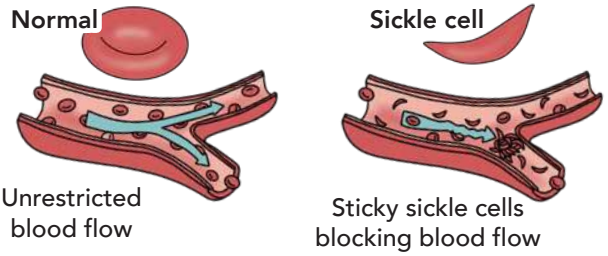
RISK FACTORS

- Children after viral illness
- Females (ages 20-40)
- Pregnancy

SICKLE CELL ANEMIA

PATHOLOGY

An inherited disease that causes the hemoglobin molecule to be defective. RBCs are weak and die earlier than healthy RBCs.



Hemoglobin S is sensitive to low amounts of oxygen in the body!

Low oxygen
↓
Causes RBCs to change their shape
↓
Sickled shaped, sticky, and stiff
↓
Causes clumping which blocks blood flow to the tissues
↓
⚠ SICKLE CELL CRISIS ⚠

3 CELL TYPES OF SICKLE CELLS CRISIS:

Acute vaso-occlusive crisis	RBCs sticking in vessels = hypoxia *(this is very painful!)* MOST COMMON
Aplastic crisis	The body stops producing enough RBCs (bone marrow can't keep up)
Sequestration crisis	The spleen stops working & becomes flooded with the sickle cells

RISK FACTORS

A patient is born with this genetic blood disorder. It's an autosomal recessive disorder (the sickle hemoglobin (HbS) gene is inherited).

It's commonly recognized early in life after maternal iron stores have been depleted.

DIAGNOSTIC

- Blood sample
- Test before birth
  (testing the amniotic fluid)

AUTOSOMAL RECESSIVE

Either parent can have the sickle cell trait, but this doesn't mean they have sickle cell anemia. BOTH parents have to pass down the sickle hemoglobin (HbS) gene.

MEDICATIONS

- Analgesics & opioids
  To help with the pain

TREATMENT/ NURSING CONSIDERATIONS

- IV fluids (stops the clumping of RBCs)
- Oxygen therapy
- RBC transfusions
- Stem cell transplant

SIGNS & SYMPTOMS

- Anemia symptoms
  (fatigued, tachycardia, pallor)
- ★ **Pain**
- Dactylitis
  (swelling of the hands & feet)
- Stroke
- Acute chest syndrome
  (tachypnea, wheezing, fever, cough)

PATIENT EDUCATION

EDUCATE on how to **prevent** sickle cell crisis:

- ✔ Vaccines up to date
- ✔ Prevent infection
  (hand hygiene, avoiding big crowds)
- ✔ Limit stress
- ✔ Avoid high altitudes
- ✔ Drink lots of water
  (stay hydrated)
- ✔ Smoking cessation
- ✔ Avoid over-exertion

MED-SURG
HEMATOLOGY

DISSEMINATED INTRAVASCULAR COAGULATION (DIC)

PATHOLOGY

Causative factor (underlying disease)

↓

Inflammatory response causes inflammation & coagulation in the vasculature

↓

The fibrinolytic system is halted

↓

Causes lots of small clots & platelets to clump

↓

Lots of small clots are using all the blood's clotting factors. This leaves other parts of the body with no means of stopping any bleeding.

TOO LITTLE CLOTTING
(BLEEDING)

+

HAPPENING AT THE SAME TIME

Excessive clotting causes blockage of blood vessel

TOO MUCH CLOTTING

↓

Can lead to organ ischemia (because organs are not getting blood supply)

SIGNS & SYMPTOMS

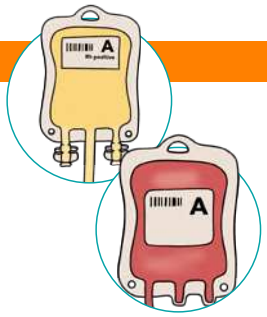
BLEEDING & **BLOOD CLOTS**

Bleeding can be minimal all the way up to hemorrhaging everywhere

Stroke, heart attack, deep vein thrombosis, or a pulmonary embolism

- Petechiae & purpura
- Hematuria
- Melena (black tarry stools)
- Nose bleeds

TREATMENT



- **Treat the underlying cause!**
- Transfusion
  - Packed RBCs
  - Fresh frozen plasma (FFP)
  - Platelets

MEDICATIONS

- **Vasopressors**
  Cause vasoconstriction which ↑ blood flow & increases perfusion to the organ
- **Heparin infusion**
  Stops the clotting which increases blood flow to the organs
- **Cryoprecipitate**
  Replaces fibrinogen, factors V & VII

RISK FACTORS

DIC is not a disease. Rather, DIC occurs due to an underlying condition or disease:

- Infection/sepsis
- Malignancy
- Allergic reactions
- Obstetric complications
- Trauma
- Shock
- Toxins

DIAGNOSTIC

- Lab tests
  - ↓ platelet & ↓ fibrinogen levels
  - Prolonged clotting time (↑ PT, aPTT)
  - ↑ D-dimer (indicates there is a clot somewhere in the body)

NURSING CONSIDERATIONS

- Administer oxygen
- IV fluids
- Correct electrolyte imbalances

MONITOR:

- For signs of bleeding
- Vital signs
- Lab values

MED-SURG
GASTRO

GASTROINTESTINAL SYSTEM OVERVIEW

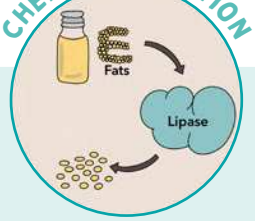
ORAL CAVITY COMPONENTS

MECHANICAL DIGESTION

Physical movement of food
(when food is broken down into smaller pieces)

EXAMPLES:
- Chewing
- Churning of the stomach

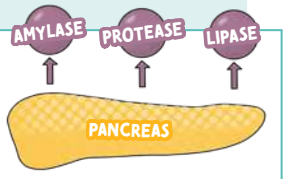
CHEMICAL DIGESTION



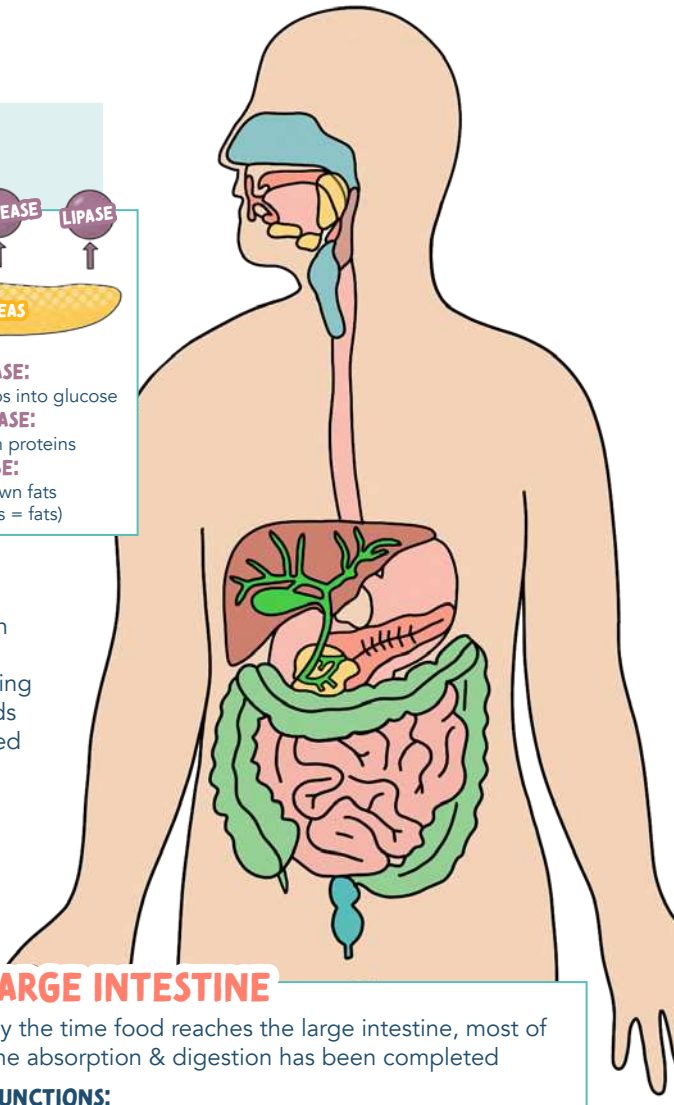
When food is broken down by ENZYMES and digestive juices

TIP: Enzymes end in "-ASE"

MEMORY TRICK: Protease think Proteins
Lipase think Lipids (fat)



AMYLASE:
breaks down carbs into glucose
PROTEASE:
breaks down proteins
LIPASE:
breaks down fats
(think lipids = fats)



ESOPHAGUS

Is a hollow muscular tube that carries food & liquid from the mouth to the stomach. It does this by peristalsis.

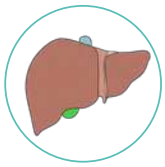
STOMACH

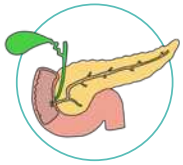
A hollow muscular organ

FUNCTIONS:
- Stores food during eating
- Secretes digestive fluids
- Moves partially digested food (chyme) into the small intestine

LIVER

FUNCTIONS:
- Filters the blood
- Metabolism of sugar, protein, and fat
- Synthesize lipoproteins (VLDL & HDL)
- Makes vitamin D
- Detoxifications
  (excretion of bilirubin and other toxins)
- Bile formation
- Drug metabolism
- Helps in blood clotting
- Synthesize proteins such as albumin and coagulation factors





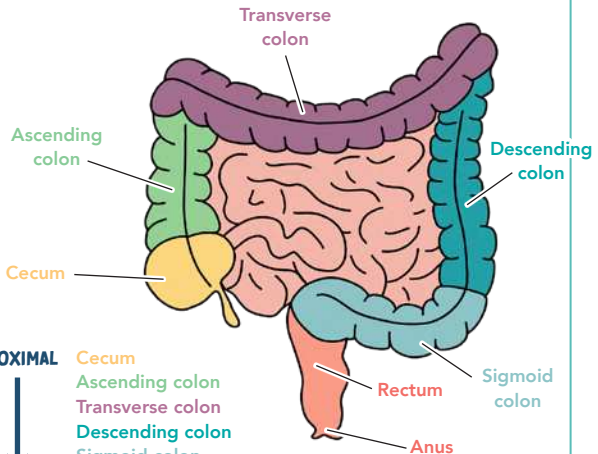
PANCREAS

Helps make pancreatic juice (enzymes). This pancreatic juice break down sugar, fat, and starch. The pancreas has both exocrine and endocrine functions.

LARGE INTESTINE

By the time food reaches the large intestine, most of the absorption & digestion has been completed

FUNCTIONS:
- **ABSORBS** water and electrolytes from food that has not been digested yet
- **DEFECATION** rids the body of any waste leftover from food and removes it through the rectum and anus

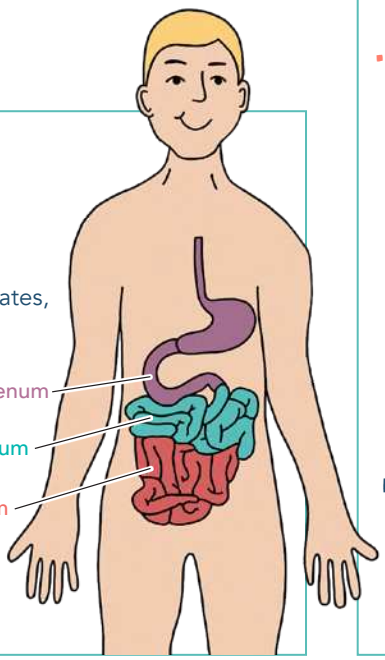


PROXIMAL
Cecum
Ascending colon
Transverse colon
Descending colon
Sigmoid colon
Rectum
Anus
DISTAL

SMALL INTESTINE

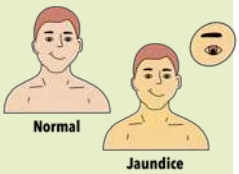
The longest portion of the GI tract (longer than the large intestine)

FUNCTIONS:
- **DIGESTION** of food from the stomach
- **ABSORPTION** of nutrients, fats, carbohydrates, vitamins, minerals, etc.) and water from food into the bloodstream to be used by the body



MEMORY TRICK: To remember the order (PROXIMAL - DISTAL)
DJ Ileum in the club!

LAB VALUES RELATED TO THE GASTROINTESTINAL SYSTEM

	EXPECTED RANGE		
AMYLASE Pancreatic enzyme	**30 – 110** U/L	↑ levels could indicate pancreatitis	**LIPASE** is a better indicator of pancreatitis than **AMYLASE** because serum lipase remains elevated for a longer period of time. MEMORY TRICK Lipase think Longer
LIPASE Pancreatic enzyme	**< 200** U/L		
BILIRUBIN Produced by the liver	Total **0.2 – 1.2** mg/dL	↑ levels could indicate liver dysfunction	**JAUNDICE:** Yellow discoloration of the skin due to high levels of bilirubin. Visible when serum bilirubin is > 2 mg/dL 
ALBUMIN	**3.5 – 5.5** g/dL	↑ levels could indicate dehydration	Albumin helps keep fluid in your bloodstream
PREALBUMIN	**15 – 36** mg/dL	↓ levels could indicate malnutrition	Prealbumin is great for assessing **NUTRITIONAL STATUS**
AST Liver enzyme	**0 – 35** U/L	↑ levels could indicate liver dysfunction	**AST** must be taken with **ALT** If ALT is normal, this means there is a problem other than liver disease, such as damage to another organ (heart, brain, muscle, kidneys)
ALT Liver enzyme	**0 – 48** U/L		
AMMONIA	**10 – 80** mcg/dL	↑ levels could indicate liver dysfunction	Ammonia (NH_3) is produced by cells throughout the body and is used by the **LIVER** to make urea. If the liver stops working, ammonia increases in the body. Too much ammonia is very toxic (especially to the brain)

Part of the liver function test (LFT)

ACUTE & CHRONIC PANCREATITIS

PATHO

The islets of Langerhans secrete **INSULIN & GLUCAGON INTO THE BLOOD STREAM**

Pancreatic tissue: secrete digestive enzymes that break down **CARBOHYDRATES, PROTEINS & FATS**

PANCREATITIS is an **AUTO-DIGESTION** of the pancreas by its own digestive enzymes released too early in the pancreas

LABS

- ↑ Amylase
- ↑ Lipase
- ↑ WBCs
- ↑ Bilirubin
- ↑ Glucose
- ↓ Platelets
- ↓ Ca & Mg

ACUTE vs CHRONIC

ACUTE: Sudden inflammation that is **REVERSIBLE** if prompt recognition and treatment is done

CHRONIC: Chronic inflammation that is **IRREVERSIBLE**

CAUSES

ACUTE

- **Gallstones**
  - Blocks the bile duct
- **Alcohol (ETOH)**
  - Damages the cells of the pancreas
- **Infection**
- **Medications**
- **Tumor**
- **Trauma**

CHRONIC

- **Repeated episodes of acute pancreatitis**
- **Excessive & prolonged consumption of alcohol (ETOH)**
  - Recurrent damage to the cells of the pancreas
- **Cystic Fibrosis**

SIGNS & SYMPTOMS

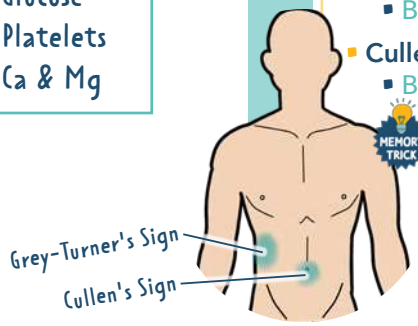
In **ACUTE**, there will still be working functions of the pancreas.

In **CHRONIC**, you will see different S&S due to the prolonged damage & loss of function

ACUTE

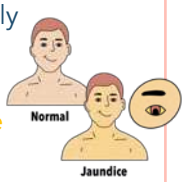
- **Sudden sever PAIN!**
  - Mid-epigastric pain LUQ
- **Nausea & vomiting**
- **Fever**
- **↑ HR & ↓ BP**
- **↑ Glucose**
- **Mental confusion & agitation**
- **Abdominal guarding**
- **Rigid/board-like abdomen**
- **Grey-Turner's Sign**
  - Bluish discoloration at the flanks
- **Cullen's Sign**
  - Bluish discoloration of the umbilicus

MEMORY TRICK: **C**ullen's = **C**ircle belly button



CHRONIC

- **Chronic epigastric pain or no pain**
- **Pain ↑ after drinking ETOH or after a fatty meal**
- **Steatorrhea "fatty stools"**
  - Oily/greasy frothy stool
- **Weight loss**
  - Can't digest food properly
- **Jaundice**
  - Yellowish color of the skin from build up of bile



- **Diabetes Mellitus**
  - Damage to the islet of Langerhans
- **Dark urine**
  - From excess bile in the body

MEDICATIONS

- Opioid analgesics
- Antibiotics
- Pancreatic enzymes
- Insulin
- Proton Pump Inhibitors (PPI's), H2 antagonists, antacids

DIGESTIVE ENZYMES (EXOCRINE)

AMYLASE: Breaks down carbs to **glucose**

PROTEASE: Breaks down **proteins**

LIPASE: Breaks down **fats**

INTERVENTIONS

- Rest the pancreas!
  - NPO
    (we don't want stimulation of the enzymes)
- IV fluids
- Pain management
- Positioning
  - Side lying ➜ fetal position, NOT supine!
- Insert NG tube
  - Remove stomach contents

MONITOR:

- Glucose
- Blood pressure
- Intake & output
- Laboratory values
- Stools

DIET

- NO ETOH!
- ↑ protein
- Limit sugars

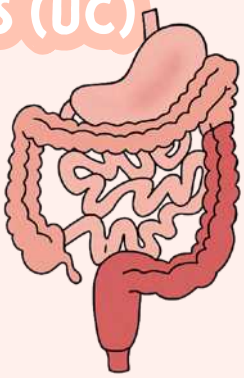
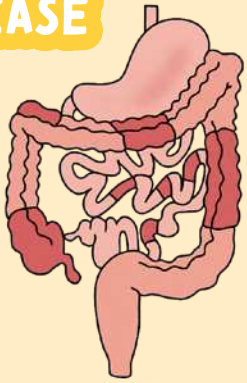
- ↓ fat (no greasy, fatty foods)
- Complex carbohydrate (fruits, vegetables, grains)

MED-SURG
GASTRO

ULCERATIVE COLITIS VS. CROHN'S DISEASE

This is not the same thing as irritable bowel syndrome (IBS)

TYPES OF Inflammatory Bowel Disease (IBD)

	MOST COMMON ULCERATIVE COLITIS (UC)	CROHN'S DISEASE
DESCRIPTION	Chronic ulceration & inflammation of the rectum & colon 	Inflammation of the gastrointestinal tract wall at ANY point through ALL layers 
LOCATION	Affects the large intestine & rectum only	Can affect anywhere in the GI tract (mouth to the anus)
THICKNESS	Inflammation affects the submucosa or mucosa	Inflammation is transmural (occurring across the entire wall)
APPEARANCE	Inflamed areas are continuous with no patches	Patches of inflammation throughout the bowel This makes a cobblestone appearance! MEMORY TRICK: Crohn's think Cobblestone
CURE	✔ **YES!** Colectomy	✘ **NO** cure, but surgery can help with symptoms
COMPLICATIONS	Toxic mega colon, rupture of bowel, dehydration Increased risk for hemorrhage/ shock	Abscess, fistulas Increased risk for infection (sepsis)
SIMILARITIES	▪ Both a form of inflammatory bowel disease (IBD) ▪ Causes of both are not completely known ▪ Both increase the risk for colon cancer ▪ Both cause inflammation & ulcers ▪ Both should consume the following diet: ↓ fiber, ↑ protein diet, & ↑ fluids	

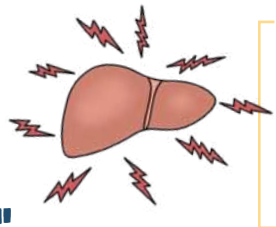
MED-SURG
GASTRO

TYPES OF HEPATITIS

HEPATITIS

LIVER + INFLAMMATION

"INFLAMMATION OF THE LIVER"

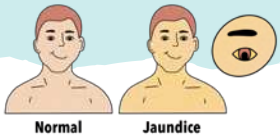


CAUSED BY:

- Viral (A, B, C, D, E) — MOST COMMON
- Excessive use of alcohol
- Hepatotoxic medications

	TRANSMISSION	SIGNS & SYMPTOMS	DIAGNOSTIC	TREATMENT	VACCINE
HAV ACUTE ONLY	**Fecal & oral** Food & water	GI symptoms (N&V, stomach pain, anorexia) Dark-colored urine Clay-colored stool Vomiting Flu-like symptoms Jaundice	Anti-HAV IgM = Active infection IgG = Recovered (It's Gone)	Supportive therapy... REST!	✔
HBV B IS BOTH ACUTE & CHRONIC	MEMORY TRICK B think Body Fluids *(Semen, saliva)* • Birth & blood • Childbirth, sex, & IV drugs		HBsAG = Active infection Anti-HBs = Immune / recovery	**ACUTE** Supportive therapy & rest **CHRONIC** Antivirals	✔
HCV ACUTE & CHRONIC	**Body fluids** Most common: IV drug users		Anti-HCV No post exposure immunoglobulin	Antivirals Interferon	✘
HDV ACUTE & CHRONIC	MEMORY TRICK Depends on B B & D = BuDs Hep D occurs with Hep B		HDAg Anti-HDV	Antivirals Interferon	✘
HEV ACUTE ONLY	**Fecal & oral** Food & water *uncooked meats, 3rd world countries*		Anti-HEV	Supportive therapy... REST!	✘

YELLOW DISCOLORATION of the skin from the buildup of bilirubin



EDUCATION for ALL types of Hepatitis!

- Rest
- Diet
- Small frequent meals
- ↑ Carbohydrates
- ↑ Calories
- ↓ Protein & fat
- Proper hand hygiene
- Do not share personal hygiene products
- Avoid sex until hepatitis antibodies are negative
- Educate on toxic substances to avoid
- Alcohol, acetaminophen, aspirin, sedatives

LABS:

All will be elevated in Hepatitis

Liver enzymes:
ALT: 0 - 48 U/L
AST: 0 - 35 U/L
Bilirubin: 0.2 - 1.2 mg/dL
Ammonia: 10 - 80 mcg/dL

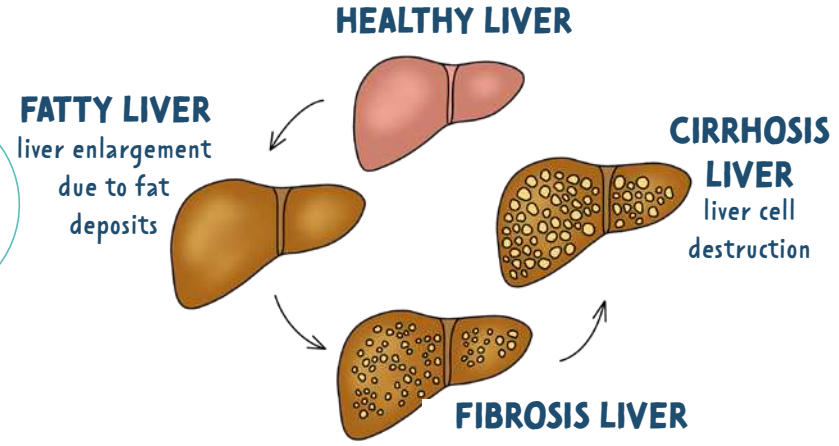
CIRRHOSIS

FUNCTIONS of a healthy Liver

1. **DETOX** the body
2. Helps to **CLOT** the blood
3. Helps to **METABOLIZE** (break down) drugs
4. **SYNTHESIS** (makes) **ALBUMIN**

If the function of the liver is disrupted, then all these functions are not working properly

STAGES OF LIVER DAMAGE



PATHOLOGY

- Liver cells are **DESTROYED** and replaced with fibrotic (scar) tissue.
- Loss of normal function of the liver.

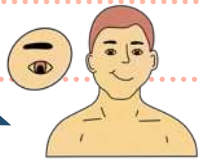
CAUSES

- **Alcoholic cirrhosis** (MOST COMMON)
  Caused by excessive alcohol intake
- Nonalcoholic fatty liver disease (NAFLD)

- Viral hepatitis B & C
- Autoimmune
- Hepatotoxic drugs
- Toxins & parasites
- Fat collection in the liver (obesity, diabetes, ↑ cholesterol)

SIGNS & SYMPTOMS

- Asterixis
  - *Liver flap*
- Ascites
- Edema
- Abdominal pain
- Chronic dyspepsia (GI upset)
- Itchy skin
- Jaundice
  - *Yellow discoloration in the eyes & skin*
- ↑ Bilirubin & ammonia
- ↓ Platelets
  - *Risk for bleeding*
- ↓ WBC's
  - *Risk for infection*


Jaundice

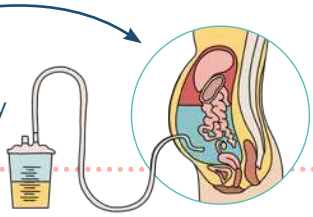

Normal

COMPLICATIONS

- Portal HTN
  - Portal veins become narrow due to scar tissue
- GI bleeding (esophageal varices)
- Splenomegaly
- Anemia
- Hepatic encephalopathy/coma
  - Due to ↑ ammonia levels (ammonia is a sedative)
- Gynecomastia
  - Breast development in men
- Hepatorenal syndrome
  - Acute kidney injury *in clients with liver failure*

TREATMENT

- Stop alcohol consumption
- Rest
- Measure abdominal girth
- Paracentesis
  - Removal of fluid from the peritoneal cavity (ascites)
- Daily weights & I&O's
- Liver transplant
- Prevent **BLEEDING**



REMEMBER: the liver normally helps clot the blood

BLEEDING PRECAUTIONS

- Use electric razor
- Use soft-bristled toothbrush
- Hold pressure on scrapes/cuts to minimize bleeding

MEDICATIONS

AVOID NARCOTICS The liver can't metabolize drugs when it's sick

- Antacids
- Diuretics
- Vitamins
- Lactulose
  - ↓ serum ammonia through the stool

MEMORY TRICK Lactulose think LactuLOOSE because it LOOSENS the bowels

⚠ Do not give acetaminophen to people with liver issues!

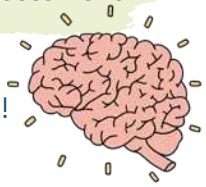
MED-SURG
NEURO

NEUROLOGICAL ASSESSMENTS

LEVEL OF CONSCIOUSNESS (LOC)

LEVEL OF CONSCIOUSNESS (LOC)
is always **#1** with neurological assessment

A change in LOC may be the only sign that there is a PROBLEM!



PUPILLARY CHANGES

PERRLA

Pupils, Equal, Round, Reactive to Light & Accommodation

NORMAL PUPIL SIZE: **2 – 6** mm

MENTAL STATUS

- Are they aware of their surroundings?
- Are they oriented to person, place, time, & situation?
- Do they have their short term & long term memory?

ASK these types of questions to assess mental status:

- What is your name?
- Do you know where you are?
- Do you know what month it is?
- Who is the current U.S. president?
- What are you doing here?

GLASGOW COMA SCALE

TOOL FOR ASSESSING A CLIENT'S RESPONSE TO STIMULI

EYE OPENING RESPONSE	Spontaneous	4
	To speech	3
	To pain	2
	No response	1
VERBAL RESPONSE	Oriented	5
	Confused	4
	Inappropriate words	3
	Unclear sounds	2
	No response	1
MOTOR RESPONSE	Obeys command	6
	Moves to localized pain	5
	Flex to withdraw from pain	4
	Abnormal flexion	3
	Abnormal extension	2
	No response	1
TOTAL	3 – 15	

INTERPRETATION

WORST: **3** Severe impairment of neurological function, coma, or brain death

<8 Unconscious patient

BEST: **15** Fully alert & oriented

DEEP TENDON REFLEX (DTR) RESPONSES

- **0** = No response ABSENT
- **1+** = Present, but sluggish or diminished
- **2+** = Active or expected response NORMAL
- **3+** = More brisk than excited; hyperactive
- **4+** = Brisk, hyperactive, with intermittent, or transient clonus

BABINSKI REFLEX (PLANTAR REFLEX)

Elicited by stroking the lateral side of the foot

INTACT CNS

The lateral sole of the foot is stroked and the toes contract & draw together.

BRAIN DYSFUNCTION

Toes fan out when stroked.

Remember this is **only normal in newborns & infants up to 2 years of age**, but **abnormal in adults!**

MEMORY TRICK

Babinski think normal in Babies & the Big toe fans out

MED-SURG
NEURO

SEIZURES

WHAT IS A SEIZURE? Abnormal & sudden electrical activity of the brain

WHAT IS EPILEPSY? Chronic seizure activity due to a chronic condition

CAUSES

- ↑ fever (Febrile seizure in child)
- CNS infection
- Drug or alcohol withdrawal
- ABG imbalance
- Hypoxia
- Brain tumor
- Hypoglycemia
- Head injury
- Hypertension

STAGES OF A SEIZURE

PRODROMAL

When symptoms start before the actual seizure

(can be days before the seizure happens)

AURA

Warning sign right before the seizure happens:

- Weird smell or taste
- Altered vision
- Dizzy

Not all patients experience an aura

ICTUS

SEIZURE!

Status Epilepticus: a seizure that lasts >5 minutes without any consciousness during the seizure

POST-ICTUS

Recovery after the seizure

- Headache
- Possible injury
- Confusion
- Very tired

GENERALIZED SEIZURES

THE ENTIRE BRAIN IS AFFECTED

TONIC-CLONIC	"Used to be called grand-mal" May begin with an aura. Stiffening (tonic) and/or rigidity (clonic) of the muscles.
MYOCLONIC	Sudden jerking or stiffening of the extremities (arms or legs).
ABSENCE	Usually looks like a blank stare that lasts seconds. Often goes unnoticed
ATONIC	Sudden loss of muscle tone. May lead to sudden falls or dropping things.

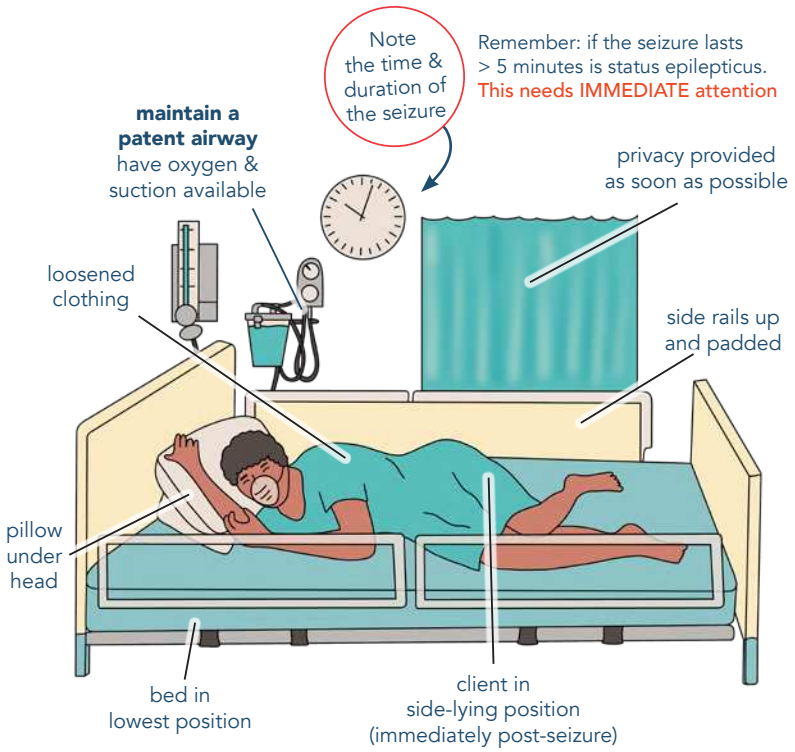
PARTIAL (FOCAL) SEIZURES

ONE AREA OF THE BRAIN IS AFFECTED

SIMPLE PARTIAL	Sensory symptoms with motor symptoms and stays aware. They may report an aura.
COMPLEX PARTIAL	Altered behavior/awareness and loses consciousness for a few seconds.

CARE DURING THE SEIZURE

SEIZURE PRECAUTIONS



DON'T

- Restrain the client
- Force the jaw open
- Place anything in their mouths
- Leave the client

MED-SURG
NEURO

CEREBROVASCULAR ACCIDENT (CVA) "STROKE"

PATHOLOGY

Sudden interruption of blood supply to the brain.

The pathology of a stroke depends on the type of stroke.

RISK FACTORS

MODIFIABLE

- ★ Hypertension
- Atherosclerosis
- Anticoagulation therapy
- Diabetes mellitus
- Obesity
- Stress
- Oral contraceptives

NON-MODIFIABLE

- Family history of strokes
- Older age
- Male gender
- Black
- Hispanic

SIGNS & SYMPTOMS

MNEMONIC

- **F** **Face drooping**
  - Uneven smile
- **A** **Arm weakness**
  - Arm numbness; can't lift arm
- **S** **Speech difficulty**
  - Slurred speech
- **T** **Time to call 911**

RIGHT BRAIN

- Behavioral changes
- Lack of impulse control
- LEFT-sided hemiparesis (1-sided weakness)

MEMORY TRICK

Right think Reckless

Remember: If the stroke occurs in the left side of the brain, the right side of the body will be affected

LEFT BRAIN

- Issues with language (aphasia)
- RIGHT-sided hemiparesis (1-sided weakness)

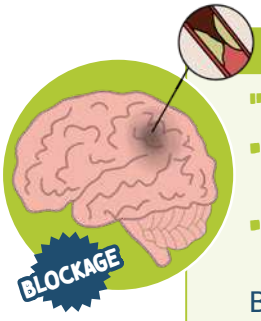
MEMORY TRICK

Left think Languages

TYPES OF APHASIA:

RECEPTIVE: Unable to comprehend speech **(Wernicke's area)**

EXPRESSIVE: Can comprehend speech, but can't respond back with speech **(Broca's area)**



ISCHEMIC STROKE

"THROMBOTIC OR EMBOLIC"

- **Thrombosis:**
  A blood clot that formed on the artery wall
- **Embolism:**
  A blood clot that has left part of the body

Blood flow is cut off which leads to **ischemia**

TRANSIENT ISCHEMIC ATTACKS (TIAs)
"Mini strokes" ▪ No cerebral infarction occurs

MEDICATIONS:

- **Fibrinolytic therapy** ("clot buster")
  Suffix: -ase
  Examples: alteplase, streptokinase

Must be given within 4.5 hours from onset of symptoms

HEMORRHAGIC STROKE

- Ruptured artery
- Aneurysm (weakening of the vessel)
- Uncontrolled hypertension

The collection of blood in the brain leads to **ischemia & increased ICP**

TREATMENT:

- **Stop the bleeding**
- **Prevent ↑ ICP**

NURSING CONSIDERATIONS

POSITIONING OF THE CLIENT

- Elevate head of bed to ↓ ICP
- Place a pillow under the affected arm in a neutral position

PREVENTATIVE DVT MEASURES

- Compression stockings
- Frequent position change
- Mobilization
- Encourage passive range of motion every 2 hours

ASSIST WITH COMMUNICATION SKILLS

- Be patient
- Make clear statements
- Ask simple questions
- Don't rush!

ASSIST WITH SAFE FEEDING

- Do not feed until gag reflex has come back
- ↓ chances of aspiration
- Keep suction at the bedside
- Crush medications

DIET MODIFICATIONS

- After a stroke, a patient will start on a liquid diet and progress slowly to a regular diet.

LIQUID

- Thin
- Nectar-like
- Honey-like
- Spoon-thick

FOOD

- Pureed
- Mechanically altered
- Mechanically softened
- Regular

MED-SURG
NEURO

CRANIAL NERVES

WHAT ARE CRANIAL NERVES?

Nerves that originate from the brain stem.
They send information to & from various parts of the body.

SE SENSORY
M MOTOR
B BOTH

START

MNEMONICS

Ooh,	Olfactory	Some	Sensory
Ooh,	Optic	Say	Sensory
Ooh	Oculomotor	Marry	Motor
To	Trochlear	Money	Motor
Touch	Trigeminal	But	Both
And	Abducens	My	Motor
Feel	Facial	Brother	Both
Very	Vestibulocochlear / Acoustic	Says	Sensory
Good	Glossopharyngeal	Big	Both
Velvet.	Vagus	Brains	Both
Such	Spinal Accessory	Matter	Motor
Heaven!	Hypoglossal	More	Motor

XII: HYPOGLOSSAL — M

GLOSSO MEANS TONGUE!

FUNCTION:
Tongue movement (swallowing & speech)

TEST:
Inspect tongue & ask to stick tongue out

XI: SPINAL ACCESSORY — M

FUNCTION:
Controls strength of neck & shoulder muscles

TEST:
Ask the client to rotate their head & shrug their shoulders

X: VAGUS — B

FUNCTION:
MOTOR - Swallowing, speaking, & cough
SENSORY - Facial sensation

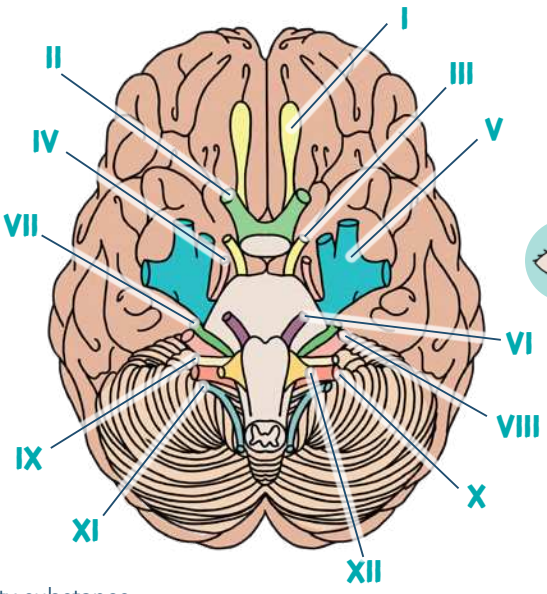
TEST:
Sensation coming from skin around the ear

IX: GLOSSOPHARYNGEAL — B

GLOSSO MEANS TONGUE!

FUNCTION:
MOTOR - Tongue movement & swallowing
SENSORY - Taste (sour & bitter)

TEST:
Test tongue by giving client sour, bitter, & salty substance.



VIII: VESTIBULOCOCHLEAR / ACOUSTIC — SE

FUNCTION:
Balance & hearing

TEST:
- Stand with eyes closed
- Otoscopic exam
- Rinne & Weber Tests

RINNE TEST


WEBER TEST

VII: FACIAL — B

FUNCTION:
MOTOR - Facial expression
SENSORY - Taste (sweet & salty)

TEST:
- Ask client to do different facial expression (Frown, smile, raise eyebrows, close eyes, blow etc)
- Test tongue by giving client sour, sweet, bitter, and salty substances.

VI: ABDUCENS — M

FUNCTION:
Controls parallel eye movement
Abduction - moving laterally
AKA away from midline

TEST:
- Look up, down, & inward
- Ask the client to follow your finger as you move it towards their face

V: TRIGEMINAL — B

FUNCTION:
MOTOR - Mastication (biting & chewing)
SENSORY - Facial sensation

TEST:
- Pressure on the forehead cheek & jaw with a cotton swab to check sensation
- Ask client to open mouth & then bite down

I: OLFACTORY — SE

FUNCTION:
Sense of smell

TEST:
Smell substance with eyes closed (test each nostril separately)

II: OPTIC — SE

FUNCTION:
Vision

TEST:
- Snellen chart
- Ophthalmoscopic exam
- Confrontation to check peripheral vision

III: OCULOMOTOR — M

FUNCTION:
Ocular (eye) motor (movement)
Controls most eye movements, pupil constriction, & upper-eyelid rise

TEST:
- Look up, down, & inward
- Ask the client to follow your finger as you move it towards their face

IV: TROCHLEAR — M

FUNCTION:
Controls downward & inward eye movement

TEST:
- Look up, down, & inward
- Ask the client to follow your finger as you move it towards their face

BURNS

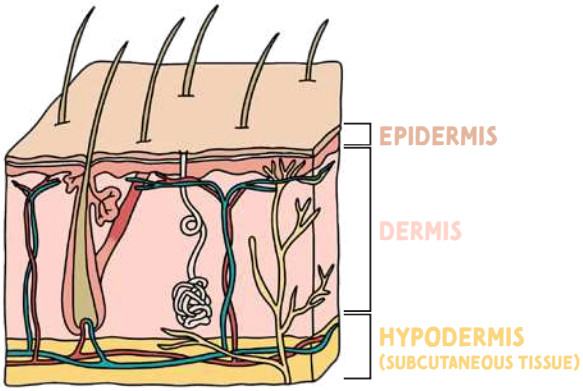
WHAT IS A BURN?

Damage to skin integrity

BURNS INJURY DEPTH

1ST DEGREE — Superficial	▪ Epidermis ▪ Pink & painful (still has nerves) ▪ No scarring	**BLANCHING**: present **HEALS**: a few days
2ND DEGREE — Superficial Partial Thickness	▪ Epidermis & dermis ▪ Blisters, shiny, & moist ▪ Painful	**BLANCHING**: present **HEALS**: 2 - 6 weeks
3RD DEGREE — Full Thickness	▪ Epidermis, dermis, & hypodermis ▪ May look black, yellow, red & wet ▪ No pain/limited pain (nerve fibers are destroyed) ▪ Skin will not heal (need skin grafting) ▪ **Eschar**: dead tissue, leathery; must be removed!	

LAYERS OF THE SKIN



TYPES OF BURNS

MOST COMMON — Thermal	Superficial heat *Examples:* *liquid, steam, fire*
Chemical	Burn caused by a toxic substance. Can be alkalotic or acidic *Examples: bleach, gasoline, paint thinner*
Radiation	Sunburns (UV radiation) & cancer treatment (radiation therapy)
Inhalation	Caused by inhaling smoke which can cause flame injury or carbon monoxide poisoning
Friction	Burn caused when an object rubs off the skin *Examples: road rash, scrapes, carpet burn*
Cold	Skin has been overexposed to cold *Examples: frostbite*
Electric	Electrical current that passes through the body, causing damage within

INHALATION INJURY

Damage to the respiratory system. Happens mostly in a **closed area**

SIGNS OF INHALATION INJURY:

- Hair singed around the face, neck, or torso
- Trouble talking
- Soot in the nose or mouth
- Confusion or anxiety

CARBON MONOXIDE (CO) POISONING

Carbon monoxide travels faster than oxygen, allowing it to bind to hgb first. Now oxygen cannot bind to hgb = **HYPOXIA**

Classic symptom: cherry red skin

Treatment: 100% O_2

POTENTIAL COMPLICATIONS

Dysrhythmias, fracture of bones. Release of **myoglobin & hemoglobin** into the blood which can clog the kidneys.

BURN LOCATION

RESPIRATORY

- Face
- Neck
- Chest
- Torso

DISABILITY

- Hands
- Feet
- Joints
- Eyes

TROUBLE HEALING

- Poor blood supply
- Diabetes
- Infection

INFECTION

Any open area where bacteria can easily enter

- Perineum
- Ears
- Eyes

COMPARTMENT SYNDROME

- In the extremities
  Tight skin such as eschar acting like a band around the skin cutting off blood circulation

MED-SURG
CRITICAL CARE

PHASES OF BURN MANAGEMENT

MNEMONIC "EAR" = EMERGENT, ACUTE, REHABILITATIVE

EMERGENT PHASE — 24 - 48 HOURS after burn

Onset of injury to the restoration of capillary permeability

PATHO

↑ Capillary permeability (leaky vessels) causing:

- Plasma leaves the intravascular space
  - Albumin & sodium follows
- Fluids shift to the interstitial tissue

LEADS TO EDEMA

Leads to fluids volume deficit (FVD) in the intravascular space

VITAL SIGNS

- ↑ Pulse
- ↓ Blood pressure
- ↓ Cardiac output

Think HYPOVOLEMIC SHOCK!

- ↓ Urine output *(from ↓ perfusion to the kidneys)*

LABS

- ↑ Potassium (K+)
- ↑ Hematocrit (HCT)
- ↓ White blood cells (WBCs)
- ↑ BUN/ceatinine

NURSING CONSIDERATIONS

Think ABCs

- Establish IV access *(preferably 2)*
- Fluids (Lactated Ringer's, crystalloids)
- Parkland formula
- Foley catheter to monitor urinary output (UOP)
  - **GOAL:** > 30 mL/hr of UOP
- Decrease edema
  - Elevate extremities above heart level

ACUTE PHASE — 48 - 72 HOURS after burn & until wounds have healed

Capillary permeability stabilized - to wound closure

PATHO

Capillary permeability is restored which leads to the body diuresing (increased urine production). All the excess fluid that shifted from the interstitial tissue shifts back into the intravascular space.

GOALS

- **PREVENT INFECTION**
  - Systemic antibiotic therapy
- **ENSURE PROPER NUTRITION**
  - Needs ↑ calories
  - Protein & Vit C to promote healing
- **ALLEVIATE PAIN**
- **WOUND CARE**
  - Premedicate before wound care
  - Debridement or grafting

NURSING CONSIDERATIONS

- **RENAL**
  - Diuresis is happening
  - Foley catheter to monitor UOP
- **RESPIRATORY**
  - Possible intubation if respiratory complications occurred
- **GASTROINTESTINAL**
  - Since the client is in FVD, there is ↓ perfusion to the stomach
    - Paralytic ileus
    - Curlings ulcer
  - Medication to decrease chance of ulcers
    - H2 histamine blocking agent (↓HCl)
  - Monitor bowel sounds
  - May need NG tube for suctioning

REHABILITATIVE PHASE — Could be weeks - years

Burn healed and the patient is functioning mentally & physically

GOALS

- Psychosocial
- Activities of daily living (ADLs)
- Physical therapy (PT)
- Occupational theory (OT)
- Cosmetic corrections

MED-SURG
CRITICAL CARE

FLUID RESUSCITATION FOR BURNS

THE PARKLAND FORMULA

Used to calculate the total volume of fluids (mL) that a patient needs **24 hours** after experiencing a burn

Apply only in 2nd & 3rd degree burns.

4 ML X TBSA (%) X BODY WEIGHT (KG)
= TOTAL ML OF FLUID NEEDED

↓

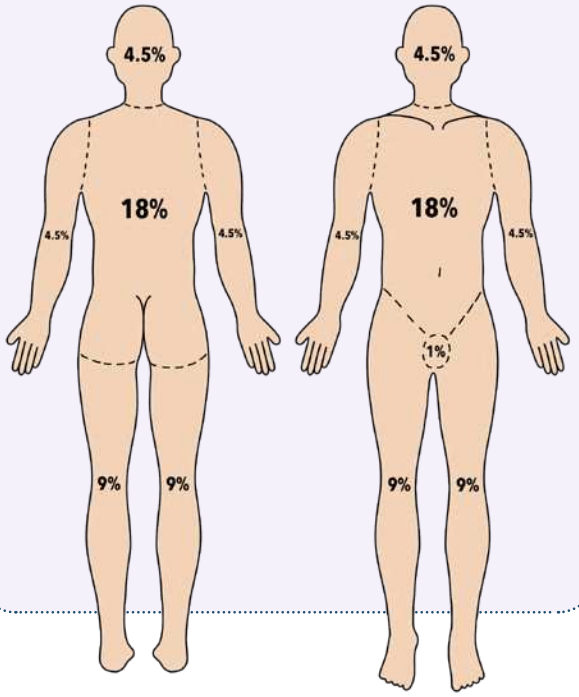
Give the first ½ of the solution in the **FIRST 8 HOURS**

↓

Over the **NEXT 16 HOURS,** give the second ½ of the solution

RULE OF NINES

Quick estimate of the % of the **total body surface area (TBSA)** has been effected by a partial & full-thickness burn in an adult client.



PRACTICE QUESTION

PART 1: CALCULATING TBSA (%)

A 25 year old male patient who weighs **79 kg** has sustained burns to the back of the right arm, posterior trunk, front of the left leg, and their anterior head and neck. Using the **Rule of Nines**, calculate the total body surface area percentage that is burned.

Back of right arm - 4.5%
Posterior trunk - 18%
Front of left leg - 9%
Anterior head & neck- 4.5%

ANSWER: 36%

NOTE:
The formula uses TBSA (%). However, you must calculate using 36. Not 0.36 (also written as 36%).

PART 2: THE PARKLAND FORMULA

Use the Parkland formula to calculate the total amount of Lactated Ringer's solution that will be given over the next 24 hours.

ANSWER: 11,376 mL

4 mL X 36% X 79 kg = 11,376 mL

↓

11,376 / 2 = 5,688 mL
FIRST 8 HOURS

↓

11,376 / 2 = 5,688 mL
NEXT 16 HOURS

Keep in mind: the question could ask you for mL given in the first 24 hours, the first 8 hours, etc., so read the question carefully.

SHOCK

WHAT IS SHOCK?

A life-threatening condition resulting from **INADEQUATE TISSUE PERFUSION.** This leads to possible cell dysfunction, cell death, and even organ failure.

HYPOVOLEMIC SHOCK

MOST COMMON TYPE OF SHOCK

ETIOLOGY

HYPOVOLEMIC

"LOW" "VOLUME" "IN THE BLOOD"

Decreased intravascular volume

CAUSES

NON-HEMORRHAGIC (not from bleeding)

- **FLUID SHIFT** (edema or ascites)
- **SEVERE DEHYDRATION** (vomiting, diarrhea, burns)

HEMORRHAGIC (from bleeding)

- **TRAUMA**
- **GI BLEED**
- **POSTPARTUM**

SIGNS & SYMPTOMS

Pulse	CO	HR	BP
Weak, thready pulse	↓ Not a lot of blood being pumped by the heart	↑ **Tachycardia** Compensating to increase blood flow	↓ **Hypotension**

Skin	CVP	SVR	O_2 Sat	Other Signs & Symptoms
Cyanosis *(Bluish tint of the lips, tongue, and fingertips)* Cool, pale skin ↓ capillary refill (>3 seconds)	↓	↑ **Vasoconstriction**	↓ blood being perfused to the body = low 0_2	**LABS CAN BE:** **↑ HCT** hemoconcentration; **↓ HCT** actually hemorrhaging the RBCs; Oliguria (urine output of <30 mL/hr); Confused, agitated *due to decreased blood flow to the brain*

TREATMENT

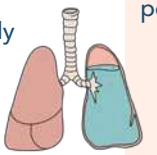
- **Large gauge IVs** *(at least 2)*
- **Fluids & blood replacement**
  - Crystalloids *(example: normal saline or Lactated Ringers)*
  - Colloids *(albumin)*
  - Blood products *(plasma, PRBCs, & PLTs)*

CARDIOGENIC SHOCK

ETIOLOGY

The heart can't pump enough blood to meet the perfusion needs of the body

NOTE:
There is enough blood, the heart just can't pump it to the body which causes **fluid accumulation** in the lungs!



CAUSES

- Damage from an acute MI
- Severe hypoxemia
- Acidosis
- Hypoglycemia
- Cardiomyopathy
- Cardiac tamponade
- Dysrhythmias

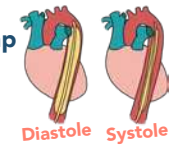
SIGNS & SYMPTOMS

Pulse	CO	HR	BP
Weak peripheral pulses	↓ Not a lot of blood being pumped by the heart	↑ **Tachycardia** Compensating to increase blood flow	↓ **Hypotension**

Skin	CVP	SVR	O_2 Sat	Other Signs & Symptoms
Cool, clammy skin ↓ capillary refill (>3 seconds)	↑	↑ **Vasoconstriction**	↓ blood being perfused to the body = low 0_2	Jugular vein distention (JVD); Chest pain; Oliguria (urine output of <30 mL/hr); Confused, agitation *due to decreased blood flow to the brain*; **From fluid accumulation in the lungs:** Dyspnea, Pulmonary edema

TREATMENT

- **For an MI:** Angioplasty Thrombolytics
- **Oxygen**
- **Vasopressors** *(example: epinephrine, dobutamine, dopamine)* — *Vasopressors cause vasoconstriction which ↑ blood flow and increases perfusion to the organs*
- **Diuretics**
  - ↓ the workload of the heart
  - ↓ extra blood volume
- **Intra-aortic balloon pump** *(helps to improve coronary artery blood flow & ↑ CO)*



BP = Blood pressure **HR** = Heart rate **CO** = Cardiac output **SVR** = Systemic vascular resistance **CVP** = Central venous pressure

MED-SURG
CRITICAL CARE

DISTRIBUTIVE SHOCK
(Septic, Neurogenic, Anaphylactic)

DISTRIBUTIVE: Leaky blood vessels → Excessive **vasodilation** (widening of vessels) → Intravascular volume pools in the peripheral blood vessels → Since the blood is in the peripherals, it is NOT perfusing the vital organs which causes relative hypovolemia

SEPTIC SHOCK (SEPSIS)

MOST COMMON TYPE OF DISTRIBUTIVE SHOCK

ETIOLOGY

Caused by widespread infection or sepsis

CAUSES

- Pneumonia
- Urosepsis
- Bacteria
- Intra-abdominal infections
- Wound infection
- Invasive procedures
- Indwelling medical devices (catheters)

TREATMENT

CORRECT THE UNDERLYING CAUSE

- Fluid replacement
- **Broad-spectrum antibiotics**
- Vasopressors (norepinephrine & dopamine)
- Neuromuscular blockade agents & sedation
  - ↓ metabolic demands & provides comfort
- Medications to prevent stress ulcers
  - H2 blocking agents
  - Proton pump inhibitors (PPIs)

Broad spectrum antibiotics are used when the organism is not yet known/determined. Once the organism is known, the client can be put on more specific antibiotics.

SIGNS & SYMPTOMS

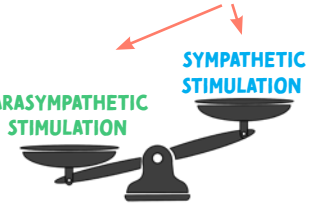
Pulse	CO	HR	BP	Other Signs & Symptoms
Bounding pulses	↑	↑ Tachycardia	↓ Hypotension	→ Hyperthermia & fever → Increased respiratory rate → GI upset: Nausea, vomiting, diarrhea, decrease gastric motility → ↑ Inflammatory markers ↑ WBCs ↑ C-reactive protein (CRP)
Skin	**CVP**	**SVR**	**O_2 Sat**	
Initially warm & flushed, but as the BP drops, the skin becomes cool, pale & mottled	↓	↓ Vasodilation	↑	

NEUROGENIC SHOCK (VASOGENIC)

ETIOLOGY

Vasodilation due to a loss of balance between

In neurogenic shock, the client mainly experiences parasympathetic stimulation which causes VASODILATION for an extended period



MEMORY TRICK: P think Peaceful

- **PARASYMPATHETIC STIMULATION** (Rest & digest) → Causes dilation (relaxing) of the smooth muscles
- **SYMPATHETIC STIMULATION** (Fight or flight) → Causes constriction (tightening) of the smooth muscles

CAUSES

- Spinal cord injury (above T6, cervical)
- Spinal anesthesia
- Nervous system damage
- Insulin reaction

MEMORY TRICK: **NEUR**ogenic = Issue with **NER**vous system

SIGNS & SYMPTOMS

EVERYTHING IS DECREASED

Remember parasympathetic means **RELAXED EVERYTHING**

CO	HR	BP
↓	↓	↓ Hypotension

the sympathetic NS is not working to compensate & ↑ the HR

RELATIVE HYPOVOLEMIA: There is enough blood volume. However, the vascular space is **dilated,** so blood volume is displaced causing hypovolemia.

Skin	CVP	SVR	O_2 Sat
Dry, warm extremities (venous blood pooling) Hypothermia: warm/dry extremities, cold body	↓	↓ Vasodilation	↓

TREATMENT

DEPENDS ON THE CAUSE OF THE SHOCK

- Spinal cord injury → **PROTECT THE SPINE:** Keep spine immobilized (cervical collar, backboards, log-rolling)
- Assess & manage airway
  May need intubation or mechanical ventilation
- Elevate the head of the bed
- IV fluids ⚠ Watch for fluid volume overload
- Increased risk for clots due to pooling of blood
  - Watch for signs of a clot
  - Compression devices
  - Antithrombotic agents (heparin)

S&S OF BLOOD CLOTS:
- Pain in the extremities
- Redness
- Tenderness
- Warmth

- Vasopressors (*example*: epinephrine, dobutamine, dopamine)

BP = Blood pressure **HR** = Heart rate **CO** = Cardiac output **SVR** = Systemic vascular resistance **CVP** = Central venous pressure

DISTRIBUTIVE SHOCK
(Septic, Neurogenic, Anaphylactic)

DISTRIBUTIVE: Leaky blood vessels → Excessive **vasodilation** (widening of vessels) → Intravascular volume pools in the peripheral blood vessels → Since the blood is in the peripherals, it is NOT perfusing the vital organs which causes relative hypovolemia

ANAPHYLACTIC SHOCK

ETIOLOGY

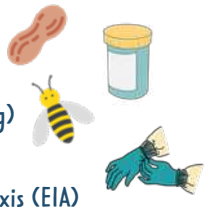
SEVERE ALLERGIC REACTION

Foreign substance (antigen)
↓
Systemic antigen-antibody reaction (IgE)
↓
Mast cells release potent vasoactive substance (histamine/bradykinin)
↓
Activates inflammatory cytokines
↓
Causes **VASODILATION** & capillary permeability

CAUSES/TRIGGERS

Often unknown (idiopathic)

- Foods (example: peanuts)
- Medications
- Insects (example: bee sting)
- Latex
- Exercise-induced anaphylaxis (EIA)



Signs & symptoms usually occur within 2 - 30 minutes of exposure to antigen

TREATMENT

REMOVE THE ALLERGEN!

- High-flow oxygen
- First-line drug: **EPINEPHRINE** ★
  - Causes vasoconstriction & bronchodilation
- Other possible medications
  - Antihistamines
    - Diphenhydramine (Benadryl)
  - Albuterol (Proventil)
  - Corticosteroids
- Fluids
- Stay with the client & monitor

BIPHASIC ANAPHYLAXIS:
A recurrence of anaphylaxis after appropriate treatment

SIGNS & SYMPTOMS

Pulse	CO	HR	BP
Rapid, weak pulse	↓	↑ Tachycardia	↓ Hypotension

CAPILLARY PERMEABILITY:
Fluid is leaving the intravascular space

Skin	CVP	SVR	O_2 Sat
Generalized flushing	↓	↓ Vasodilation	↓

Other Signs & Symptoms

- **CARDIAC**
  - Cardiac dysrhythmias or cardiac arrest
- **GI**
  - Nausea/vomiting
  - Acute abdominal pain
- **FEELING OF IMPENDING DOOM**
- **RESPIRATORY**
  - Bronchoconstriction
    - Difficulty breathing
    - Wheezing
    - Coughing
    - Unable to speak
- **SKIN**
  - Itching, generalized flushing, redness, hives, or a rash may be present

HOW TO USE AN EPINEPHRINE AUTO-INJECTOR (EAI)

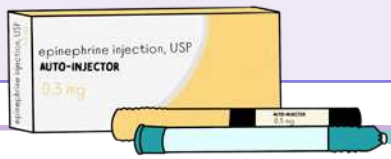
EDUCATION POINTS:

- Store in dark room
- Administer EAI immediately after the first sign of an allergic reaction

EXPECTED SYMPTOMS AFTER ADMINISTRATION:

- Tachycardia
- Palpitations
- Dizziness

INJECT IN THE OUTER THIGH AT A 90° ANGLE



BP = Blood pressure **HR** = Heart rate **CO** = Cardiac output **SVR** = Systemic vascular resistance **CVP** = Central venous pressure

ABGs

ABG
ARTERIAL BLOOD GAS

ABGs MEASURE HOW ACIDIC OR ALKALOTIC THE BLOOD IS IN THE ARTERIAL CIRCULATION.

*also a measure of gases such as O_2 & Co_2

4 MUST-KNOW COMPONENTS

PH	Measurement of how acidic or alkalotic your blood is	regulated by both lungs & kidneys	7.35 - 7.45
$PACO_2$	Measurement of carbon dioxide in the blood CO_2 think aCid	Regulated by the lungs	35 - 45
HCO_3	Measurement of bicarbonate in the blood Bicarbonate think Base	Regulated by the kidneys	22 - 26
PAO_2	Measurement of oxygen in the blood	Regulated by the lungs	80 - 100

Value not needed to interpret alkalosis or acidosis. It just tells you if the patient is hypoxic or not.

ABG INTERPRETATION

1 KNOW YOUR LAB VALUES!

	ACIDOSIS	NORMAL	ALKALOSIS
PH	< 7.35 ↓	7.35 - 7.45	> 7.45 ↑
CO_2	> 45 ↑	35 - 45	< 35 ↓
HCO_3	< 22 ↓	22 - 26	> 26 ↑

2 RESPIRATORY OR A METABOLIC PROBLEM?

there are 2 ways to analyze the information

ROME METHOD

Respiratory	PH ↑	CO_2 ↓	Alkalosis
Opposite	PH ↓	CO_2 ↑	Acidosis
Metabolic	PH ↑	HCO_3 ↑	Alkalosis
Equal	PH ↓	HCO_3 ↓	Acidosis

TIC-TAC-TOE METHOD

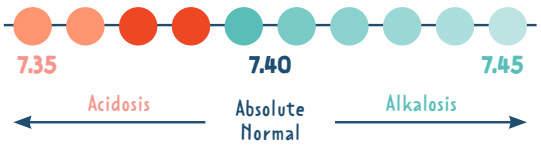
ACID	NORMAL	BASE

3 UNCOMPENSATED, PARTIALLY COMPENSATED, OR FULLY COMPENSATED?

If the **PH** is out of range & **CO_2** or **HCO_3** is in range = **UNCOMPENSATED**

If **CO_2**, **HCO_3** & **PH** are **ALL** out of range = **PARTIALLY COMPENSATED**

If **PH** is in range (7.35 - 7.45) = **FULLY COMPENSATED**



PH IN RANGE? Just because the PH is "normal", it can still fall on a acidotic side or alkalotic side

How do the organs Compensate?

KIDNEYS

Excreting excess **ACID** & **BICARB (HCO_3)**
OR
Retaining **HYDROGEN** & **BICARB (HCO_3)**

MEMORY TRICK: B think BASE — BICARB HYDROGEN

hours - days to compensate

LUNGS

HYPERventilation = ↓ CO_2 = **ALKALOSIS**

HYPOventilation = ↑ CO_2 = **ACIDOSIS**

MEMORY TRICK: CO_2 think ACID — CO_2

compensates FAST!

ABG PRACTICE QUESTION EXAMPLE

QUESTION

A client with a bowel obstruction has been treated with gastric suctioning for 4 days. The nurse notices an increase in nasogastric drainage. Which Acid-base imbalance does that nurse correctly identify?

The patient labs are the following →

Ph **7.50**
$PaCO_2$ **50** mm Hg
PaO_2 **90** mm Hg
HCO_3 **32** mEq/L

Value not needed to interpret alkalosis or acidosis. It just tells you if the patient is hypoxic or not.

TIC-TAC-TOE METHOD

1 What does the problem give you?

PH	7.50	○ ACIDIC	✓ ALKALOTIC	○ NORMAL
CO_2	50	✓ ACIDIC	○ ALKALOTIC	○ NORMAL
HCO_3	32	○ ACIDIC	✓ ALKALOTIC	○ NORMAL

2

ACID	NORMAL	BASE
CO_2		PH
		HCO_3

- ○ RESPIRATORY ACIDOSIS
- ○ RESPIRATORY ALKALOSIS
- ○ METABOLIC ACIDOSIS
- ✓ METABOLIC ALKALOSIS

3 UNCOMPENSATED, PARTIALLY COMPENSATED, or FULLY COMPENSATED?

If CO_2, HCO_3 & PH are ALL out of range

Is the pH in range? ○ YES ✓ NO
Is the CO_2 in range? ○ YES ✓ NO
Is the HCO_3 in range? ○ YES ✓ NO

- ○ UNCOMPENSATED
- ✓ PARTIALLY COMPENSATED
- ○ FULLY COMPENSATED

FINAL ANSWER:
METABOLIC ALKALOSIS, PARTIALLY COMPENSATED

ROME METHOD

1 What does the problem give you?

PH	7.50	○ ACIDIC	✓ ALKALOTIC	○ NORMAL
CO_2	50	✓ ACIDIC	○ ALKALOTIC	○ NORMAL
HCO_3	32	○ ACIDIC	✓ ALKALOTIC	○ NORMAL

2 Which of the four scenarios from the ROME method matches the information given in your problem?

Respiratory	PH ↑	CO_2 ↓	Alkalosis
Opposite	PH ↓	CO_2 ↑	Acidosis
Metabolic	PH ↑	HCO_3 ↑	Alkalosis
Equal	PH ↓	HCO_3 ↓	Acidosis

- ○ RESPIRATORY ACIDOSIS
- ○ RESPIRATORY ALKALOSIS
- ○ METABOLIC ACIDOSIS
- ✓ METABOLIC ALKALOSIS

3 UNCOMPENSATED, PARTIALLY COMPENSATED, or FULLY COMPENSATED?

If CO_2, HCO_3 & PH are ALL out of range

Is the pH in range? ○ YES ✓ NO
Is the CO_2 in range? ○ YES ✓ NO
Is the HCO_3 in range? ○ YES ✓ NO

- ○ UNCOMPENSATED
- ✓ PARTIALLY COMPENSATED
- ○ FULLY COMPENSATED

FINAL ANSWER:
METABOLIC ALKALOSIS, PARTIALLY COMPENSATED

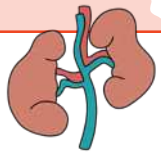
RESPIRATORY ACIDOSIS VS. RESPIRATORY ALKALOSIS

RESPIRATORY ACIDOSIS

PATHOPHYSIOLOGY

LUNG PROBLEM

The lungs are **RETAINING** too much **CO_2**



KIDNEYS COMPENSATE

The kidneys excrete excess **HYDROGEN** & retain **BICARB** (HCO_3)

PH	CO_2
< 7.35	> 45

CAUSES

RETAINING CO_2: "Depress" breathing

MNEMONIC

- **D**rugs (opioids & sedatives)
- **E**dema (fluid in the lungs)
- **P**neumonia (excess mucus in the lungs)
- **R**espiratory center of the brain is damaged
- **E**mboli (pulmonary emboli)
- **S**pasms of the bronchial (asthma)
- **S**ac elasticity damage (COPD & emphysema)

All these things cause impaired gas exchange

SIGNS & SYMPTOMS

- ↑ Blood pressure
- ↑ Respiration rate
- ↑ Heart rate
- Restlessness
- Confusion
- Headache
- Sleepy / coma

INTERVENTIONS

- Administer O_2
- Semi-Fowler's position
- Turn, cough, & deep-breathe (TCDB)
- Pneumonia: ↑ fluids to thin secretions & administer antibiotics
- If CO_2 >50, they may need an endotracheal tube
- Monitor potassium levels

NORMAL K+
3.5 - 5.0 mmol/L

RESPIRATORY ALKALOSIS

PATHOPHYSIOLOGY

LUNG PROBLEM

The lungs are **LOSING** too much **CO_2**

KIDNEYS COMPENSATE

The kidneys excrete excess **BICARB** (HCO_3) & retain **HYDROGEN**

PH	CO_2
> 7.45	< 35

CAUSES

LOSING CO_2: "Tachypnea"

- ↑ Temperature
- Aspirin toxicity
- Hyperventilation

SIGNS & SYMPTOMS

- ↑ Heart rate
- Confused & tired
- Tetany
- EKG changes
- (+) Chvostek's sign

Twitching of the facial muscles when tapping the facial nerve in response to **HYPOCALCEMIA**

INTERVENTIONS

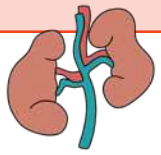
- Provide emotional support
- Fix the breathing problem!
- Encourage good breathing patterns
- Rebreathing into a paper bag
- Give anti-anxiety medications or sedatives to ↓ breathing rate
- Monitor K+ & Ca- levels

NORMAL CA-
9 - 11 mg/dL

METABOLIC ACIDOSIS VS. METABOLIC ALKALOSIS

METABOLIC ACIDOSIS

PATHOPHYSIOLOGY



KIDNEY PROBLEM

Too much **HYDROGEN**
Too little **BICARB** (HCO_3)

LUNGS COMPENSATE

The lungs will blow off **CO_2**

PH	HCO_3
< 7.35	< 22

CAUSES

- Diabetic ketoacidosis → Not enough insulin = ↑ fat metabolism = excess ketones (acid)
- Acute/chronic kidney injury
- Malnutrition → Breaking down of fats = excess ketones (acid)
- Severe diarrhea → Remember Bicarb comes out of your Base

SIGNS & SYMPTOMS

- ↑ Respiratory rate → **KUSSMAUL'S BREATHING** Deep rapid breathing >20 breaths per minute
- Hyperkalemia
  - Muscle twitching
  - Weakness
  - Arrhythmias
- ↓ Blood pressure
- Confusion

INTERVENTIONS

NORMAL K+ 3.5 - 5.0 mmol/L

- Monitor intake & output
- Administer IV solution of sodium bicarb to ↑ bases & ↓ acids
- Initiate seizure precaution
- Monitor K+ levels

DIABETIC KETOACIDOSIS (DKA)

- **Give insulin** (this stops the breakdown of fats which stops ketones from being produced)
- **Monitor for hypovolemia due to polyuria**

KIDNEY DISEASE

- Dialysis to remove toxins
- Diet
  - ↑ Calories
  - ↓ Protein

METABOLIC ALKALOSIS

PATHOPHYSIOLOGY

KIDNEY PROBLEM

Too much **BICARB** (HCO_3)
Too little **HYDROGEN**

LUNGS COMPENSATE

The lungs will retain **CO_2**

PH	HCO_3
> 7.45	> 26

CAUSES

- Too many antacids → Too much sodium bicarbonate (BASE)
- Diuretics
- Excess vomiting → Excess loss of hydrochloric acid (HCL) from the stomach
- Hyperaldosteronism

SIGNS & SYMPTOMS

- ↓ Respiratory rate → **HYPOVENTILATION** <12 breaths per minute
- ↓ Potassium (K+)
  - Dysrhythmias
  - Muscle cramps/weakness
  - Vomiting
  - Tetany
  - Tremors
  - EKG changes

INTERVENTIONS

NORMAL CA- 9 - 11 mg/dL

- Monitor K+ and Ca- levels
- Administer IV fluids to help the kidneys get rid of bicarbonate
- Replace K+
- Give antiemetics for vomiting (Zofran or Phenergan)
- Watch for signs of respiratory distress

Metabolic **ACIDOSIS** = ↑ serum potassium
Metabolic **ALKALOSIS** = ↓ serum potassium

FRACTURES

WHAT IS A FRACTURE? A fracture is a complete or incomplete disturbance in the progression of bone structure

TYPES OF FRACTURES

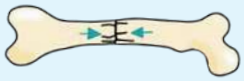
COMMINUTED
The bone is crushed causing lots of little fragments

TRANSVERSE
The bone is fractured straight across

OBLIQUE
The fracture runs at an angle across the bone

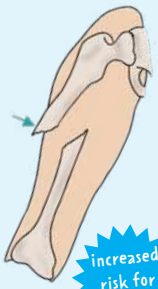
commonly seen in children

GREENSTICK
One side of the bone is bent, the other is broken



IMPACTED
The fractured bone is driven into another bone

SPIRAL
The break partially encircles the bone



increased risk for INFECTION

OPEN/COMPOUND
A fracture where the bone breaks through the skin

STAGES OF BONE HEALING

STAGE I

HEMATOMA FORMATION

- First 1-2 days of fracture
- Bleeding into the injured site occurs

MNEMONIC
He **F**ell **B**ecause he was **R**unning

STAGE II

FIBROCARTILAGINOUS CALLUS FORMATION

- Formation of granulation tissue
- Reconstruction of bone begins
- Still not strong enough to bear weight

STAGE III

BONY CALLUS FORMATION (OSSIFICATION)

- 3rd - 4th week of fracture healing
- Mature bone is replacing the callus

STAGE IV

REMODELING

- This may take months to years!
- Compact bone replaces spongy bone
- X-rays are used to monitor the progress of bone healing

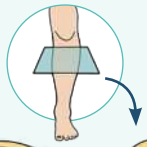
NURSING ASSESSMENT POST-FRACTURE

Neurovascular assessments

5 P's

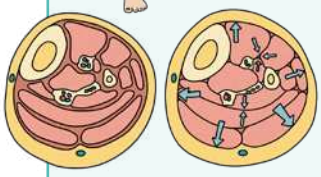
- **P** Pain
- **P** Pallor
- **P** Pulselessness
- **P** Paresthesia (burning or tingling sensation)
- **P** Paralysis

COMPARTMENT SYNDROME



Increased pressure and build-up, causes tissue impairment leading to cell death!

Pressure ↑
↓
Blood flow cut off
↓
Tissue damage due to HYPOXIA (lack of oxygen)



Normal

Compartment Syndrome
Muscle swelling causing compression of nerves and vessels

SIGNS & SYMPTOMS

- Deep, throbbing, unrelenting pain
- Pain unrelieved by medications
- Disproportional to the injury
- Intensifies with passive ROM

TREATMENT

IMMEDIATE

- Place extremity at the heart level (not above heart level)
- Open the cast or splint

FASCIOTOMY
Fascia is cut to relieve tension & pressure

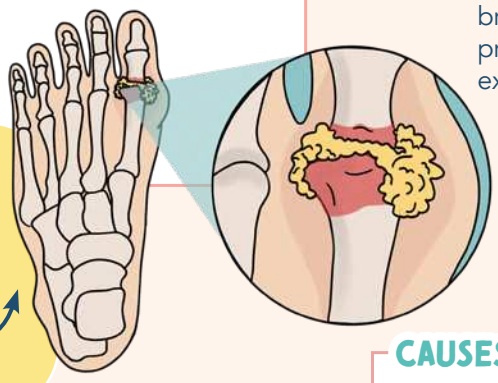
GOUT

PATHOLOGY

Gout is a form of arthritis characterized by increased uric acid levels.

HYPERURICEMIA
"high" "uric acid" "in the blood"

This causes deposits of uric acid crystals in the joints.



TOPHI

Accumulation of sodium urate crystals in joints such as the big toe and hands, or other areas such as the ears.

MEMORY TRICK: Tophi think Toe

WHAT IS URIC ACID?

Uric acid is created from purine breakdown during digestion. It's produced by the liver and is mostly excreted by the kidneys.

EXPECTED RANGE:
F: 2.5 - 8 mg/dL
M: 1.9 - 7.5 mg/dL

SIGNS & SYMPTOMS

Can be **ACUTE** or **CHRONIC**

- Acute gouty arthritis
- Pain (severe)
- Swelling
- Warmth at the site
- Bone deformity
- Joint damage
- Tophi
- Renal calculi

CAUSES

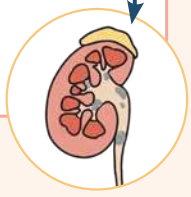
- Diet high in purines
- Certain medications
  - Diuretics (causes dehydration)
  - Aspirin
  - Cyclosporine
- Disorder of purine metabolism
- Kidney problems
  - Inadequate excretion of uric acid by the kidneys

EDUCATION

- Educate on avoiding:
  - Foods high in purines
  - Medications (aspirin)
  - Alcohol
  - Dehydration

- Stay hydrated: 2-3 liters per day

- Uric acid deposits can cause kidney stones, fluids help prevent this!
- Weight loss program if overweight



MEDICATIONS

GENERIC	TRADE NAME
allopurinol	Aloprim, Zyloprim, Lopurin

MEMORY TRICK: AlloPurinol → Prevents gout

GENERIC	TRADE NAME
colchicine	Mitigare, Colcrys

MEMORY TRICK: Colchicine → for aCute gout attacks

For more information about gout medications, see the musculoskeletal section in the Pharmacology Bundle

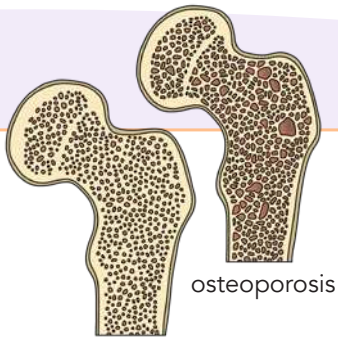
OSTEOPOROSIS

PATHOLOGY

OSTEOPOROSIS

"relating to bone" + "porous"

Osteoporosis essentially means: **HAVING POROUS BONES**



healthy bone — osteoporosis

Normal bone marrow has small holes in it, but osteoporosis causes much larger holes

The rate of **BONE RESORPTION** (osteoCLASTS) is greater than the rate of **BONE FORMATION** (osteoBLASTS)
= ↓ **DECREASED TOTAL BONE MASS**

DIAGNOSTIC

Bone density test:
Dual-energy x-ray absorptiometry **(DEXA)**

This process takes X-ray images measuring calcium and other minerals in the bones

RISK FACTORS

C **C**alcium & vitamin intake is LOW

A **A**ge: **women after menopause**
(the decrease in estrogen at menopause causes increase bone resorption)

L **L**ifestyle (smoking, excessive alcohol intake, sedentary lifestyle, immobility)

C **C**aucasian or Asian women

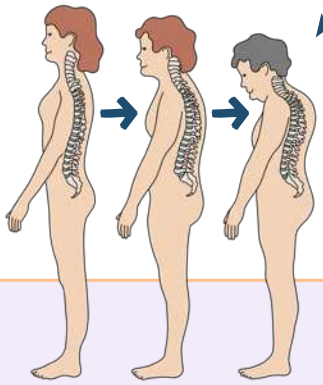
I **I**nherited (family history)

U **U**nderweight/malabsorption disorder
(Celiac disease, bariatric surgery, eating disorders)

M **M**edications: **long-term use of corticosteroids**, anticonvulsants, levothyroxine, long-term use of proton pump inhibitors, etc.

SIGNS & SYMPTOMS

- May be asymptomatic until a fracture occurs
- **FRACTURES** (hips, spine, wrist)
- Low back, neck, or hip pain
- The back will be rounded (hunch back) causing height loss



FRACTURES

Clients often think they fell and broke something, **BUT** bones may break first causing them to fall.

NURSING INTERVENTIONS

ASSESSING FOR RISK FACTORS

Educate on stopping smoking & limiting alcohol

EDUCATE ON WAYS TO PREVENT OSTEOPOROSIS

TEACHING ABOUT PREVENTING INJURY

AT HOSPITAL

- Use call light
- Non-slip socks
- Communicate falls risk
- Clutter-free environment

PREVENTION

- Weight-bearing exercises (weights, hiking, etc).
- Consume foods rich in calcium & vitamin D

AT HOME

- No area rugs (risk for falling)
- Watch out for pets
- Keep glasses near by

MEDICATIONS

- Calcium supplements with Vitamin D
- Bisphosphonates (ends in "**DRONATE**")

For more information about bisphosphonates, see the Pharmacology Bundle

OSTEOARTHRITIS (OA) & RHEUMATOID ARTHRITIS (RA)

OSTEOARTHRITIS (OA)

PATHOLOGY

OA is a noninflammatory degenerative disorder of the joints. It's caused by the breakdown of cartilage between the joints.

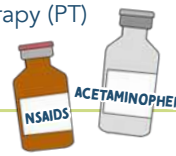
The articular cartilage breaks down, which leads to damage to the bone.

RISK FACTORS

- **OBESITY**
- Older age
- Female gender
- Certain occupations (heavy labor)
- Genetics

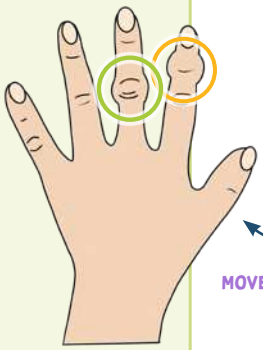
TREATMENT

- Orthotic devices (splints, braces, knee braces)
- Walking aids (canes)
- Exercise
- Weight loss
- Occupational therapy (OT) & physical therapy (PT)
- Analgesics



DISTAL
Distal interphalangeal (DIP) called **HEBERDEN'S NODES**

PROXIMAL
Proximal interphalangeal (PIP) called **BOUCHARD'S NODES**



SIGNS & SYMPTOMS

- Pain
- Stiffness after activity (subsiding within 30 min)
- Functional impairment
- Bony enlargements

Occurring mostly at the weight-bearing joints (hips, knees)

MOVEMENT / EXERCISE → Aggravated / symptoms worsen
REST → Symptoms are relieved

RHEUMATOID ARTHRITIS (RA)

PATHOLOGY

Exact mechanism is unknown

RA is a chronic, inflammatory type of arthritis. It's classified as an autoimmune disease.

STAGES OF RHEUMATOID ARTHRITIS

1. **SYNOVITIS**
   - Inflammation of the synovium
   - Synovial membrane thickens
2. **PANNUS FORMATION**
   - Pannus is a layer of vascular fibrous tissue
3. **FIBROUS ANKYLOSIS**
   - Joint invaded by fibrous connective tissue
4. **BONY ANKYLOSIS**
   - When the bones are fused together

This causes loss of...
- Articular surfaces
- Joint motion
- Ligament elasticity

SIGNS & SYMPTOMS

- Symmetric joint pain
- Symptoms are typically **BILATERAL** & symmetric
- Stiffness in the morning (lasting >1 hour)
- Swelling, warmth, and redness
- Deformity of the fingers
- Can effect all joints (fingers, wrists, neck, shoulders, etc).
- Systemic effects: heart, lungs, skin, etc.

DIAGNOSIS

- Hard to diagnose because symptoms are very similar to other diseases
  - (+) Rheumatoid factor
  - Increase erythrocyte sedimentation
  - C-reactive protein (indicates inflammation in the body)
  - X-ray shows joint deterioration

RISK FACTORS

May cause an inflammatory response & destructive synovial fluid:
- Environmental factors (smoking, pollution)
- Bacterial or viral illness
- Cigarette smoking
- Family history

TREATMENT

NO CURE

GOAL: Decrease joint pain & swelling. Decrease changes of joint deformity & minimize disability.

- Medications
- Surgery
  - **SYNOVECTOMY:** removal of synovium
  - **JOINT REPLACEMENT**
  - **ARTHRODESIS:** "joint fusion"
- Joint support
  - Splints & assistive devices

- Range of motion (ROM) exercise
- Low impact exercise (walking, water aerobics, etc).
- Occupational therapy (OT) & physical therapy (PT)
- Heat or cold? **HEAT →** For stiffness **COLD →** For pain/inflammation