



Quick Reference Guide

1. Patient with High BP (Hypertensive)	1
2. Patient with Low BP (Hypotensive)	3
3. Low H/H (Anemia / Possible Bleed)	5
4. High/Low Electrolytes (Quick Pattern Guide)	7
5. Abnormal Coags (High INR / Long PT/PTT)	9
6. LVADs (Very High-Level View)	10
7. Art Lines: Over vs Under Damping (Quick Visual Cue Sheet)	12
8. CVP: Basic Troubleshooting Framework	14
9. Big Picture: How to Think About Vasopressors	15
Quick Mental Cheat - IMC	15
1. Norepinephrine (Levophed)	16
2. Epinephrine	17
3. Phenylephrine (Neo-Synephrine)	18
4. Vasopressin (ADH analog)	19
5. Dopamine	20
6. Dobutamine (Inotrope)	21
7. Milrinone (Inotrope / "Inodilator")	22
8. Angiotensin II (Giapreza)	23
9. Midodrine (Oral Vasopressor)	24
10. Quick Safety Checklist for Any Vasopressor	26
10. General Cardiac Medications Overview	27
1. Beta Blockers	27
2. Nitrates	28
3. Pulmonary Hypertension (PH) Meds	29
a) PDE-5 inhibitors (for PH)	29
b) Endothelin Receptor Antagonists (ERAs)	30
c) Prostacyclin Analogues / Prostacyclin Receptor Agonists	30
d) Soluble Guanylate Cyclase Stimulators	31
4. Diuretics	32
a) Loop Diuretics	32
b) Thiazide & Thiazide-like Diuretics	33
c) Potassium-Sparing / Aldosterone Antagonists	33
d) Osmotic Diuretics	34
Cheat Sheet	35
11. External Pacing – Safety & Values	36



1. Patient with High BP (Hypertensive)

S/S to check

- Headache, vision changes, photophobia
- Neuro: confusion, slurred speech, unilateral weakness, facial droop
- Chest pain, SOB, palpitations
- Nausea/vomiting (think increased ICP / hypertensive emergency)
- Pregnancy status in appropriate patients (preeclampsia s/s)

V/S & monitoring

- Trend BPs (look at last 24 hrs, not just the one bad number)
- **MAP** (often target range ordered) or 60-80 by default
- HR & rhythm on tele → tachy, brady, new arrhythmia?
- RR, SpO₂, pain score
- Weight / I&O if volume overload is suspected

Labs to consider

- BMP (Na, K, BUN/Cr – kidney function, electrolyte issues)
- Troponin, BNP if chest pain/heart failure symptoms per orders
- UA/protein if pregnancy-related concerns
- Prior imaging: last echo, CT head, etc. (just review, not order)

Meds to review

- Scheduled antihypertensives:
 - ACEI/ARB (lisinopril, losartan, etc.)



- Beta blockers (**metoprolol**, carvedilol)
 - CCBs (amlodipine, diltiazem)
 - PRN BP meds on MAR (**hydralazine**, **labetalol**, etc.)
 - Diuretics (**furosemide**, bumetanide) if fluid overload - will help with chronic HTN
 - Any meds recently **held** or **missed** that might explain the spike
-



2. Patient with Low BP (Hypotensive)

S/S to check

- Dizziness, lightheadedness, syncope
- Mental status: new confusion, agitation, “not acting right”
- Chest pain, SOB, new/worse fatigue
- Cool, clammy skin, delayed cap refill
- Decreased urine output, dark/concentrated urine
- Consider over diuresis
- Any obvious or occult bleeding (drains, stool, urine, emesis, surgical sites)

V/S & monitoring

- Confirm: recheck BP manually + check correct cuff size
- **MAP** (most places worry < 65 unless otherwise ordered)
- HR & rhythm: new tachycardia, bradycardia, heart block, arrhythmias
- RR, SpO₂, temp (fever → consider sepsis)
- I&O trend over the last 4–24 hrs

Labs to consider

- CBC (H/H → bleeding? WBC → infection?)
- BMP (Cr/BUN → renal perfusion, K⁺ changes)
- Lactate, blood cultures (if sepsis suspected per protocol)
- Troponin (if chest pain/ischemia picture)
- ABG/VBG if respiratory compromise



Meds to review

- Recently given antihypertensives (if yes, which + when)
 - Diuretics (lasix, bumex) → volume depletion?
 - Opioids, sedatives, anxiolytics → vasodilation / decreased sympathetic tone
 - Vasodilators, nitrates, PDE inhibitors, etc.
 - Any dialysis/CRRT treatments or fluid removals
-



3. Low H/H (Anemia / Possible Bleed)

S/S to check

- SOB at rest or with minimal exertion
- Chest pain, palpitations, tachycardia
- Dizziness, syncope, fatigue, weakness
- Pale or cool skin, diaphoresis
- S/S of active bleeding:
 - Hematemesis, coffee-ground emesis
 - Melena, hematochezia
 - Hematuria
 - Oozing from IV sites, central lines, drains

V/S & monitoring

- HR (often ↑ before BP drops)
- BP & MAP, including orthostatic trends if appropriate
- RR & SpO₂ (especially on exertion)
- Tele for new ST changes or arrhythmias
- I&O, drain outputs, any chest tube/JP output trends



Labs to consider

- H/H trends (how fast falling, not just the number)
- Platelets, INR/PTT (coagulopathy?)
- Type & screen / type & crossmatch
- BMP (BUN often ↑ in upper GI bleed)
- Iron studies/B12/folate if chronic anemia workup is in progress

Meds to review

- Anticoagulants (heparin, enoxaparin, warfarin, DOACs)
 - Antiplatelets (aspirin, clopidogrel, etc.)
 - NSAIDs (risk for GI bleed)
 - Any orders for blood products (PRBCs, platelets, FFP, cryo) → check status and consent
-



4. High/Low Electrolytes (Quick Pattern Guide)

Potassium (K⁺)

Hyperkalemia (high K⁺):

- S/S: weakness, paresthesias, palpitations, possible flaccid paralysis
- V/S/monitor: tele for **peaked T waves, widened QRS, arrhythmias**, brady/asystole risk
- Labs: K⁺ trend, BUN/Cr (renal function), other electrolytes
- Meds to review:
 - K⁺ supplements (scheduled and PRN)
 - ACEI/ARB, spironolactone, eplerenone
 - Trimethoprim, NSAIDs, etc.
- Treat Hyperkalemia with **A DICK**:
 - *A - Albuterol Nebulizer
 - *D - 50% Dextrose IV push
 - *I - Regular Insulin IV push
 - *C - Calcium Gluconate IV
 - *K - Kayexalate orally or rectally
 - *S - Sodium Bicarbonate IV (if patient is acidotic)

Hypokalemia (low K⁺):

- S/S: muscle cramps, weakness, constipation/ileus, palpitations
- Monitor: tele for **U waves, PVCs, VT**, prolonged QT
- Labs: K⁺ trend, Mg²⁺ (often low together)
- Meds to review:
 - Loop/thiazide diuretics
 - Insulin/dextrose, albuterol (shifts K⁺ intracellular)
 - Laxatives, steroids



Sodium (Na^+)

Hypernatremia:

- S/S: confusion, lethargy, irritability, possibly seizures
- V/S: orthostatic hypotension, tachycardia (dehydration)
- Labs: Na^+ trend, BUN/Cr, serum osmolality, urine studies if available
- Meds: high-dose diuretics, osmotic diuretics, NS/3% saline infusions

Hyponatremia:

- S/S: confusion, headache, nausea, vomiting, seizures, decreased LOC
- V/S: may be normal or slightly low BP; watch for fluid overload signs (edema, crackles)
- Labs: Na^+ trend, serum osmolality, urine Na^+ if available
- Meds: thiazide diuretics, antidepressants, anticonvulsants, desmopressin, etc.

Magnesium (Mg^{2+}) & Calcium (Ca^{2+}) – ultra quick

Low Mg^{2+} / Low Ca^{2+} :

- S/S: twitching, tremors, tetany, Trousseau/Chvostek, arrhythmias
- Monitor: tele (prolonged QT, torsades with low Mg^{2+})
- Meds: diuretics, PPIs, poor intake/TPN issues

High Mg^{2+} / High Ca^{2+} :

- S/S: weakness, decreased DTRs, bradycardia, hypotension (esp. Mg^{2+}), confusion
- Think: renal failure, excess supplements, malignancy (for Ca^{2+})



5. Abnormal Coags (High INR / Long PT/PTT)

S/S to check

- Easy bruising, petechiae, ecchymoses
- Oozing from IV sites, gums, nose
- Hematuria, GI bleeding, heavy menses
- Any recent invasive procedures (line placements, biopsies, surgeries)

V/S & monitoring

- BP, HR for signs of bleeding/shock
- Neuro checks: sudden headache, confusion, focal deficits → ICH concern
- I&O (hematuria, low urine output)

Labs to consider

- INR, PT, aPTT
- Platelet count
- Fibrinogen, D-dimer (if DIC concern)
- LFTs (liver function)
- H/H trend

Meds to review

- Warfarin (check last dose + indication)
- Heparin/LMWH, DOACs (apixaban, rivaroxaban, etc.)
- Antiplatelets (ASA, clopidogrel, ticagrelor)
- Herbal/supplements (ginkgo, ginseng, etc. if documented)



6. LVADs (Very High-Level View)

⚠️ Every LVAD program has **strict protocols**. This is just a pattern checklist; always follow your VAD team's instructions.

S/S to check (patient first, device second)

- Neuro: any stroke-like symptoms (weakness, slurred speech, confusion, vision loss)
- Perfusion: LOC, cap refill, skin temp, urine output
- SOB, chest pain, dizziness, syncope
- Bleeding: GI bleed, epistaxis, hematuria, driveline bleeding

Device assessments

- Is the pump "hum" present and continuous? (HM3 will have the High and Low Hum)
- Controller: Any alarms/messages?
- Power: Are **two power sources** connected (batteries/wall)?
- Driveline: Dressing intact, no pulling, no redness/purulence

V/S & monitoring

- Many LVAD pts have **no palpable pulse** and weird NIBPs
- Use **Doppler MAP** per protocol (Normal target 60–80 MAP)
- Tele for arrhythmias (AFib, VT can decrease flow), but most have AICD - PM.

Labs to consider

- H/H (hemolysis/bleeding)
- LDH, haptoglobin, bilirubin (hemolysis markers)
- INR (if on warfarin—often a target range)



- BMP (renal perfusion, K⁺)

Meds to review

- Anticoag: warfarin (with set INR goal)
- Antiplatelet: aspirin ± others
- HF meds: beta blockers, ACEI/ARB/ARNI, diuretics, etc., as ordered
- Any ACHS (antibiotics for driveline infection, etc.)

Alarms – very general

- **Low flow:** think low volume, RV failure, obstruction, tamponade, big arrhythmia
 - **Low battery/power:** fix power FIRST, per protocol - Cart or Emergency bag should be available at all times
 - **Controller issues:** VAD coordinator guidance, contact CNC, New controller is located in Emergency Bag
-



7. Art Lines: Over vs Under Damping (Quick Visual Cue Sheet)

Always:

- Check the patient first (does reading fit the picture?)
- Check transducer level and zero (phlebostatic axis in correct position)
- Ensure pressure bag at ~300 mmHg and continuous flush

Over-damped waveform

- **Appearance:** Sluggish, rounded waveform, little/no dicrotic notch
- **Numbers:**
 - SBP falsely **low**
 - DBP falsely **high**
 - Narrow pulse pressure
- **Common causes:**
 - Air bubbles, clot, kinks in tubing
 - Loose connections
 - Catheter against the vessel wall
- **Nurse troubleshooting:**
 - Inspect and flush the line
 - Remove air, straighten tubing, and check all connections
 - Re-zero and level
 - Compare with cuff BP



Under-damped waveform

- **Appearance:** Very tall, “spiky” waveform with lots of oscillations
 - **Numbers:**
 - SBP falsely **high**
 - DBP falsely **low**
 - Wide pulse pressure
 - **Common causes:**
 - Tubing too long or stiff
 - Excessive stopcocks
 - **Nurse troubleshooting:**
 - Ensure standard-length tubing
 - Check for extra stopcocks/devices
 - Re-zero, re-level
 - Compare with cuff BP
-



8. CVP: Basic Troubleshooting Framework

Think: 1) Line & equipment, 2) Patient position, 3) Hemodynamics.

Check the setup

- Transducer level at phlebostatic axis
- Zeroed correctly at start of shift and with bed changes
- No air, no kinks, all clamps open
- Correct port (distal lumen in CVC/PA cath per policy)

Patient factors

- Patient flat or at ordered HOB angle when reading?
- On mechanical ventilation? (PEEP and intrathoracic pressure can raise CVP)
- Recent fluid bolus, diuresis, or bleeding?

Patterns (very simplified)

- **Low CVP** (if accurate):
 - Possible hypovolemia, vasodilation, dehydration
 - Check: dry mucous membranes, poor skin turgor, tachycardia, low BP/MAP, low UOP
- **High CVP** (if accurate):
 - Possible fluid overload / RV failure / pulmonary HTN / tamponade
 - Check: JVD, edema, crackles, hepatomegaly, low UOP, hypotension

Meds & interventions to be aware of

- Recent diuretics or large fluid boluses
- Vasopressors or vasodilators
- Inotropes that affect RV/LV function



9. Big Picture: How to Think About Vasopressors

“Pressors” = meds that \uparrow BP/MAP by:

- Squeezing vessels (**vasoconstriction**)
- Increasing contractility (**inotropy**)
- Increasing HR (**chronotropy**)

Most act on α (**alpha**) and β (**beta**) receptors:

- α_1 : vasoconstriction \rightarrow \uparrow SVR \rightarrow \uparrow BP
- β_1 : \uparrow HR & contractility \rightarrow \uparrow CO
- β_2 : vasodilation/bronchodilation (usually weaker in this context)

Many require a **central line**, **cardiac monitoring**, and **frequent reassessment**.

Quick Mental Cheat - IMC

- **Dobutamine** – IV, β_1 , “**pump helper**,” may \downarrow BP, watch HR/arrhythmias
- **Milrinone** – IV, **PDE-3 inodilator**, “**pump + vasodilate**,” good for RV/pulm HTN, long half-life, watch BP & kidneys
- **Midodrine** – oral α_1 , “**daytime squeeze pill**,” chronic/step-down hypotension, watch for supine hypertension



1. Norepinephrine (Levophed)

Receptors / Effect

- Strong α_1 (vasoconstriction), some β_1 (inotropy)
- \uparrow SVR and MAP with less HR bump than dopamine/epi

Commonly used for

- First-line in many forms of **septic shock** and **vasodilatory shock** in guidelines

What to remember

- Go-to “**workhorse**” **pressor** in many ICUs
- Watch:
 - Fingers/toes for **ischemia** on high doses (intense vasoconstriction)
 - HR/rhythm – tachyarrhythmias possible, but less than dopamine/epi
- Prefer **central line**; if peripheral:
 - Check site **very frequently**
 - Know your **extravasation protocol** (e.g., phentolamine, elevation, notify provider)



2. Epinephrine

Receptors / Effect

- Mixed $\alpha_1 + \beta_1 + \beta_2$
- \uparrow HR, \uparrow contractility, \uparrow SVR (dose-dependent)

Commonly used for

- **Cardiac arrest (ACLS)** - 1mg - 1:10,000 IV Bolus from Preloads in crash cart
- Allergic reaction - 0.3mg - 1:1,000 IM from glass ampules
- Drip in refractory **septic shock** or **cardiogenic shock** per protocol

What to remember

- Very **pro-arrhythmic** (watch for SVT, VT, AFib with RVR)
- Can cause **lactic acidosis** and **hyperglycemia**
- Expect \uparrow HR and often \uparrow ectopy/PVCs
- **Central line strongly preferred** for continuous infusion



3. Phenylephrine (Neo-Synephrine)

Receptors / Effect

- Almost pure α_1 **agonist**
- Vasoconstriction $\rightarrow \uparrow$ SVR, \uparrow BP
- Little direct effect on HR/contractility

Commonly used for

- Hypotension with **tachyarrhythmias** when you don't want β_1 stimulation
- OR/ICU and procedural areas for **transient hypotension** (boluses/drips)

What to remember

- Good when **HR is already high** and you just need more **squeeze**
- Can cause **reflex bradycardia**
- Watch for **decreased organ perfusion**:
 - MAP looks "fine" but extremities are cold, mottled \rightarrow too much clamp



4. Vasopressin (ADH analog)

Receptors / Effect

- Acts on **V₁ receptors** → vasoconstriction
- Acts on **V₂ receptors** in kidneys → water reabsorption
- **Non-adrenergic** (not α or β) → often used as an **add-on** to catecholamines

Commonly used for

- Adjunct in **septic shock** when norepi alone isn't enough
- Some protocols for **GI bleeding, post-cardiac surgery**, etc.

What to remember

- Often run at a **fixed dose** (not titrated) in many protocols
- Can help **reduce norepi requirements**
- Watch for **decreased perfusion** to gut, skin, extremities (intense vasoconstriction)
- Older ACLS algorithms used it; now **epi** is preferred, but you may still see references



5. Dopamine

Receptors / Effect (dose-dependent conceptually)

- Low-dose: dopaminergic (renal/mesenteric vasodilation – “renal dose” is now considered **outdated**)
- Mid-dose: β_1 → ↑ HR & contractility
- High-dose: α_1 → vasoconstriction

Commonly used for

- Historically for **shock & bradycardia**
- Many guidelines now prefer **norepi or other agents** due to arrhythmia risk

What to remember

- Big risk: **tachyarrhythmias** (SVT, VT)
- Not as common in many modern ICUs; if you see it, it's fine to wonder:
 - “Why dopamine instead of norepi/epi?” (just ask respectfully)
- Monitor HR, rhythm, UOP, and watch for **ectopy**



6. Dobutamine (Inotrope)

What it is / Receptors

- Mainly β_1 agonist, some β_2
- Think: “more squeeze, mild vasodilation”

Hemodynamic effect

- \uparrow **Contractility** and **cardiac output**
- Mild \downarrow SVR \rightarrow **BP can drop** even though CO improves

Common uses

- **Cardiogenic shock** with low CO
- Decompensated **systolic HF**
- Sometimes in combo with norepi:
 - **Norepi = squeeze**
 - **Dobutamine = squeeze + pump**

What to remember

- BP: may **lower BP**; don't be surprised if MAP dips when starting/titrating
- HR/rhythm: **tachycardia, PVCs, SVT, VT** \rightarrow continuous tele
- Chest pain/ischemia: \uparrow myocardial O_2 demand
- Often **central line preferred**, ICU-level monitoring
- Think of it as: “**help the heart squeeze,**” **not primarily a BP drug**



7. Milrinone (Inotrope / “Inodilator”)

What it is

- **PDE-3 inhibitor** → ↑ intracellular cAMP in heart & vessels
- Think: “**dobutamine’s cousin that also relaxes the vessels and lungs**”

Hemodynamic effect

- ↑ **Contractility (inotropy)**
- **Vasodilation** of systemic & pulmonary vasculature → ↓ SVR & ↓ PVR
- Can significantly **drop BP**, especially if volume-depleted

Common uses

- Advanced **systolic heart failure** (acute decompensation)
- **Cardiogenic shock**, especially with RV involvement or **pulmonary HTN**
- Post–cardiac surgery, **LVAD** patients as bridge/support
- Sometimes used long-term as a **continuous home infusion**

Key pharmacology pearls

- **Renal clearance** → doses often adjusted in kidney dysfunction
- **Long half-life** vs dobutamine:
 - Changes take **longer to show up**
 - Bad effects (like hypotension) can **linger**



What to remember

- BP: careful monitoring for **hypotension** and dizziness
 - HR/rhythm: risk of **ventricular arrhythmias**
 - Renal function: watch **Cr/BUN and UOP** (affects drug level)
 - Watch perfusion:
 - Better: **warm extremities, improved UOP, clearer mentation**
 - Worse: **cold, mottled, low UOP, rising lactate**
-

8. Angiotensin II (Giapreza)

Receptors / Effect

- Synthetic **angiotensin II** → **potent vasoconstriction**
- ↑ SVR and MAP

Commonly used for

- **Refractory vasodilatory shock** (e.g., septic shock) not responding to catecholamines + vasopressin
- Typically in **advanced/tertiary ICUs**

What to remember

- You may **not see it often** unless you're in a big cardiac/medical ICU
 - Requires **very close monitoring** and is usually tightly controlled by ICU team + pharmacy
 - **Thrombotic risk** – patients often on DVT prophylaxis as ordered
-



9. Midodrine (Oral Vasopressor)

What it is / Effect

- Oral α_1 **agonist** → vasoconstriction
- Think: “**daytime squeeze pill**” often used to keep BP up when weaning off IV pressors or for chronic orthostatic hypotension

Hemodynamic effect

- \uparrow SVR → \uparrow BP / MAP
- No direct inotropy; effect is mostly **vascular**, not “pump”

Common uses

- **Chronic orthostatic hypotension**
- Step-down/IMC: **weaning from IV pressors** in pts who still run soft but are otherwise stable
- Helps avoid restarting an IV pressor every time they stand up / ambulate

What to remember

- **Timing**
 - Usually given **during the day** (when pt is upright & active)
 - Often **avoided near bedtime** due to risk of **supine hypertension**
- **BP monitoring**
 - Check BP **before** and ~1 hour **after** dose (per unit policy)
 - Know **hold parameters** (e.g., “hold if SBP > ___ or MAP > ___”)
- **Side effects**
 - Supine hypertension (headache, vision changes, chest pain when lying flat)



- “Goosebumps,” scalp tingling/itching, urinary retention
- **Not for crashing hypotension**
 - Onset is **not instant** → think **supportive, not rescue**
 - You still need **IV pressors** for acute shock per protocol



10. Quick Safety Checklist for Any Vasopressor

When you see a pressor or inotrope, quickly ask yourself:

1. Do I understand the reason it's ordered?

- Septic, cardiogenic, neurogenic, post-op, etc.

2. Is access appropriate?

- Central line vs peripheral policy
- Site checks **documented** and performed

3. What's the ordered MAP/BP goal?

- Even if you didn't choose it, know what you're aiming for

4. What is the titration order?

- Minimum and maximum rates
- How often you can adjust
- Documentation requirements

5. What am I watching for?

- HR & rhythm: **brady vs tachy vs ectopy**
- Extremities: **warm vs cold, mottled, cyanotic digits**
- UOP, mental status, **lactate trends** (per provider orders)

6. What's the backup plan?

- If BP tanks despite titration → **who do I call, what protocol?**
- If **extravasation** occurs → know your facility's protocol (e.g., phentolamine, elevation, notify provider)



10. General Cardiac Medications Overview

1. Beta Blockers

Examples (common ones you'll see)

- **Metoprolol** (Lopressor, Toprol XL)
- **Carvedilol** (Coreg – also has some α -blocking)
- **Atenolol, Bisoprolol**
- **Labetalol** (mixed α/β – often IV for BP control)
- **Esmolol** (IV drip, short-acting, ICU/OR)

Think of it as...

“**Brake pedal** for the heart” – slows HR and decreases squeeze to reduce O_2 demand.

Common uses

- Rate control in **AFib**, SVT (some situations)
- **Chronic HF** (carvedilol, metoprolol succinate, bisoprolol)
- **Post-MI**, CAD, angina (reduce workload)
- BP control (often not first-line alone, but commonly used)

Watch for

- **HR & BP:**
 - Hold parameters like HR < 50–60, SBP < 90–100 (per order set)
- **Signs of intolerance:**
 - Dizziness, fatigue, near-syncope



- Worsening SOB/edema in pts with decompensated HF if started/aggressively titrated
 - **Asthma/COPD:**
 - Non-selective β -blockers (propranolol) can worsen bronchospasm
 - Cardioselective (metoprolol, bisoprolol) are “safer” but still use caution
 - **Masking hypoglycemia:**
 - Can blunt tachycardic response in diabetics
 - **Never stop abruptly:**
 - Rebound tachycardia, hypertension, angina/MI risk — usually tapered
-

2. Nitrates

Examples

- **Nitroglycerin** (SL, IV drip, paste, spray)
- **Isosorbide mononitrate/dinitrate**

Think of it as...

“**Venous and coronary vasodilator**” – drops preload and improves coronary blood flow = less chest pain.

Common uses

- **Acute angina** and chronic angina prevention
- ACS (with appropriate BP and no contraindications)
- Sometimes in acute HF to reduce preload/afterload (IV nitro)

Watch for



- **BP:**
 - Hypotension, especially after multiple SL tabs or starting IV drip
 - Check BP before and after dosing per protocol
 - **Headache & flushing:**
 - Very common; reassure patient but also assess severity
 - **Chest pain assessment:**
 - Re-check pain, vitals, and EKG if ordered after each SL dose
 - **Contraindications:**
 - Recent **PDE-5 inhibitors** (sildenafil/Viagra, tadalafil/Cialis, etc.) → risk of profound hypotension
 - **Tolerance:**
 - Long-term oral/topical nitrates often have **“nitrate-free” intervals** (e.g., at night) to prevent tolerance
-

3. Pulmonary Hypertension (PH) Meds

a) PDE-5 inhibitors (for PH)

- **Sildenafil (Revatio), Tadalafil (Adcirca)** for pulmonary arterial HTN (PAH)
- **Think:** vasodilation of pulmonary vasculature → ↓ PVR, improved RV output

Watch for

- BP (systemic hypotension)
- Headache, flushing
- **Absolutely avoid nitrates** (same interaction as Viagra for ED)



b) Endothelin Receptor Antagonists (ERAs)

- **Bosentan, Ambrisentan, Macitentan**

Think of it as...

“Block a powerful vasoconstrictor (endothelin)” → pulmonary vasodilation, ↓ vascular remodeling.

Watch for

- **Liver function** (LFT monitoring)
- Edema, anemia (check CBC)
- Teratogenic → strict pregnancy precautions in women of childbearing age

c) Prostacyclin Analogues / Prostacyclin Receptor Agonists

- **Epoprostenol (Flolan, Veletri)** – continuous IV
- **Treprostinil (Remodulin)** - IV, SQ, inhaled, PO
- **Iloprost** (inhaled)
- **Selexipag** (oral prostacyclin receptor agonist)

Think of it as...

“**Very potent vasodilators + antiplatelet**” effects in the pulmonary circulation.

Watch for

- **Line safety:**
 - For continuous IV epoprostenol/treprostinil → **infusion must NEVER be interrupted** → risk of rebound PH and death



- BP: systemic hypotension, flushing, jaw pain, headache
 - Bleeding risk (antiplatelet effect)
 - For inhaled: bronchospasm, cough
-

d) Soluble Guanylate Cyclase Stimulators

- **Riociguat**

Think of it as...

“Boosts NO pathway” → vasodilation in pulmonary circulation.

Watch for

- BP (hypotension)
- **Contraindicated with PDE-5 inhibitors or nitrates** (stacked vasodilation)
- Pregnancy precautions

For new grads: you don't need to be a PH pharmacist.

Your job:

- Know **this is a specialty med**
 - Don't allow missed doses without escalating
 - Watch **BP, symptoms, and timing** (especially for continuous infusions and paired drugs like nitrates/PDE-5s)
-



4. Diuretics

a) Loop Diuretics

Examples

- **Furosemide** (Lasix)
- **Bumetanide** (Bumex)
- **Torsemide**

Think of it as...

“**Big gun fluid remover**” – pulls fluid off fast, especially from lungs.

Common uses

- Acute **HF exacerbation** (pulmonary edema)
- Volume overload (edema, ascites)
- Sometimes for HTN (adjunct)

Watch for

- **I&O, daily weights** – are we actually pulling fluid?
- **Electrolytes:**
 - $\downarrow K^+$, $\downarrow Mg^{2+}$, sometimes $\downarrow Na^+$, metabolic alkalosis
- **Renal function:**
 - Watch BUN/Cr, UOP (oliguria \rightarrow maybe kidneys are not happy)
- **BP:** orthostatic hypotension
- **Symptoms:** dizziness, weakness, cramps (low K^+/Mg^{2+})



b) Thiazide & Thiazide-like Diuretics

Examples

- **Hydrochlorothiazide (HCTZ)**
- **Chlorthalidone**
- **Metolazone** (often used with loops in HF)

Think of it as...

“Gentler, longer-acting diuretics” – more for BP control and mild-mod edema.

Common uses

- **Hypertension** (very common outpatient med)
- Chronic edema, HF adjunct (metolazone + loop = “sequential nephron blockade”)

Watch for

- Electrolytes:
 - \downarrow K^+ , \downarrow Na^+
 - \uparrow Ca^{2+}
- **Glucose & lipids**: can worsen in diabetics (long term)
- Dehydration, dizziness, orthostasis

c) Potassium-Sparing / Aldosterone Antagonists

Examples

- **Spironolactone**
- **Eplerenone**
- **Amiloride, Triamterene** (usually combined with thiazides)



Think of it as...

“Milder diuretics that spare K^+ and block aldosterone.”

Common uses

- **HF with reduced EF** (spironolactone, eplerenone – mortality benefit)
- Cirrhosis/ascites (spironolactone)
- Adjunct to prevent hypokalemia from loops/thiazides

Watch for

- **High K^+ (hyperkalemia):**
 - Especially with ACEI/ARB, ARNI, or K^+ supplements
- **Renal function:** decreased GFR → higher K^+ risk
- Spironolactone: can cause **gynecomastia**, menstrual irregularities

d) Osmotic Diuretics

Example

- **Mannitol**

Think of it as...

“Sugar water that pulls fluid” – shifts fluid from brain/eye into blood then out via kidneys.

Common uses

- ↑ ICP, cerebral edema
- Certain cases of acute glaucoma

Watch for

- Initial **fluid overload** (pulled into intravascular space) → then diuresis
- BP and signs of HF decompensation in fragile hearts
- Renal function and UOP (needs functioning kidneys)



Cheat Sheet

Class	Examples	Think of it as...	Key watches
Beta blockers	Metoprolol, Carvedilol, Labetalol	Heart brake pedal	HR/BP, bronchospasm, masking hypo
Nitrates	Nitro, Isosorbide	Chest pain reliever , vasodilator	BP, headache, NO PDE-5s (PHTN)
PH meds	Remodulin, Sildenafil, Bosentan, Epoprostenol	Pulm vasodilators	BP, line safety, drug interactions
Loop diuretics	Lasix, Bumex	Big gun fluid off	I&O, K ⁺ /Mg ²⁺ , BP, kidney function
Thiazides	HCTZ, Metolazone	Gentler, BP diuretics	Na ⁺ /K ⁺ , Ca ²⁺ , glucose, orthostasis
K-sparing	Spirolactone, Eplerenone	K⁺-friendly aldosterone blockers	HyperK, renal function, gynecomastia
Osmotic	Mannitol	Brain/eye fluid shift	ICP, volume status, kidneys



11. External Pacing – Safety & Values

1. **Transcutaneous pacing** – pacing pads via defib/monitor
2. **Temporary transvenous pacing** – a pacing wire in the heart attached to an **external pacemaker box**

You'll see both, but external **boxes** and wires (TVP) are very common in cardiac units/ICUs. Make sure they are capped and cared for if not being actively used.

Core concepts (apply to both)

Four basic ideas to understand:

- **Rate (bpm)** – how fast the pacemaker is trying to pace
- **Output (mA)** – how strong the electrical stimulus is
- **Sensitivity (mV)** – how well the pacemaker “sees” the patient’s own beats
- **Capture** – did the pacer actually make the heart beat?



A. Transcutaneous Pacing (pads on chest)

When used:

- Usually **emergent/short-term** for symptomatic bradycardia while you fix the cause or place a transvenous/permanent pacer.

Stepwise mental model:

1. **Apply pads correctly** - anterior/posterior (preferred) or ant/lat
2. Set **pacing mode** (often demand) and **rate** (commonly ~60–80 bpm or as ordered).
3. Increase **output (mA)** until you see **electrical capture**:
 - Each pacer spike followed by a wide QRS on the monitor.
4. Confirm **mechanical capture**:
 - Palpable pulse with each paced beat or HR on pulse ox matching paced rate.

Safety points:

- It's **painful** – if the patient is conscious and time allows, advocate for **analgesia/sedation**. *No one has ever died from pain!*
- Make sure the **monitor ECG leads (3 LEAD)** are on and giving a clean signal (pads don't show a good ECG by themselves).
- Continuous monitoring: watch for loss of capture, changes in rhythm, skin burns, or breakdown under pads.
- Reassess Vitals Regularly - Blood Pressure may need additional assistance.

(You won't usually be fiddling with sensitivity here – the defib handles it.)



B. Temporary Transvenous Pacer (TVP + Box)

Typical knobs on the box:

- **Mode** – e.g., VVI, AAI, DDD (ventricular pacing only, atrial only, dual-chamber)
- **Rate (bpm)** – ~ 60–80, but you **always** follow the order.
- **Output (mA)** – strength of impulse
- **Sensitivity (mV)** – how big a signal the pacer needs to “see” a native beat

1. Output & Capture

- **Output (mA)** = current delivered to the myocardium.
- **Capture threshold** = **lowest mA** that still consistently causes a beat after each spike.

How it's usually set (conceptually):

1. Set a rate above native so the pacer is doing the work.
2. Start with a **higher mA** and slowly **turn it down** until capture is lost.
3. Note that minimum mA = **capture threshold**.
4. Then set the output to about **2× the capture threshold** to give a safety margin (or per protocol, often “threshold + 2–3 mA” or “+10%”).

2. Sensitivity (mV)

- **Sensitivity** = how well the device “sees” intrinsic beats.
- It's measured in **millivolts (mV)**; a **lower number = more sensitive** (picks up smaller signals).

Problems to recognize:

- **Under-sensing** (pacer isn't seeing native beats):
 - Pacing spikes show up **on top of** QRS/T waves (dangerous).
- **Over-sensing** (pacer thinks noise = beats):
 - Pacer doesn't fire even though the patient is brady/asystolic.



C. Nursing Safety Checklist for External Pacers

Pulled and simplified from multiple pacing protocols.

General:

- **Never** assume the box is set correctly – **check settings at the start of every shift:**
 - Mode, rate, output, sensitivity, battery status, alarms.
- Ensure the **control panel is locked** if your device has that feature, to prevent accidental knob bumps.
- Secure all connections (wires at skin, cable into box) – label clearly (“**Temporary pacer – DO NOT TURN OFF**”).
- Make sure to wear gloves while touching exposed ends of the pacing wires.

Battery & power:

- Know **how to change the battery** and whether your policy requires **two RNs at bedside** for a change.
- Never disconnect external power without checking battery strength.

Insertion site & movement:

- **Jugular/subclavian/antecubital sites:**
 - Limit arm movement on the affected side; excessive stretching can dislodge the wire.
 - HOB often limited (e.g., $\leq 45^\circ$) depending on protocol.
- **Femoral site:**
 - Keep the leg mostly straight and limit hip flexion to avoid wire displacement.



Ongoing assessment:

- Continuous **telemetry** – watch for:
 - Consistent **capture** (spike followed by appropriate P/QRS)
 - HR that matches the **set rate** (or demand behavior)
- Frequent **pacer checks** after:
 - Patient repositioning
 - Bed transfers, transport, procedures
 - Big electrolyte shifts (especially K^+ , Mg^{2+} , acid–base) – can alter thresholds.

If things go south:

- Loss of capture or pacer failure + symptomatic patient = **emergency**:
 - Check patient first (pulse, responsiveness).
 - Check connections and quickly turn output up if trained/allowed.
 - Call for help (charge, provider, RRT, code) while someone manages ABCs.