

Vital Signs & Clinical Reasoning (Emergency Medicine)

Why Vital Signs Matter in the ED

Vital signs are often the first abnormal data point in critically ill patients. In Emergency Medicine, **trend + context > single value.**

Normal vital signs do NOT rule out life threatening disease.

The Core Vital Signs (Think ABCs)

- Heart Rate (HR): perfusion & compensation
- Blood Pressure (BP): late marker of shock
- Respiratory Rate (RR): earliest marker of deterioration
- Temperature: infection, inflammation, exposure
- Pain & Skin: physiologic stress, perfusion, shock type

Heart Rate

Tachycardia = compensation until proven otherwise.

Common ED causes: fever ($\uparrow$ HR $\sim$ 8–10 bpm per 1°F), pain, anxiety, hypovolemia, dehydration, sepsis, PE, hemorrhage.

Dangerous causes: shock (all types), arrhythmias, toxicologic exposure (cocaine, meth, PCP), thyrotoxicosis.

USMLE Pearl: Tachycardia + normal BP = early shock.

Blood Pressure

Hypotension is a late finding. A "normal" BP may still represent shock.

Adult BP: Normal $<120/80$ | Pre-HTN $120/80$ – $139/89$ | HTN $\geq 140/90$.

USMLE Pearls: Loss of radial pulse $\approx$ SBP <80 mm Hg; loss of femoral pulse $\approx$ SBP <70 mm Hg.

Respiratory Rate (RR)

Most sensitive vital sign in the ED.

Tachypnea suggests metabolic acidosis (DKA, sepsis), PE, pneumonia, pain, or CNS pathology.

USMLE Pearl: Unexplained tachypnea = metabolic acidosis until proven otherwise.

Temperature

Normal temperature is a range and varies by measurement site (rectal $>$ oral $>$ axillary) and time of day (lowest early morning). Fever

may be benign or life threatening. **Absence of fever does NOT exclude infection.**

USMLE Pearl: Elderly and immunocompromised patients may be septic without fever.

Vital Signs & Shock (High-Yield)

Early (compensated): tachycardia, normal BP, cool/clammy skin.

Uncompensated: hypotension, weak/thready pulse, cyanosis.

Late: bradycardia, severe hypotension, decreased respirations.

Shock Index

Shock Index = $\text{HR} \div \text{SBP}$. Normal 0.5–0.7. >0.9 = high risk and predicts need for aggressive intervention.

Special Shock Pattern: Neurogenic Shock

Hypotension + bradycardia + warm, flushed skin.

USMLE Pearl: The only shock state with hypotension and bradycardia.

Clinical Reasoning in the ED

ED mindset: multiple diagnoses considered simultaneously; vital signs rapidly shift probabilities.

7-Step Approach

1) History 2) Focused questions 3) Broad differentials 4) Assign pre-test probabilities 5) Targeted exam 6) Hypothesis driven testing 7)

Assessment & plan.

USMLE Pearl: Tests should answer a question—never order without a hypothesis.

High-Yield EM Takeaways

Always trend vital signs. HR and RR change before BP. Skin findings matter. Treat the patient, not the number.

SHOCK — HIGH-YIELD

Definition

Shock is a state of inadequate tissue perfusion resulting in cellular hypoxia, lactic acidosis, and organ dysfunction.

FOUR STAGES OF SHOCK

(Progression: Initial → Compensatory → Progressive → Refractory)

1. Initial

- ↓ Tissue perfusion → cellular hypoxia
- ↑ Lactic acid → metabolic acidosis
- Liver unable to clear lactate due to ↓ O_2

USMLE Tip: Lab abnormalities may precede vital sign changes.

2. Compensatory

Physiologic mechanisms attempt to preserve MAP and pH.

Key responses

- Hyperventilation → ↓ CO_2 → ↑ pH
- Sympathetic activation
 - Norepinephrine: vasoconstriction
 - Epinephrine: ↑ HR, ↑ CO
- Baroreceptor activation
- RAAS: Na^+ and H_2O retention
- ADH (vasopressin): water retention

Blood shunted away from

- Kidneys, GI tract, skin

Preserved for

- Brain, heart, lungs

Clinical signs

- Tachycardia
- Normal or near-normal BP
- ↓ urine output

USMLE Tip: Tachycardia with normal BP = compensated shock

3. Progressive (Decompensated)

- Compensatory mechanisms fail
- Worsening metabolic acidosis
- ↓ Cardiac output
- Hypotension
- Oliguria
- Altered mental status

USMLE Tip: This is when shock becomes clinically obvious.

4. Refractory (Irreversible)

- Severe cellular and organ damage
- Multi-organ failure
- Brain damage
- No response to fluids or vasopressors
- Death imminent
-

TYPES OF SHOCK

Mnemonic: CHODE

1. HYPOVOLEMIC SHOCK (MOST COMMON)

Cause

- ↓ Intravascular volume
- Usually hemorrhage (internal or external)

Key findings

- Tachycardia
- Narrow pulse pressure (early)
- Hypotension (late)
- Cool, clammy skin
- ↓ Urine output
- Altered mental status
-

2. CARDIOGENIC SHOCK

Cause

- Failure of the heart to pump effectively

Most common cause

- Large myocardial infarction

Other causes

- Arrhythmias
- Cardiomyopathy
- Acute CHF
- Valvular rupture
- Cardiac contusion
- Air embolism

Key findings

- Hypotension
- Pulmonary edema
- ↑ JVP
- Cool extremities

USMLE Tip:

Fluids worsen cardiogenic shock → treat with inotropes/pressors.

3. DISTRIBUTIVE SHOCK

Pathophysiology

- ↓ Systemic vascular resistance
- Relative hypovolemia due to vasodilation

Types

- Septic
- Anaphylactic
- Neurogenic

Key findings

- Warm, flushed skin (early)
- Wide pulse pressure
- Hypotension despite normal volume

USMLE Tip: Warm shock = distributive shock

4. OBSTRUCTIVE SHOCK

Cause

- Mechanical obstruction to blood flow

Examples

- Cardiac tamponade
- Tension pneumothorax
- Massive pulmonary embolism

Classic clues

- Hypotension
- Elevated JVP
- Clear lungs (tamponade)

5. ENDOCRINE SHOCK

Causes

- Acute adrenal insufficiency
 - Sudden steroid withdrawal
 - Stress without steroid dose increase
- Hypothyroidism
 - ↓ Cardiac output → hypotension
- Thyrotoxicosis
 - Reversible cardiomyopathy

USMLE Tip: Refractory hypotension → consider adrenal crisis

Comparison of Major Shock Types

Shock Type	Primary Problem	CO	SVR	Skin	Key Clue
Hypovolemic	↓ Volume	↓	↑	Cold/clammy	Hemorrhage, dehydration
Cardiogenic	Pump failure	↓	↑	Cold/clammy	MI, pulmonary edema
Distributive	Vasodilation	↑/N	↓	Warm (early)	Sepsis, anaphylaxis
Obstructive	Flow blocked	↓	↑	Cold	JVD + hypotension
Endocrine	Hormonal failure	↓	↑/↓	Variable	Steroid withdrawal

ULTRA-HIGH-YIELD EXAM PEARLS

- Shock ≠ hypotension (early shock may have normal BP)
- Tachycardia is an early sign
- Oliguria = shock until proven otherwise
- Elevated lactate = tissue hypoxia
- Warm vs cold extremities helps identify shock type

Approach to the Altered Patient (AMS) – USMLE High-Yield Summary

Altered Mental Status (AMS) is a symptom, not a diagnosis.

Causes range from rapidly reversible (hypoglycemia, opioid overdose) to immediately life-threatening (ICH, meningitis, encephalitis). A structured, systematic approach saves lives.

Step 1: ABCs + D (Always Tested on USMLE)

ABCs

- Airway: Is it protected?
- Breathing: RR, depth, SpO₂ → give O₂ if hypoxic
- Circulation: BP, pulse, rhythm, skin (warm vs clammy)

💡 USMLE Pearl: Hypoxia and hypotension alone can cause AMS.

D = Disability

- GCS or AVPU
- Look for seizure clues: tongue trauma, incontinence, postictal state
- Pupils (pinpoint = opioids → give naloxone)
- Fingerstick glucose on every AMS patient
 - Hypoglycemia is common, deadly, and reversible

Step 2: Exposure

- Fully undress the patient
- Look for:
 - Trauma
 - Transdermal patches
 - Dialysis access
 - Infection sources
 - Temperature abnormalities

Step 3: Broad Differential – Think AEIOU TIPS

A Alcohol

E Epilepsy, Electrolytes, Encephalopathy

I Insulin (hypo/hyperglycemia)

O Opiates, Oxygen deprivation

U Uremia

T Trauma, Temperature

I Infection

P Poisons, Psychogenic

S Stroke, Seizure

💡 USMLE Pearl: AMS is often multifactorial, especially in the elderly.

Delirium vs Dementia vs Psychosis (Classic Exam Table)

Feature	Delirium	Dementia	Psychosis
Onset	Acute (hrs-days)	Chronic	Variable
Course	Fluctuating	Progressive	Variable
LOC	Altered	Normal	Variable
Hallucinations	Visual	Rare	Auditory
Cause	Medical	Neurodegenerative	

🚑 Board Pearl:

Delirium = medical emergency until proven otherwise

Step 4: History = Detective Work

AMS patients can't give reliable histories:

- Call family, nursing facility, EMS
- Ask: "Is this baseline?"
- Acute change in dementia = delirium

Step 5: Focused Physical Exam Clues

- Asterixis → hepatic or uremic encephalopathy
- Fever + AMS → think infection (meningitis, sepsis)
- Nuchal rigidity → CNS infection or SAH
- New murmur + AMS → endocarditis → embolic stroke

Diagnostic Testing (USMLE Logic)

Order tests based on H&P, but err on liberal testing:

Core Tests

- Glucose, BMP, Ca^{2+}
- BUN/Cr, ABG/VBG
- LFTs, ammonia
- CBC, lactate
- UA, CXR
- EKG
- Drug levels/toxicology
- CT head (non-contrast) if trauma, stroke, ↓LOC

💡 Pearl: CT before LP if ↑ICP suspected.

High-Yield Treatments to Memorize

- Hypoglycemia: D50 → may need repeat or feeding
- Opioid overdose: Naloxone (short half-life → re-dose)
- Wernicke encephalopathy: Thiamine before glucose
- Infection: Early antibiotics
- Cerebral edema: Steroids (vasogenic edema)

Disposition Principles

Most AMS patients require admission.

Safe discharge ONLY if:

- Cause identified
- Fully reversed
- Patient returned to baseline
- Reliable social support

🚫 Never clear for psych without ruling out organic causes

Pearls & Pitfalls (Frequently Tested)

- Subtle behavioral changes matter
- Delirium has high mortality if missed
- Always check glucose
- Don't allow AMA discharge without documented capacity
- Elderly may have infection without fever or leukocytosis

The Poisoned Patient

1. Core Principles

Definitions

- **Poisoning** = toxic exposure causing symptoms, usually **unintentional**
- **Overdose** = usually **intentional** toxic exposure
 - Suicide attempt
 - Recreational drug misuse

Epidemiology

- Highest risk groups:
 - **Children age 1–5**
 - **Elderly**
 - Toxic exposure in age **6–12** is unusual → consider possible psychiatric/social concerns.
-

2. Initial Approach = ABCs FIRST

Emergency Stabilization

Always prioritize:

1. **Airway**
2. **Breathing**
3. **Circulation**

Then:

- Vitals
 - Glucose
 - ECG
 - Labs
 - Antidotes/decontamination
-

3. “Coma Cocktail” (Classic USMLE Concept)

For unexplained altered mental status:

- **Naloxone**
- **Thiamine**
- **Dextrose** (if hypoglycemic)

Important Doses

- Naloxone: **2 mg IV/IM/IN**
 - Thiamine: **100 mg IV**
 - D50: **50 mL IV** if low glucose
-

4. High-Yield Intubation Indications in Toxicology

Think “Loss of airway or ventilation”

Common causes:

- **Opioids** → respiratory depression
- **Organophosphates** → bronchorrhea
- **Corrosives** → airway edema
- **Seizures** (isoniazid, theophylline)
- **Pulmonary edema**
- **Severe CNS depression**

USMLE Pearl

If patient:

- cannot protect airway,
- has hypoventilation,
- or massive secretions

→ **Intubate early**

5. The "Five Ws" History

Who

- Age
- Weight
- Psychiatric history
- Substance abuse history

What

- Substance
- Dose
- Co-ingestants
- Extended-release vs immediate-release

When

- Time of ingestion

Where

- Route (ingestion, inhalation, injection)
- Location

Why

- Intentional vs accidental

USMLE Tip

Always ask:

- "Could this be an extended-release preparation?"
because toxicity may be delayed.

6. High-Yield Diagnostic Tests

Basic Labs

- CBC
- CMP
- Ethanol level
- Acetaminophen level
- Salicylate level
- Coags
- Drug screen

ABG > VBG

Especially important for:

- salicylates
 - carbon monoxide
 - severe poisoning
-

7. ECG Findings — VERY HIGH YIELD

TCA Overdose

Classic:

- Wide QRS
- Arrhythmias
- Terminal R wave in aVR

Treatment

- Sodium bicarbonate

USMLE Buzzword

Wide QRS + hypotension + seizures in overdose

→ Think TCA toxicity

Digoxin Toxicity

Can cause:

- AV block
- Junctional rhythm
- Ventricular arrhythmias

Treatment

- Digoxin immune Fab
-

Cocaine

Can cause:

- MI
- ST elevation/depression
- Tachyarrhythmias

USMLE Pearl

Avoid pure beta blockers in acute cocaine toxicity.

Diphenhydramine / Antihistamines

Can cause:

- Tachycardia
 - Anticholinergic toxidrome
 - QT prolongation
-

8. Toxidromes — MUST KNOW

Opioid

Classic triad:

- CNS depression
- Respiratory depression
- Pinpoint pupils

Treatment:

- Naloxone
-

Anticholinergic

"Hot as a hare, blind as a bat..."

Findings:

- Dry skin
- Mydriasis
- Urinary retention
- Delirium
- Tachycardia

Causes:

- Diphenhydramine
- TCAs
- Atropine

Cholinergic (Organophosphates)

SLUDGE:

- Salivation
- Lacrimation
- Urination
- Diarrhea
- GI upset
- Emesis

PLUS:

- Bronchorrhea
- Miosis

Treatment:

- **Atropine**
- **Pralidoxime**

Sympathomimetic

- Cocaine
- Amphetamines

Findings:

- Tachycardia
- HTN
- Diaphoresis
- Mydriasis
- Agitation

9. Activated Charcoal — High Yield

Works Best:

Within 1 hour of ingestion.

Dose

- **Adults: 25–100 g**
- **Children: 0.5–1 g/kg**

Contraindications

Do NOT give if:

- Caustic ingestion
- Airway unprotected
- Bowel obstruction
- Hydrocarbon ingestion with aspiration risk

USMLE Pearl

Charcoal does NOT bind:

- Iron
 - Lithium
 - Alcohols
-

10. Gastric Lavage

Rarely used now.

Possible indications:

- Massive life-threatening ingestion
- Within ~1 hour

Contraindications:

- Caustics
 - Hydrocarbons
 - Unprotected airway
-

11. Hemodialysis

Use mnemonic:

"ME SALT"

- Methanol
- Ethylene glycol
- Salicylates
- Alcohols (toxic)
- Lithium
- Theophylline

USMLE Tip

Dialysis works best for toxins with:

- low molecular weight
 - low protein binding
 - low volume of distribution
-

12. Important Poisonings

Acetaminophen

Most common cause of acute liver failure.

Antidote

- N-acetylcysteine (NAC)

Lab

- AST/ALT elevation
 - Use Rumack-Matthew nomogram
-

Salicylate Toxicity

Symptoms:

- Tinnitus
- Tachypnea
- Fever
- Mixed respiratory alkalosis + metabolic acidosis

Treatment

- Sodium bicarbonate
- Dialysis if severe

Avoid:

- Intubation if possible unless necessary because worsening acidosis can occur.

Carbon Monoxide

Symptoms:

- Headache
- Cherry-red skin (rare)
- Flu-like illness

Diagnosis

- Carboxyhemoglobin level

Treatment

- 100% oxygen
- Hyperbaric oxygen if severe

Calcium Channel Blocker Overdose

Most common cardiovascular drug overdose death.

Findings:

- Bradycardia
- Hypotension
- Hyperglycemia

Treatment:

- Calcium
- High-dose insulin therapy
- Vasopressors

13. Decontamination of Skin/Eyes

Steps:

1. Remove contaminated clothing
2. Brush off dry powders
3. Irrigate copiously

USMLE Pearl

Healthcare workers can become secondarily contaminated.

14. Body Packers

Drug packets (usually cocaine/heroin).

Complications:

- Bowel obstruction
- Packet rupture → massive overdose

Management

- Surgery if rupture or obstruction

15. Most Important USMLE Associations

Poisoning	Classic Clue	Antidote
Acetaminophen	Liver failure	NAC
Opioids	Pinpoint pupils	Naloxone
Organophosphates	SLUDGE	Atropine + pralidoxime
TCA	Wide QRS	Sodium bicarbonate
Methanol	Blindness	Fomepizole
Ethylene glycol	Calcium oxalate crystals	Fomepizole
Digoxin	Yellow vision/arrhythmias	Dig Fab
Cyanide	Severe lactic acidosis	Hydroxocobalamin
Iron	GI bleed + acidosis	Deferoxamine

16. Rapid USMLE Review Pearls

- Wide QRS overdose → think TCA
- Hypoglycemia + altered mental status → give **dextrose**
- Alcoholic/confused patient → give **thiamine before glucose**
- Organophosphates cause **wet** patients
- Anticholinergics cause **dry** patients
- Activated charcoal ineffective for **iron/lithium/alcohols**
- Calcium channel blocker overdose → **hyperglycemia**
- Salicylates cause **mixed acid-base disorder**
- Opioid overdose kills via **respiratory depression**

One-Minute Board Review

Sick poisoned patient approach:

1. ABCs
2. Glucose
3. ECG
4. Acetaminophen/salicylate levels
5. Identify toxidrome
6. Give antidote if available
7. Consider charcoal/dialysis when indicated

ECG Review

Systematic ECG Interpretation

Always approach ECGs in the same order:

1. Rate
2. Rhythm
3. Axis
4. Intervals (PR, QRS, QT)
5. Hypertrophy
6. Conduction Blocks
7. ST-Segment and T-Wave Changes
8. Clinical Correlation

USMLE Pearl: Never interpret an ECG without considering the clinical scenario.

Four Rhythm Questions

When analyzing any rhythm strip, ask:

1. Are P waves present?
 2. Is the QRS narrow (<120 ms) or wide (>120 ms)?
 3. What is the relationship between P waves and QRS complexes?
 4. Is the rhythm regular or irregular?
-

Pacemaker Rates

Pacemaker Site Intrinsic Rate

SA Node	60–100 bpm
AV Node	40–60 bpm
Ventricles	30–45 bpm

USMLE Pearl: A ventricular escape rhythm around 30–40 bpm suggests complete heart block.

Axis Determination

Lead I aVF Axis

Positive Positive Normal

Positive Negative Left Axis Deviation

Negative Positive Right Axis Deviation

Negative Negative Extreme Axis Deviation

Important Associations

Left Axis Deviation

- Left anterior fascicular block
- Left ventricular hypertrophy

Right Axis Deviation

- Right ventricular hypertrophy
- Pulmonary hypertension
- Left posterior fascicular block

Must-Know Arrhythmias

Atrial Fibrillation

- No distinct P waves
- Irregularly irregular rhythm
- Increased stroke risk

Management:

- Rate control
- Anticoagulation when indicated

Atrial Flutter

- Sawtooth flutter waves
- Atrial rate approximately 300 bpm
- Commonly 2:1 conduction

Supraventricular Tachycardia (SVT)

- Regular narrow-complex tachycardia
- Treated with vagal maneuvers and adenosine

Ventricular Tachycardia

- Wide-complex tachycardia
- Treat unstable patients with synchronized cardioversion

USMLE Pearl: Assume a wide-complex tachycardia is VT until proven otherwise.

AV Blocks

First-Degree AV Block

- PR interval > 200 ms
- Every P wave conducts

Causes:

- Increased vagal tone
- Beta blockers
- Digoxin

Mobitz I (Wenckebach)

- Progressive PR prolongation
- Dropped QRS complex

Common Causes:

- Inferior MI
- Digoxin toxicity

Mobitz II

- Fixed PR interval
- Sudden dropped beat

Important:

- Often progresses to complete heart block

- Requires pacemaker

Third-Degree AV Block

- Complete AV dissociation
- P waves and QRS complexes are independent

Treatment:

- Permanent pacemaker
-

Bundle Branch Blocks

Right Bundle Branch Block (RBBB)

ECG Findings:

- Wide QRS
- M-shaped QRS in V1
- W-shaped QRS in V6

Mnemonic:

"M in V1, W in V6"

Left Bundle Branch Block (LBBB)

ECG Findings:

- Wide QRS
- W-shaped QRS in V1
- M-shaped QRS in V6

Mnemonic:

"W in V1, M in V6"

USMLE Pearl: New LBBB with ischemic symptoms may represent STEMI equivalent.

Myocardial Ischemia and Infarction

Ischemia

- T-wave inversion

Injury

- ST-segment elevation

Infarction

- Pathologic Q waves

Evolution of Acute MI

1. Hyperacute T waves
 2. ST elevation
 3. T-wave inversion
 4. Pathologic Q waves
-

STEMI Localization

Inferior MI

Leads:

- II
- III
- aVF

Usually due to:

- Right coronary artery occlusion

Associated Findings:

- Bradycardia
- AV block

Anterior MI

Leads:

- V1–V4

Usually due to:

- LAD occlusion

Lateral MI

Leads:

- I
- aVL
- V5
- V6

Usually due to:

- Left circumflex occlusion

Posterior MI

Findings:

- ST depression in V1–V3
- Tall R waves in V1–V3

Pathologic Q Waves

Criteria:

- Width > 0.04 seconds
- Depth > one-third of R-wave height

Suggests:

- Prior myocardial infarction

Note:

Small Q waves in lateral leads may be normal.

Early Repolarization

Seen in:

- Young healthy adults
- Athletes

Characteristics:

- J-point elevation
- Stable ECG findings
- No symptoms

USMLE Pearl: ST elevation in a healthy asymptomatic athlete is often early repolarization rather than STEMI.

Electrolyte Abnormalities

Hypokalemia

ECG Findings:

- Flattened T waves
- Prominent U waves

Clinical Significance:

- Increases risk of digoxin toxicity

Hyperkalemia

ECG Findings:

- Peaked T waves
- Widened QRS
- Sine-wave pattern in severe cases

Treatment:

- Calcium gluconate

Digoxin Toxicity

Symptoms:

- Nausea
- Vomiting
- Visual disturbances
- Arrhythmias

ECG Findings:

- AV block
- Junctional rhythms
- Atrial tachycardia with block

Risk Factors:

- Hypokalemia
- Renal failure

Wolff-Parkinson-White Syndrome

ECG Findings:

- Short PR interval
- Delta wave
- Wide QRS

Clinical Importance:

- Predisposes to AV reentrant tachycardia
- Can cause dangerous AF with rapid ventricular response

USMLE Pearl: Avoid AV nodal blockers in patients with atrial fibrillation and WPW.

Top 10 USMLE ECG Diagnoses

1. Atrial fibrillation
 2. Atrial flutter
 3. Supraventricular tachycardia
 4. Ventricular tachycardia
 5. First-degree AV block
 6. Mobitz I AV block
 7. Mobitz II AV block
 8. Complete heart block
 9. STEMI localization
 10. Wolff-Parkinson-White syndrome
-

Exam-Day ECG Strategy

For every ECG:

1. Determine the rate.
2. Determine if the rhythm is regular or irregular.
3. Look for P waves.
4. Determine whether the QRS is narrow or wide.
5. Evaluate ST segments and T waves.
6. Correlate findings with the clinical presentation.

Chest Trauma “5-Minute Killers”

The “Early Killer”

Brain death can occur after <10 minutes of oxygen deprivation, so the first priority in trauma is ALWAYS the airway (A in ABCs).

The 5 Immediate Life-Threatening Chest Injuries

1. Tension pneumothorax
2. Open pneumothorax
3. Cardiac tamponade
4. Massive hemothorax
5. Flail chest

1. Tension Pneumothorax

Air enters pleural space and cannot escape → rising intrathoracic pressure → collapse of lung + decreased venous return → obstructive shock.

Classic Findings

- Severe dyspnea
- Hypotension/hypoperfusion
- Distended neck veins (JVD)
- Absent or decreased breath sounds on affected side
- Hyperresonance to percussion
- Tracheal deviation away from affected side (late finding)

USMLE Tip

Diagnosis is **clinical** — do NOT wait for chest x-ray.

Treatment

Immediate:

1. Needle thoracostomy
2. Then chest tube (tube thoracostomy)

USMLE Pearls

- Tension pneumothorax = **obstructive shock**
- Most common board clue:
 - trauma + hypotension + unilateral absent breath sounds + JVD

2. Open Pneumothorax (“Sucking Chest Wound”)

Open defect in chest wall allows air movement between atmosphere and pleural space.

Findings

- Obvious chest wall wound
- Respiratory distress
- “Sucking” sound
- Often associated with hemothorax

Treatment

1. Cover with **3-sided occlusive dressing**
 - prevents air entry
 - allows air to escape
2. Chest tube placement

USMLE Tip

Never seal all 4 sides initially → can convert to tension pneumothorax.

3. Cardiac Tamponade

Blood accumulates in pericardial sac → impaired ventricular filling → obstructive shock.

Common after:

- Penetrating trauma (stab wounds)
- Blunt trauma to anterior chest

Beck Triad

- Hypotension
- JVD
- Muffled heart sounds

USMLE Tip

Tamponade and tension pneumothorax both cause:

- hypotension
- JVD
- shock

Differentiate:

- Tamponade → muffled heart sounds

- Tension PTX → absent breath sounds

Important Concept

Very small amounts of blood (150–200 mL) can cause tamponade, so a normal chest x-ray does NOT exclude it.

Treatment

Initial:

- Pericardiocentesis

Definitive:

- Surgical repair/thoracotomy

USMLE Pearls

- FAST exam is highly useful
- Removal of even 5–10 mL may improve cardiac output dramatically

4. Massive Hemothorax

Large accumulation of blood in pleural cavity.

Definition

≥1500 mL blood in one hemithorax.

Each hemithorax can hold up to 40–50% of blood volume.

Causes

- Lung injury
- Intercostal artery injury
- Internal mammary artery injury

Why It Kills

1. Hypovolemic shock

Loss of preload

2. Hypoxia

Collapsed lung → V/Q mismatch

3. Compression

Pressure impairs venous return and lung expansion

Findings

- Shock
- Dullness to percussion
- Decreased breath sounds
- Respiratory distress

Treatment

1. Immediate chest tube
2. Thoracotomy if continued bleeding

Surgical Indications (high-yield)

Persistent bleeding:

- 1500 mL initially OR
- 200 mL/hr for several hours

USMLE Tip

Massive hemothorax = **hypovolemic shock**

Tension pneumothorax/tamponade = **obstructive shock**

5. Flail Chest

Multiple rib fractures causing a free-floating chest wall segment.

Definition

- ≥ 3 adjacent ribs fractured
- each fractured in ≥ 2 places

Usually associated with pulmonary contusion.

Paradoxical Movement

During inspiration:

- flail segment moves inward

During expiration:

- moves outward

Main Problem

Pulmonary contusion $\rightarrow$ hypoxemia

NOT the rib fractures themselves.

Complications

- Increased work of breathing
- Respiratory fatigue
- Respiratory arrest

Treatment

Mild cases

- Pain control
- Pulmonary hygiene
- Incentive spirometry
- Restrict excess IV fluids

Severe cases

Ventilatory support if:

- persistent hypoxemia
- shock
- severe associated injuries
- elderly patients
- many rib fractures

USMLE Pearls

- Most common cause of death in flail chest = pulmonary contusion
- Positive pressure ventilation helps stabilize chest wall internally

Rapid Comparison Table (Very High Yield)

?

Condition	Key Findings	Shock Type	Treatment
ension Pneumothorax	Absent breath sounds, hyperresonance, tracheal deviation	Obstructive	Needle decompression + chest tube
open Pneumothorax	Sucking chest wound	Respiratory compromise	3-sided dressing + chest tube
cardiac Tamponade	Beck triad	Obstructive	Pericardiocentesis
Hemothorax	Dullness, shock, decreased breath sounds	Hypovolemic	Chest tube + thoracotomy
flail Chest	Paradoxical chest motion	Respiratory failure	Analgesia/Ventilation

Must-Know USMLE Associations

Hyperresonance

→ Pneumothorax

Dullness to percussion

→ Hemothorax

Beck Triad

{Beck Triad} = {Hypotension} + {JVD} + {Muffled Heart Sounds}

→ Cardiac tamponade

Paradoxical chest wall movement

→ Flail chest

Tracheal deviation away from lesion

→ Tension pneumothorax

Quick Exam Strategy

When given a trauma patient:

1. Assess airway first
2. Determine:
 - obstructive shock?
 - hypovolemic shock?
 - respiratory failure?
3. Use percussion findings:
 - Hyperresonance = air
 - Dullness = blood
4. If unstable:
 - treat clinically before imaging

One-Line Memory Tricks

- **Tension PTX:** "Air under pressure shifts the mediastinum."
- **Tamponade:** "Heart squeezed by blood."
- **Massive hemothorax:** "Chest fills with blood."
- **Flail chest:** "Broken ribs move backward."
- **Open PTX:** "Hole in chest wall sucks air."

Shortness of Breath (Dyspnea)

Definition

Dyspnea = the subjective sensation of uncomfortable breathing.

- Can be normal during heavy exercise.
- Sudden severe dyspnea is always an emergency until proven otherwise.

Initial Approach to Any Dyspneic Patient (ABCs)

First Priorities

1. Airway
2. Breathing
3. Circulation
4. Pulse oximetry
5. Cardiac monitor
6. Oxygen as needed

Always ask:

- Is this respiratory?
- Cardiac?
- Metabolic?
- Toxicologic?
- Hematologic?
- Neurologic?

USMLE Pearl: Not all shortness of breath comes from the lungs.

Life-Threatening Causes (Must Never Miss)

Pulmonary Embolism (PE)

Clues

- Sudden onset dyspnea
- Hypoxia
- Tachycardia
- Pleuritic chest pain
- Hemoptysis
- Normal lung exam is common

ECG Findings

- Sinus tachycardia (most common)
- Right axis deviation
- Right bundle branch block

- T-wave inversion V1-V3
- S1Q3T3 (classic but uncommon)

Chest X-ray

Usually normal.

Diagnosis

- CT Pulmonary Angiography
- V/Q scan if contrast contraindicated

Treatment

- Oxygen
- Anticoagulation
- Thrombolysis for unstable patients

USMLE Pearl: A normal chest x-ray does NOT exclude PE.

Massive Hemoptysis

Definition:

600 mL blood

Immediate Priorities

- **Protect airway (intubate)**
- **Aggressive suctioning**
- **Bleeding lung DOWN**
- Call Interventional Radiology for bronchial artery embolization

USMLE Pearl: Patients die from asphyxiation, not blood loss.

Acute Decompensated Heart Failure (Flash Pulmonary Edema)

Classic Presentation

- **Sudden nighttime dyspnea (PND)**
- **Severe hypertension**
- **Bilateral rales**
- **Wheezing ("cardiac asthma")**
- **S3 gallop**
- **Pulmonary edema on chest x-ray**

Initial Treatment

1. Oxygen
2. CPAP/BiPAP
3. Nitroglycerin (first-line)
4. Diuretics if volume overloaded

BNP

- <100 → CHF unlikely
 - 500 → CHF likely

Avoid

- Beta blockers during acute decompensation

USMLE Pearl: Vasodilators (nitroglycerin) are first-line—not furosemide.

Noncardiogenic Pulmonary Edema

Causes

- Heroin overdose/Naloxone
- ARDS
- Aspiration
- Drowning
- Neurogenic pulmonary edema
- Inhalation injury
- Fluid overload

Treatment

- Oxygen
- Positive-pressure ventilation if needed
- Treat underlying cause

Thyroid Storm

Presentation

- Fever
- Severe tachycardia
- Atrial fibrillation
- Hypertension
- Anxiety
- Tremor
- Altered mental status

Treatment Order (Very High Yield)

1. Beta blocker (Propranolol)
2. PTU or Methimazole
3. Wait 1 hour
4. Iodine
5. Steroids
6. Cooling measures
7. Treat precipitating factor

USMLE Pearl: Never give iodine before PTU/methimazole.

Asthma Exacerbation

Moderate-Severe Treatment

- High-flow oxygen
- Continuous albuterol
- Ipratropium (first hour)
- Early systemic steroids
- Epinephrine/Terbutaline if severe
- Magnesium sulfate (adjunct for severe attacks)

Intubation

Indications:

- Exhaustion
- Altered mental status
- Silent chest
- Rising CO₂
- Respiratory arrest

Ventilator Pearls

- Low respiratory rate (6–12/min)
- Low tidal volume (6 mL/kg ideal body weight)
- High inspiratory flow
- Allow prolonged exhalation
- Permissive hypercapnia acceptable

If Hypotension After Intubation

Think:

- Auto-PEEP (breath stacking)
- Tension pneumothorax
- Medication effect

USMLE Pearl: A "quiet chest" in an asthmatic is a very ominous sign.

COPD

Chronic Bronchitis ("Blue Bloater")

- Chronic productive cough
- Cyanosis
- Obesity
- Peripheral edema
- Cor pulmonale

Chest X-ray:

- Increased bronchovascular markings
- Enlarged heart

Emphysema ("Pink Puffer")

- Thin
- Barrel chest
- Pursed-lip breathing
- Hyperinflation
- Minimal cough

Chest X-ray:

- Hyperinflation
- Bullae
- Small heart

ABG Interpretation

ABG is preferred over VBG in severe COPD.

Look for:

- Hypoxemia
- Hypercapnia
- Acidosis

High-Yield Rule

A pH <7.30 suggests acute respiratory failure even in chronic CO₂ retainers.

Differential Diagnosis of Dyspnea (USMLE)

Pulmonary

- Asthma
- COPD
- Pneumonia
- PE
- Pneumothorax
- Pleural effusion

Cardiac

- CHF
- ACS/MI
- Arrhythmia
- Pericardial tamponade

Metabolic

- Diabetic ketoacidosis
- Metabolic acidosis
- Sepsis

Hematologic

- Severe anemia

Toxicologic

- Carbon monoxide
- Opioid overdose
- Salicylates

Endocrine

- Thyroid storm

Psychiatric

- Panic attack (diagnosis of exclusion)

USMLE Rapid Review

Sudden dyspnea + hypoxia + clear lungs

→ Pulmonary embolism

Sudden nighttime dyspnea + hypertension + pulmonary edema

→ Acute CHF

Fever + atrial fibrillation + anxiety + tremor

→ Thyroid storm

Severe asthma + silent chest

→ Impending respiratory failure

Massive hemoptysis

→ Airway first, bleeding side down, Interventional Radiology

Narcan followed by pulmonary edema

→ Noncardiogenic pulmonary edema

Dyspnea with normal pulmonary workup

→ Consider anemia, DKA, ACS, arrhythmia, metabolic acidosis, thyroid disease, or panic disorder.

Top Exam Pearls

- **ABCs always come first.**
- Oxygen is appropriate for almost every unstable dyspneic patient.
- **PE often has a normal chest x-ray.**
- **S3 is the most specific physical finding for CHF.**
- Pulmonary edema is the most specific chest x-ray finding for CHF.
- **BNP <100 essentially excludes CHF.**
- Nitroglycerin is first-line for hypertensive pulmonary edema.
- **CPAP/BiPAP reduces intubation in CHF.**
- **Silent lungs in asthma = impending arrest.**
- Auto-PEEP is a common cause of hypotension after intubating severe asthma.
- **Thyroid storm treatment sequence: Beta blocker → PTU/Methimazole → Wait 1 hour → Iodine → Steroids.**

