

# Internal Medicine Intern Survival Guide

2023

**THIS BOOK BELONGS TO:**

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**Disclaimer**

**This handbook is meant to serve as a guide to the practice of internal medicine. All information contained within is believed to be reliable and accurate but is by no means exhaustive on any one topic. The guidelines found within are only recommendations as to the practice of medicine. The editors of this book do not provide any guarantee of their accuracy or completeness.**

***~For internal academic use only~***

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### **Tips for Residency**

- Remember, patient care takes priority over chart review, writing notes, etc. Go see your patients first thing in the morning and check in on them periodically during the day.
- Don't forget to communicate with your patient's family members. Get contact information for your patient's emergency contact on admission.
- If you need help, ask for it. When a patient looks sick, call your upper level or attending. It's always better to be safe than sorry!
- Just because you order it, doesn't mean it will happen. Be proactive and check to see your orders have been done. Go over complicated orders with the nurses, pharmacists, etc.
- Things will get easier in time. By the end of intern year, you'll be a pro at all this stuff.
- Check your orders twice.

### **Procedure Policy**

- Complete minimum number
- Any staff who is credentialed or any resident who has been signed off to perform the procedure independently can observe
- Log procedure in New Innovations
- If not signed off in New Innovations to do independent -> don't do it independently.

## **Levels of Supervision**

### **Direct Supervision:**

- 1) The supervising physician is physically present with the resident during the key portions of the patient interaction.
  - PGY-1 residents must initially be supervised directly.
  - A supervising physician must be immediately available to be physically present for PGY-1 residents on inpatient rotations who have demonstrated the skills sufficient to progress to indirect supervision.
- 2) The supervising physician and/or patient is not physically present with the resident and the supervising physician is concurrently monitoring the patient care through appropriate telecommunication technology.

**Indirect Supervision:** The supervising physician is not providing physical or concurrent visual or audio supervision but is immediately available to the resident for guidance and is available to provide appropriate direct supervision.

**Oversight:** The supervising physician is available to provide review of procedures/encounters with feedback provided after care is delivered.

## **Mandatory Attending Notifications**

- To ensure timely communication and patient safety the resident is required to immediately communicate directly (telephone or in person) with attending for any event listed below:
  - Emergency room consults that will be discharged to home
  - Clinic consults that will be discharged to home
  - Admissions
  - ICU transfers from floor or from another hospital
  - Discharges to include against medical advice
  - Transfers to another hospital, skilled nursing facility, or inpatient rehab center
  - Patient death
  - Any significant clinical deterioration
  - Prior to performing any invasive procedure
  - Change in code status
  - Any event that may compromise patient safety
  - Questions or concerns
  - Error in care
  - Family request
  - Palliative care discussion
  - Transition of care within MHG
  - Code situation
  - Conflict with patient or family
  - Conflict with staff member



## **The Nurses Call You About....**

### **Chest Pain**

- GO TO BEDSIDE. Ask nurse to get vital signs and EKG on the phone.
- Complete EKG, troponin, CXR, tele review.
- Consider can't miss causes (ACS, dissection, tamponade, PE, pneumothorax, pericarditis, esophageal rupture or impaction, etc)
- If STEMI, immediately call on-call cardiologist and start heparin drip, aspirin load, and plavix or brilinta load +ICU transfer.
- If angina, give nitro Q3-5 min. If not relieved by 2nd dose, call cards and consider a nitro GTT.
- If NSTEMI, consider suspicion for CABG before you give Plavix (requires period to wash out if they need a CABG).
- If it sounds like GI pain, can consider GI cocktail (for symptomatic relief)

### **Shortness of Breath/Hypoxia/Tachypnea**

- GO TO BEDSIDE. Ask nurse to get vital signs on the phone
- Do not simply turn up oxygen and walk away.
- Consider can't miss causes (PTX, PE, pulm edema/fluid overload, ARDS, PNA, overdose, bronchospasm, MI, anemia)
- If decompensating, call RRT, get ABG and stat portable CXR; consider EKG.
- Get help! Upper level, respiratory, RRT
- Escalate therapy: NC, oxymask, high flow, BiPAP, intubation
- If pt needs intubation, it's better to start earlier than later. Call pulm.
- Targeted tx like diuretics (crackles, volume overload) and nebs as appropriate
- Prove to yourself this isn't a PE. (Wells score, look for unilateral leg swelling, low threshold for CT/PE)

### **Acute Cough/Hemoptysis**

- Make sure there's no dyspnea, tachypnea, hypoxia, worsening pulmonary edema, hemoptysis. If so, consider CXR/CT, ABG, CBC
- Consider causes: PND, meds, GERD and tx appropriately
- Otherwise tx symptoms: robatussin, cepacol, Tessalon perles, albuterol nebs, Atrovent nebs

### **Nausea**

- Zofran 4mg IV q6-12h PRN (watch QTc)
- Phenergan 12.5-25mg PO/IV/IM/PR q4-6h PRN (watch QTc)
- Compazine 5-10mg PO q6-8h or IV q3-4h PRN (watch QTc)
- Caution in Parkinson's pts as blocking the dopamine can mimic neuroleptic malignant syndrome.
- Non-QTc prolonging options:
  - Vitamin B6: 10-25mg 3-4x daily PRN
  - Tigan: 200mg IM 3-4x daily PRN, 300mg PO 3-4x daily PRN
  - Can also try smelling an alcohol swab or ginger ale

### **Constipation**

- Always check bowel sounds & ask if pt is passing flatus
- If suspecting obstruction/ileus- check KUB before giving any further treatments. Consider obstruction before giving laxatives.
- Many options including:
  - Laxatives: Miralax, Senna, Dulcolax, Bisacodyl 5-10mg PO, lactulose.
  - Chocolate Bomb: 30cc milk of mag, 30cc mineral oil, senekot crushed all mixed with chocolate ice cream/pudding/apple sauce
- If impaction, consider Soap suds enema, Tap water enema, HOG enema

- Opioid-induced:
  - Avoid fiber or bulking agents, it just makes the problem worse
  - Consider Relistor (methylnaltrexone) if laxatives fail-- remember risk of bowel perforation. (Oral narkan also option)

### **Diarrhea**

- Is this actually diarrhea? Determine number of episodes and stool description. Consider overflow incontinence from constipation (KUB if needed to check stool burden)
- If large volume, check RFP and volume status of pt
- Rule out CDiff/infectious causes before considering Imodium
- GI PCR includes CDiff, but obtain CDiff first if diarrhea starts during hospitalization.
- Need “special contact” precautions while CDiff test is pending.
- A positive CDiff does not make the diagnosis. Consider if several episodes of large volume watery diarrhea or high suspicion given context (recent abx)

### **Pain**

- If new or changed, be sure to consider ddx and investigate further if appropriate (i.e. don't just give morphine to a hypertensive guy with new tearing back pain). Do treat pain and listen to patients.
- Caution with opiates (esp elderly and AKI/CKD)
- When transitioning on/off PCA and between opiates, use MME calculator
- Always start bowel regimen and order PRN naloxone with opioids
  - Mild Pain:
    - Acetaminophen 500mg PO 1-2 tabs q6hrs PRN (preferred)

- Ibuprofen 400-800mg PO q6-8hrs PRN
- Moderate Pain:
  - Ofirmev (Acetaminophen) IV 1g x1
  - Toradol (NSAID) 30-60mg IV/IM x1 (watch kidneys)
  - Tramadol 50mg PO q4-6h PRN, or 50-100mg IV/IM x1
  - Roxicodone (oxycodone IR): 5-10mg q4-6h PRN (Requires renal dosing)
  - Tylenol #3 (with codeine) 30/300mg PO q4h PRN (no renal dosing)
  - Percocet 5/325mg 1-2 tabs PO q4-6hrs PRN (no renal dosing)
  - Vicodin 5/500mg 1-2 tabs PO q 4-6hrs PRN (no renal dosing)
- Severe Pain:
  - Morphine 1-4mg IV q2-4h PRN (↓ dose in renal failure)
  - Dilaudid 0.5-2mg IV q4hrs PRN
  - Fentanyl 25mcg IV Q1 PRN (ICU setting)

### **Headache**

- Can't miss causes: (ICH, meningitis, mass lesion, HTN emergency, GCA)
- Consider need for CT, LP
- However, sinister causes starting while inpatient without preceding fall or history of symptoms prior to admission are rare. Most common causes include tension HA, migraine, medication induced.
- Symptomatic tx: Tylenol, Toradol, triptans if mod-severe migraine without contraindication to triptan (ex. CAD, CVA), IV Mg, anti-nausea meds

### **Altered Mental Status**

- Go to bedside. Get vitals with pulse ox, accucheck. Full neuro exam.
- Consider alcohol withdrawal. People aren't always honest about their use.
- Eval for AEIOU-TIPS: Alcohol/acidosis/ammonia/arrhythmias, Electrolytes/Encephalopathy, Infection, Ischemia, Oxygen/Opiates/Overdose, Uremia, Temperature/Trauma, Insulin (Hypo/hyper), Poisoning/psychiatric, Stroke/seizure
- Consider Head CT to evaluate for mass/bleeding
- Consider workup w/glucose, CMP, TSH, B12/folate, UDS, ETOH, CX
- Tx TONG: thiamine, O2, narkan, glucose
- For sundowning/hospital delirium, reorient as first option. Turn off TV, turn on lights, deescalate as able. Encourage family at bedside. Use delirium order set, consider stopping overnight vitals checks
- If severe agitation: Haldol (QTc), Geodon, Seroquel, olanzapine, risperidone, etc.

### **Insomnia**

- Especially tricky in elderly as these medications are notorious for inducing delirium and agitation. Use with caution.
  - Melatonin 3-6mg PO (least effective but least side effects, try first)
  - Lunesta Start 1mg, increase to 2-3mg if indicated
  - Ambien (avoid in age >70) 5mg PO (can use 10mg in younger pts)
  - Benadryl 25mg PO (avoid in age >70)
  - Restoril 15-30mg PO (avoid in age > 70)

### Decreased Urine Output

- If there is a foley, is it flushing? If not, consider exchanging foley.
- If no foley, bladder scan. If **>400cc** or symptomatic, consider in and out catheterization and rescan in several hours.
- If confirmed they are not making adequate urine, consider reasons for worsening renal function. Consider volume challenge with small fluid bolus if hypovolemic. Consider Lasix if hypervolemic. Get UA first so you have accurate sample for microscopy/urine studies if needed.
- If retaining urine, place foley and eval med list for any anticholinergic drugs.

### Fever

- Get full set vitals. Fever is T>100.4F (38C) for an hour or T>101F (38.3C) once.
- Always calculate ANC if chemo patient/cancer patient. Severe neutropenia = ANC <500 or anticipated nadir <500 within 48h
- Neutropenic fever: BCX, UA and UCX, CXR. Start cefepime or zosyn (+ vanc if unstable, or if suspect pna or SSTI, or vasc access infx. Vesicular lesions, add acyclovir)
- Ddx: Infection, malignancy, autoimmune, drug, endocrine.
- Infection: Labs and imaging based on suspected source. Re-culture (2 straight stick peripherals and from any lines/ports).
- Start/broaden abx if new infxn or pt worsening clinically
- Tx with tylenol if sx bothersome to pt. Remember tylenol may mask fever.

### Hypothermia

- Get full set of VITALS. T <36C=hypothermia, T<95F (35C) should be eval'd.
- Ddx: sepsis, infxn, hypothyroid, adrenal insuff, burns, spinal injury.
- Rectal temp is more accurate. **No rectal temp in neutropenia!**

- Correct underlying problem- can also use warming blankets/bear hugger

### **Hypotension**

- Get full set of vitals and immediately go to bedside to evaluate patient.
- DO NOT simply treat the number, investigate the cause, ddx:
- Hypovolemic (bleeding, volume depletion, third spacing)
- Cardiogenic (MI, arrhythmia, CHF, valvular)
- Distributive (Sepsis, neurogenic, anaphylactic)
- Obstructive (PE, PTX, Tamponade)
- Medications (anti-HTN, anaphylaxis, BPH drugs etc.)
- Recheck manual BP (ensuring appropriate cuff size) and other vitals
- Careful physical exam, signs of end organ perfusion (orthostats, AMS, UOP)
- Labs and imaging should be based on suspected cause. Note that in an older or immunocompromised person, the only sign of a bacteremia and impending MOF might be persistent hypotension.
- Give IVF bolus if hypovolemic. (If CHF or hypervolemic, use wisely). Do a double leg raise first to test fluid responsiveness
- If hypotension is fluid refractory and symptomatic, start pressors:
- Levophed can use prior to central line only for short time. (PICC = CVC)
- Vasopressin (2nd choice pressor in most cases, non-titratable)
- Epinephrine

### **Hypertension**

- Consider can't miss causes: withdrawal from ETOH or meds, drugs, cushing's reflex, aortic dissection, ischemic stroke, ICH, thyrotoxicosis
- HTN Emergency: Hypertension >180 SBP and >120 DBP + end organ damage (brain, CV, kidney, heme, optho)

- Assess for end organ damage:
  - Ask about AMS, headache, chest pain, SOB, lightheadedness, hematuria
  - Exam including neuro exam with fundoscopy
  - Consider checking troponin, EKG, CXR, CTA chest, CT head, UA, BMP, CBC, peripheral smear based on hx/exam
- Hypertensive Emergency:
- ICU admission, a-line, use a titratable gtt (cardene, esmolol)
  - Choice of tx agent & BP goal varies based on specific scenario!!
  - In general: lower MAP by ~ 25% in first hour, & then (if stable) to 160/100 mm Hg by ~6 hours, w/ cautious return to normal BP over next 24-48 hours (Exceptions below)
  - Ischemic stroke: Allow HTN. Tx w/ tPA: goal BP < 180/105 1st 24 hrs; use labetalol, nicardipine, clevidipine. Not tx with tPA: goal <220/120
  - Dissection: Decrease fast! Goal SBP < 120 mm Hg in 20 min, HR ≤ 60 bpm. Beta blocker first (ie. Esmolol) If not at goal, add nitroprusside OR nicardipine. (tx w/ BB first then vasodilator TOGETHER). Call Vascular Surgery before admit (if we have coverage)
  - ICH: acutely lower SBP to <140. Nicardipine, clevidipine, esmolol etc
- No evidence of end-organ damage:
  - Treat with PO meds, targeting BP <160/100 in 24 hours

### **Bradycardia**

- Get full set of VITALS. Stat EKG. Review tele.
- Consider can't miss causes:
  - Meds (BB, CCB, dig, antiarrhythmics, lithium, Aricept)
  - Cardiac: SSS, inferior MI, 2nd or 3rd degree AV block, pacemaker malfunction, vasovagal (transient)



- Other: hypothyroid, hypothermia, K derangement etc
- Are they unstable or symptomatic (AMS, dizzy, chest pain, syncope)?
  - Follow ACLS guidelines (atropine 0.5-1mg IV)
- Call an RRT or even code if you need help.
- Place pacer pads on the patient (can always take them off)
- If ECG shows either Type II 2nd degree or 3rd degree AV block, place pacer pads, consider transcutaneous pacing. Call Cardiology ASAP for possible transvenous pacing. Transfer to ICU.
- Consider BB, CCB, digoxin overdose; check dig level; consider reversal (give calcium, glucagon, consider epi gtt)
- If stable, keep atropine at bedside and monitor on telemetry.

### **Tachycardia**

- Get full set of VITALS, follow ACLS guidelines as indicated
- Ensure patient is stable, EKG, a printout of tele strip to see how rhythm started (gradual or rapid onset), go see the patient.
- If Wide QRS: This is VT until proven otherwise and you should be attaching defibrillator pads as you call the senior resident/Code Blue.
- For non-sustained VT, check to see if pt had symptoms.
- Check and treat electrolyte abnormalities.
- If becomes unstable, defibrillate (120-200 J biphasic). ACLS.
- If Narrow Complex QRS: SVT differential includes: Sinus tachycardia, atrial fib, atrial flutter, AVNRT, AVRT.
- If unable to tell what the underlying rhythm is, consider slowing the rate with Valsalva (standard or modified), adenosine push
- AFib/Aflutter with RVR
  - Metoprolol (5mg IV q5min IV x3, 25-100mg po q6-q12), follow w/ esmolol GTT (call cards first)
  - Diltiazem (0.25-0.35 mg/kg IV, or 10-15 mg/hr gtt)

(monitor BP).

- Avoid in HFrEF
- Consider Amiodarone load (150mg IV load → 1mg/min x6hr → 0.5mg/min x18h) or Digoxin (0.25mg q6h x2);  
Call cards
- If unstable, consider Cardioversion (call your upper level)
- New AFib will need work up; echo, thyroid, eval reversible causes
- For Sinus Tachycardia, treat underlying cause (pulmonary embolus, pain, hypovolemia, hypoxia, anemia, anxiety, infection, fever, etc.)

### **Elevated PTT on a Heparin Drip (GTT)**

- A patient is on a heparin drip, and the nurses call you about the PTT suddenly jumping to 100+++
- Tell them to **draw it from the opposite arm** from the one where the heparin is going in and call you back with the repeat lab. If still high, ask them follow the protocol.

### **Can we take the patient's IV out?**

- With very limited exceptions (pt d/c'ing on hospice or pt outright refusal) you always need to keep an IV in the hospital, for ACLS reasons. (new nurses will call about this frequently.)

### **The patient's evening blood sugar is high!**

- Inpatient blood glucose goal for most is 140 – 180 (NICE-SUGAR). Stricter goal for post-surgical patients.
- Prior to giving basal insulin, consider current diet (NPO?), prior hypoglycemic events, is the patient insulin naïve.
- If patient uses home insulin, consider 70-80% of home total daily dose
- Make sure your correction dose and BG check orders have the

same timing (AC&HS vs TIDWM)

Table 1. Determining a TDD for Insulin-Naïve Patients	
TDD Estimation	Patient Characteristics
0.3 units/kg body weight	<ul style="list-style-type: none"><li>• Underweight</li><li>• Older age</li><li>• Hemodialysis</li></ul>
0.4 units/kg body weight	<ul style="list-style-type: none"><li>• Normal weight</li></ul>
0.5 units/kg body weight	<ul style="list-style-type: none"><li>• Overweight</li></ul>
≥ 0.6 units/kg body weight	<ul style="list-style-type: none"><li>• Obese</li><li>• Insulin resistant</li><li>• Glucocorticoids</li></ul>

## **Internal Medicine General Topics**

### **A. Electrolytes**

#### **Hypomagnesaemia**

- Goal 2, must correct before correcting potassium
- Usually caused by poor intake, malabsorption, or GI/renal losses
- Can lead to hypokalemia, hypocalcemia, arrhythmia, seizures.
- Symptoms include lethargy, weakness, AMS, malaise.
- PO: 400mg Mg Oxide PO BID-TID. Takes several days, (causes diarrhea)
- IV: 2-8g Mg Sulfate in NS/D5W (max 4g/100cc), consider following:
  - 1.6-1.9 give 2g Mg Sulfate over 1-2 hrs
  - 1.0-1.5 give 4g Mg Sulfate over 4-12 hrs
  - <1.0 give 8g Mg Sulfate over 12-24 hrs
- Expect approximately a 0.1 increase for every gram given IV

#### **Hypokalemia**

- Mild (3.1-3.5), moderate (2.5-3.0), severe (<2.5 or sx)
- General goal potassium around 4.0 (for cardiac patients)
- Causes: Lasix, GI and renal losses, insulin, poor intake, alkalosis, hyperaldosteronism, Cushings, hypomagnesemia, B-agonists, DTS, DKA
- Leads to arrhythmia, ileus, weakness, inc cardiac digoxin susceptibility
- Labs: consider hypoMg
- ECG changes: U waves, flat/inverted T waves, QT prolongation, VT
- Replacement: (~100mEq K increases K by 1mEq/L (i.e. from 3 to 4)
- PO is preferred to IV, MUST be conservative in CKD/AKI pts

- Always replete Mg. Recheck K levels after IV correction
- For PO: Replace with KCl or K-HCO<sub>3</sub> (if acidotic) 40meq PO (pill or elixir) Q4hour if able
- For IV: \*NEVER push IV potassium, go low&slow, inc freq not dose
  - Give KCl 10meq/100 mL / hr via PIV, or
  - 20meq/100mL/ hr via CVC/PICC
- For severe (<3.0), can use both oral and IV

### **Hyperkalemia**

#### **This is an emergency!**

- Mild (5.5-5.9), mod (6.0-6.5), severe (>6.5 or >5.5 w/sx or ECG changes)
- Causes: AKI/CKD, oliguria/anuria, ACE-I/ARBs, K-sparing diuretics, Bactrim, cyclosporine, rhabdo, hemolysis, insulin deficiency, metabolic acidosis, pseudohyperK, digoxin toxicity, excess intake, low aldo
- Review meds and stop any that could be contributing
- Sx: weakness, paralysis, decreased bowel motility
- Leads to fatal arrhythmia! Get stat EKG & see the patient- esp if >6.0 ,
- If K>6.0 or EKG changes (peaked T waves, PR prolongation, wide QRS):
  - Give 1 amp Calcium Gluconate IV push (10-20mL 10% IV soln over 2-3 min, can cause transient BP drop; lasts 30-60 min). May repeat in 5 min if no response.
  - Shift K: one amp D50, 10 units regular insulin IV (monitor for low FSG), & Albuterol neb
  - Remove K: IV Lasix (give fluid back if necessary), Patiromer (less gut necrosis than kayexalate)
  - Dialysis as a last resort (For A, E, I, O, U)
- Check labs frequently - call nephro if not improving, don't

check TTKG

### **Hypophosphatemia**

- Goal 2-3, treat to goal. Needed to make ATP
- Can be given via PO or IV routes, equally effective.
- Oral replacement:
  - Neutra-phos 1-2 packets QID (note high sodium load ~800mg/day)
  - KPhos 2 tablets 500 BID x1, TID, TID with meals, or QID
  - Consider adding 1-2 containers of skim milk to each meal
- Consider IV replacement ONLY when symptomatic OR serum concentration
  - $<1$  as IV can precipitate hypocalcemia, ARF
  - 2.3-3 give 0.08-0.16mmol/kg (KPhos or NaPhos mixed in NS/D5W with max 15mmol/100cc) and infuse over 4-8 hrs
  - 1.5-2.3 give 0.16-0.32mmol/kg over 4-8 hrs
  - $<1.5$  give 0.32- 0.64mmol/kg over 4-8 hrs

### **Hyperphosphatemia**

- Causes: TLS, Rhabdo, Exogenous phosphate, AKI/CKD, hypoparathyroidism, acromegaly, bisphosphonates, vit d tox
- Acute hyperphosphatemia with hypocalcemia can be life threatening. If renal function is intact hyperphos usually resolves within 6 to 12 hours and phos excretion can be increased with NS infusion (may increase hypocalcemia)
- Hemodialysis may be indicated for acute management.
- Progressive or persistent hyperphosphatemia  $>4.5$ mg/dl is indication for treatment
- Restrict dietary phosphate intake (renal diet, intake $<900$ mg/day)
- Consider addition of phos-binders for phos $>6$ mg/dl
- Phos binders – calcium versus non-calcium
- Non-calcium – consider sevelamer 800mg TID with meals

### **Hypocalcemia**

- Causes: Removal of parathyroids, neck irradiation, autoimmune destruction, infiltrative dz, plasmaphoresis, vit D def, hypoMg, pancreatitis, rhabdo, kidney failure, TLS, pseudohypoparathyroidism
- Corrected Calcium:  $Ca + [(4 - \text{serum albumin}) \times 0.8]$
- If unsure about the corrected calcium, order ionized calcium
- Sxs: paresthesias, Chvosteks/Trousseau's, tetany, seizures, heart block,  $\uparrow$ QTc
- ECG to evaluate for QTc prolongation, check for & tx hypoMg
- PO (asymptomatic patients): Ca gluconate 500-1000 mg PO TID, TUMS (Calcium Carbonate) OTC 600 mg PO TID (200mg of elemental Ca)
- IV: 1 gram CaGluc (0.465 mEq, 9.3 mg/mL elemental Ca) or 1g of CaCl (1.4 mEq, 27mg/mL elemental Ca, \*Vesicant, give via central line\*), consider:
  - If Ionized Ca: 4-5mg/dL, 1-1.2mmol/L); 2g CaGluc over 2hrs
  - If Ionized Ca: <4 mg/dL, <1mmol/L); 4g CaGluc over 4hrs
  - If severe sx seizure/tetany; 1-2g CaGluc over 10 min; Q1H til sx resolve
- Emergency (arrhythmia): 1-2 amps of Calcium Gluconate
- Repeat Ca levels 2-6 hours post infusion

### **Hypercalcemia**

- Mild ULN -12 mg/dL; Mod 12-14mg/dL; Severe >14mg/dL
- Common causes: malignancy, most common outpatient cause is primary hyperparathyroidism(check PTH first), other causes lithium, thiazides, excessive Vit D/Ca intake, sarcoidosis
- Sx: nephrolithiasis, bone pain, GI complaints, confusion, coma (stones, bones, groans, moans, psych overtones)
- Aggressive IVF to goal UOP 100-150cc/hour

- +/- calcitonin 4 IU/kg IM or SC Q12hours, efficacy limited to 1st 48 hrs
- +/- zoledronic acid 4mg IV over 15 min - caution in renal impairment
- +/- glucocorticoids if 2/2 to sarcoid/granulomatous dz, lymphoma

### **Hypernatremia**

- Assess volume status. Caused by water deficit relative to sodium concentration.
- Most common cause is impaired free water access/intake (If pt is tube fed, consider need for increasing free water flushes; discuss with nutrition).
- Other etiologies to consider: central/nephrogenic diabetes insipidus, osmotic diarrhea, intracranial mass, alcohol use
- Eval with urine and serum osm, urine sodium, RFP. Don't forget to correct sodium for glucose (will correct higher if hyperglycemic).
- Calculate free water deficit (MDCalc).
- If chronic, correct by no more than 10 meq in 24h to avoid cerebral edema. Use D5W or 1/2NS to reduce salt load.
- The best way to correct is via the gut (Drink to thirst, NG tube if in)

### **Hyponatremia**

- There is a great algorithm on uptodate for determining etiology.
- First thing to determine – acute (<48H confirmed) or chronic (correct acute immediately, chronic must be corrected slowly).
- Obtain urine/serum osm, urine sodium, urine K, RFP
- Assess volume status:
  - Hypovolemic, provide volume resuscitation with NS or LR.
  - Hypervolemic, provide diuresis and closely monitor.
  - Euvolemic, determine if ADH is inappropriately present (pain, nausea, pulmonary disease, malignancy). Also consider decreased solute intake (tea and toast, beer potomania),



primary polydipsia.

- Free water restriction and treat underlying cause (engage nutrition if decreased solute intake)
- Chronic: 4-6meq correction per day. Monitor closely for over-correction to avoid osmotic demyelination syndrome. Can give DDAVP if correcting too quickly and urine output rapidly increasing.

### **Albumin:**

- Usually does not need repleted, but in a few cases it does:
  - Large volume para: >5L fluid taken = give 6-8 G/L 25% albumin
  - SBP: give 25% albumin IV 1-1.5 g/kg ideal body weight (max 100 g) within 6 hrs and again day 3.
  - ARDS: 25 g 25% Q8, give with Lasix infusion
  - You may see 5% albumin being used as a 2nd line colloid fluid solution in hypovolemia, but data is limited.

### **IV Fluids:**

#### **Isotonic, for volume expansion:**

- Recent 2022 large meta-analysis:  
NS = LR = Plasmalyte for most IM/ICU indications.
- NS = theoretical risk of hyperchloremic metabolic acidosis (higher risk at volumes >10 L)
- LR = mythical risk of hyperkalemia (1 L of LR = 4 meq K). Also LR is NOT lactate.
- Very little evidence for colloids in resuscitation

#### **Free Water, for hyponatremia:**

- D5W- calculate free water deficit
-

## **B. Cardiology**

### **Basic EKG Interpretation**

X axis = time, 10sec; 1 small box = 1mm = 40msec; 1big box = 5 small= 200msec  
Y axis = voltage; 1 small box = 1mm = 0.1mV; 1big box = 5 small= 0.5mV

**Rate:** (# of R waves on 10 sec ECG) \* 6; or (#R waves in two 3sec blocks) \* 10

--or-- Count each big box between R waves: 300, 150, 75, 60, 50, 43, 37, 33, 30

### **Rhythm**

- Is the rhythm regular?
- Is there a P for every QRS and QRS for every P?
- Where are the P-waves coming from? Upright in I/II/aVF = sinus
- Is PR interval normal, between 0.12-0.2 sec (< 1 large box) If "no" to any of the above, then arrhythmia or block present.

### **Supraventricular Arrhythmias (narrow QRS < 0.12, 3 small boxes)**

- Multifocal atrial tachycardia: > 3 dif shape P waves, atrial rate >100, if <100: wandering atrial pacemaker
- Atrial fibrillation: irregular, chaotic, no P waves, variable vent rate
- Atrial flutter: regular, saw-toothed, 2:1, 3:1, 4:1 block
- Ectopic Atrial Tachycardia: regular, 100-200 bpm, P waves but not sinus
- Paroxysmal SVT (PSVT): regular, 150-200 bpm, sporadic, self-terminating
- AV nodal re-entrant tachycardia (AVNRT): Most common subtype PSVT (slow-fast > fast-slow > slow-slow), will often see retrograde conducted (inverted) P waves in ST segment (RP <70ms)
- AVRT: Less common, accessory pathway dependent. P wave

typically upright, longer RP interval than AVNRT (>70ms)

### Ventricular Arrhythmias (wide QRS > 3 small box, below AV node)

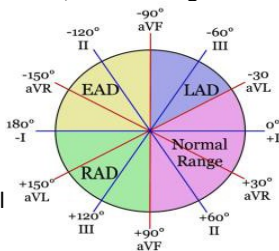
- Ventricular fibrillation: chaotic baseline, no QRS → SHOCK
- Ventricular Tachycardia: 120-200 bpm, “tomb stones” → SHOCK
- Accelerated Idioventricular: 40-100 bpm. Often this is a reperfusion rhythm following coronary artery occlusion, usually transient & benign
- Idioventricular/Ventricular escape rhythm: 20-40 bpm

### Ectopic Beats and Rhythms

- Premature Atrial contraction: narrow QRS preceded by (often non-sinus) P wave
- Premature Junctional contraction: early, narrow QRS, but no preceding P wave (usually retrograde/inverted during/after QRS)
- Premature Ventricular contraction: wide QRS, no P wave

### Axis

- Look at I & II (aVF not needed. Leads I, II can distinguish normal/abnormal)
- Normal: QRS (+) in I, (+) in II
- LAD: QRS (+) in I, (-) in II
- RAD: QRS (-) in I, (+) in II



### Intervals: PR abnormalities

- Pre-excitation/short PR interval
  - PR interval <120ms
- 1st degree AV block:
  - PR interval > 200ms (1 big box)
- 2nd degree AV block
  - Mobitz 1 (Wenckebach): increasing PR interval, then P w/out QRS

- Mobitz 2: constant PR interval then P wave without QRS
- 3rd degree AV block
  - P waves not related to QRS, atrial rate > vent rate

### **Intervals: QRS abnormal = bundle branch block, fascicular block**

- Normal = <100ms; moderate prolongation 100-120ms (incomplete BBB/nonspecific IVCD if 110-120ms); severe prolongation (>120ms)
- RBBB: QRSD  $\geq$ 120ms; RSR' V1 & V2 (rabbit ears); deep S wave in I, V6
- LBBB: QRSD  $\geq$ 120ms; broad monophasic R in I, aVL, V5-V6; deep S in V1&V2

### **Intervals: QTc**

- Represents the time taken for ventricular depol & repol
- Varies with heart rate, should be less than  $\frac{1}{2}$  R-R interval
- Long QTc predisposes to ventricular arrhythmia; esp. Torsades
- QTc is prolonged if > 440ms in men or > 460ms in women (O'Keefe >470ms men and >480ms in women)

### **Hypertrophy**

- RVH: typically RAD; R>S in V1, R in V1  $\geq$  6mm, S in V5  $\geq$ 10mm, S in V6  $\geq$ 3mm, R in aVR  $\geq$ 4mm
- LVH: R in V5/V6 + S in V1  $\geq$  35mm or R in aVL  $\geq$ 11mm (Sokolov-Lyon criteria). Alternatively R in aVL +S in V3 >28mm in men or >20mm in women (Cornell)

### **Ischemia/ Infarct**

- Ischemia: ST segment depression, TWI
- Injury: ST segment elevation
- Infarct: Q waves

- Significant Q waves = >20ms duration in V2-V3 or >30ms in any other lead AND >1mm in depth in 2 contiguous leads for Q-wave MI
- Q waves in I, aVL, V5/V6 normal as are isolated Q waves in III, aVR, V1
- **Posterior MI:** ST elevations II, III, aVF + ST depressions V1-V3 = STEMI if depressions in V1-V3, consider posterior ECG
- **T-waves:** Typically upright in I, II, V3-V6 and inverted in aVR, V1

### Coronary Artery Territories

- Septal V1, V2 – LAD territory
- Anterior V3, V4 - LAD territory (anteroseptal Q wave MI = V1-V3)
- Apical V5, V6- distal LAD territory
- Inferior II, III, aVF – RCA territory
- Lateral I, aVL +/- V5, V6 – left circumflex territory
- Posterior V1, V2 (ST depression are really elevations) – RCA vs LCx

### Other

- RAE: P wave > 2.5m in II,III,aVF; & P wave >1.5mm in V1,V2
- LAE: Broad double peaked “bifid” P wave in II; & biphasic P wave in V1
- RV Strain: ST depression & TWI in leads a/w RV: V1-V3, II,III,aVF
- LV strain: Ischemia: ST segment depression, TWI
- Hyperkalemia: peaked T wave, ↓QT, ↑PR, wide QRS
- Hypercalcemia: ↓QT, flat T waves, J point elevation
- Pericarditis: diffuse ST elevations, upward concavity, PR depression

- Pulmonary embolism
  - sinus tachycardia most common (44%)
  - associated with: STE V1-3, TWI V1-V4, new RBBB, RAD
  - SI QIII TIII pattern – deep S wave in lead I, Q wave in III, inverted T wave in III. found in only 20% of patients with PE
- Digoxin EKG effect
  - Downsloping ST depression with a characteristic “sagging”
  - Flattened, inverted, or biphasic T wave
  - Shortened QT interval
  - Other features: long PR interval, U waves, J point depression, complete heart block with afib (regularized afib)
- Brugada Syndrome (don't confuse w/ Brugada Criteria, SVT vs VT)
  - Mutation in cardiac Na channel causing predisposition to arrhythmia & sudden cardiac death? all pts get ICD!
  - Type 1: Coved ST segment elevation >2mm in >1 of V1-V3 followed by a negative T wave
  - Type 2: > 2mm saddleback shaped ST elevation

### Sgarbossa's Criteria

- To detect MI on EKG in the setting of LBBB, or device. 90% specificity of STEMI (but only 36% sensitivity). If 3 points or more, diagnosis of MI.
- ST elevation  $\geq 1$  mm in a lead with upward (concordant) QRS complex - 5 pts
- ST depression  $\geq 1$  mm in lead V1, V2, or V3 - 3 pts
- ST elevation  $\geq 5$  mm in a lead with downward (discordant) QRS complex – 2pts

## Pacemakers

I	II	III	IV
Chamber(s) paced	Chamber(s) sensed	Response to sensing	Rate adaptive
O = none	O = none	O = none	O = none
A = atrium	A = atrium	I = Inhibited	R = rate adaptive
V = ventricle	V = ventricle	T = Triggered	
D = dual	D = dual	D = dual	

- PPM indications: high degree AV block (2° II or 3° w/ sx or HR <40 or pause >3s sinus, 5s A-fib), SSS, chronotrop incomp a/w sx, Tachy/Brady
- CRT/BiV Pacing: LVEF  $\leq$  35% + NYHA II-IV sx despite GDMT + LBBB w/ QRS >150ms (c/s LBBB >120, QRS >150, >40% v-pace for pacing induced CM)
- ICD: 2° prevention following VT/VF arrest w/o reverse cause, asymp w/ sustained VT + struct heart dis. 1° prev: LVEF <30 post MI or EF <35 & NYHA II-III sx (>40 days post MI, 90 post revasc)
- Consider Life Vest w/ EF <35% but not met time criteria

### Graded Exercise Testing; lead V5 is a good place to start

#### Indications for GXT Testing

- 1) Adult px with intermediate pretest probability of CAD based on age, gender and symptoms (see Table 2)
- 2) High pretest prob of CAD (Table 2) but (-) GXT may need cath.
- 3) Known or possible h/o CAD with change in clinical status
- 4) Known or suspected exercise-induced arrhythmias
- 5) LVH with <1mm ST depression
- 6) Post-CABG, intervention or MI for exercise capacity
- 7) Patients with vasospastic angina

- 8) Identify appropriate setting for rate adaptive pacemaker

### Contraindications to Exercise ECG Testing

#### Absolute:

- 1) Acute MI w/in 5 days
- 2) Unstable angina uncontrolled with meds
- 3) Uncontrolled arrhythmias causing symptoms
- 4) Symptomatic severe AS
- 5) Uncontrolled symptomatic CHF
- 6) Acute PE or PI
- 7) Acute myocarditis or pericarditis
- 8) Acute aortic dissection
- 9) Uninterpretable ECG = LBBB or LVH with strain

#### Relative:

- 1) Known left main stenosis
- 2) Moderate stenotic valvular heart disease
- 3) Electrolyte abnormalities
- 4) Uncontrolled HTN: SBP>200 or DPB> 110
- 5) Tachy or bradyarrhythmias
- 6) Hypertrophic cardiomyopathy/other outflow obstruction
- 7) High degree A-V block
- 8) Inability to exercise 2<sup>nd</sup> to mental/physical impairment

### When to terminate Exercise stress ECG

- Achieve predicted HR (relative-cont. if gauging exercise capacity)
- Pt fatigue, dyspnea, claudication, syncope, refusal, severe angina  
Arrhythmias: increase freq., PVC's, new AV blk, concerning arryth. V-tach or BBB not distinguishable from VT
- Diagnostic ST changes = CP and ST dep., ST elev.
- BP>150/115, or SBP>10mmHg decrease or failure SBP with workload



### **Duke Treadmill Score:**

Exercise (time) – 5(ST depression in mm) – 4(angina symptoms)

- Predicts 5-year all-cause mortality, not specifically cardiac

### **Positive GXT**

- 1)  $\geq 1$ mm, 60-80ms Jpt-ST depression (flat or Down) over 3 consecutive beats
- 2) ST segment elevations in 3 consecutive beats
- 3) Typical angina
- 5) Failure to augment SBP with workload
- 6) Inappropriately slow/drop in HR (chronotropic incompetence)

### **High Risk GXT**

- 1)  $>2$ mm ST depressions over 3 consecutive beats
- 2) Early (+) =  $< 6$ min &/or  $HR < 120$
- 3) Drop SBP  $> 10$ mmHG
- 4) V-tach
- 5) ST elevations
- 6) ST changes
- 7) ST changes persist  $> 10$ mm into recovery
- 8) Angina

### **Indications for Myocardial Perfusion Imaging with GXT**

- 1) One or more resting EKG changes
  - a. complete LBBB, pre-excitation, ventricular pacing
  - b. 1mm ST depression at rest
- 2) Pt has CP and cannot exercise – pharm stress and images
- 3) Equivocal GXT or pt w/intermediate risk
- 4) Eval correlation b/w coronary stenosis and ischemia
- 5) Assess myocardial viability post-MI or re-vascularization

### **Post-procedure patients**

- Have higher concern in these patients.
- Post-femoral access complications:
  - Bleeding: Bleeding from cath site/hematoma is not

uncommon

- In “high stick”, there is potential for retroperitoneal bleeding
- Treat with pressure for 30 minutes to site
- If Hg drops, consider imaging (non-contrast CT abdomen/pelvis), transfusions, and phone calls to rule this out.
- Cholesterol/Closure Device Emboli
- Be sure to evaluate pulses in both feet immediately after cath so that you will have a comparison.
- Acutely cold/painful/pale/pulseless feet, requires urgent intervention
- Post-radial access
  - TR band positioned on wrist with small green box immediately proximal to puncture site. The nurses will slowly deflate TR band. Can reinflate or apply pressure if bleeding.
  - Avoid manipulation of wrist for 24h
  - Complications: ischemia, emboli, hematoma as above, (though cannot lose much blood volume into wrist. If hematoma forms, apply compression.
- Tamponade:
  - Complication of PCI, ICD/pacer placement and revision.
  - Remember Beck’s Triad: hypotension, JVD, quiet heart sounds
  - Initial treatment is aggressively pushing fluids as a bridge to percutaneous drainage of pericardial contents. Ultrasound them
- Stent thrombosis:
  - Acute chest pain in a post-PCI pt should be taken very seriously
  - EKG stat and appropriate chest pain treatment. Call upper level
- Medication complications:
  - Most admitted post-cath patients will have undergone PCI and be on DAPT 6-12 mos, +/- GP IIb/IIIa inhibitor if high risk or no P2Y12 prior to cath

- Can cause bleeding, but also thrombocytopenia/MAHAs. F/u post-CBC.

**Clopidogrel (Plavix) vs Ticagrelor (Brilinta) vs Prasugrel (Effient)**

- Plavix = use in stable PCI. Prodrug, requires activation via CYP450 (CYP2C19)
- Brilinta = higher risk of bleeding, use in STEMI. Reversible w/ monoclonal ab.
  - ADR: bradycardia, dyspnea
- Prasugrel = most potent, no prodrug, use in STEMI.
  - Avoid in patient's w/ hx of TIA/stroke, hepatic dysfunction

## **C. Pulmonology**

### **Basic Chest Radiograph Interpretation**

**Key is systematically reviewing all x-rays the same way every time**

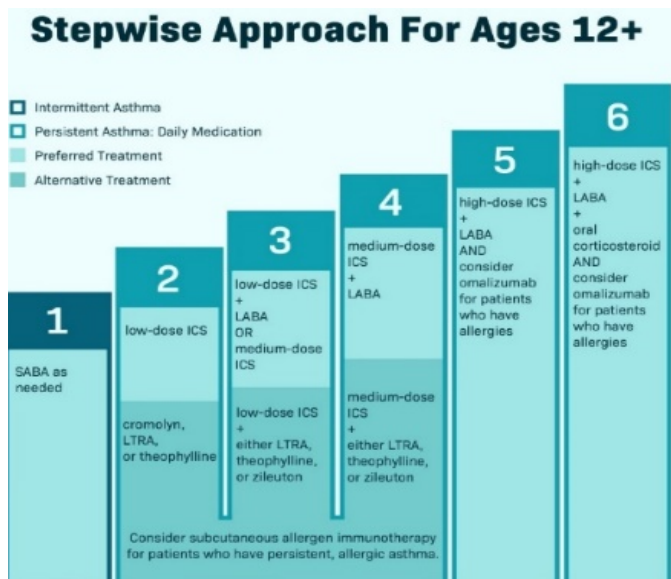
- A: Assessment of Quality & Airway
- Assessment of Quality (PIER Mnemonic)
- P: Position- AP, PA, oblique, lateral
- I: Inspiration - see 9-11 posterior ribs
- E: Exposure - see outline of spinal column below diaphragm
- R: Rotation - spinous processes midline btw clavicle heads
- Airway (Midline, shifted, splayed carina, etc)
- B: Bones and Soft Tissue
- C: Cardiac
- D: Diaphragm
- E: Effusions / Extrathoracic Soft Tissue
- F: Fields, Fissures, Foreign Bodies
- G: Great Vessels / Gastric Bubble
- H: Hila and Mediastinum
- I: Impression

### **Treating a COPD Exacerbation:**

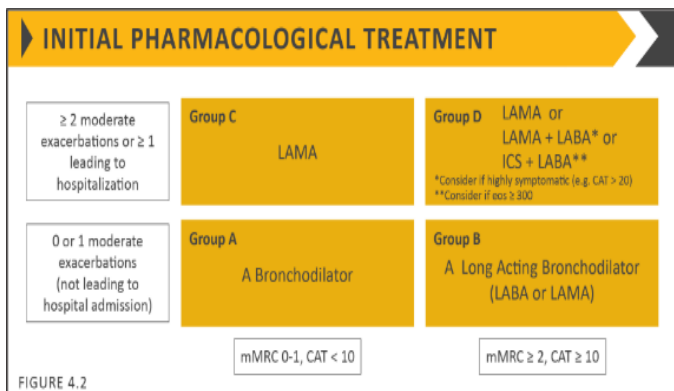
- Hold home inhalers
- Continuous Pulse Ox, change titrate O2 order to 88-92%
- Duonebs Q6h, albuterol nebs Q2h PRN
- Prednisone 40 mg QD x 5 days, Solumedrol 60mg BID if severe
- Antibiotic tx if concern for infection (ie pneumonia), worsened hypoxia, change in sputum production or purulence
- Outpt:
  - FQ if many risk factors
  - Azithromycin if not
- Hospitalized, Few risk factors for poor outcomes:
  - Macrolide (azithromycin)

- Hospitalized, Age >65, FEV <30%, >2 exacerbations in 1 yr, cont home O2:
  - Cefepime or Zosyn (antipseudomonals)
  - IV Levoquin or Ceftriaxone if none of above

## Asthma Stepwise Treatment



## COPD GOLD Group Treatment (2022)



\*A separate algorithm is provided for follow-up treatment, management based on symptoms and exacerbations (recommendations do not depend on the patient's GOLD group at diagnosis)

## **D. Gastroenterology**

### **Abdominal Pain Differential**

- RUQ: cholelithiasis, cholangitis, hepatitis, portal vein thrombosis
- Epigastric: MI, pancreatitis PUD, GERD, gastritis
- LUQ: MI, splenomegaly, splenic infarct, PUD
- RLQ: appendicitis, nephrolithiasis, pyelo, colitis, IBD, hernia, ovarian cyst/torsion, PID/TOA, ectopic
- LLQ: diverticulitis and RLQ causes
- Suprapubic: UTI, urinary retention

### **Elevated Liver Enzymes**

Per ACG guidelines (straightforward -> read them)

- ALT: 29 to 33 IU/l for males, 19 to 25 IU/l for females
- DDx: Hep A/B/C, NAFLD, alcohol, hemochromatosis, autoimmune hep, Wilson's disease, A1AT deficiency, offending medications, hypotension
- Initial workup usually includes LFTs, RUQUS, viral hepatitis panel, stopping offending medications.
- Patients with elevated BMI and other features of metabolic syndrome with mild elevations of ALT should undergo screening for NAFLD with right upper quadrant ultrasound.
- Those with hepatic steatosis can be scored by FIB-4 or NAFLD Fibrosis Score (MDCalc) for consideration for risk of progression to fibrosis/consideration for liver biopsy.

### **GI bleed**

- Upper: above ligament of Trietz
  - Sx: n/v, hematemesis, coffee-ground emesis, epigastric pain, vasovagal, melena, hematochezia (brisk bleed)
  - DDx: PUD, varices, gastritis, erosive esophagitis, Mallory-weiss tear, vascular lesions (AVM, Dieulafoy, GAVE, Aortoenteric fistula)

- Lower: below ligament of Trietz
  - Sx: diarrhea, tenesmus, BRBPR, hematochezia, melena (R colon)
  - DDX: Diverticular, polyp/tumor, colitis, vascular/AVMs, anorectal disorder, vasculitis
- Management:
  - Assess severity: tachycardia, orthostatic vitals, hypotension, drop in Hct 6% or Hgb 2g/dL, or  $\geq 2$ u PRBC
  - Vitals, 2 large bore IVs in AC fossa
  - Volume resuscitate: IVF until normal MS, VS, UOP
  - Can anticoagulation/antiplatelet be stopped safely?
  - Labs (draw in pediatric tubes): CBC, coags, type and cross
  - Goal Hgb  $>7$ g/dL or 8g/dL if CAD
  - If suspect UGIB: protonix 80mg IVx1, then 40mg IV q12hrs
  - If cirrhosis/varices, consider octreotide, ceftriaxone
  - If unstable, transfer to ICU and contact GI for potential emergent scope

### **Colonoscopy**

- ACS, ACG recommends screening at age 45, USPSTF: 50
  - Refer to ACG clinical guidelines: colorectal cancer screening 2021

2012 ACG Recs for Surveillance:




Baseline colonoscopy: most advanced finding(s)	Recommended surveillance interval (y)
No polyps	10
Small (<10 mm) hyperplastic polyps in rectum or sigmoid	10
1–2 small (<10 mm) tubular adenomas	5–10
3–10 tubular adenomas	3
>10 adenomas	<3
One or more tubular adenomas $\geq 10$ mm	3
One or more villous adenomas	3
Adenoma with HGD	3
Serrated lesions	
Sessile serrated polyp(s) <10 mm with no dysplasia	5
Sessile serrated polyp(s) $\geq 10$ mm	3
OR	
Sessile serrated polyp with dysplasia	
OR	
Traditional serrated adenoma	
Serrated polyposis syndrome <sup>a</sup>	1

## E. Nephrology


### Chronic Kidney Disease (CKD)


- Defined as  $\geq 3$  months of reduced GFR ( $<60$ ) and/or kidney damage (imaging/path/markers)
- Can use CKD-EPI to calculate estimated GFR, if no acute changes in Cr.
- Etiologies: DM (45%), HTN/RAS (27%), glom (10%), interstitial (5%), PKD (2%)

### CKD Classification and Staging

 Green: Low risk (LR)

 Yellow: Moderate risk (MR)

 Orange: High risk (HR)

 Red: Very high risk (VHR)

Kidney damage stage Urine albumin/creatinine ratio Description and range		
A1	A2	A3
Normal to mild increase $<30\text{mg/g}$	Moderate increase $30-300\text{mg/g}$	Severe increase $>300\text{mg/g}$

Kidney function stage GFR ( $\text{ml/min/1.73m}^2$ ) Description and range	G1	Normal or high	$\geq 90$	LR	MR	HR
	G2	Mild decrease	60-89	LR	MR	HR
	G3a	Mild to moderate decrease	45-59	MR	HR	VHR
	G3b	Moderate to severe decrease	30-44	HR	VHR	VHR
	G4	Severe decrease	15-29	VHR	VHR	VHR
	G5	Kidney failure	$<15$	VHR	VHR	VHR

**\*\* Note \*\*** Drops in creatinine in patients with advanced disease may signify muscle loss due to chronic

disease and NOT improvement of renal fx

### Acute Kidney Injury (AKI)

- Abrupt increase in Cr in <48h of  $\geq 0.3$  mg/dl OR Cr  $\geq 50\%$  OR UOP
- $<0.5$  mL/kg/hr for  $>6$ h
- DDX: prerenal, intrinsic, post-renal. Consult pocket med etc for ddx.
- Initial eval: hx, volume status, RFP, UA, urine microscopy, calculate FeNa or FeUrea if on diuretics or fluids, consider renal US for obstruction
- Hold offending meds: NSAIDs, ACEI/ARB, etc. Avoid contrast if possible. (If you have to give contrast, chase w/ fluids)
- Renal dose meds! CHECK UP TO DATE IF NOT SURE
- Further workup and Tx based on etiology
- Indications for emergent dialysis: AEIOU (Acidemia, Electrolyte disorder: hyper K, hyper Ca, tumor lysis), Intoxication: methanol, ethylene glycol, lithium, salicylates, Volume Overload (CHF), Uremia: pericarditis, encephalopathy, bleeding)

### Acid-Base Disorders

- 1: Is there alkalemia or acidemia present? pH  $>$  or  $<$  7.4?
- 2: Is the disturbance respiratory or metabolic?  $p\text{CO}_2$   $>$  or  $<$  40?
- 3: Is there appropriate compensation for the 1<sup>o</sup> disturbance?
  - compensation does not always return pH to normal
  - Metabolic Acidosis: Winter's Formula
    - $\text{PaCO}_2 = (1.5 \times [\text{HCO}_3^-]) + 8 (\pm 2)$
  - Metabolic alkalosis
    - Increase in  $\text{PaCO}_2 = 40 + 0.6(\Delta\text{HCO}_3^-)$
  - Acute respiratory acidosis
    - Increase in  $[\text{HCO}_3^-] = \Delta\text{PaCO}_2/10 (\pm 3)$
  - Chronic respiratory acidosis (3-5+ days)

Normal values  $\approx$

pH 7.4 (7.35-7.45)

$\text{PaCO}_2$  40 (35-45)

$\text{HCO}_3^-$  24 (22-26)

$\text{PaO}_2$  100 (80-100)

- Increase in  $[\text{HCO}_3^-] = 3.5(\Delta \text{ PaCO}_2/10)$
- Acute respiratory alkalosis
  - Decrease in  $[\text{HCO}_3^-] = 2(\Delta \text{ PaCO}_2/10)$
- Chronic respiratory alkalosis
  - Decrease in  $[\text{HCO}_3^-] = (5-7)(\Delta \text{ PaCO}_2/10)$

4: Calculate the anion gap

- $\text{AG} = [\text{Na}^+] - ([\text{Cl}^-] + [\text{HCO}_3^-]) - 12 \pm 2$
- A normal anion gap is approximately 9-12 meq/L.
- In patients with hypoalbuminemia, the normal AG is about 2.5 meq/L lower for each 1 gm/dL decrease in the plasma albumin

5: If there is an anion gap, assess the relationship between the increase in the anion gap and the decrease in  $[\text{HCO}_3^-]$

- Assess the ratio of the change in the anion gap ( $\Delta \text{AG}$ ) to the change in  $[\text{HCO}_3^-]$ :  $\Delta \text{AG}/\Delta[\text{HCO}_3^-]$
- This ratio should be between 1.0 and 2.0 if an uncomplicated anion gap metabolic acidosis is present.
- If ratio falls outside of range, another metabolic disorder is present:
  - If  $\Delta \text{AG}/\Delta[\text{HCO}_3^-] < 1.0$ , then a concurrent non-anion gap metabolic acidosis is likely to be present.
  - If  $\Delta \text{AG}/\Delta[\text{HCO}_3^-] > 2.0$ , then a concurrent metabolic alkalosis is likely to be present.

## F. Endocrine

### Diabetes

- Type “Insulin”, “Low”, “Medium”, or “High” into the order set menu to find the insulin sliding scale order set.
- Hold oral meds, GLP-1 agonists while inpatient. Continue Jardiance if stable renal function and no other contraindication (increased risk euglycemic DKA)
- Weight based insulin: 0.4 units/kg/day for the average individual. Half as long-acting, then split the remaining half into 3 doses to be given with each meal.
- Patients will ideally be on basal/bolus insulin regimens, particularly if they require insulin outpatient.
- Remember to decrease basal and discontinue bolus if they are NPO. Also a good idea to decrease insulin doses inpatient as they will typically not be eating their usual diet (typically 80% of home dose). For U500, decrease to 50-60%
- Type 1 DM ALWAYS need basal, even if NPO
- Hypoglycemic?
  - Recheck glucose 15min after ½ cup of juice/regular soda (or other source of simple carbs)
  - **Altered?** 25 ml D50 IV push, repeat until glucose >100 mg/dl

## G. Infectious Disease

Cross reference local antibiotic coverage with Antibigram

### Antibiotic Tips

#### MRSA Coverage

- SSTI: Bactrim, clindamycin, doxycycline (also long-acting oritavancin)
- Bacteremia: Vancomycin, daptomycin, linezolid, ceftaroline
- > Daptomycin: don't use for susp Pulm source; inactivated by surfactant; also check weekly CK levels to check for myopathy

#### Pseudomonas Coverage

- Zosyn, Ceftaz/cefepime, carbapenems (except erta), Zerbexa, FQ (PO), aztreonam
- Cefepime doesn't cover anaerobes, but it does have good CNS penetration.

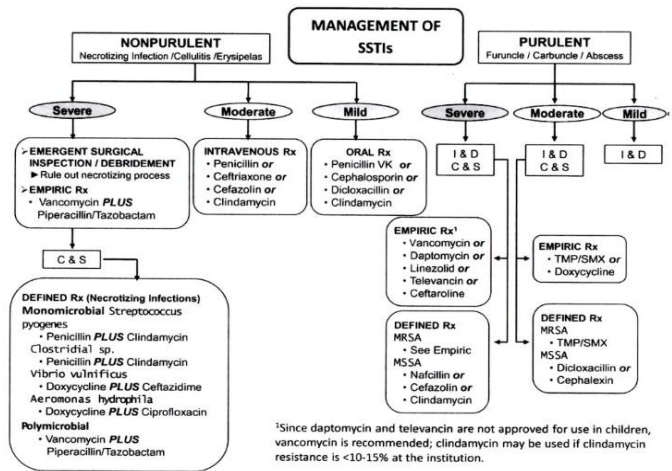
#### Vancomycin dosing

**Pharmacy to Dose:** Order "Vancomycin per Pharmacy" for pharmacists to manage therapeutic drug monitoring per 81 MDG vancomycin protocol. Simply write indication and trough goal in Essentris order.

**Loading dose:** A dose of approximately **30mg/kg (actual body weight) x1** with a maximum dose of 2000mg, or the table below can be used:

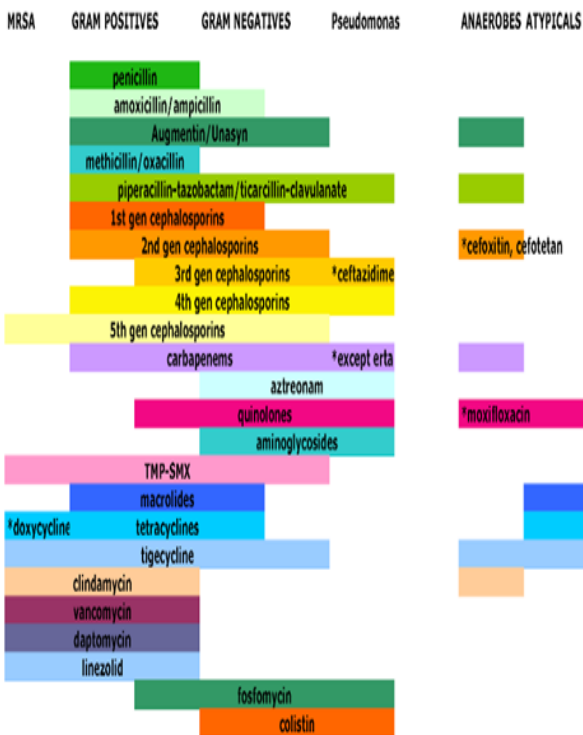
Total Body Weight	45-65 kg	65-85 kg	>85 kg
Loading dose	1000mg IVx1	1500mg* IVx1	2000mg* IVx1

**Monitoring:** Vancomycin trough levels should be drawn 30 min before administration of fourth dose, assuming dose given at its



<sup>1</sup>Since daptomycin and televancin are not approved for use in children, vancomycin is recommended; clindamycin may be used if clindamycin resistance is <10-15% at the institution.

regular dosing interval.





## H. Neurology/Psych

### Dizziness

#### HINTS EXAM

- “Head Impulse testing, Nystagmus, and a Test of Skew.”
- To distinguish central vs peripheral causes

#### Dix-Hallpike Maneuver

- To test for BPPV

### Seizure

- Place patient in lateral decubitus position, call NEURO
  - Pad and protect but do not immobilize
  - Do not insert objects or fingers in patient's mouth
  - Make sure the patient has adequate IV access, i.e. 2+ PIVs
  - Get an accucheck to rule out hypoglycemia and consider alcohol withdrawal as cause in patients without seizure history
  - For a single first-time seizure that has stopped on its own, no treatment is warranted beyond treating any provoking factors.
  - Status epilepticus (tonic-clonic >5min, 2+ tonic-clonics in a row)
1. Benzos first. Choose one.
    - Ativan 0.1mg/kg IV: either max 2mg/min or load 4mg, then 2mg IV q2min up to 8mg
    - Valium 0.15mg/kg IV: max 10mg/dose, then 5mg IV q2min up to 30mg
    - No IV access? IM Versed (or nasal, buccal): pts > 40kg: 10mg, 13-40kg: 5mg
  2. Load Anti-Epileptic Drug (AED) at the same time. Choose one.
    - Keppra (levetiracetam/LEV): 60 mg/kg (max 4500mg) IV push over 15 minutes
    - Alternatives: Phenytoin, Valproic Acid, fosphenytoin
  3. Add a second AED (ask neurology for recs) if still seizing

4. Give anesthetic if still seizing. EEG, intubate if not already done
  - Versed 200mcg/kg IV load, then 0.75-10mcg/min gtt
  - Propofol 1-2mg/kg load, then 2-10mg/kg/hr gtt
  - Pentobarbital 5-20mg/kg load, then 1-4mg/kg/hr gtt
5. DDx: Metabolic meds, intox/withdrawal, infection, vascular, tumor

## Stroke

NIHSS - MD-Calc has NIHSS and TPA contraindications

**Table 3.2. National Institutes of Health Stroke Scale (maximum = 42)**

Response	(Score)	Response	(Score)
Level of consciousness		Motor arm (left and right)	
alert	(0)	no drift	(0)
drowsy	(1)	drift before 10 seconds	(1)
stuporous	(2)	falls before 10 seconds	(2)
coma	(3)	no effort against gravity	(3)
		no movement	(4)
Response to level of consciousness questions*		Motor leg (left and right)	
answers both correctly	(0)	no drift	(0)
answers one correctly	(1)	drift before 5-10 seconds	(1)
answers neither correctly	(2)	falls before 5-10 seconds	(2)
		no effort against gravity	(3)
		no movement	(4)
Response to level of consciousness commands†		Ataxia	
obeys both correctly	(0)	absent	(0)
obeys one correctly	(1)	one limb	(1)
obeys neither	(2)	two limbs	(2)
Pupillary response		Sensory	
both reactive	(0)	normal	(0)
one reactive	(1)	mild	(1)
neither reactive	(2)	severe loss	(2)
Gaze		Language	
normal	(0)	normal	(0)
partial gaze palsy	(1)	mild aphasia	(1)
total gaze palsy	(2)	severe aphasia	(2)
		mute or global aphasia	(3)
Visual fields		Facial palsy	
no visual loss	(0)	normal	(0)
partial hemianopsia	(1)	minor paralysis	(1)
complete hemianopsia	(2)	partial paralysis	(2)
bilateral hemianopsia	(3)	complete paralysis	(3)
Dysarthria		Extinction/inattention	
normal	(0)	normal	(0)
mild	(1)	mild	(1)
severe	(2)	severe	(2)

\* Level of consciousness questions: "How old are you?" "What month is this?"

† Level of consciousness commands: "Squeeze my hand" (using nonparetic hand), "Close your eyes."

<4 = Good prognosis -- No tPA

4-20 = mild to moderate - ideal tPA

>20 = severe deficit --No tPA

## **I. Hematology/Oncology**

### **Heme / Onc Urgencies & Emergencies**

#### **Acute Leukemia**

- Sx: B symptoms, fatigue, infxn, bleeding/petechiae, leukostasis (SOB, HA, TIA/CVA), DIC, bone pain, LAD, N/V, neuro sx
- Dx: peripheral smear shows over 20% blasts, can see Auer rods in AML, variable pancytopenia
- Tx: DON'T ADMIT. Transfer out of KMC, emergent induction chemo
- Major emergency concerns: DIC, TLS, infection, leukostasis

#### **How to Identify a Myeloblast on Smear: 5 ½ Morphologic Features**

1. Large cell size
  2. Large nucleus to cytoplasm ratio (5:1, large nucleus, minimal cytoplasm)
  3. Lacey open chromatin (makes sense, DNA is open for rapid transcription)
  4. No granules in cytoplasm (which is minimal & light bluish color)
  5. Nucleoli ( 2+, distinct pale circles in nucleus, make ribosomes)
- ☐ +/- Auer rods in AML, Call Heme/Onc if blasts >15%

#### **Leukostasis**

- Common in AML, ☐☐WBC ☐ hyperviscosity & occlusion of microvasculature☐ organ ischemia
- Sx: a/w ischemic organ: hypoxia, SOB, HA, TIA/CVA, MI, HA, vision Δ's
- Dx: WBC 50+ & signs/sx of tissue hypoxia, (☐lactate) emergent chemo; if delay in chemo then IVF, leukopheresis, hydroxyurea

## **Tumor Lysis Syndrome**

- Large tumor burden or rapidly proliferating tumor → spontaneous or tx induced rapid cell turnover → release intracellular contents
- **Dx:** ↑K, ↑Uric acid, ↑LDH, ↑lactate, ↑Phos causing ↓calcium (b/c phos binds), DIC, AKI (urate crystals)
- **Ddx:** high grade lymphoma Burkitt's, ALL, AML, CML in blast crisis
- **Tx:** aggressive IVF, allopurinol 300mg PO BID, rasburicase 0.15mg/kg (check for G6PDH first) or diuretics for goal UOP 80-100cc/hr, treat hyper K, hyper Phos, hypo Ca. Dialysis if uncontrolled hyper K, oliguria & vol overload, ↑Ca. Consider sodium bicarb gtt for pH & urine alkalization to ↑uric acid solubility (may cause CaPhos precip)
- \* **if suspect from acute leukemia, do not admit, transfer out of KMC**

## **Brain Metastases causing ↑ ICP / neuro sx**

- **Tx: Do not admit, transfer out of KMC, no Neuro Surg, do give steroids**
- stat dexamethasone 10mg IV & repeat Q6H, emergent Neuro Surg consult & decompression, consider mannitol & seizure ppx
- \* LP CONTRAINDICATED in ICP from mass effect → brainstem herniation
- DO NOT GIVE ANTICOAGULATION to known or suspected brain mets w/ focal neuro deficits

- **Microangiopathic Hemolytic Anemia (MAHA)**

- **Sx:** HUS (renal) triad: ↓plt + MAHA + AKI. TTP (systemic)pentad: triad + fever + neuro sx ("FATRN")
- **Dx:** anemia w/ SCHISTOCYTES, ↓plt, ↑LDH, (↑Plt & MAHA)
- **Ddx:** TTP, HUS, DIC, malignant HTN, mechanical valve, cancer, eclampsia/HELLP syndrome, drugs, vasculitis
- **Tx: emergent plasma exchange in TTP is lifesaving=DON'T ADMIT** (10% die 1<sup>st</sup> day); FFP if delay to plex; continue plex until plt>150
- \***platelet transfusion contraindicated b/c ↑ microvascular thrombosis**

### **Disseminated intravascular coagulation (DIC)**

- Trauma, shock, sepsis, cancer, obstetric complications ↑ massive coag cascade activation↑clots in microvasculature↑ischemia + MAHA
- ↑consumption of coag factors↑ bleeding
- **Sx:** clots, bleeding, multi organ failure
- **Dx:** ↑PT, ↑PTT, ↑ FDP/D-dimer, ↑fibrinogen, ↓plts, ↓rbcs (MAHA/schisto's)
- **Tx:** tx underlying cause, support w/ plts, FFP, cryo (goal fibrinogen >100)

### **Spinal Cord Compression**

- **Mxn:** mets to vertebrae grow into epidural space, or cause fracture w/ retropulsed bone fragments into epidural space
- **Sx:** vertebral pain, neuro sx: ↓strength, ↓ sensation, bowel/bladder dysfn, ↓reflex
- **Dx:** MRI entire spine
- **Tx:** dexamethasone 10mg IV stat & then 4mg IV Q6H, emergent Neuro Surg consult & decompression, emergent radiation
- \***do not admit, transfer out of KMC, no Neuro Surg, do give steroids**

## Transfusion Medicine

Blood Products and Indications	
Packed red blood cells (PRBCs)	acute blood loss or to ↑ O <sub>2</sub> -carrying capacity if end organ ischemia. 1 U PRBC → ↑ Hb by ~1 g/dL. Large-volume transfusion PRBC → ↓ Ca, ↑ K, ↓ plt, ↑ coags (may need concurrent transfusion plt & FFP).
Platelets (plts)	Plts <10,000/μL or <20,000/μL with infection or ↑ bleeding risk or <50,000/μL with active bleeding or preprocedure. 6 U pooled donor plts ≈ 1 single donor plt apheresis unit (reduces alloimmunization) → ↑ plt count by ~30–60,000/μL. Contraindicated in TTP/HUS, HELLP, HIT. Refractory: ↑ <5000/μL 30–60 min posttransfusion. Suggests alloimmunization → trial ABO-matched plts. If still refractory ✓ panel reactive Abs (PRA) to assess utility HLA-matched plts.
Fresh frozen plasma (FFP)	Contains all coagulation factors. For bleeding due to deficiency of multiple coagulation factors (eg, DIC, TTP/HUS, liver disease, warfarin excess, dilution) or $INR > 2$ preprocedure.
Cryoprecipitate	Enriched for fibrinogen, vWF/VIII, and XIII. For bleeding in vWD, factor XIII deficiency or fibrinogen <100 mg/dL (eg, DIC).
Irradiated	Prevents donor T-cell proliferation. Use if risk of transfusion-assoc GVHD (HSCT, heme malignancy, congenital immunodef).
CMV-negative	From CMV-negative donors. For CMV-seronegative pregnant women, transplant candidates/recipients, SCID, AIDS Pts.
Leukoreduced	WBCs cause HLA alloimmunization and fever (cytokine release) and carry CMV. For chronically transfused Pts, potential transplant recipients, h/o febrile nonhemolytic transfusion reaction, cases in which CMV-negative products are desired but unavailable.
Intravenous immune globulin (IVIg)	Polyvalent IgG from >1000 donors. For postexposure prophylaxis (eg, HAV), certain autoimmune disorders (eg, ITP, Guillain-Barré, MG ? CIDP), congenital or acquired hypogammaglobulinemia (CVID, CLL).
Plasmapheresis and cytapheeresis	Removes large mol wt subst (eg, cryoglobulinemia, Goodpasture's, Guillain-Barré, hyperviscosity syndrome, TTP) or cells (eg, leukemia w/ hyperleukocytosis, sx thrombocytosis, sickle cell) from plasma.

### Transfusion reactions

- For all reactions (except minor allergic): **stop transfusion**; send remaining blood product and fresh blood sample to blood bank
- Acute hemolytic**: fever, hypotension, flank pain, renal failure <24 h after transfusion  
Due to ABO incompatibility → preformed Abs against donor RBCs  
Treatment: vigorous IVF, maintain UOP with diuretics, mannitol, or dopamine
- Delayed hemolytic**: generally less severe than acute hemolytic; 5–7 d after transfusion  
Due to undetected allo-Abs against minor antigens → anamnestic response  
Treatment: usually no specific therapy required; dx is important for future transfusion
- Febrile nonhemolytic**: fever and rigors 0–6 h after transfusion  
Due to Abs against donor WBCs and cytokines released from cells in blood product  
Treatment: acetaminophen ± meperidine; rule out infection and hemolysis
- Allergic**: urticaria; rarely, **anaphylaxis**: bronchospasm, laryngeal edema, hypotension  
Reaction to transfused proteins; anaphylaxis seen in IgA-deficient Pts w/ anti-IgA Abs  
Treatment: urticaria → diphenhydramine; anaphylaxis → epinephrine ± glucocorticoids
- Transfusion-related acute lung injury (TRALI)**: noncardiogenic pulmonary edema  
Due to donor Abs that bind recipient WBCs, which then aggregate in pulmonary vasculature and release mediators causing ↑ capillary permeability, Rx: see "ARDS."

## Iron Panel Tests

	IRON PANEL TESTS					
	Iron	TIBC	Ferritin	Transferrin Sat (Fe/TIBC)	Transferrin	Hgb
IDA	↓	↑	↓	↓	↑	↓
Thalassemia	↑	↓	↑	↑	↓	↓
ACI	↓	↓	↑	↓	↓	↓
B12 Def	↑	↓	↑	↑	↓	↓

## 4T Score for HIT- Heparin Induced Thrombocytopenia

	2 points	1 point	0 point
<b>Thrombo-cytopenia</b>	↓ >50% & nadir >20k	↓ 30-50% or nadir 10-19k	↓ <30% or nadir <10%
<b>Timing</b>	5-10 d or <1d if hep w/in 30 d	? 5-10d (unclear), >10d, or <1d if hep w/in 30-100 d	<4d w/o recent hep
<b>Thrombosis</b>	New clot, skin necrosis, acute rxn	Prog/recurrent clot, suspect DVT	None
<b>Other cause</b>	None	Possible	Definite
<i>*Point Pretest Prob: Low ≤ 3: 99% NPV; Med 4-5: 22% PPV; High 6-8: 64% PPV</i>			
<i>Tx: dc hep, avoid plts, reverse if on warfarin, argatroban, start warfarin @ plt &gt;150</i>			



## J. Allergy

### Anaphylaxis

- Sudden onset of an illness (minutes to several hours), with involvement of the skin, mucosal tissue, or both (eg generalizes hives, itching or flushing, swollen lips-tongue-uvula) AND at least one of the following:
  - Sudden respiratory sx's (SOB, wheeze, cough, stridor, hypox)
  - Sudden reduced BP or sx's of end-organ dysfunction (hypotonia, collapse, incontinence)
- **OR** Two or more of the following that occur suddenly after exposure to a likely allergen or other trigger for that pt (minutes to hours):
  - Sudden skin/mucosal signs (hives, itch, swollen lips-tongue-uvula)
  - Sudden respiratory sx's (SOB, wheeze, cough, stridor, hypox)
  - Sudden reduced BP or sx's of end-organ dysfunction (hypotonia, collapse, incontinence)
  - Sudden GI sx's (crampy ab pain, vomiting)
- **OR** 3. Reduced BP after exposure to a known allergen for that pt
  - SBP <90 or greater than 30% from that pt's baseline
- Management
  - Reduce exposure to trigger (d/c offending medication)
  - Assess ABCs, mental status, skin, and body weight
  - Inject epinephrine intramuscularly in the mid-anterior thigh
    - NOT sub-Q, NOT in another location
  - 0.5mg for adults (or 0.01mg/kg if <50kg)
  - Repeat dose in 5-15 minutes if needed, usually only need 1-2

- Use IV bolus/slow infusion only if severe shock or cardiac arrest
  - Place pt on back, elevate legs
  - High-flow O<sub>2</sub> (6-8LPM) by facemask/OPA when indicated
  - Large bore IVs, give 1-2L normal saline rapidly. H<sub>1</sub>/H<sub>2</sub> blockers adjunct.
  - Monitor BP, cardiac function, and resp status at frequent intervals
- 
- RISK OF BIPHASIC ANAPHYLAXIS = admit for obs for 24 hrs
    - \*will commonly happen at 10 hrs, but can up to 72.
  - If no known trigger, consult/ref to allergy

## **K. Geriatrics**

### **Falls**

- Absolutely must evaluate a patient who has fallen.
- Eval for head trauma and neuro exam and consider head CT
- Look for fractures visually and w/ XR
- Review medication list for anything that may be contributing.
- If significant polypharmacy, consider reducing medications where clinically reasonable.

### **Dementia**

- Workup should include: CBC, CMP, B12, TSH, RPR, HIV
- Look for anticholinergic meds, depression
- MMSE/MOCA: >27 normal, 20-26 mild, 12-19 moderate, <12 severe

## **L. End of Life**

### **Comfort care**

- The focus of care should be to optimize patient comfort and to allow a peaceful death in the presence of family and friends.
- Consider carefully what medications and procedures the patient is receiving and whether or not they are necessary (i.e. does the benefit in the short term justify the burden or disruption in a dying patient?)
- Recommendations:
  - General Care- Private room with 24 hour visitation
  - STOP nonessential medications.
  - STOP unnecessary labs, needle sticks, radiographs, etc.
  - Oral Care- Lip balm/ water q4hrs ATC dry lips/ mouth
  - Eye Care- Artificial tears 2 drops to eyes q4hrs PRN dry

eyes

- Fever- Acetaminophen 650mg PO/PR q4hrs PRN T > 101 F
- Nausea- Metocloperamide 10mg q6hrs IV/PO q6hrs ATC
- Bowel regimen- Bisacodyl 10mg supp PRN no BM x 48hrs
- Agitated Delirium- Haloperidol 1mg SL q8hrs PRN agitation
- Seizures- Lorazepam 2mg IV q4hrs PRN seizure > 5 min
  
- Pain or Dyspnea- Reassess frequently. Titrate to symptom relief. If patient opioid naïve, consider:
  - Morphine sulfate 5mg PO q4hrs ATC or
  - Morphine sulfate 2mg IV q4hrs ATC or
  - Morphine sulfate 1mg/hr IV continuous infusion
- If patient previously on opioid for symptoms, titrate starting from current dose and adjust based on patient needs
  - Labored breathing/ Anxiety- Lorazepam 0.5mg IV q4hrs PRN. Use opioids as 1st line treatment and Lorazepam as adjunct
  - Excessive secretions- Scopolamine, or Glycopyrrolate

### **Pronouncing Death**

- **ALWAYS** contact the family and attending, no matter the time
- If family is present, prepare yourself before entering the room, introduce yourself and explain what you're going to do.

- Feel for carotid pulse, listen for heart/lung sounds, look for respirations, check pupils for reactivity. Be brief.
- Express your condolences to the family. Ask if they would like to see the Chaplain. Ask if they would like an autopsy. Ask name of funeral home.
- Do death note and death certificate. (MS has an online death registry)

## M. Critical Care Medicine

### Daily considerations in the ICU

<ul style="list-style-type: none"><li>• <b>F: Feeding/Fluids</b></li><li>• <b>A: Analgesia</b></li><li>• <b>S: Sedation and pain control</b></li><li>• <b>T: Thromboprophylaxis</b></li><li>• <b>H: Head of bed @ 30 degrees</b></li><li>• <b>U: Ulcer prophylaxis (GI)</b></li><li>• <b>G: Glycemic control</b></li><li>• <b>S: SBT/supplemental O2</b></li><li>• <b>B: Bowel regimen</b></li><li>• <b>I: Indwelling catheters/lines</b></li><li>• <b>D: Drug De-escalation</b></li></ul>	<ul style="list-style-type: none"><li>• <b>Update family daily</b></li><li>• <b>Assess volume status daily</b></li><li>• <b>Safety risks</b></li><li>• <b>Meds &amp; drips: Know current rate/dose</b></li></ul>
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### Respiratory Failure

- Hypercarbia ( $\text{PaCO}_2 > 45$ ,  $\text{pH} < 7.35$ )
  - $\uparrow$   $\text{CO}_2$  production: fever, sepsis, seizures, high CHO load in pt w/ underlying pulmonary disease
  - $\uparrow$  dead space: intrinsic lung disease (asthma, COPD, CF, pulm fibrosis), chest wall disorders (scoliosis)
  - $\downarrow$  minute ventilation: Drug overdose, metabolic derangements (myxedema, hypokalemia), CNS disease (spinal cord lesions), PNS disease (GBS, MG, ALS, botulism), muscle disease (myositis, muscular dystrophy), chest wall disorders (scoliosis), upper airway obstruction
- Hypoxia ( $\text{PaO}_2 < 60$ ,  $\text{SaO}_2 < 90$ )
  - $\downarrow$   $\text{FiO}_2$ : High altitude, tubing (of ventilator) not connected (nl A-a gradient, can correct w/ increased  $\text{FiO}_2$ )

- ↓ Diffusion: COPD, parenchymal lung disease (can correct w/ increased  $\text{FiO}_2$ )
- V/Q mismatch: Large PE, PNA, atelectasis, asthma (high A-a gradient, can correct w/ ↑  $\text{FiO}_2$ )
- Hypoventilation (nl A-a gradient, can correct w/ ↑  $\text{FiO}_2$ )
- Shunt: Severe ARDS, intracardiac, etc (high A-a gradient, cannot correct w/ ↑  $\text{FiO}_2$ )
- $\text{PAO}_2 - \text{PaO}_2$  gradient:  $(713 * \text{FiO}_2) - [(\text{PaCO}_2/0.8) - \text{PaO}_2]$   
 Nrmal A-a gradient =  $(\text{Age}/4) + 4$  (or use gradient =  $0.43 * \text{age}$ )
- If A-a gradient WNL &  $\text{PaCO}_2$  is high, then likely 2/2 hypoventilation
- If A-a gradient is high, then the cause is shunt, V/Q mismatch or  $\text{DO}_2/\text{VO}_2$  ( $\text{O}_2$  Delivery/Consumption) imbalance such as anemia, low cardiac output or hypermetabolism.

Treatment goal: correct hypoxemia, high  $\text{FiO}_2$ , restore lung volumes by recruiting more alveoli (with PEEP)

### **Types of Supplemental Oxygen**

- Nasal cannula: 50 cc reservoir (nasopharynx/oropharynx),  $\text{O}_2$  flow 1-6 L/min,  $\text{FiO}_2$  0.24-0.46.  $\text{FiO}_2$ : each liter per minute adds 3-4%  $\text{FiO}_2$  to room air 21%
  - (ie. 1lpm = 24%, 2lpm = 28%, 3lpm = 32%, 4lpm = 36%, 5lpm = 40%)
- Oxygen face mask: 150-250 cc reservoir,  $\text{O}_2$  flow 5-10 L/min,  $\text{FiO}_2$  0.4-0.6.
- Non-rebreather: 750-1250 cc reservoir,  $\text{O}_2$  flow 5-10 L/min,  $\text{FiO}_2$  0.4-1.
- Non-invasive positive-pressure Ventilation: BiPAP vs. CPAP

- Use CPAP (=IPAP) if primary problem is oxygenation (hypoxia)
- Use BiPAP if primary problem is ventilation (hypercapnia)

Device	FiO2 delivered	Uses
Blow by	<30%	Spontaneously breathing children
Nasal Cannula 1-4lpm	25-40%	Low dose oxygen to spontaneously breathing patients
Simple mask	35-50%	Low dose oxygen to spontaneously breathing patients
Partial rebreather mask	50-60%	Use to conserve oxygen
Nonrebreather mask	65-95%	High dose oxygen to spontaneously breathing patients
Self-inflating ventilation bag (ambu)	95-100%, with reservoir	Use to provide assisted ventilation / oxygenation
Flow-inflating bag	100%	(Anesthesia) Use to provide assisted ventilation / oxygenation

### Intubation Medications

- PRETREATMENT : 100% FIO2 & ANALGESIA (if BP tolerates)
  - **Fentanyl**: \*use low dose as a sympatholytic **premedication**, 1-2mcg/kg, 25-50mcg, onset <60sec. Avoid if increased ICP, hypotensive, resp dep
- SEDATION / INDUCTION
  - **Etomidate**: **Nonbarbituate hypnotic. Dosed 0.2-0.3mg/kg (ask for 40mg, give 20, can give other 20 if need)**, short onset (<1min), short duration (3-5 min). Drawbacks: adrenal suppression (avoid in sepsis), hypotension
  - **Ketamine**: Disassociative hypnotic acting as NDMA receptor antagonist blocking glutamine; **dosed 2mg/kg**, short acting <1min, short duration (5-10min); **use: any RSI**,



**esp if HD unstable, septic, reactive airway dz**

- **Propofol:** acts on GABA, 2 mg/kg, onset 15-45 sec, duration: 5 – 10 min, use in HD stable pts, reactive airway dz, status epilepticus. Drawbacks: hypotension, resp dep, pain on injection, very short acting
- PARALYTICS- immediately after induction agent
  - **Succinylcholine:** **Depolarizing** paralytic. Dosed 1-1.5mg/kg (**if don't know weight, 100mg usually works**), short onset (<1min), short duration (6-20min). **Many contraindications:** Burns, **hyperK**, increased ICP, denervation, prolonged immobility, malignant hyperthermia.
  - **Rocuronium:** **Nondepolarizing** paralytic; dosed 0.6-1.2mg/kg, short onset 1-2 min; intermediate duration 20-30 minutes. Use if can't do succ
- BP Meds
  - **Liter of IVF-** have setup if pt becomes hypotensive during intubation
  - Phenylephrine: Alpha agonist, useful if BP drops during intubation; dosed 50-500mcg, don't exceed 500mcg, don't

Drug	Normotensive Dose	Normotensive Dose (70 kg Pt)	Hypotensive Dose
Ketamine	2 mg/kg	140 mg	0.5 mg/kg
Etomidate	0.3 mg/kg	20 mg	10 mg
Propofol	1.5-3 mg/kg	150 mg	15 mg
Succinylcholine	1.5-2 mg/kg	140 mg	2 mg/kg
Rocuronium	1.2 mg/kg	80 mg	1.6 mg/kg

repeat more than every 10-15m; immediate onset,  
intermediate duration 15-20min

### **Rapid Sequence Intubation**

12-step program to intubation:

- 1) Have a plan (position, blade, oxygen, suction, tube, access, medications, mask, support staff)
  - 2) Have a back-up plan (glidescope, bougie, LMA, anesthesia, etc)
  - 3) Communicate said plan
  - 4) Prep patient (get all lines out of way), check equipment (check bulb of scope, lube tube, get stylet in desired position), get meds
  - 5) Position patient (sniffing position, head of bed slightly elevated)
  - 6) Preoxygenate for at least 5 min BVM or high flow O<sub>2</sub> (100% SpO<sub>2</sub>)
  - 7) Cricoid pressure (if RSI to prevent aspiration)
  - 8) Push meds
  - 9) Continue bag mask ventilation
  - 10) Spread jaw, sweep tongue (if using Mac blade), lift up and out (think lifting to far corner of room); BURP (back/up/right pressure) on trachea to help view cords)
  - 11) When you see cords, don't remove your view, ask for your equipment ("tube"), push ETT just past cords, inflate cuff
  - 12) Verify position (end tidal CO<sub>2</sub> monitor, auscultation, CXR), adjust tube accordingly and secure
- Set initial ventilator settings based on clinical scenario and patient factors

See ARDSNET reference

Generic adult setting: Vt 400-500cc (or 5cc/kg), PEEP 5, RR 14, FiO<sub>2</sub> 40%

• **Goals of ventilation**

- Oxygenate patient (PaO<sub>2</sub> ~55-60/SpO<sub>2</sub> >90% or 88% in COPD patients, if dramatically over this go down on FiO<sub>2</sub> or PEEP)
- Minimize harm to patient (Peak pressures <35, plateaus <30, tidal volumes 6mL/kg IBW)
- Ventilate patient (PaCO<sub>2</sub> adjusted to achieve pH 7.3-7.4)

**Determinants of oxygenation:** PEEP, FIO<sub>2</sub> (to lesser extent PaCO<sub>2</sub>)

**Determinants of ventilation:** Minute ventilation = rate x tidal volume

**Troubleshooting vent**

- **DOPES** (Displacement - ETT, Obstruction – tube circuit, PTX, Equipment failure-vent, Stacked breaths- autopeep)
- Patient starts crumpling. Get RT, remove vent, bag ventilate w/100% O<sub>2</sub>, examine tubes/lines, examine patient, look at previous vent trends
- High peak/plateau pressures = pulm edema, consolidation, atelectasis, mainstemmed tube, tension pneumo, chest wall trauma. Recs: check tube, suction patient, adjust tube depth if changed or positioning of patient from last CXR, shoot CXR
- Increased peak/plateau pressure difference = bronchospasm, secretions, inspiratory circuit obstruction. Recs: suction, nebs (ipratropium/albuterol)
- Auto-PEEP: Flow loop doesn't return to baseline, indicative of obstructive disease. Recs: Nebs and decrease rate or I:E ratio

- Inhaled > exhaled volumes: Circuit of cuff leak or bronchopleural fistula. Check cuff pressure, inflate to goal ~20-30
- Over-breathing vent: Patient has too low tidal volumes or, more likely, is agitated/in pain. Recs: Check gas, if overventilated, sedate
- Exhaled > inhaled volumes: Nebulizer in circuit, will cause autopeep transiently. Recs: Let the neb finish and reassess

### **Can I take them off vent?**

- Daily spontaneous breathing trial (>24 hours on vent, FiO2 50% or less, PEEP 5 or less, off vasopressors or on  $\leq 2\text{mcg/kg/min}$  norepinephrine)
- Use pressure support mode w/PS  $\leq 5\text{cmH}_2\text{O}$  over PEEP, leaving PEEP and FiO2 same
- Passes if >1 hour without: RR >35 or <8 for 5 min, SpO2 <90% for 5 min, abrupt change in mental status, new arrhythmia, respiratory distress, HR >20% from baseline
- Check **RSBI** on **PS** mode if <105, consider extubation if passing SBT, PaO2 after >80, FiO2 <40, spontaneous RR 10-20, NIF -20 to -25 or better, cough reflex present, electrolytes wnl, resolution of inciting event

### **Supportive Ventilation Basic Primer**

#### **1. Noninvasive Positive pressure ventilation**

CPAP: continuous positive airway pressure. Patient initiates breaths and machine provides pressure constantly

BIPAP / BiLevel Positive Airway Pressure: Inspiratory PAP and Expiratory PAP/PEEP

IPAP: Patient initiates breaths and machine provides pressure at inspiration

EPAP: after breath initiated by patient, machine continues to

deliver some pressure, and this helps keep the alveoli open, and thus improves recruitment of alveoli and decreases work of breathing

- Uses: Effective in treating decompensated COPD, CHF

## 2. Invasive: intubation + mechanical ventilation

-Indications: Failure of airway maintenance, protection, oxygenation, ventilation. Anticipated need for intubation (impending resp fatigue):

- Basic Modes:

- **Volume A/C (assist control):**

- Pt initiates breath, then machine provides a full set volume
- Standard settings: PEEP 5, Vt 400-500(5cc/kg), RR 14, FiO<sub>2</sub> 240%
- Check ABGs and Watch for respiratory alkalosis from hyperventilation, given patient will get full volume every time a breath is initiated therefore tachypnea can lead to stacking and cause hyperventilation.

- **Pressure controlled**

- Fixed pressure. Vt will vary depending on patient's lungs compliance. Therefore monitor Vt: can be too small in poor compliance, which leads to poor ventilation.

- **SIMV (synchronized intermittent mandatory ventilation) & PEEP**

- Patient is allowed to initiate breaths which trigger the machine to provide a volume or pressure support, but if the patient does not initiate a breath, the machine will also provide a minimum set number of mandatory breaths.

## Sepsis

- SOFA >>> SIRS
  - SOFA >2 = sepsis
  - Calc SOFA: MD CALC, go to “evidence” to est FiO2.
    - \*PaO2: spO2 90% ≈ 60mmHG paO2, 100% ≈ 90mmHG
- Sepsis: organ dysfunction (SOFA ≥ 2) consequent to infection
- Septic Shock: sepsis w/ hypotension requiring pressors for MAP ≥ 65 and blood lactate >2 despite appropriate volume resuscitation
- Early goal directed therapy, Surviving Sepsis Campaign. Doing these within 6hrs of presentation has been shown to decrease mortality:
  - IVF resuscitation with NS, target MAP >65mmHg
  - Obtain 2 sets of blood cx, then start broad spectrum antibiotics
  - Vasopressors: see below
  - Consider central line and arterial line placements early.
- The following should be done within the FIRST hour of presentation:
  - IVF resuscitation of 30mL/kg (avoid excess fluids)
  - Lactate level, trend q6 or until not elevated
  - 2 blood cultures before antibiotics
  - Broad spectrum antibiotics (vanc/cefepime)
  - MRSA nares most sensitive in resp. source sepsis.

## Vasopressors

**Start immediately if not fluid responsive. Don't wait!** MAP goal usually 65mmHg. All patients requiring vasopressors eventually need a-line and central line.

(Can run low dose levophed thru peripheral for a few hours if needed)

- **Norepinephrine (1st choice pressor in septic shock)**
  - All around good pressor for septic & cardiogenic shock.
  - Receptors:  $A1 > B1 > B2$ . Mostly increased SVR and pulse pressure
  - Dose range 0.01-3  $\mu\text{g}/\text{kg}/\text{min}$
  - Start at 5 mcg/min, titrate to MAP (usually goal 65)
- **Vasopressin**
  - Consider in: Vasodilatory shock, often adjunct to norepinephrine
  - Receptors: V1 (SM increases SVR), V2 (renal collecting system= inc H2O reabsorption)
  - Sensitizes vasculature to norepinephrine. Inhibits vasodilation, inhibits  $K^+$  channels and NO production. Effects preserved during acidosis and hypoxemia
  - Infusion 0.04 U/min (no titration)
- **Epinephrine**
  - Good all-around pressor. Increases coronary blood flow and arterial/venous pulmonary pressures like NE.
  - Surviving Sepsis Point: Epinephrine favored when additional agent is needed to maintain adequate blood pressure
  - Receptors:  $A1 > B1 > B2$ . More alpha at high dose. More beta at low dose.
  - Dose range: 1-10 mcg/min
- **Dopamine:** Probably won't use.
  - Receptors: D1, D2, B1 (cardiac chronotropy/inotropy), A1 (Systemic vascular resistance)
  - Dosing: 0.5-3.0  $\mu\text{g}/\text{kg}/\text{min}$

- **Phenylephrine**

- Useful for hypotension, PDE5+nitrate use, HOCM
- May cause compensatory bradycardia 2/2 baroreceptor response
- Receptors: Alpha 1 = increase in SVR
- Bolus 100-500 µg every 10-15m
- Infusion: 0.4-9.1 µg/kg/min

- **Dobutamine:**

- Increases myocardial O<sub>2</sub> consumption, increases risk of ischemia, tolerance develops rapidly, proarrhythmogenic
- Receptors: B<sub>1</sub>: B<sub>2</sub> = 3:1 affinity (more inotropy than chronotropy), A<sub>1</sub> (systemic vascular resistance)
- <5 µg/kg/min = B<sub>1</sub> and B<sub>2</sub> effects> A effects = chronotropy and inotropy with vasodilation; start 0.5- 1mcg/kg/min
- 5-15 µg/kg/min = B<sub>1</sub> and B<sub>2</sub> predominate with (minimal) effects on SVR
- >15 µg/kg/min = A predominates = increase in SVR (max dose 40 µg/kg/min by manufacturer, ACC/AHA/Surviving Sepsis say no more than 20 µg/kg/min)

- **Milrinone**

- Phosphodiesterase 3 inhibitor = increases intracellular cAMP increasing cardiac contractility and vasodilation in periphery
- Increases diastolic relaxation, decreases preload, decreases afterload, decreases SVR
- 50 µg/kg administered over 10 minutes followed by maintenance dose 0.125-0.75 µg/kg/min
- Recommended Use: Heart failure. Adrenergic receptors are downregulated and catecholaminergic agents may be less



effective

- Patient critically ill, persistently Hypotensive even on pressors with no obvious reason? **Check a random cortisol**
  - Stress Dose Steroids = 50mg hydrocortisone q6

### **VTE Prophylaxis**

- ☐ VTE risk in inpatients is increased 130x compared to gen population
  - ☐ Prophylaxis recommended for pts with any of the following RF:
    - Age >60, CHF, COPD exacerbation, sepsis, IBD, known thrombophilia, prolonged immobility >3 days, previous VTE, elevated D-dimer
  - ☐ Low-risk pts (with no risk factors):
    - Early ambulation +/- mechanical prophylaxis sufficient
  - ☐ Moderate (1+ RF) or high-risk patients (critically-ill, cancer, stroke)
    - Heparin +/- mechanical prophylaxis
    - LMWH reasonable if CrCl >30
  - Not needed if pt already on oral anticoagulant
  - Watch for evidence of HIT, esp with UFH
    - For pts with a h/o HIT, fondaparinux may be used as alternate
  - ☐ Contraindications to pharmacologic prophylaxis (heparin):
    - Active bleeding or intracranial hemorrhage
    - Surgical procedure is planned in the immediate 6 to 12 hours
    - Moderate or severe coagulopathy
    - Severe bleeding diathesis or thrombocytopenia
- Epistaxis and menstrual bleeding are NOT contraindications

### **Stress Ulcer Prophylaxis**

- ASHP Guidelines- GI prophylaxis appropriate for patients

admitted to the ICU with one or more of the following:

- Mechanical ventilation >48 hours
- Coagulopathy
- GI ulcer or bleeding within the past year
- Glasgow Coma Score  $\leq 10$
- Thermal injury >35% BSA
- Multiple trauma
- Transplantation patients in the ICU

perioperatively

- Hepatic failure or partial hepatectomy
- Spinal cord injury
- Patients with at least 2 of the following:
  - Sepsis
  - ICU stay >1 week
  - Occult GI bleeding  $\geq 6$  days
  - Steroids- >250 mg hydrocortisone or equivalent per day

## **USPSTF Preventative Services**

### **Alcohol use**

- If high use, get AUDIT-C score

### **Colon cancer**

- Screening recommendations:
  - Ages 50-75 (Grade A) \*Updates currently in progress\*
  - 76-85 consider if >10-yr life expectancy (Grade C)
  - >85 do not screen (Grade D)
  - Per ACG, everyone should start at 45yo
  - If two 1<sup>st</sup> degree relatives w/ colon ca- start at 40 or 10 years before earliest diagnosis
  - Screening options: ACG Colorectal Screening Guidelines 2021

### **Depression**

- If positive screen by tech, get PHQ-9 score

### **Diabetes**

- Screen in asymptomatic adults with BP >135/80
- If BP <135/80, consider screening if DM would affect treatment
- Screening options: ADA recs screening Q3 years.
  - Fasting FSG  $\geq 126$  (confirmed on separate day)
  - 2-hr post-load plasma > 200
  - Hemoglobin A1C >6.5
  - Random >200 with symptoms
- In patients with DM:
  - If uncontrolled, check A1C q3mo
  - If controlled check A1C q6 mo
  - Also annual lipids, urine microalb/Cr, eye & foot exams, vaccines

## **HBV**

- Screen in someone from a country with Hep B prevalence >2%, or parent from country with prevalence >8% and pt born in U.S. but not vaccinated in infancy (basically all countries except North America, West Europe or Australia)
  - If positive refer to ID

## **HCV**

- Screen in anyone born 1945-1965
  - If positive refer to ID, can order viral load at the same time

## **HIV**

- Screen at least once age 15-65
- Also recommended in pts with STDs or initiating tx for TB
- Remember to check viral load too if acute infection suspected
- If positive refer to ID, can order viral load at the same time

## **Hyperlipidemia**

- Screen in men >35 or women >45, repeat every 5 years
- ACC/AHA ASCVD guidelines

## **Falls risk assessment**

- If you think they're increased risk, perform 'timed get up and go test'. If abnormal, refer to PT & check vitamin D. Can request fall risk reduction program through home health.

## **Immunizations**

- Can send pts directly to immun. clinic in basement, no appt req
- Asplenic patients: PPSV23, PCV13, Hib, Meningococcal
- Pneumovax(PPSV23): everyone >65
- Prevnar (PCV13): >65, shared decision making (Underlying

medical conditions may consider more strongly)

- Shingrex: >50 (regardless of prior varicella or zoster infection)
- Td: Every 10 years, or with acute wound and status unknown
- Influenza: Yearly, avoid live vacc in COPD, CHF, immunocomp
- Hep B: Pts with DM, cirrhosis, and ESRD on dialysis
- HPV: Women 11-26, Men 9-26 (and 27-45 in HIV+, MSM)

### **Lung Cancer**

- Annual low dose CT
- Asymptomatic adults 50-80 yo w/ 20 pack-year smoking history and currently smoke or have quit smoking within past 15 years
- Discontinue screening when pt has not smoked for 15 years

### **Obesity**

- If BMI>30, refer to nutrition class and/or counseling
- Bariatric surgery monitoring:
  - Annually: Anemia, Vitamin A, B12, D, folate, iron, zinc
  - +/- : Vitamin E, K, selenium, copper, thiamine

### Men Only

#### **AAA Screening**

- One-time screen in men 65-75 who have ever smoked

**Prostate cancer: Routine PSA screening NOT recommended**

### Women only

#### **Breast Cancer**

- Mammogram every year 50-74 yo
- <50 or >75, case by case, risk factors, pt preference
- If abnormal radiology will usually recommend US vs MRI
- Insufficient evidence to support clinical breast exam, digital mammography, or MRI as screening modalities

- BRCA genetic counseling:
  - If positive, get FHS-7 score. If high, consult genetics.
  - Assess risk at: <http://www.cancer.gov/bcrisktool/>
  - Consider tamoxifen, raloxifene, though no data for improved survival, & there is ↑ risk for DVT/PE, uterine ca
  - Likely be referred to surgery for prophylactic mastectomy

## **Osteoporosis**

- DEXA Screening recommended for:
  - Women  $\geq 65$
  - Women  $< 65$  whose fx risk is  $\geq 65$  WF w/o additional RF
  - Consider screening men  $> 70$
- If DEXA shows osteoporosis (T score  $< -2.5$ ), then treat
- If DEXA shows osteopenia (T score  $-2.5$  to  $-1.0$ ):
  - Calculate FRAX score: <https://www.shef.ac.uk/FRAX/>
  - If high 10-yr risk ( $> 3\%$  hip or  $> 20\%$  major fx) then treat
- Treatment
  - Lifestyle- exercise, smoking cess, ↓ EtOH, fall risk assess.
  - Always check RFP (GFR and Ca) and Vit D prior to tx
  - If vitamin D  $< 30$ , replete with weekly Drisdol prior to tx
  - Bisphosphonates (first-line)
    - PO alendronate or risedronate- usually weekly doses
    - IV zoledronate (Reclast)- infusion every 2 years
    - Contraind in GFR  $< 30$ , esophageal/GI disorder (for PO)
  - Denosumab (Prolia)- mAb against RANK-L, ↓ osteoclast act
    - Q6month Sub-Q injections
    - Only consider if failed or contraind to bisphos.
  - Romosozumab (Evenity) anabolic, mAb that inhibits sclerostin (promotes bone formation)
    - High risk for fracture or intolerant to other therapies
    - Not for use if MI or CVA w/in prior year; potential risk for CV death, MI, CVA
    - Q1month Sub-Q injections for 1 year

- Teriparatide (Forteo)- PTH analog
  - Daily Sub-Q injections
  - Preferred in severe OP or steroid-induced OP
- Raloxifene, calcitonin- Less efficacy, last-line

### **Cervical cancer (Pap Smear)**

- We don't do these. Refer to Women's Health.
- 21-65- Screen with cytology every 3 years
- 30-65- Screen with cytology AND HPV testing every 5 years
- <30- Do not screen with HPV (alone or with cyto)
- <21, >65, or had a hysterectomy (& w/o cervix)- Do not screen

### **Smoking Cessation Options**

- All patients should be referred to the Smoking Cessation Clinic at the Health and Wellness Center
- AHLTA "con- smoking cessation", goes to Joy Schaubhut (376-3171)
- TRICARE Quit Line: 1-877-414-9949
- Nicorette gum
  - At onset of craving, can be combined with patch and orals, pt should cease smoking
  - Dose depends on #cigarettes/day
- Transdermal patch, combine with gum/orals. Should cease smoking.
  - Taper based on #cigarettes/day
- Zyban (Bupropion)- screen for contraindications
  - If no effect at 7 weeks, unlikely to work
  - Maintenance up to 6 months
  - Warning in renal/hepatic patients
  - Bupropion and nicotine together better than either alone
- Chantix- screen for contraindications
  - Course of Chantix is 12 weeks, can extend to 24 weeks

total

- Target starting one week before quitting
- Prescribe starter pack, pt should call for continuation pack
- Inquire about SI/HI before each time patient fills Chantix
- If unsuccessful or relapse, can do another trial

### Useful Websites & Resources

- 🔗 Dynamed (bullet point format, cites evidence) Free with ACP membership
- 🔗 Uptodate
- 🔗 Life in the fast lane (esp. for cardiology, crit care)
- 🔗 Youtube🔗 NEJM “procedure name” (tutorial videos for procedures)
- 🔗 Emcrit website (podcast for EM and Critical care)
- 🔗 FOAM Cast- Free Open Access Medical Education
- 🔗 Curbsiders – Internal Med Podcast on high yield topics
- 🔗 National Comprehensive Cancer Network: [www.nccn.org](http://www.nccn.org)
- 🔗 Guidelines: Resident Resources->Articles & Powerpoints->Guidelines
- 🔗 Dotphrase.org

### **Mississippi Prescription Monitoring Program:**

- <https://mississippi.pmpaware.net/login>
- Can look up prescription history and prescribing providers of narcotics and other high-risk meds for a given patient

### **Commonly Used Calculators/Formulas**

- 🔗 ACS (STEMI, NSTEMI, UA):
  - **HEART Score:** For chest pain in ED, risk of MACE within 6-weeks
  - **GRACE score:** In-hospital and 1-yr mortality after ACS
  - **Killip Class:** degree of CHF after ACS, 30-day mortality
  - **TIMI:** 14-day risk of death, MI, or urgent PCI after ACS



❑ AKI:

- **FeNa:** <1% suggests prerenal, >1% suggests ATN or post-renal
- **FeUrea:** Used when pt on diuretics, <35% suggests prerenal

❑ Atrial fibrillation

- **CHA2DS2-VASc:** Yearly risk of CVA with A-fib
- **HAS-BLED:** Risk of major bleeding with 1-yr on OAC

❑ Cardiovascular risk

- **ACC/AHA CV Risk:** 10y risk of ASCVD (MI, CVA, coronary death)
- **Framingham Risk Score:** 10y risk of ASCVD

❑ CHF

- **NYHA Functional Class:** Level of functionality in CHF patients

❑ Cirrhosis/Hepatitis

- **Discriminant Function/Maddrey Score:** Severity of alcoholic hepatitis
- **Lille Model:** If alcoholic hepatitis is steroid responsive
- **Child Pugh:** Severity of cirrhosis, mortality before & after TIPSS
- **MELD:** Prognosis in liver failure, prioritizes for liver transplant
- **SAAG (Serum-ascites albumin gradient):**
  - $\geq 1.1$ - P-HTN from Liver Fail, Budd-Chiari, Myxedema, SBP
  - $< 1.1$  Peritoneal TB, CA, Nephrotic Synd, or Pancreatitis

❑ Creatinine Clearance

- **CrCl CKD-EPI:** Best for GFR of  $\geq 60$  ml/min
- **CrCl Cockcroft-Gault** or **MDRD:** Better for GFR of  $< 60$  ml/min

❑ Critically Ill:

- **APACHE II-** Severity of illness and risk of death
- **Aa Gradient=**  $(713 \times \text{FiO}_2) - (\text{PaCO}_2/0.8) - \text{PaO}_2$
- Normal is  $0.29 \times \text{age}$

- **PaO<sub>2</sub>/FiO<sub>2</sub> (P/F) ratio:** ARDS if <300. Quantifies severity
  - **SOFA:** Level of end-organ dysfunction in ICU patients
- ☐ CVA/TIA:
- **ABCD<sup>2</sup>**- 2,7, and 90 day risk of CVA after TIA
  - **NIH Stroke Scale:** Quantify severity of stroke, track progress
- ☐ DVT
- ☐ **Well's score for DVT-** Pretest probability of DVT
- ☐ Electrolytes:
- **Corrected Na in hyperglycemia** = serum Na + (1.6 for every 100 md/dL of glucose above 100)
  - **Corrected Ca in hypoalbuminemia** = Ca + [(4.0-Albumin) x 0.8]
  - **Free water deficit in hypernatremia**  

$$= (\text{Kg} \times 0.6) \times [(140 - \text{serum Na}) / 140]$$
  - Try to give half in the first 8 hrs, then the rest in next 24h
  - Usually best to give free water PO or per NG if possible
- ☐ Endocarditis
- ☐ **DUKE criteria:** Makes diagnosis of endocarditis
- ☐ GI Bleed
- ☐ **GBS score:** Likelihood upper GI bleed will need intervention
- ☐ HIT
- ☐ **4 T's:** Pretest probability of having HIT
- ☐ Osteoporosis/enia
- ☐ **FRAX score:** 10y risk of major osteoporotic fx
- ☐ Pancreatitis:
- **BISAP:** Risk of in-hospital mortality
  - **Ranson's Criteria:** Mortality in acute panc, outdated, req 48 hrs
- ☐ Pleural Effusion
- ☐ **Light's Criteria** for Transudative Effusion
- Failing any one of the criteria makes it an exudate

- 1. Effusion Protein / Serum Protein  $< 0.5$
- 2. Effusion LDH / Serum LDH  $< 0.6$
- 3. Effusion LDH  $< 200$
- Etiology:
  - Transudate: CHF, Kidney Dz, Cirrhosis
  - Exudate: Parapneumonic ( $> 1,000$  WBC), Empyema ( $> 100,000$  WBC) + positive gram stain of pleural fluid, TB, PE, CA, RA, Esophageal rupture, Pancreatic Fistula, SLE

☐ Pneumonia:

- **CURB 65:** 30-day mortality, outpatient vs inpatient tx
- **Pna Severity Index (PORT):** Same as CURB but more detailed
- **Shorr score:** for MRSA PNA

☐ Pre-Op:

- **NSQIP calculator:**  
<http://riskcalculator.facs.org/RiskCalculator/>
- **Gupta calculator:**  
[https://qxmd.com/calculate/calculator\\_245/gupta-perioperative-cardiac-risk](https://qxmd.com/calculate/calculator_245/gupta-perioperative-cardiac-risk)
- **RCRI**

☐ Pulmonary embolism:

- **PERC:** Rules out PE if all criteria negative
- **PESI:** Severity of PE, inpatient vs outpatient
- **Well's Score for PE:** Pretest probability of PE

## **Practical Tips to Running a Code**

### **A Few Words**

Everyone is nervous during his/her first CODE BLUE experiences. DON'T WORRY THIS IS TOTALLY NORMAL! Eventually, with time and practice, you'll be the one who runs fastest to get there to competently & confidently run the show  
Take a deep breath, use your ACLS cards, you got this.

### **REMEMBER:**

- The #1 thing for coronary & cerebral perfusion: GOOD COMPRESSIONS
- Coach & make compressors switch if they look tired
- Study! Practice on paper/in your head/ with a buddy/ in the sim lab. This grows competency which saves lives and grows confidence.
- Don't forget the 5 H's & T's (or Kotti- 2 Lungs/ 2 Hearts / 3 up & 3 down)
- For VF and VT shock! (200 J biphasic)
- Epinephrine is your friend. (1mg q3-5min via IV; 2.5mg q3-5min via ETT)  
(Give every other pulse check)
- Patients aren't dead unless they're warm and dead

Good luck! "Whether you think you can or whether you think you can't, you're right."

### **Assess and Take Command**

Ask who's running the code, if no one is running it, announce that you are. If compressions haven't been started, **check for pulse** & confirm code status.  
If pulseless and ok for resuscitation:  
Go to foot of bed – this is your home now. Get a 3 second update about the situation.

### **Compressions, Breaths, Access, Leads, FSG**

Ensure there are adequate people for compressions and adequate compressions; don't forget body board under patient!

- 2 inches in, 100/min – encourage and coach!!
- End tidal CO2 at least 10mmHg, goal close to 20mmHg

Check IV Access; patient should have 2 large bore IVs in AC fossa preferably, any will do, IO if needed

Make sure someone (preferably RT) is bagging patient

Get leads on patient ASAP (you need to know shockable or not ASAP) CHECK A FINGER STICK GLUCOSE!

### **Assign Specific People to Specific Roles:**

- 1) Recorder/Timekeeper- This person needs to tell you when 2 minutes is up for each cycle of compressions and when the next dose of Epi is due
- 2) RN for medications (immediately get Epi and IVF)
- 3) RN to collect CODE LABS
- 4) People for compressions, rotate compressor Q2min, ( 2 inches deep, 100/min, allow recoil, backboard)
- 5) RT to bag patient ( breath every 6 seconds, 8-10 per minute)
- 6) Tech to attach leads, cycle BP cuff
- 7) Someone to pull up chart, get history and get most recent labs
- 8) Someone to contact family and update them
- 9) Enforcer for crowd control

**\*\*\*DECLARE THE RHYTHM / ALGORHYTHM OUT  
LOUD!!!\*\*\***

**Analyze Waveform, Think and Act: PEA / ASYSTOLE  
(H&T's)**

- Once leads are attached, stop and check for rhythm and pulse.
- Think about the potential reasons this patient coded, look for & treat reversible causes!
- If Asystole/PEA: (5 H's & T's), or (Kotti: 2Heart, 2Lungs, 3up 3down)
- Asystole/PEA: CPR q2min → check pulse, rhythm, shock if VT/VF → Resume CPR q2min with EpiQ3min → repeat

Cause		Signs	Tx
Hypovolemia	Blood volume loss	Tachycardia Hypotension	Blood, Fluid Bolus
Hypoxia	Airway obstruction	Low O2 sat, Cyanosis (*CO poison)	ABG, Secure airway, ventilate w/ O2, b/l BS, chest rise
Hydrogen ions (acidosis)	Hypo-perfusion, Anaerobic metabolism	Low QRS	ABG, secure airway, Ventilate, Sodium Bicarb 1meq/kg
Hypokalemia	Many	Flat T waves, U wave	Mg 2gm, controlled K infusion (always diluted K)
Hyperkalemia	Many	Peak T wave, wide QRS	Calcium chloride, Insulin/glucose, Lasix, Bicarb, kayexalate, albuterol, dialysis
Hypothermia	Exposure	Pt cold, bradycardic, J wave	Warm blankets/warm IVF 42°C, peritoneal /bladder lavage meds less effective if cold
Hypoglycemia	Sepsis Adrenal failure Excess insulin	AMS, arrhythmia	25g IV dextrose

Cause		Sign	Tx
Toxins	Overdose; TCA/Dig/BB/ CCB Cocaine	Long QTc, check pupil,	-call poison control -antidote
Tamponade	Fluid in pericardium -ineffective pump	Low voltage, tachy, narrow qrs, JVD, muffled heart	-bolus IVF - pericardiocentesis, subxiphoid aim for shoulder
Tension PTX	High pressure compresses thoracic structures	Narrow qts, brady, clinical dx, tachy, hypotension, JVD, trach deviation, unequal BS	-needle decompression (pt dies if wait for CXR)
Thrombosis (acute MI)	Coronary plaque rupture	ST changes, TWI, q waves CP/trop	PCI
Thrombosis (Massive PE)		Tachycardia , hypoxia, JVD	Lytics



## **Analyze Waveform, Think and Act: Vtach /VFib (ELECTRICITY!)**

- Once leads are attached, stop and check for rhythm and pulse. Think about the potential reasons this patient coded!
- If Vtach or Vfib...SHOCK SHOCK SHOCK SHOCK!

- VT/VF: Shock → CPR q2min → check pulse, rhythm, shock if VT/VF

→ Resume CPR q2min with Epi q3min → repeat, (alternate Amio w/ Epi)

- We typically use biphasic defibrillators
- Initial dose: 200J
- Repeat deliveries can be up-titrated to maximum setting
- When you see a shockable rhythm, continue compressions & charge...don't stand there without compressions and wait till the defibrillator is ready!!
- When ready, hold compressions then... "Everyone clear!" "Deliver shock"
- Resume compressions for 2 full minutes
- DON'T FORGET END TIDAL CAPNOGRAPHY! (Can stop a code mid-compression if ETCO2 rises to 35-40 mmHG)

### **Troubleshooting: All IV lines are blown!**

- Epi can be given via ETT! ☑ give epi 2.5mg via ETT instead of 1mg IV
- Ask RN to attempt PIV
- Place an intraosseous line ☑ takes < 1 min & gets fluid to heart in 3 sec
- Place central line

### **OMG! Patient got ROSC! What do I do?**

- Get Vital signs and an EKG!!!
  - If new LBBB or ST elevation, treat per STEMI protocol
- Consider hypothermia protocol (decrease metabolic rate and reactions that can produce toxic metabolites)
  - Indications: best data for comatose VF/Vtach with ROSC <1 hr
  - Contraindications: hemorrhagic CVA, trauma, GCS >8, overdose, pre-existing hypothermia, sepsis, hypotension, coagulopathy

- |                          |                      |   |
|--------------------------|----------------------|---|
| -Maintain O2 sat >94%    | -IVF/pressors PRN    | - |
| Line patient out         |                      |   |
| -Treat reversible causes | -Update Family       | - |
| Write Code Note          |                      |   |
| -Discuss w/ primary team | -Thank the code team |   |

### **Pressors PRN after ROSC**

- Adequate volume resuscitation is essential to minimize risk of vasopressor- mediated splanchnic hypoperfusion.
- Norepinephrine IV infusion “Levophed” (1<sup>st</sup> line for septic shock) 0.1-0.5 mcg/kg per minute (70kg adult = 7-35mcg per minute)
- Dopamine IV infusion: 5-10mcg/kg/min

- Epinephrine IV infusion: 0.1-0.5 mcg/kg/min (70kg = 7-35mcg/min)

**....When do I know to “call it”?**

- There is no magic number as to when to call it; case by case basis. Talk to family if able.
- Factors to consider: pt age, comorbidities, prognosis, QOL before code

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