UC Health

University of Cincinnati

Medical Center

University of Cincinnati

Department of Surgery

Section of General Surgery

Division of Surgical Critical Care

Surgical ICU Manual

2025

Table of Contents

Respiratory Care

- Room Air = 21% O_2
- Nasal Cannula = 3% with each L O_2
- Incentive Spirometry Goal: ≥15 mL/kg of ideal body weight (see next page)

Pulmonary Volume Expansion Protocol

Assess and treat per RT pulmonary volume expansion criteria order to be entered in EPIC

Indications:

- Presence of atelectasis on chest x-ray
- Restrictive lung disease associated with quadriplegia / dysfunctional diaphragm
- Risk for developing atelectasis:
    - Upper abdominal surgery, including laparoscopic procedures
    - Thoracic surgery
    - COPD
    - Restrictive lung disease
    - Age > 70
    - Obesity
    - Smoking history > 30 pack years
    - Neurosurgery patients unable to clear secretions
    - Anticipated prolonged bed rest (≥ 3 days)
    - Chest trauma (≥ 2 Rib fractures, chest tube in place)
    - Immediately post extubation
- Any patient with IS ≤ 10 mL/kg/IBW, **or** <75% of predicted value per Nomogram
- If patient does not achieve ≥ 50% of predicted value with IS, patient will be started on EzPAP protocol per RT (q4 hours in ICU and q6 hours on the floor)

Predictive Nomogram–Inspiratory Capacity* (mL)**

FEMALE

AGE IN YEARS	HEIGHT IN INCHES								
	58"	60"	62"	64"	66"	68"	70"	72"	74"
20	1900	2100	2300	2500	2700	2900	3100	3300	3500
25	1850	2050	2250	2450	2650	2850	3050	3250	3450
30	1800	2000	2200	2400	2600	2800	3000	3200	3400
35	1750	1950	2150	2350	2550	2750	2950	3150	3350
40	1700	1900	2100	2300	2500	2700	2900	3100	3300
45	1650	1850	2050	2250	2450	2650	2850	3050	3250
50	1600	1800	2000	2200	2400	2600	2800	3000	3200
55	1550	1750	1950	2150	2350	2550	2750	2950	3150
60	1500	1700	1900	2100	2300	2500	2700	2900	3100
65	1450	1650	1850	2050	2250	2450	2650	2850	3050
70	1400	1600	1800	2000	2200	2400	2600	2800	3000
75	1350	1550	1750	1950	2150	2350	2550	2750	2950
80	1300	1500	1700	1900	2100	2300	2500	2700	2900

MALE

AGE IN YEARS	HEIGHT IN INCHES										
	58"	60"	62"	64"	66"	68"	70"	72"	74"	76"	78"
20	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000
25	1950	2150	2350	2550	2750	2950	3150	3350	3550	3750	3950
30	1900	2100	2300	2500	2700	2900	3100	3300	3500	3700	3900
35	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800
40	1750	1950	2150	2350	2550	2750	2950	3150	3350	3550	3750
45	1700	1900	2100	2300	2500	2700	2900	3100	3300	3500	3700
50	1650	1850	2050	2250	2450	2650	2850	3050	3250	3450	3650
55	1550	1750	1950	2150	2350	2550	2750	2950	3150	3350	3550
60	1500	1700	1900	2100	2300	2500	2700	2900	3100	3300	3500
65	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400
70	1350	1550	1750	1950	2150	2350	2550	2750	2950	3150	3350
75	1300	1500	1700	1900	2100	2300	2500	2700	2900	3100	3300
80	1250	1450	1650	1850	2050	2250	2450	2650	2850	2050	3250

* Formula used in the above Nomogram published in The American Review of Respiratory Diseases official journal of American Thoracic Society, September 1979, Vol. 120, Number 3 by G. Polgar and V. Promadhat

** Milliliters — Inspiratory capacity measured in milliliters rounded off to the nearest 50 ml.

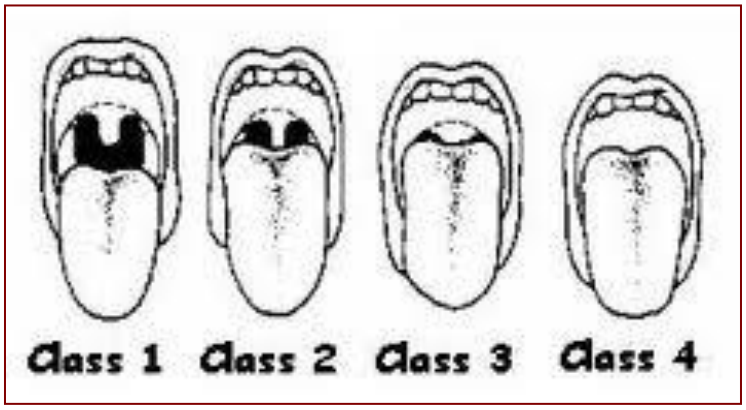
ASA Physical Status Classification System

Class 1	Healthy patient, no medical problems
Class 2	Mild systemic disease
Class 3	Severe systemic disease, but not incapacitating
Class 4	Severe systemic disease that is a constant threat to life
Class 5	Moribund, not expected to live 24h irrespective of operation
"E" is added to the status to designate an emergency operation	

Mallampati classification:

Predicts ease of intubation. Classes are determined by looking at the anatomy of the oral cavity, specifically, it is based on the visibility of the base of the uvula, faucial pillars, and soft palate.

Class 1	Full visibility of tonsils, uvula and soft palate
Class 2	Visibility of hard and soft palate, upper portion of tonsils and uvula
Class 3	Soft and hard palate and base of the uvula are visible
Class 4	Only hard palate visible



Bronchoscopy

https://www.youtube.com/watch?v=ScaCO9MB-_o

Intubation:

Anesthesia for emergent intubation: **584-3333**
Emergency Airway Stat (including trauma team): **584-4444**
If the ICU fellow/attending is not available, call Anesthesia attending **513-519-1111**

Indications include:
Failure to protect airway
Failure of oxygenation
Failure of ventilation

6 P's

Preparation

- Ensure proper positioning
- Suction ready at head of bed
- Ensure adequate IV access, pulse oximetry
- Consider NG placement

Preoxygenation

- Mask ventilate with an oral or nasal airway in place, Ambu bag

Premedication

- Lidocaine – may blunt rise in ICP associated with airway manipulation
    - 1.5-3 mg/kg (average 100mg) 3 minutes prior to intubation
- Atropine – 0.02 mg/kg can minimize vagal effects and bradycardia especially if < 8 yo
- Sedation – should ALWAYS be used if paralyzing patient
    - Etomidate - ↓ ICP, few hemodynamic effects, may cause adrenal insufficiency
        - **0.3 mg/kg IV** **70kg adult: 20mg** **100kg adult: 30mg**
        - 30-60sec to onset of action 5 minute duration
    - Ketamine – may ↑ ICP, minimal hemodynamic effects
        - **1.5 mg/kg**
    - Propofol - ↓ ICP, may cause hypotension
        - **1-3 mg/kg** for induction
    - Benzodiazepines – amnesia and sedation, causes cardiopulmonary depression
        - Versed 0.1-0.4 mg/kg
    - Opiates
        - Fentanyl 2-10 mcg/kg
        - Morphine 0.1-0.2 mg/kg

Paralysis

- Succinylcholine – depolarizing, will see fasciculations
    - **1.5 mg/kg IV** **70kg adult: 100mg** **100kg adult: 150 mg**
    - 60sec to onset of action 5-7 minute duration
    - Hyperkalemia -- avoid in burns >24h, renal failure, paresis >1wk

Consider optional agents – nondepolarizing and last 30-60 min

- Rocuronium 1.5 mg/kg (50 mg vial) x 1
- Vecuronium 0.1 mg/kg (10mg) IV x 1

Placement of tube

Post-intubation management – listen to breath sounds, check $ETCO_2$, obtain CXR

Common Ventilator Modes

Volume controlled ventilation: set tidal volume (TV) delivered with each inspiration. Gas flow then stops allowing passive recoil exhalation

Pressure controlled ventilation: ventilator flows gas into patient until set peak inspiratory pressure (PIP) reached. Gas flow then stops allowing passive recoil exhalation.

Auto flow / Pressure regulated volume control (PRVC) – A target volume is set and ventilator will vary the inspiratory flow with each breath to achieve the target volume at the lowest possible peak pressure. The inspiratory time Ti limits the length of the inspiratory cycle and therefore I:E ratio.

Vent Modes:

Controlled Mechanical Ventilation (CMV): Ventilator delivers preset breath at a specific rate. Patient respiratory efforts are ignored by the ventilator, which is considerably uncomfortable for conscious patients.

Assist Control (AC): preset tidal volume or peak pressures delivered each time patient initiates a breath. Usually have minimum breath rate as backup for apneic events. Only alarms to warn of tachypnea.

Synchronized Intermittent Mandatory Ventilation (SIMV): Ventilator provides a pre-set breath (either pressure or volume limited) at a specific respiratory rate. Within the time cycle, the first patient breath delivers the preset ventilator breath. If the patient fails to initiate, the vent delivers the preset breath at the end of the cycle. Additional spontaneous breaths do not trigger an SIMV breath. SIMV is often used to wean by turning down the rate, requiring the patient to take additional spontaneous breaths.

Pressure Support Ventilation (PSV): Decreases the work of spontaneous breathing due to high resistance to airflow within the narrow airway diameter. PSV is often combined with SIMV to support additional breaths. PSV breaths are designed to cut short when the inspiratory flow reaches a % of peak inspiratory flow (10-25%).

Continuous Positive Airway Pressure (CPAP): Continuous elevated pressure provided through the airway circuit, preventing alveolar collapse at end-expiration

Airway Pressure Release Ventilation (APRV): APRV uses an elevated baseline “Pressure high” and achieves tidal ventilation by briefly releasing P High to allow CO_2 exchange through passive exhalation (to P Low). Exhalation time (T Low) is usually < 1sec to prevent complete alveolar collapse. Used for patients with difficult oxygenation. Weaning is done by decreasing P High and increasing T High (Drop and Stretch), slowly lowering the mean airway pressure.

Oxygenation goal: SpO_2 88-95% or PaO_2 55-80 mmHg

Evaluation for Extubation – decision to be made by Attending or Fellow:

All intubated patients should have weaning trial if:

$FiO_2 \leq 50\%$, PEEP ≤ 8, Vent rate ≤ 16, RR ≤ 30, pH ≥ 7.32, $SpO_2 \geq 92\%$

Spontaneous breathing trial (SBT) – performed between 0400 and 0600

- Weaning parameters to be obtained on Spontaneous mode without pressure support
- Stop SBT if HR >140, SBP changes to >180 or <90, RR > 30, $SpO_2 < 90\%$, increased anxiety
- ABG drawn at end of SBT

Pulmonary mechanics desired for intubation:

- Rapid shallow breathing index (RSBI, RR/TV) < 105

Optional / additional parameters

- Negative inspiratory force (NIF) > -20
- Vital Capacity (VC) > 15 mL/kg
- + cuff leak (Zhou T J Evid Based Med 2011;4:242-254)
- Change in RSBI during SBT < 20% (Segal LN Intensive Care Med 2010;36:487-495)

Consider: has the reason for intubation been corrected, is mental status appropriate, character and clearance of secretions

(Yang KL, Tobin MJ. "A prospective study of indexes predicting the outcome of trials of weaning from mechanical ventilation" NEJM 1991;324 (21): 1445–50)

Reintubation

Patients who fail extubation may not be salvaged by noninvasive positive-pressure ventilation. (Esteban. Noninvasive positive pressure ventilation… NEJM 2004)

Consideration of Tracheostomy

Early vs late trach (< 4 day vs 10 days):)Early showed no difference in ICU or hospital mortality in considering (TracMan, JAMA 2013;309(20):2121-9).

Tracheostomy can decrease continuous sedation needs
(Wallen T. J Trauma Acute Care Surg. 2022 Oct 1;93(4):545-551)

Procedural considerations

Where – OR vs in ICU
How – percutaneous vs open
Anticoagulation status
C-spine stabilization – collar, recent anterior fixation

Acute respiratory distress syndrome (ARDS)

Definition - A type of acute diffuse, inflammatory lung injury, leading to increased pulmonary vascular permeability, increased lung weight, and loss of aerated lung tissue.
Clinical hallmarks are hypoxemia and bilateral radiographic opacities, associated with increased venous admixture, increased physiological dead space, and decreased lung compliance. morphological hallmark of the acute phase is diffuse alveolar damage (ie, edema, inflammation, hyaline membrane, or hemorrhage). (Ware and Matthay. The acute respiratory distress syndrome. NEJM 2000;342:1334-49)

ARDS New Global Definition 2023

● new definition criteria	Classification		
	Mild	**Moderate**	**Severe**
Time to instalation	Up to seven days - known risk fator(s)		
Pulmonary edema	Not explained by cardiogenic edema or intravascular volume overload		
Radiologic features	Bilateral infiltrates on chest X-ray or CT or lung ultrasound (by a trained professional) (not explained by nodules, pleural effusion or atelectasis)		
Hypoxemia **PaO_2/FIO_2****	201-300 with NIV/CPAP PEEP ≥ 5* or HFNO > 30l/min	101 - 200 com PEEP ≥ 5	≤ 100 com PEEP ≥ 5
Hypoxemia **SpO_2/FIO_2**	≤ 315 with SpO_2 ≤ 97%		

xlung www.xlung.net

Am J Respir Crit Care Med 2023;207:A6229

Therapeutic strategies

Low tidal volume ventilation

6 mL/kg vs. 12 mL/kg associated with decreased mortality (31% vs. 40%), increased ventilator-free days and number of days without non-pulmonary organ system failures despite lower initial PaO_2:FiO_2 ratio and persistently higher RR and $PaCO_2$ in lower tidal volume group (ARDSNet NEJM 2000; 342:1301-08)

Permissive hypercapnia – secondary to low tidal volume ventilation, maintain pH > 7.2

Open lung strategy – increase PEEP to optimal level based on lower inflection point on PV curve (Briel Higher vs lower PEEP in pts with ALI and ARDS. JAMA 2010; 303:865-73)

APRV – think about initiation if FiO_2 >0.6 and SpO_2 <88% with PEEP >15 or plateau pressure > 30 cmH_2O, or mean airway pressure >24 cmH_2O (Habashi. APRV summary CCM 2005; 33:S228-40)

HFOV – OSCILLATE and OSCAR trials showed no improvement in mortality

Recruitment maneuvers – Sustained high PEEP (ex. 30 cmH_2O for seconds or 40/20 with I:E 1:1 for 2 minutes) (Fan. RMs for ALI. Am J Respir Crit Care Med 2008; 178:1156-63)

High vs Low Peep No mortality benefit/vent free days in patient with ARDS in high vs low peep keeping volume vent < 6ml/kg and plataue pressure <= 30 cm H2O. (ALEVOLI 2004)

Fluid management – conservative fluid management is superior to a liberal strategy (ARDSNet. Comparison of two fluid management strategies in ALI. NEJM 2006; 354:2564-75)

Neuromuscular blockade – improves survival and increased time off of ventilator for severe ARDS (ACURASYS Study. NMBs in early ARDS. NEJM 2010; 363:107-16)

(ROSE. Early NM blockade with high peep vs high peep and light sedation – no mortality benefit. NEJM 2019)

Prone positioning – improves V/Q mismatch, oxygenation, and survival (PROSEVA Study. Prone positioning in severe ARDS. NEJM 2013; 368:2159-68)

NO – inhaled pulmonary vasodilator to reduce pulmonary vascular resistance, improves oxygenation short-term but does not affect mortality (Adhikari et al. Effect of nitric oxide on oxygenation and mortality in ALI: systematic review and meta-analysis. BMJ 2007;334:779)

Steroids – controversial, RCTs support both opinions to use steroids or not (ARDSNet. Efficacy and safety of corticosteroids for persistent ARDS. NEJM 2006;354:1671-84) and (Meduri et al. Methylprednisolone infusion in early ARDS. Chest 2007;131:954-63). Surgical patients may have additional wound/anastomotic healing issues which need to be taken into consideration before initiating steroids

DEXA-ARDS (Lancet Respiratory Medicine. 2020;8(3)267-276) 20mg once daily IV from day 1 to day 5, 10mg once daily IV from day 6 to day 10, treatment continued until day 10 or until extubated if before day 10

Extra Corporeal Membranous Oxygenation (ECMO)

Consider in cases of reversible injury that prevents adequate oxygenation of blood by lungs, despite maximization of ventilator modes.

- Evaluate lungs with Murray Lung Injury Score
- Contraindicated with CNS injury, major burn, advanced liver failure, uncontrolled bleeding, and severe pulmonary disease on ventilator > 10 days.
- If considering, place IJ & Femoral CVC for access for cannulas

(CESAR trial. Lancet 2009; 374:1351-63)

Chronic Obstructive Pulmonary Disease (COPD)

In exacerbation, consider non invasive ventilatory strategies to decrease need for ET intubation, reduce intubation, length of hospital stay, in-hospital mortality (Brochard et al. NEJM 1995)

Systemic steroid therapy improves clinical outcomes hospitalized with COPD exacerbation (Niewoehner. NEJM 1999)

Hypoxemia Algorithm

1: Basic Lung Protective Ventilation Strategy

- Maintain patient triggering the ventilator
- V_T = 6-8 ml/kg Pplat < 30 cm H_2O
- Idealized body weight
- Men – 50 + 2.3 (Ht inches -60)
- Women = 45.5 + 2.3 (Ht inches -60)
- Follow PEEP/FIO2 table ALVEOLI Trial (Min 5 cm)
- PaO2 goal > 60 mm Hg SpO2 > 92%
- Perform PV curve to determine Best PEEP - requires chemical paralysis
- Adaptive pressure ventilation (Autoflow, etc) monitor tidal volume to prevent excess V_T
- A/C or SIMV pH goal > 7.25, $PaCO_2$ goal < 65 mm Hg

2: Asynchrony, Step 1

- Breath type: Use PC or Adaptive pressure breath
- Modes: consider use of PSV, PAV or NAVA (spontaneous breathing)
- Evaluate for auto-PEEP
- Pharmacologic interventions – sedation, neuromuscular blockade
- Change rise time, insp flow/time to meet patient demand

3: Asynchrony Step 2

- Increase VT 1 mL/kg (max 8 mL/kg), provided Pplat ≤28-30 cm H2O
- Consider placing Pes catheter for transpulmonary pressure PTP at end expiration should be > 2 cm H_2O

Refractory Hypoxemia Definition

- <24hrs PaO_2 < 55mHg (SpO_2 < 88%), FiO_2 >0.8, PEEP >20cm H_2O
- 24-72 hrs PaO_2 < 55mHg (SpO_2 < 88%), FiO_2 >0.7, PEEP >14cm H_2O

4: Recruitment Maneuvers

Indicated if: Acute oxygen desaturation on FiO_2 > 0.6

- Set Pmax to 15 cm > PEEP; Increase PEEP in 5 cm H2O increments every 30 seconds
- Abort if hypotension occurs or agitation

5: Pressure control, inverse ratio ventilation (PCIRV)

- Lengthen inspiratory time to increase Paw
- Avoid auto-PEEP – Monitor WOB and hemodynamic response

6: Airway pressure release ventilation (APRV)

- Patient should not be paralyzed
- Set P_{HIGH} to match current mean airway pressure with P_{LOW} = 0 cmH_2O
- Set T_{HIGH} and T_{LOW}, adjust T_{HIGH} to optimize ventilation, goal to bring FiO_2 to 0.5
- Wean by dropping P_{HIGH} 2-5 cmH_2O to 16-20 and stretching T_{HIGH} by 0.5 to 12-15 sec, then CPAP only (Habashi)

7: Consider paralytic trial – rocuronium or vecuronium, if success start Nimbex (cisatracurium) drip

8: Inhaled nitric oxide

- Inhaled nitric oxide (0-40ppm) – assure adequate lung recruitment
- P/F increase with nitric oxide for one hour - if success (P/F improvement of > 20%), consider continuation

9: Prone Position

Indicated if:

- P/F < 150, FIO2 > 0.6, Compliance < 30 mL/cm H2O, PEEP > 12 cm
- Prone goal 18 hrs/day for 48 hrs
- P/F improvement of > 20% = success; initial trial with pillows only

8: ECMO

- **Oxygenation index** = (FiO_2 x mean airway pressure x 100)/PaO_2
- Consider consult for VV ECMO if respiratory failure < 10 days
- Adult 18-65 yo with weight <125kg or BMI≤35
- Uncompensated hypercarbia with pH <7.20
- SOFA score ≤ 12
- Pplat >30cmH_2O for < 7days, High FiO_2 (>0.8) < 7 days
- Life expectancy > 5 years, lack of chronic disease contributing to morbidity
- Contraindications: established MOSF, cannot anticoagulate or receive blood products

UCMC Surgical Intensive Care Unit Proning Protocol for ARDS

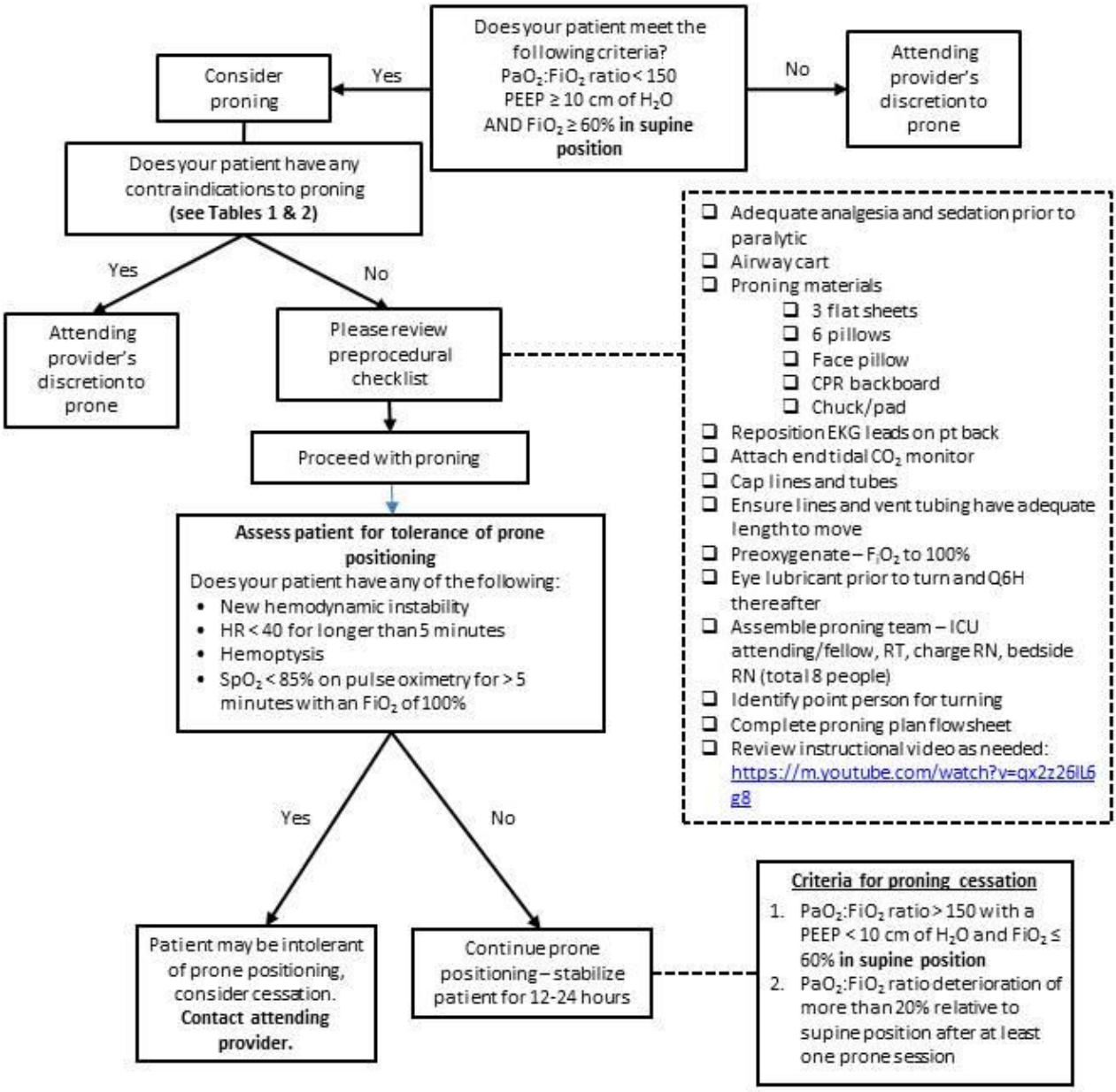


Table 1. Relative Contraindications for Manual Proning
Traumatic brain injury with potential for elevated ICP
Cervical spine collar
Cervical kyphosis or other spine limitations
Unstable spine (requires spinal clearance from appropriate service)
Sternotomy in past 15 days
External device which preclude proning (e.g., external fixation; traction)
Open abdomen*
Unstable facial fractures*

Evaluate on a case-by-case basis by attending physician

Table 2. Relative Contraindications for RotoProne© Bed
Traumatic brain injury with potential for elevated ICP
Body weight > 350 lbs
Sternotomy in past 15 days
External device which preclude proning (e.g., external fixation; traction)
Unstable facial fractures*
Open abdomen*

Evaluate on a case-by-case basis by attending physician

Version 2.2; 5/23/2017

SICU Manual Proning Step-By-Step

1. Watch video at https://www.youtube.com/watch?v=qx2z26IL6g8
2. Turn pt, place flat sheet under pt. Move ECG leads from front to back, removing all ECG stickers from front.
3. Place Mepilex on face, knees, shins and tops of feet.
4. RT at HOB. 3 staff members on each side of pt.
5. A small back board (obtain from Educator's office) is then placed between the bed frame and the mattress. The face pillow will be placed on it at a later point.
6. Tuck pt hands under buttocks on both sides.
7. Place flat sheet on top of pt from top of shoulders to feet.
8. Place 2 pillows on chest, 2 pillows on hips and 2 pillows on shins.
9. Place flat sheet on top of pillows from top of shoulders to feet.
10. Taking all 3 flat sheets, staff on the ventilator side tightly roll the sheets together under (so the roll is going underneath). The staff on the opposite side of the ventilator tightly roll the sheets together upwards (so the roll is going up).
11. Utilizing the rolled sheets, on the count of the RT, move the patient up in the bed so their head is hovering off the head of the bed (RT will support the head and hold the tube).
12. Utilizing the rolled sheets, on the count of the RT, move the patient to a side-lying position toward the ventilator.
13. At this point, the roll underneath the patient will be handed off from one side's staff member to their opposite counterpart. Before moving to the next step, ensure the staff members on the opposite side of the ventilator have a firm grasp on the roll underneath the patient with both hands and the staff on the side of the ventilator have the roll on top of the patient with both hands.
14. On the count of the RT, the patient is proned. The staff members will pull whichever roll they have, toward them.
15. Remove the top sheet to see if the patient is centered on the pillows. If an adjustment needs to be made, all 6 staff members take the sheet closest to the patient and lift patient up as someone else adjusts the pillows underneath the patient (the sheet on top of the pillows).
16. The anesthesia face pillow (in the equip room) is then placed on top of the back board at the head of the bed. If the height is not adequate, it can be built up by placing a couple blankets below the pillow. See pictures below.
17. RT will then position the patients head/face into the face pillow. The patient might need to be boosted again to get their head/face in the right position. To boost, always take the bottom flat sheet (the sheet under the pillows).
18. The patient's arms should be positioned to the swimmers position and alternated every two hours.
19. The bed can then be put into reverse Trendelenburg.

Table 1. Summary of Ventilator Procedures in the Lower- and Higher-PEEP Groups.*

Procedure	Value													
Ventilator mode	Volume assist/control													
Tidal-volume goal	6 ml/kg of predicted body weight													
Plateau-pressure goal	≤30 cm of water													
Ventilator rate and pH goal	6–35, adjusted to achieve arterial pH ≥7.30 if possible													
Inspiration:expiration time	1:1–1:3													
Oxygenation goal														
PaO_2	55–80 mm Hg													
SpO_2	88–95%													
Weaning	Weaning attempted by means of pressure support when level of arterial oxygenation acceptable with PEEP ≤8 cm of water and FiO_2 ≤0.40													
Allowable combinations of PEEP and FiO_2†														
Lower-PEEP group														
FiO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	5	5	8	8	10	10	10	12	14	14	14	16	18	18–24
Higher-PEEP group (before protocol changed to use higher levels of PEEP)														
FiO_2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5–0.8	0.8	0.9	1.0	
PEEP	5	8	10	12	14	14	16	16	18	20	22	22	22–24	
Higher-PEEP group (after protocol changed to use higher levels of PEEP)														
FiO_2	0.3	0.3	0.4	0.4	0.5	0.5	0.5–0.8	0.8	0.9	1.0				
PEEP	12	14	14	16	16	18	20	22	22	22–24				

ARDSNet Higher versus lower positive-end-expiratory pressures in patients with the acute respiratory distress syndrome. NEJM 351(4); 2004: 327-335

***Murray Score=Average Score of All Four Parameters**

(Score>3=Predicted mortality at least 80%)

Parameter-Score	0	1	2	3	4
PaO2/FiO2 (on 100%)	≥40kPA 300mmHg	30-40kPA 225-299mmHg	23-30kPA 175-224mmHg	13-23kPA 100-174mmHg	<13kPA <100mmHg
CXR quadrants	Normal	1	2	3	4
PEEP (cmH2O)	≤5	6-8	9-11	12-14	≥15
Compliance (ml/cmH2O)	≥80	60-79	40-59	20-39	≤19

Source: Murray JF. Am Rev Respir Dis 1988 Sep; 138(3):720-3

Attachment #1: ARDS / Oxygenation: Adult Nitric Oxide Eligibility and Response Assessment Form

Patient Name _____ DOB _____
Medical Record Number: _____
Location: _____
Ordering Physician: _____
ICU Attending Physician Approval: (YES___ / Name_____) (NO___*DO NOT PROCEED*)

Pa02____ FiO2____ PaO2 / FiO2____ PCWP____ PA Mean ____ CVP____

Step 1: "Maximal Conventional Therapy" approaches performed / attempted:

A. Oxygen Maximized to 100% FiO2 on Mechanical Ventilation? YES o NO o
B. PEEP increased to ≥ 15 cmH2O? YES o NO o
CONTRAINDICATED DUE TO: **Decrease in Blood Pressure** o
Decrease in Cardiac Output o
OTHER:_____ o
C. Patient Prone Positioning Attempted? YES o NO o
CONTRAINDICATED DUE TO: **Head Injury (ICP)** o
Multiple Chest Tubes / Drains o
Open Abdominal / Thoracic Wounds o
OTHER:_____ o

If YES / CONTRAINDICATED was answered to ALL of the above, proceed with the following:

Criteria for ARDS/Oxygenation Nitric Oxide use:

D. Is the PaO2 / FiO2 ≤ 100? YES o NO o
E. Is the PWCP ≤ 18? YES o NO o No Measurement Available o

If YES / No Measurement Available were answered to ALL of the above, proceed to STEP 2:
If NO was answered to any, proceed with the following:

F. The RCP contacted the Attending Physician to confirm order for off- criteria Nitric Oxide use? YES o NO o
G. Attending Physician confirms order for Nitric Oxide off-criteria use? YES o NO o
H. Medical Director of individual ICU and Medical Director of Respiratory Care [Mitchell Rashkin, M.D. (513- 558-4410)] informed of off-criteria use for review within 24 hours? YES o NO o

If NO was answered to ANY of the above, DO NOT PROCEED with Nitric Oxide Setup!
If YES was answered to ALL of the above, proceed to STEP 2

Step 2: RCP Checklist for Starting Nitric Oxide (N.O.)/Documentation:

A. Obtain ABG and document Methemoglobin level (baseline) before starting Nitric Oxide? YES o NO o

B. Start Nitric Oxide at 20 PPM for ARDS / Oxygenation
C. RCP called Mike (584-7738) and Cyndi (584-3007) to communicate patient name, location, mr# and N.O. start date & time. YES o NO o
1. Document N.O. Cylinder Serial Number:_____ ___ YES o NO o (Tank #1)
2. Document Start Date:_____ Time:_____ (enter 0 if new tank). YES o NO o (Go to step B)
3. If more than one N.O. Cylinders used (Tank #1), document N.O. Cylinder #2 Serial Number: _____ YES o NO o (Tank #2)
4. Document Start Date:_____ Time:_____ (enter 0 if new tank). YES o NO o (Go to step B)
5. If more than two N.O. Cylinders used (Tank #2), document N.O. Cylinder #3 Serial Number: _____ YES o NO o (Tank #3)
6. Document Start Date:_____ Time:_____ (enter 0 if new tank). YES o NO o (Go to step B)

D. **If YES was answered to ALL of the above, go to Step 3.**
E. **If NO was answered to ANY of the above, complete information before proceeding!**

Step 3: Response Criteria One Hour post Nitric Oxide Setup

A. **Adult Response:** One hour after Nitric Oxide start Time (Step 2: C, #2), RCP checks for patient response to therapy:

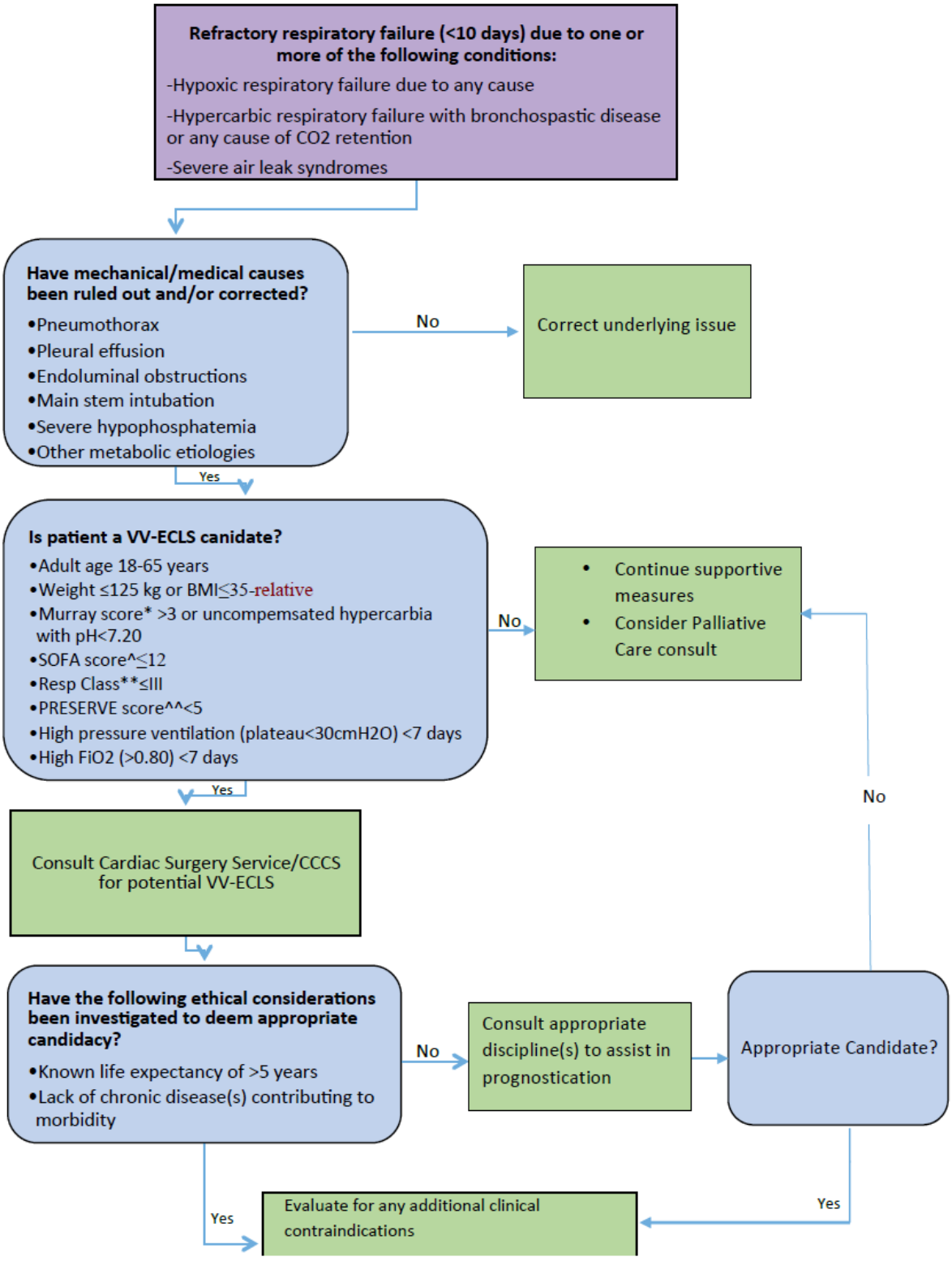
1. For ARDS / Oxygenation:

a. RCP obtains ABG (PaO2) one hour after Nitric Oxide start Time.
PaO2 (One hour after Nitric Setup) _____mmHg.
b. RCP calculates Minimal Response PaO2 (MRP) to continue therapy.
PaO2 (Initial) _____ mmHg * 1.2 = _____ (MRP).
c. Is the PaO2 value in 1.a. (One hour after) ≥ PaO2 MPR value in 1.b. (Minimum Response PaO2)? YES o NO o
d. RCP documents Methemoglobin level 1 hour after Nitric Oxide start time. YES o NO o
e. **If YES was answered to ALL of the above, go to Step 4:**
f. **If NO was answered to ANY of the above, notify Attending Physician and go to Step 5.**

Step 4: Daily Weaning Criteria/ Documentation:

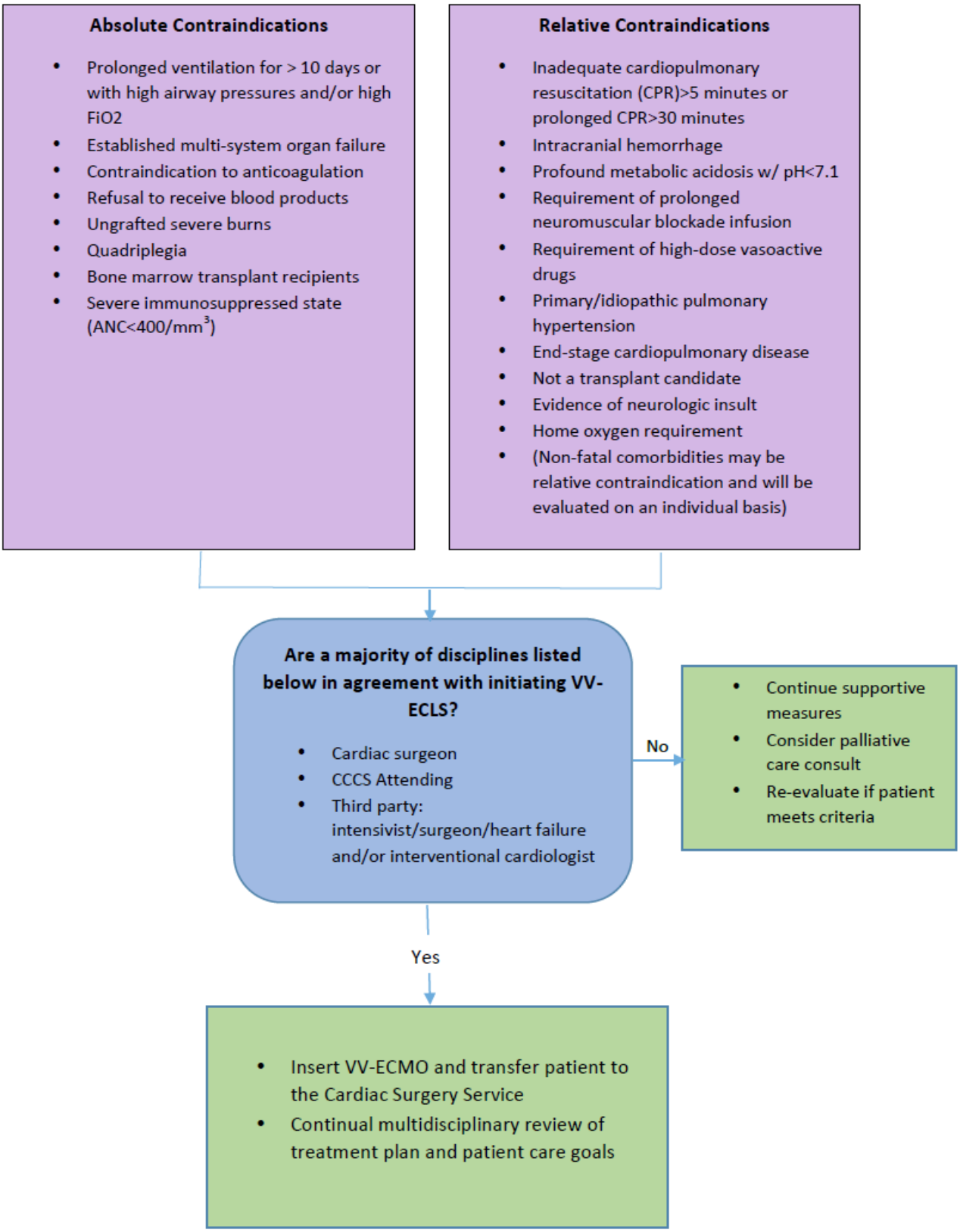
A. Adult ARDS/ Oxygenation Daily Weaning Criteria (if NO, document why on chart 1).
1. After four hours of Nitric Oxide start time with patient set FiO2 at 100%, obtain baseline ABG.
a. If SaO2 ≥ 90% with FiO2 at 100%, RCP attempted to wean N.O. from 20 to10 PPM? YES o NO o
b. After 4 hours on Nitric Oxide at 10 PPM at FiO2 at 100%, RCP attempted to wean N.O. form 10 to 5 PPM? YES o NO o
c. After 4 hours with FiO2 at 100%, RCP obtains ABG. If SaO2 ≥ 90, RCP attempts to wean FiO2 to 70% as tolerated, maintaining SpO2 ≥ 90%. YES o NO o
d. After N.O. weaned to 5 PPM and FiO2 ≤ 70%, daily weaning trials begin the following A.M. per protocol (Step 4, A.#2) YES o NO o
2. RCP performs daily weaning trial of Nitric Oxide as stated below and documents in chart #1 (document in chart below each daily trial?). YES o NO o
a. At 5 PPM and FiO2 ≤ 70%, wean N.O. by 1 PPM every 30 minutes. You may increase the FiO2 10% in order to maintain SpO2 ≥ 90%.
b. Discontinue N.O. if PaO2 remains stable, KEEP NITRIC OFF and go to **Step 5.**
c. If unable to discontinue N.O., **repeat Step 4, as applicable.** If patient is on Nitric Oxide > 48 hours and FiO2 remains above 70%, contact the Attending Physician to determine course of action.
d. Attempt to wean each day between 0400 to 0900.

UC Health-UCMC Adult Respiratory Failure ECMO Selection Guidelines



Murray Score – Murray JF Am Rev Respir Dis 1988 Sep;138(3):720-723 (see above, page 11)
RESP score – Schmidt M. Am J Respir Crit Care Med 2014 June;189(11):1374-1382
PRESERVE score – Schmidt M. Intensive Care Med 2013 Aug; 39:1704-1713

Algorothm 2. Evaluating Contraindications and Making Treatment Decisions



Management of Cardiac Dysrhythmia / ACLS

Obtain 12 lead EKG, continuous monitoring, cardiac enzymes, electrolytes

Bradycardia: HR < 60 bpm

- Asymptomatic: observe, continuous monitor, review meds and medical history
- Symptomatic: continuous monitors, O2, review meds and medical history
    - Prepare transcutaneous pacing
        - If 2nd degree type II or 3rd degree heart block – use immediately
    - Atropine 0.5 mg IV push
        - Can repeat to total of 3mg
        - NOT for 2nd degree type II or 3rd degree heart block
    - Epinephrine 2-10 mcg/min infusion
        - or Dopamine 2-10 mcg/kg/min infusion
    - Prepare for transvenous pacing

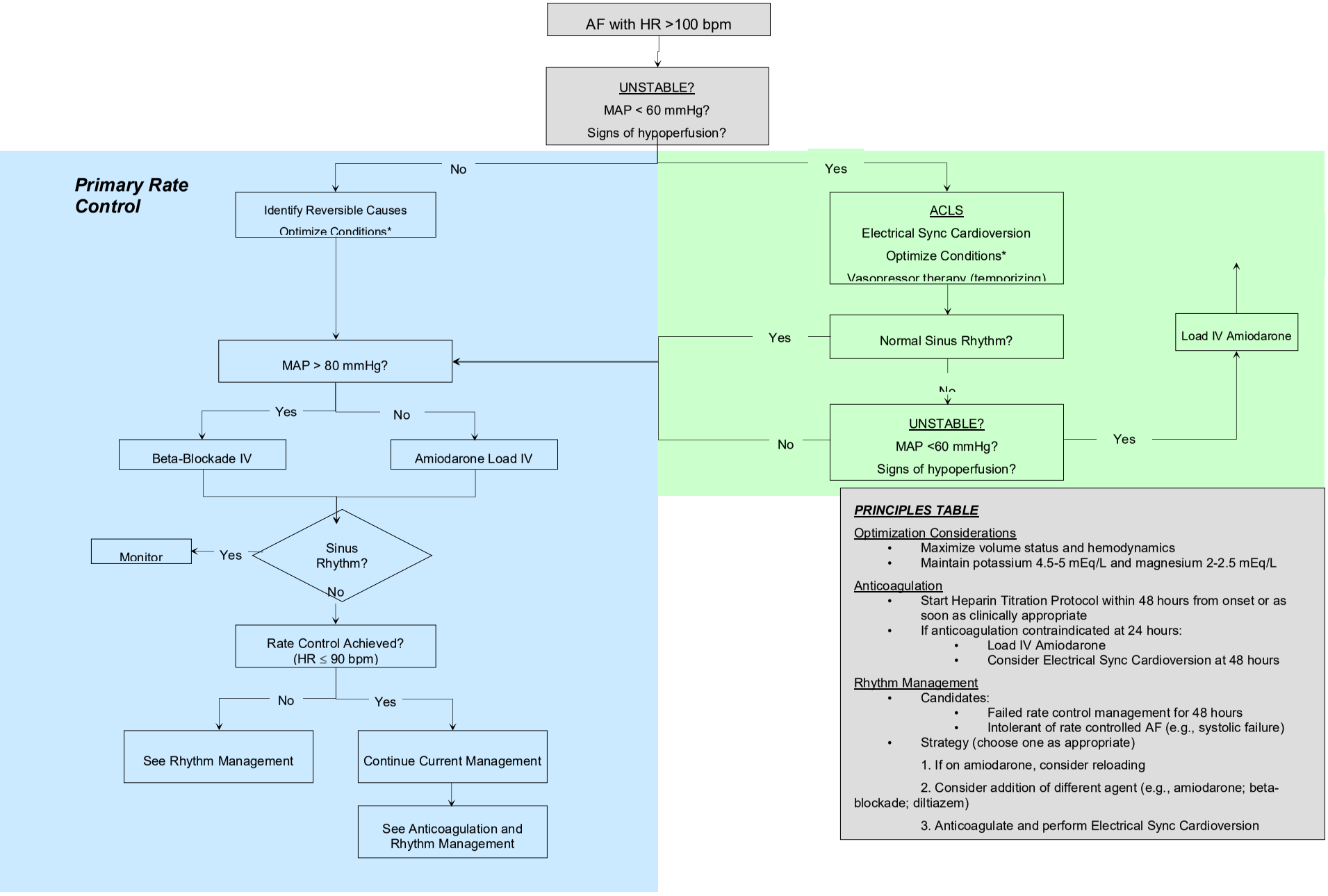
Pulseless Arrest

- Continuous monitoring, O2, Intubate if needed, place Pacer pads on chest
- PEA / Asystole (non-shockable)
    - Epinephrine 1 mg IV, q 3-5min
    - CPR: 5 cycles (~ 2 min), Reevaluate rhythm
- "Shockable": Vfib / Pulseless Vtach / torsades
    - Shock: Monopolar 360volts
    - Resume CPR x5 cycles (~2min), Reevaluate rhythm
    - Shock + Epinephrine 1mg IV q3-5 min
    - CPR
    - Shock + anti-arrhythmic
        - Amiodarone 300mg IV, can repeat 150 mg in 3-5min
        - Lidocaine 1-1.5mg/kg, can repeat 0.5-0.75mg/kg, max 3mg/kg
        - Magnesium 1-2gms IV

Tachycardia: A-fib, A-flutter, re-entry SVT, mono/poly VT, wide complex VT

- O2, establish IV, continuous monitoring, O2
- **Unstable**: Synchronized cardioversion
  - Sedate if conscious
  - A-fib or A-flutter: start synchronized 200/300/360 volts
  - Monomorphic VTach (with pulse): monopolar 100/200/300/360
- **Stable**: Obtain 12 lead EKG
  - Narrow complex: (QRS ≤ 0.12)
    - Regular rhythm
      - Vagal maneuvers
      - Adenosine 6mg IV push
        - Repeat at 12mg IV, may repeat once more
        - Converted
          - Watch, consider Beta blockers or Diltiazem
        - Not Converted – (Afib or A flutter)
          - Rate control with Beta blocker or Amiodarone
    - Irregular rhythm (Afib, or A flutter, Multifocal A tach)
      - Rate control with Beta blocker, Amiodarone, or Diltiazem
  - Wide complex (QRS ≥ 0.12)
    - Regular rhythm
      - SVT
        - Adenosine 6mg IV push
      - VT
        - Amiodarone 150 mg over10 min, repeat x1
        - Elective synchronized cardioversion
    - Irregular rhythm
      - A-fib, rate controlled
        - Beta blocker, Amiodarone, or Diltiazem
      - AF + WPW
        - Avoid Adenosine, digoxin, diltiazem
        - Amiodarone 150 mg over 10 min
      - Torsades
        - Magnesium 1-2gms

Protocol for the Management of Postoperative and Posttraumatic Atrial Fibrillation (AF)



PRINCIPLES TABLE

Optimization Considerations
- Maximize volume status and hemodynamics
- Maintain potassium 4.5-5 mEq/L and magnesium 2-2.5 mEq/L

Anticoagulation
- Start Heparin Titration Protocol within 48 hours from onset or as soon as clinically appropriate
- If anticoagulation contraindicated at 24 hours:
  - Load IV Amiodarone
  - Consider Electrical Sync Cardioversion at 48 hours

Rhythm Management
- Candidates:
  - Failed rate control management for 48 hours
  - Intolerant of rate controlled AF (e.g., systolic failure)
- Strategy (choose one as appropriate)

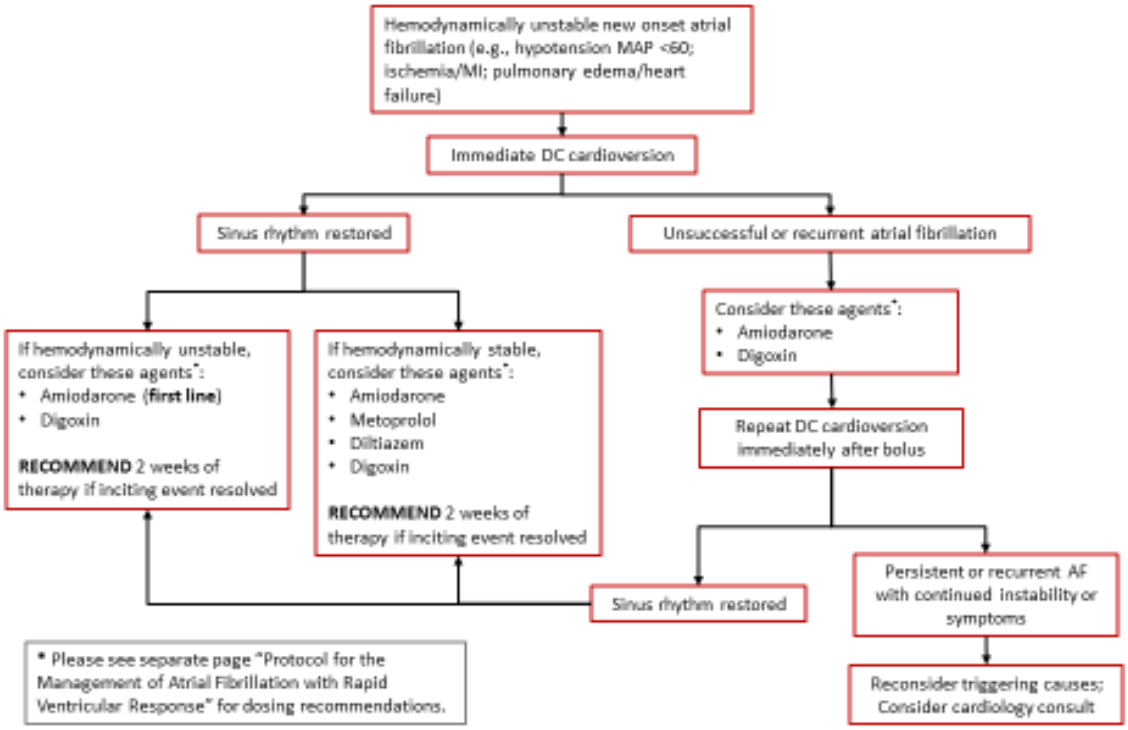
1. If on amiodarone, consider reloading

2. Consider addition of different agent (e.g., amiodarone; beta-blockade; diltiazem)

3. Anticoagulate and perform Electrical Sync Cardioversion

New Onset Atrial Fibrillation Protocol

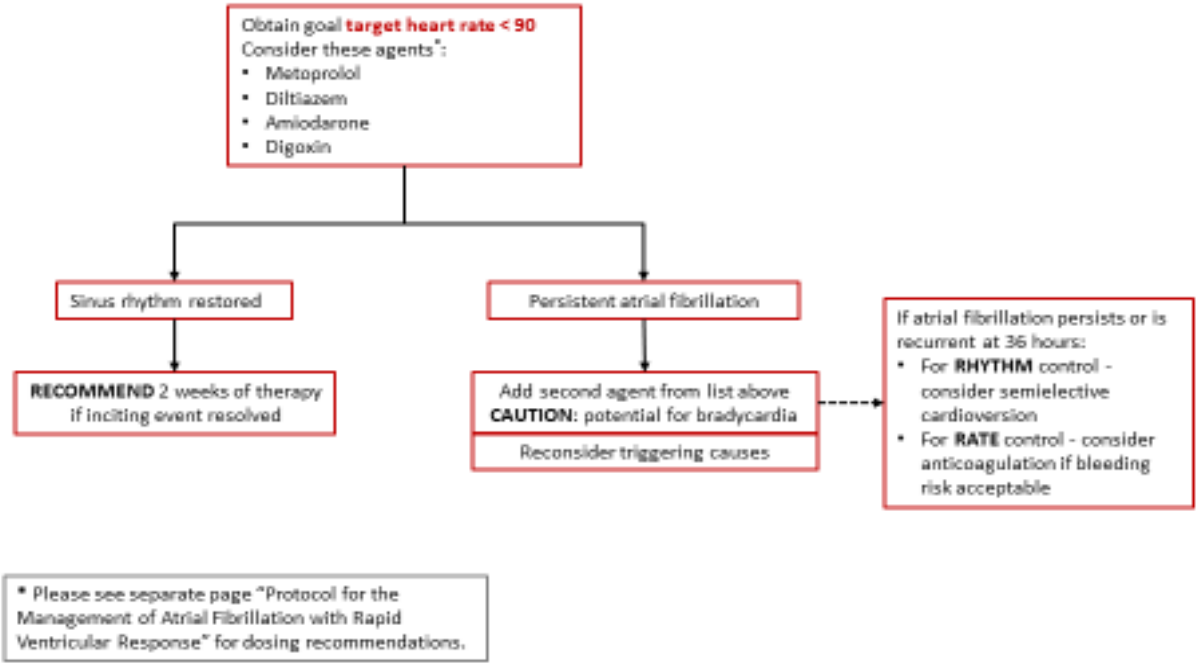
Hemodynamically unstable for less than 48 hours



New Onset Atrial Fibrillation Protocol

Hemodynamically stable for less than 48 hours

In the surgical patient with inciting event, the goal should be rhythm conversion rather than rate control



University of Cincinnati Medical Center—Surgical Intensive Care Unit

Protocol for the Management of Atrial Fibrillation with Rapid Ventricular Response

Metoprolol
- *Not for patients with low or marginal blood pressure*
- IVP 5-10 mg (always start with 5) Q15min up to 3 times
- Schedule IV or PO to maintain rate or rhythm control (IV:PO is ~1:5 [for 24 hours dose] given in divided doses Q8H or Q12H)

Diltiazem
- *Not for patients with LVEF <50% or decompensated heart failure*
- Bolus 5-15 mg over 2 minutes then gtt at 5-15 mg/hr
- Convert to PO (IV:PO is ~1:1 [for 24 hour dose] given in divided doses Q6h)—stop gtt after 3rd PO dose

Amiodarone
- Bolus 150 mg over 10 minutes then gtt at 1 mg/min
- Consider additional bolus if remain AF with RVR after ~30 minutes
- After 24 hours of gtt: initiate 400 mg PO BID x 1 week, then 400 mg PO daily x 1 week —stop gtt a two hours after first PO dose

Digoxin†
- *Consider in patients with known LV dysfunction or HF*
- *Will not have as rapid of affect as other agents*
- For patients >70 KG and Cr_{Cl} > 50 mL/min: load with 500 mcg IV/PO x 1, followed by 250 mcg IV/PO Q2H x 2 doses (carefully assess clinical response before each additional load bolus), followed by 125 – 250 mcg IV/PO daily.

† For patients < 70 KG and/or Cr_{Cl} < 50 mL/min: please consult pharmacy for dosing recommendations.

PRINCIPLES

Optimization of Clinical Status
- Optimize volume status and hemodynamics
  - May benefit from diuresis
  - May benefit from temporary use of vasopressors while rate and/or rhythm being managed
- Maintain potassium 4.5-5 mEq/L and magnesium 2-2.5 mEq/L

Anticoagulation
- Consider Heparin Protocol at 36 hours from onset (if not converted to normal sinus rhythm)
- If anticoagulation contraindicated, consider electrical cardioversion within 48 hours

DC Cardioversion
- Synchronized: 100-200J, increase energy with subsequent shocks if needed
- Unsynchronized only if defibrillator unable to sync—200J

Bolus IV amiodarone with first shock then initiate a drip

References

AHA/ACC/HRS Guideline for the Management of Patients with Atrial Fibrillation. JACC. 2014;64:e1-76.

Van Gelder I et al. Lenient versus strict rate control in patients with atrial fibrillation. NEJM. 2010;362:1363-73.

AHA. Management of bradycardia and tachyarrhythmias. Circulation. 2005;112:IV-67-IV-77.

AHA. ACLS Electrical Therapies. Circulation. 2005;112:IV-35-IV-46.

Updated 9/2016

$CHADS_2$ Scoring System

Risk Factor	Score
Congestive heart failure (LV dysfunction)	1
Hypertension	1
Age ≥75	1
Diabetes mellitus	1
Stroke, TIA, thromboembolism	2
Range	**0-6**

N.B: Applies to paroxysmal AF (PAF), as well.
Gage, et al. JAMA 2001; 285(22): 2864-70.

CHA_2DS_2-VASc Scoring System

Risk Factor	Score
Congestive heart failure (LV dysfunction)	1
Hypertension	1
Age ≥75	2
Diabetes mellitus	1
Stroke, TIA, thromboembolism	2
Vascular disease	1
Age 65-74	1
Sex category (i.e. female sex)	1
Maximum score	**9**

Note: Maximum score is 9 since age may contribute 0, 1 or 2 points.
Eur Heart J. 2010 Oct;31(19):2369-429. Epub 2010 Aug 29.

AT9 Stroke Prevention Guidelines

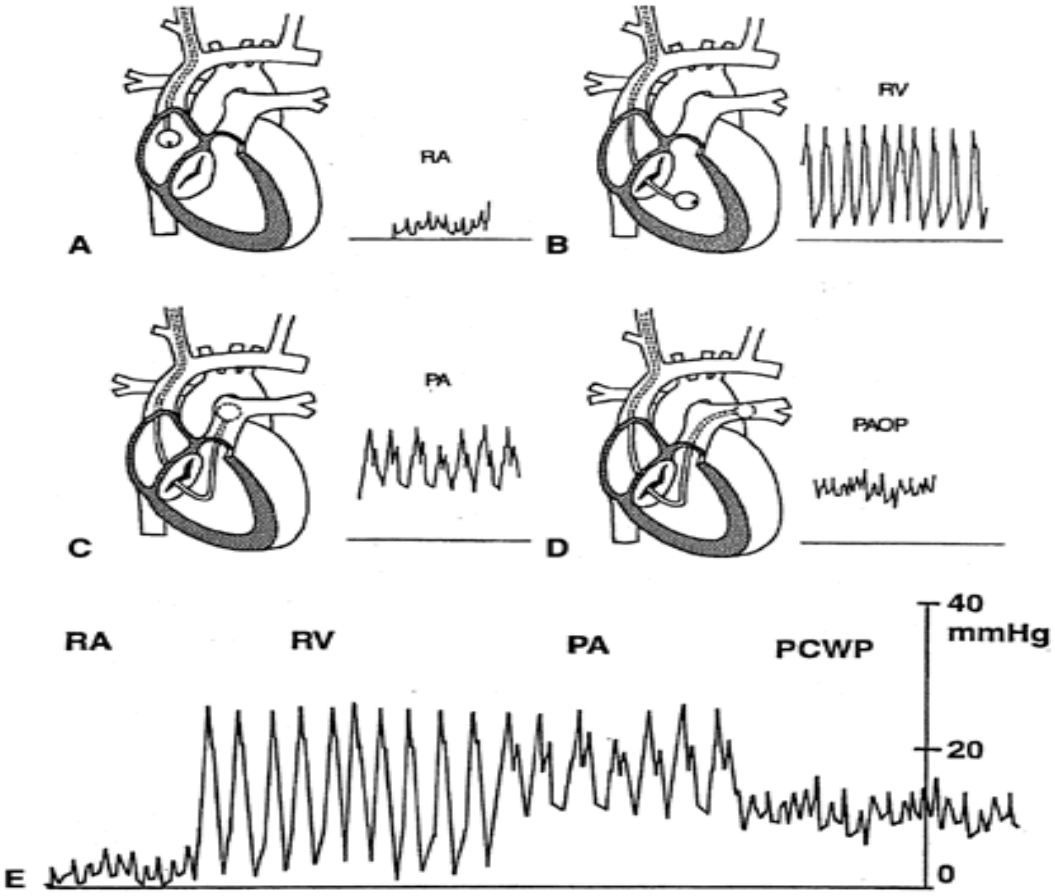
Clinical Profile (Applies to PAF, as well)	Treatment Recommendation
$CHADS_2$ ≥2	OAC, Warfarin, INR 2-3, vs no Rx: 1A OAC > (C+A) > ASA: 1B
1 non-stroke/TIA RF: $CHADS_2$ = 1	OAC, Warfarin, INR 2-3: 2B
0 RF: $CHADS_2$ = 0	No AT Rx: 2B

Other RFs to consider: age 65-74, female; renal dysfunction, e.g., eGFR <60
ACCP 9 (Chest 2012; 141(2)(Suppl):e531S -e575S).

Swan-Ganz Pulmonary Artery (PA) Catheter

- Attending should be involved in decision to place the catheter.
- Nurse should be aware of planned procedure, and an experienced person (respiratory therapist) available to assist in Catheter insertion
- Must first place a 9 Fr Cordis into either Subclavian or Internal Jugular. Preferably the LSC or RIJ

Tracing as catheter placed through heart



Normal values of Swan Ganz

Cardiovascular Parameter	Abbreviation	Normal Range
Central Venous Pressure	CVP	1 – 6 mmHg
Pulmonary Capillary Wedge Pressure	PCWP	6 – 12 mmHg
Cardiac Index	CI	2.4 – 4 L/min/m^2
Stroke Volume Index	SVI	40 – 70 mL/beat/m^2
LV Stroke Work Index	LV SWI	40 – 60 g x m/m^2
Right Ventricle (RV)		
Stroke Work Index	RV SWI	4 – 8 g x m/m^2
Ejection Fraction	RV EF	46 – 50 %
End-Diastolic Volume	RV EDV	80 – 150 mL/ m^2
Systemic Vascular Resistance Index	SVRI	1,600 – 2,400 dynes x sec^1 x cm^5/ m^2
Pulmonary Vascular Resistance Index	PVRI	200 – 400 dynes x sec^1 x cm^5/ m^2
End Diastolic Volume Index	EDVI	90-120

Massive Transfusion Protocol (MTP)

Emergency Department blood products

2 units O- PRBCs, 2 units O+ PRBCs, and 2 units of thawed plasma are available in the ED blood refrigerator for immediate use

2 units low titer O+ whole blood available in ED blood refrigerator for use in **trauma patients**

Massive transfusion protocol

Attending trauma surgeon, Attending anesthesiologist, Senior trauma resident may activate

Notify Blood Bank **584-7888**

Initial cooler for MTP contains:

- 6 units PRBC
- 6 units FFP
- 5 units pooled (1 dose) platelets should arrive with odd numbered coolers
- 10 units (1 dose) cryoprecipitate is available by request

- 6 units whole blood available **by direct request** for use in **trauma patients**

Massive transfusion trigger points

UC Trigger Points

- Temp < 97.5°F
- HR > 110
- SBP < 90 (or <100 for age >55)
- Base deficit < -6
- INR > 1.5
- Hgb < 11

Schreiber M, Perkins J, Kiraly L, Underwood S, Wade C, Holcomb JB. Early predictors of massive transfusion in combat casualties. J Am Coll Surg. 2007;205:541–545

McLaughlin DF, Niles SE, Salinas J, Perkins JG, Cox ED, Wade CE, Holcomb JB. A predictive model for massive transfusion in combat casualty patients. J Trauma. 2008;64:S57–63

Larson CR, White CE, Spinella PC, Jones JA, Holcomb JB, Blackbourne LH, Wade CE. Association of shock, coagulopathy, and initial vital signs with massive transfusion in combat casualties. J Trauma. 2010;69(Suppl 1):S26–32

Assessment of Blood Consumption (ABC) score

1 point for each component, ≥ 2 consider MTP

- SBP < 90mmHg
- HR > 120 bpm
- Penetrating mechanism of injury
- FAST exam positive

Nunez TC, Voskresensky IV, Dossett LA, Shinall R, Dutton WD, Cotton BA. Early prediction of massive transfusion in trauma: simple as ABC (assessment of blood consumption)? J Trauma. 2009 Feb;66(2):346-52.

Trauma Associated Severe Hemorrhage (TASH) score

Variables	Variable	Points	Score
	<7	8	
	<9	6	
Hemoglobin (mg/dl)	<10	4	
	<11	3	
	<12	2	
	<-10	4	
Base excess (mmol/L)	<-6	3	
	<-2	1	
Sytolic blood pressure (mmHg)	<100 <120	4 1	
Heart rate (beats/min)	>120	2	
Free intraabdominal fluid (e.g.by FAST)		3	
Clinically instable pelvic fracture		6	
Open or dislocated femur fracture		3	
Male gender		1	
TASH $_{\text{(sum of score points)}}$=			

Probability for mass transfusion	
TASH	P
1-8	<5%
9	6%
10	8%
11	11%
12	14%
13	18%
14	23%
15	29%
16	35%
17	43%
18	50%
19	57%
20	65%
21	71%
22	77%
23	82%
24+	>85%

Yücel N, Lefering R, Maegele M, Vorweg M, Tjardes T, Ruchholtz S, Neugebauer EA, Wappler F, Bouillon B, Rixen D, Polytrauma Study Group of the German Trauma Society. Trauma Associated Severe Hemorrhage (TASH)-Score: probability of mass transfusion as surrogate for life threatening hemorrhage after multiple trauma. J Trauma. 2006 Jun; 60(6):1228-36

MTP Trials

PROMMTT – J Trauma Acute Care Surg. 2013 Jul;75(1 Suppl 1)

Plasma transfusion early in resuscitation is associated with decreased mortality

PROPPR – JAMA. 2015 Feb 3;313(5):471-82.

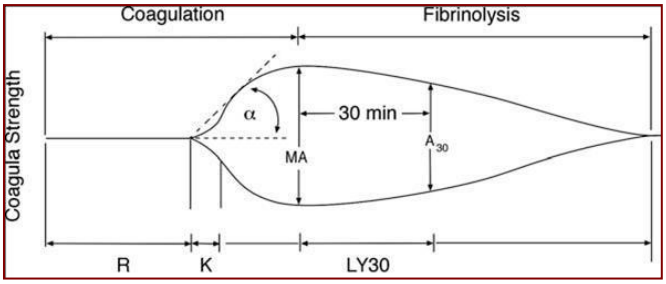
Randomized 1:1:1 vs. 1:1:2, showed decreased exsanguination at 3 hrs in 1:1:1 group

TRICC/TRISS/Villanueva 2013

Multiple trials, in multiple settings, show a restrictive transfusion goal of 7 is safe for patients, and may even provide mortality/side effect benefit

Thrombelastography (TEG)

- A viscoelastic test of coagulopathy that graphs the speed and strength of blood clot formation and reflects coagulation factors, platelet function, and fibrinolysis.
- Access results real-time in the TEG icon in EPIC



R time:

- Time between start of the assay and initial clot formation representing clotting factors.
- Normal CK R time: 4.6-9.1 min
- Decreased – hypercoagulable state, moderate hemodilution
- Increased – factor deficiency or severe hemodilution

Maximum Amplitude (MA):

- Greatest amplitude of tracing reflects absolute clot strength.
- Normal CRT: 52-70 mm
- Clot strength and platelet function
- Decreased with platelet or fibrinogen deficiency

Functional fibrinogen:

- Portion of the total clot strength related to fibrinogen conversion to fibrin
- Normal CFF: 15-32 mm
- Decreased by fibrinogen deficiency

LY30 Lysis time:

- % amplitude reduction 30 minutes after MA time.
- Normal CK LY30: 0-2.6%
- Represents clot stability and fibrinolysis
- Can treat with tranexamic acid (2g) or aminocaproic acid (Amicar) 5 gram IV for 1sthr, then 1 gm/hr infusion

TEG Order Label	Cartridge Parameters
TEGHEPARINASE	**Citrated: K, KH, RT, FF**
TEGECMOLIVER	Citrated: K, KH, RTH, FFH
TEGLYSIS	Citrated: K-R, RT-MA, MA-FF
TEGPLATELETMAP	Platelet mapping for ADP, AA

Simplified TEG-based resuscitation strategy for patients already receiving PRBCs

CK R-time > 9 min	**Transfuse plasma**
CRT MA < 55 mm	**Transfuse platelets**
CFF MA < 15mm	**Transfuse cryoprecipitate or fibrinogen concentrate**
CK LY30 >3%	**Administer tranexamic acid**

Tranexamic acid (TXA) in trauma patients

The early use of TXA should be considered for any patient with an elevated LY30 ≥3%, with ongoing or massive transfusion, and within 3 hours of initial trauma.

Dosing: TXA

a. Infuse 1 gram of tranexamic acid in 100 ml of 0.9% NS over 10 minutes intravenously

b. Infuse a second 1-gram dose intravenously over 8 hours infused with 0.9% NS carrier

Tranexamic acid (TXA), an anti-fibrinolytic agent, has been used to decrease bleeding and the need for blood transfusions in surgical settings.

TXA is an anti-fibrinolytic that inhibits both plasminogen activation and plasmin activity, thus preventing clot break-down rather than promoting new clot formation.

Recent Trials

LY30 <3% is associated with a 10% mortality, LY30 ≥ 3% gives mortality of 20% (p<0.001). Increasing percentages of lysis are associated with increased mortality (≥ 4% gives mortality 35% and ≥ 5% gives mortality 58%).

Cotton BA, Harvin JA, Kostousouv V, Minei KM, Radwan ZA, Schöchl H, Wade CE, Holcomb JB, Matijevic N. Hyperfibrinolysis at admission is an uncommon but highly lethal event associated with shock and prehospital fluid administration. *J Trauma Acute Care Surg*. 2011 Aug; 73(2):365-70

CRASH 2 - Lancet. 2010 Jul 3;376(9734):23-32

TXA reduced risk of death in pts with risk of bleeding (14 vs 16%, in 20,000 pts)

Roberts I, Shakur H, Afolabi A, Brohi K, Coats T, Dewan Y, Gando S, Guyatt G, Hunt BJ, Morales C, Perel P, Prieto-Merino D, Woolley T. The importance of early treatment with tranexamic acid in bleeding trauma patients: an exploratory analysis of the CRASH-2 randomised controlled trial. *Lancet*. 2011 Mar 26; 377: 1096-101.

Post-hoc analysis of the CRASH-2 data: TXA given 1-3hrs post-trauma reduced the risk of death due to bleeding by 21% (6.1% to 4.8%). TXA after 3 hours increased the risk of death due to bleeding (4.4% vs. 3.1%).

MATTERs – TXA improved mortality in massively transfused (14 vs 28%), retrospective study

Harvin JA, Peirce CA, Mims MM, Hudson JA, Podbielski JM, Wade CE, Holcomb JB, Cotton BA. The impact of tranexamic acid on mortality in injured patients with hyperfibrinolysis. J Trauma Acute Care Surg. 2015 May;78(5):905-11

Retrospective study, TXA was not associated with decreased mortality or LY30

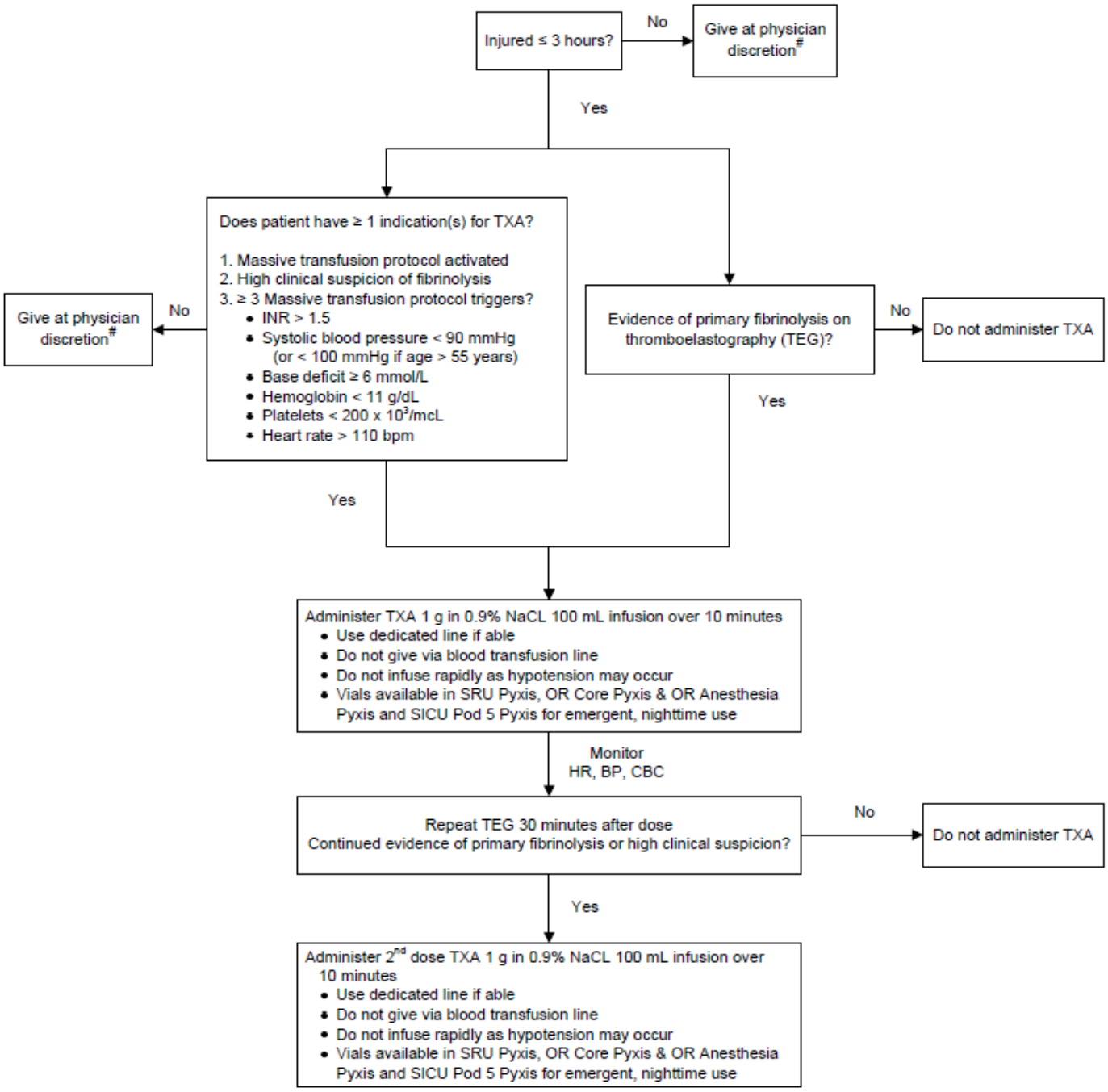
CRASH 3 – 2020, TXA decreased head injury related mortality for moderate but not severe TBI

STAAMP - 2020, TXA reduced mortality if given <1hr after injury and if SBP < 70mmHg

Tactical Combat Casualty Care 2024 – 2g bolus

If a casualty will likely need a blood transfusion (for example: presents with hemorrhagic shock, elevated lactate, one or more major amputations, penetrating torso trauma, or evidence of severe bleeding) OR in TBI if signs or symptoms of significant TBI or has altered metal status associated with blast injury or blunt trauma.

Tranexamic Acid (TXA) in Traumatic Injury Protocol*



*Contraindicated in patients with:
- History of venous thromboembolism
- Hypercoagulable state
- Acquired disturbance of color vision
- Disseminated intravascular coagulopathy
- Allergy to TXA

Use with caution in patients age > 45 years or with isolated traumatic brain injury.

#TXA empirically administered after 3 hours of injury may increase mortality.
Use with caution if clinical indications not present.

Anticoagulant Reversal

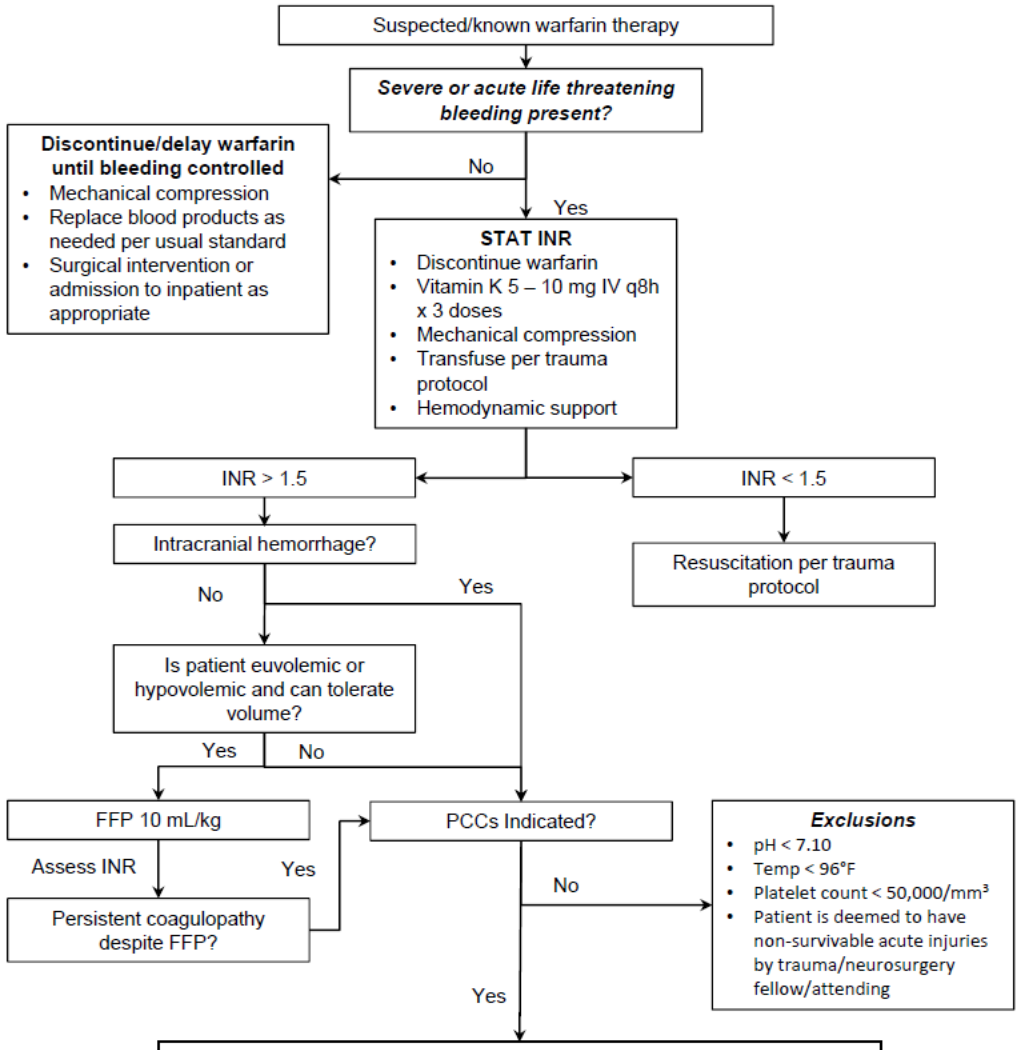
Warfarin

PCCs should be considered for the reversal of the following warfarin-associated bleeding:

1. Acute, life-threatening bleeding supplemented with vitamin K 5 – 10 mg by slow IV infusion and time and/or volume status precludes the use of FFP.
2. Intracranial hemorrhage that time and/or volume status precludes the use of FFP.

The attending or fellow must give the order for PCC.

Warfarin (Coumadin®, Jantoven®) Associated Bleeding Treatment Algorithm



Kcentra Dosing			
INR	2 – 3.9	4 – 6	> 6
Dose (units/kg)	25	35	50
Max Dose (units)	2500	3500	5000

Contact Pharmacy for the rapid facilitation of medication delivery:
Speak to area clinical pharmacists (ED, ICU, or Trauma)
ED Pharmacy – phone: 688-5497
Central Pharmacy – phone: 584-6337
Clinical On-Call Pager – 343-5412

Dabigatran (Pradaxa), Rivaroxaban (Xarelto), Apixaban (Eliquis)

Table 1. New oral anticoagulant properties.

	Dabigatran	*Rivaroxaban*	*Apixaban*
Brand Name	Pradaxa	Xarelto	Eliquis
Direct factor inhibition	IIa	Xa	Xa
Renal Clearance	80%	33%	25%
Prodrug	Yes	No	No
Time to peak	1.5-2 hours	2-3 hours	3 hours
Bioavailability	3-7%	80%	66%
Protein Binding	35%	>90%	87%
Elimination	~100% unchanged drug and active metabolites	~50% unchanged drug, 50% inactive metabolites	~70% unchanged drug, ~30% inactive metabolites
Urine elimination	~80%	~70%	~70%
Fecal elimination	~20%	~30%	~30%
Half-life (hours)			
CrCl > 80 mL/min	14-17	5-9	8-15
CrCl 50 – 69 mL/min	16.6	8.7	14.6
CrCl 30 – 49 mL/min	18.7	9	17.6
CrCl < 30 mL/min	27.5	9.5	17.3
Dialyzable	Yes	Unlikely	Unlikely
CYP metabolism	No	30% CPY3A4, 2J2	15% CYP3A4

Table 2. Composition of US-available prothrombin complex concentrates.

	Factor Levels (IU/mL)				*Protein Levels (IU/mL)*		
PCC	II	VII	IX	X	C	S	Other
3-Factor							
Bebulin	24-37	<5	24-37	24-37	-	-	Heparin
Profilnine	87	-	69	54	-	-	-
4-Fector							
Kcentra	Yes[†]	Yes[†]	Yes[†]	Yes[†]	Yes[†]	Yes[†]	Inactivated
Feiba	1.3	0.9	1.4	1.1	1.1	-	Activated

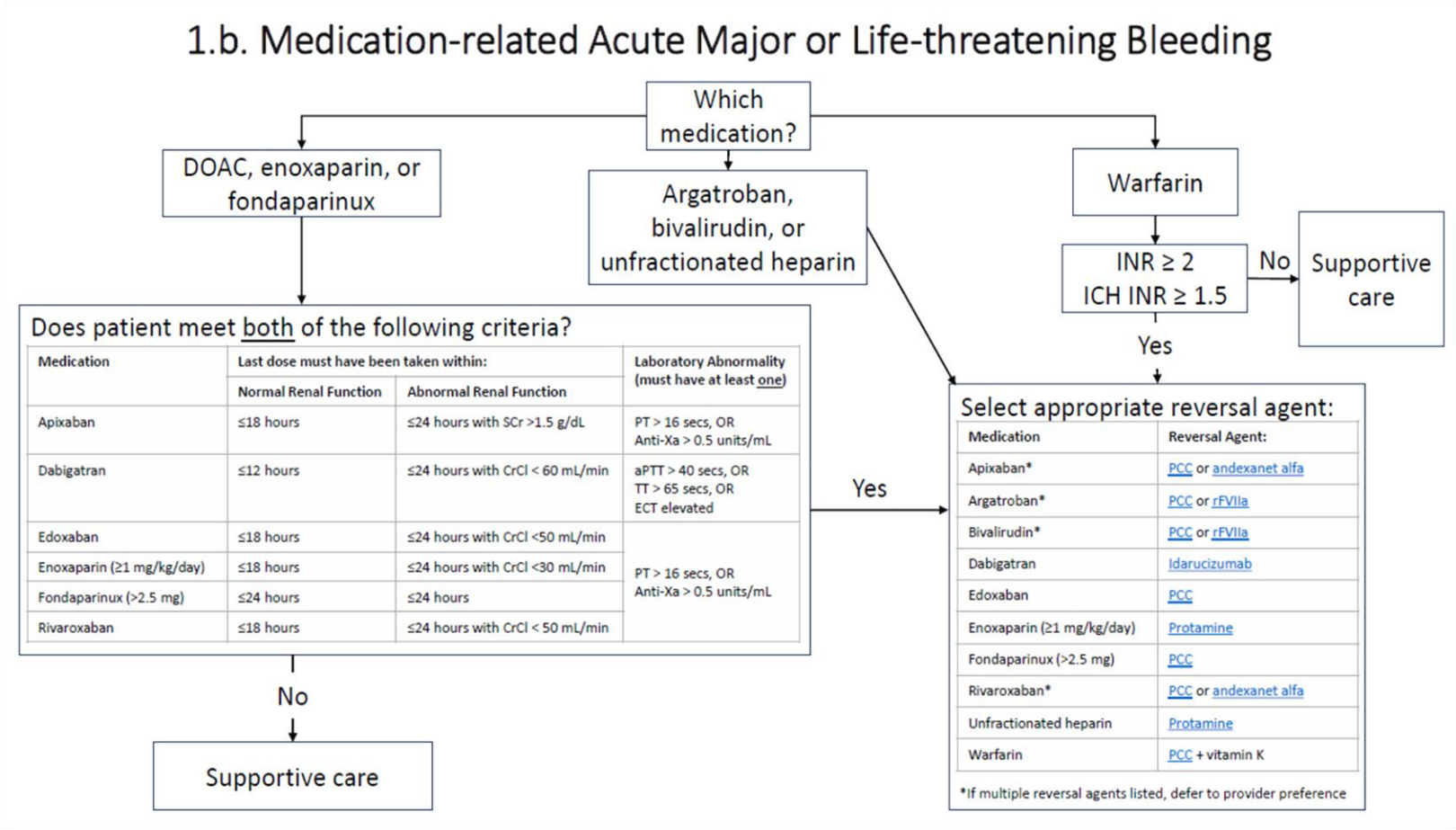
Table 3. Dabigatran sensitivity and utility of currently available anticoagulation parameters.

Assay	*Dabigatran*		
	Sensitivity	*Bleeding*	*Utility*
PT	Insensitive	Increased	Potentially
INR	Insensitive	Increased	Potentially
aPTT	Sensitive	Increased	Potentially, but response flattens had high serum concentrations
TT	Too Sensitive	Increased	Potentially, very sensitive at low concentrations but not useful at high concentrations
Anti-Xa	Insensitive	No effect	Inadequate
Fibrinogen	Insensitive	Normal to decreased	Potentially

Table 4. Rivoroxaban/apixaban sensitivity and utility of currently available anticoagulation parameters.

Assay	*Rivaroxaban / Apixaban*		
	Sensitivity	*Bleeding*	*Utility*
PT	Insensitive	Increased	Potentially
INR	Insensitive	Increased	Potentially
aPTT	Sensitive	Increased	Potentially, but response flattens had high serum concentrations
TT	Insensitive	No effect	Potentially, very sensitive at low concentrations but not useful at high concentrations
Anti-Xa	Sensitive*	Increased	Potentially, tests often note calibrated to drug
Fibrinogen	Insensitive	No effect	Inadequate

1.b. Medication-related Acute Major or Life-threatening Bleeding



Medication	Last dose must have been taken within:		Laboratory Abnormality (must have at least one)
	Normal Renal Function	Abnormal Renal Function	
Apixaban	≤18 hours	≤24 hours with SCr >1.5 g/dL	PT > 16 secs, OR Anti-Xa > 0.5 units/mL
Dabigatran	≤12 hours	≤24 hours with CrCl < 60 mL/min	aPTT > 40 secs, OR TT > 65 secs, OR ECT elevated
Edoxaban	≤18 hours	≤24 hours with CrCl <50 mL/min	PT > 16 secs, OR Anti-Xa > 0.5 units/mL
Enoxaparin (≥1 mg/kg/day)	≤18 hours	≤24 hours with CrCl <30 mL/min	
Fondaparinux (>2.5 mg)	≤24 hours	≤24 hours	
Rivaroxaban	≤18 hours	≤24 hours with CrCl < 50 mL/min	

Medication	Reversal Agent:
Apixaban*	PCC or andexanet alfa
Argatroban*	PCC or rFVIIa
Bivalirudin*	PCC or rFVIIa
Dabigatran	Idarucizumab
Edoxaban	PCC
Enoxaparin (≥1 mg/kg/day)	Protamine
Fondaparinux (>2.5 mg)	PCC
Rivaroxaban*	PCC or andexanet alfa
Unfractionated heparin	Protamine
Warfarin	PCC + vitamin K

Prothrombin complex concentrate (PCC)* Indications and Dosing

Indication	Product	Dosing - based on Factor IX activity	Notes
Trauma (off-label) – TBI patients needing emergent placement of devices like external ventricular drains	Kcentra	25 units Factor IX activity/kg IV bolus (max 5000 units) Administer IVP at a rate of 30 mL/minute (or 750 units/minute)	• Goal INR ≤1.4 • Order must be prescribed by ED/trauma/neurosurgery/neurocritical care attending or fellow physician • Do NOT administer if TEG obtained and R time normal
Life-threatening, non-anticoagulant coagulopathy with acute bleeding (off-label), unresponsive to significant clotting factor replacement (see notes)	Kcentra	25-50 units Factor IX activity/kg IV bolus (max 5000 units) Administer IVP at a rate of 30 mL/minute (or 750 units/minute)	**Laboratory parameter** / **Required clotting factor replacement** Platelets < 50,000/mm³ — Administration of > 12 units of platelets INR > 1.5 — Administration of 10 – 15 ml/kg FFP and Vitamin K 10 mg IV PTT > 50 sec — Administration of Protamine 50 mg IV only if due to heparin use Fibrinogen < 100mg/dL — Administration of > 10 units of cryoprecipitate Do NOT administer if TEG obtained and R time normal
Warfarin-associated acute major or life-threatening bleeding or Urgent warfarin reversal for planned heart transplant	Kcentra	INR 1.5-7.5 AND weight < 100 kg: 1,500 units Factor IX activity IV x1 over 2 minutes OR INR > 7.5, ICH, OR weight > 100 kg: 2,000 units Factor IX activity IV x1 over 3 minutes If INR remains > 2 and ongoing bleed can consider an additional 500 units	• Consider if time to reversal and/or volume status preclude use of FFP and vitamin K • For warfarin-associated ICH – order must be prescribed by ED/trauma/neurosurgery/neurocritical care attending or fellow physician • Vitamin K 10 mg/50 mL NS IVPB over 60 min x1 should be given with PCC • For heart transplant: to be given 2-3 hours before planned incision

Life-threatening bleeding associated with rivaroxaban, apixaban, or edoxaban (off-label) who meet administration and laboratory criteria (see notes)	Kcentra	2,000 units Factor IX activity IV x1 (fixed dose) over 3 minutes
		OR
		50 units Factor IX activity/kg x1 (max 5000 units) infused at a rate of 30 mL/minute (or 750 units/minute)
		(Weight-based dosing preferred in ICH)
		
		Apixaban
		• No minimal effective dose established; use lowest dose possible
		• Give with activated charcoal if <2 hours from last dose
			• NOT to be administered with Andexxa
			• Criteria
			  • Last dose administered within 18 hours or 24 hours in patients with renal insufficiency (CrCl below 50 mL/min or serum creatinine above 1.5 mg/dL)
			  • PT GREATER than 16 sec or Anti Factor Xa GREATER than 0.5 units/mL
			• Dose should be determined based on hemostasis and clinical symptoms. Laboratory parameters unreliably correlate with proportional changes in plasma drug concentrations

Life-threatening bleeding associated with fondaparinux (>2.5 mg), argatroban, or bivalirudin (off-label)	Feiba-NF	20-50 units Factor IX activity/kg IV bolus Administer IVP at a rate of 10 units/kg/min	• Reversal NOT recommended for VTE prophylaxis unless evidence of bioaccumulation or impaired clearance • Argatroban/bivalirudin: data very limited. Should be used for salvage therapy only. Efficacy and safety unknown.

DVT Prophylaxis

General Surgery, Surgical Oncology, and Transplant patient options:

- Heparin 5000 units subcutaneous q8 hours
- Enoxaparin (Lovenox®) 40 mg subcutaneous q24 hours

Trauma Patient Guidelines:

- All patients receive enoxaparin BID, dosing based on AGE and WEIGHT
- Check anti-Xa prior to the 4th dose for dose adjustment

When to hold prophylactic chemoprophylaxis:

1. Solid organ injury: ≥ Grade IV liver/spleen laceration – start after 24 hours if Hgb stable
2. Intracranial bleeding – start 24 hours after stable head CT
3. Incomplete spinal cord injury associated with epidural hematoma – start at 72 hours and check with Spine service
4. ICP monitor – hold for 12 hours prior to and 4 hours after monitor placement; hold enoxaparin for 12 hours or heparin for 4 hours after monitor removal
5. Spinal surgery – hold for 72 hours post-op, check with Spine service
6. Ongoing uncontrolled bleeding or uncorrected coagulopathy
7. Intraocular injuries with risk of hemorrhage – consult Ophthalmology
8. Epidural placement or removal
    - Must hold Heparin subQ for 4 hrs prior to epidural placement if receiving > 10,000 units per day total
    - Must hold Enoxaparin for 24 hrs prior to epidural placement if receiving > 40 mg per day total
    - If patient may need epidural, start heparin instead of enoxaparin until epidural placed

VTE Treatment / Therapeutic Dosing

- Initiate treatment for VTE that are either an acute proximal DVT (popliteal vein or higher) or PE or both
- Distal veins include: Gastrocnemic, Anterior tibial, Soleus, Peroneal, Posterior tibial veins
    - No anticoagulation needed for isolated DVT in these veins
    - Consider repeat duplex US in one week to evaluate for proximal extension of clot
- Inferior vena cava (IVC) filter should be placed in patients who have a contraindication to therapeutic anticoagulation.

When to hold therapeutic anticoagulation:

- Solid organ injury – 72 hours after stable hemoglobin
- Traumatic brain injury – 14 days
- Spinal injury or surgery – 14 days
- Intracranial / Epidural drains
    - Hold enoxaparin for 24 hours or heparin for 4 hours prior to placement
    - Hold enoxaparin for 12 hours or heparin for 1 hour after placement
    - Hold enoxaparin for 24 hours or heparin for 4 hours after removal

Heparin infusion adjustment protocol

There are four protocols as Heparin Continuous Infusion order sets in Epic:

1. Standard Dose Protocol – recommended for use in patients with DVT, Pulmonary Embolism, Atrial Fibrillation, Valvular Heart Disease and Arterial Thrombus.
2. Standard Dose Without Bolus Protocol – for use in patients who require Standard Heparin Protocol but are at elevated risk of bleed.
3. Low Dose Protocol – for use in patients with Acute Coronary Syndrome and in Neuroscience patients.
4. Low Dose Without Bolus Protocol – for use in patients who require Low Dose Heparin Protocol but are at elevated risk of bleed.
   This protocol should be ordered for Trauma Service patients with a documented traumatic brain injury.

When changing from a heparin continuous infusion to therapeutic enoxaparin (Lovenox®), order the heparin infusion to be discontinued at the same time the first dose of enoxaparin (Lovenox®) is administered.

Heparin-Induced Thrombocytopenia (HIT)

HIT is a hypercoagulable state resulting from a hypersensitivity reaction to unfractionated heparin or low-molecular weight heparin. HIT is mediated by an IgG antibody that reacts with platelet factor 4 (PF4/heparin complex) which binds to platelets and inducing a strong intravascular platelet activation.

Clinical features: Thrombocytopenia (<100-150) or Relative Thrombocytopenia (40-50% decrease from baseline). Platelet count usually drops to ~50 x 10^3/µl, but not to extreme lows as is seen with other immune drug-induced thrombocytopenias. If Plt count is < 15, it is likely not HIT.

- Typically occurs 4-14 days after initiation of heparin, but can occur on day 1 if patient has had prior exposure in last 4 weeks.
- Half of those with thrombocytopenia will also have thromboses, which can be arterial or venous, but venous is more common.
- 4T score for HIT

Thrombocytopenia	2 points: if Plt count fall by >50% of previous or nadir is 20-100k 1 point: if Plt count fall 30-50% or the nadir is 10-19k 0 points: if Plt count fall <30% or the nadir is <10k
Timing	2 points: if Plt count fall between days 5-10 after starting heparin or less than a day if reexposure within 30 days of heparin 1 point: if Plt count fall is after day 10 0 points: if Plt count fall < 5 days after starting heparin
Thrombosis	2 points: new thrombosis, skin necrosis, or systemic reaction 1 point: progressive or recurrent thrombosis, silent thrombosis, red skin 0 points: no symptoms
Alternative cause possible	2 points: no other cause 1 point: possible alternative cause 0 points: definite alternative cause

  - Score of 0-8 generated
    - 0 – 3 HIT is unlikely (NPV 0.998)
    - 4 – 5 intermediate probability (PPV 0.14)
    - 6 – 8 high probability (PPV 0.64)

Warkentin TE, Heddle NM (March 2003). Laboratory diagnosis of immune heparin-induced thrombocytopenia. *Curr Hematol Rep.* 2003; 2 (2): 148–57.
Cuker A, Gimotty PA, Crowther MA, Warkentin T. Predictive value of the 4Ts scoring system for heparin-induced thrombocytopenia: a systematic review and meta-analysis. *Blood.* 2012; 120 (20): 4160–4167

Diagnosis: send HIT panel assay to check antibody, then serotonin release assay to confirm
Other common causes of thrombocytopenia include sepsis, DIC, hemodilution, medications, massive PE, liver disease, pseudo-thrombocytopenia, and post-transfusion purpura
Treatment:

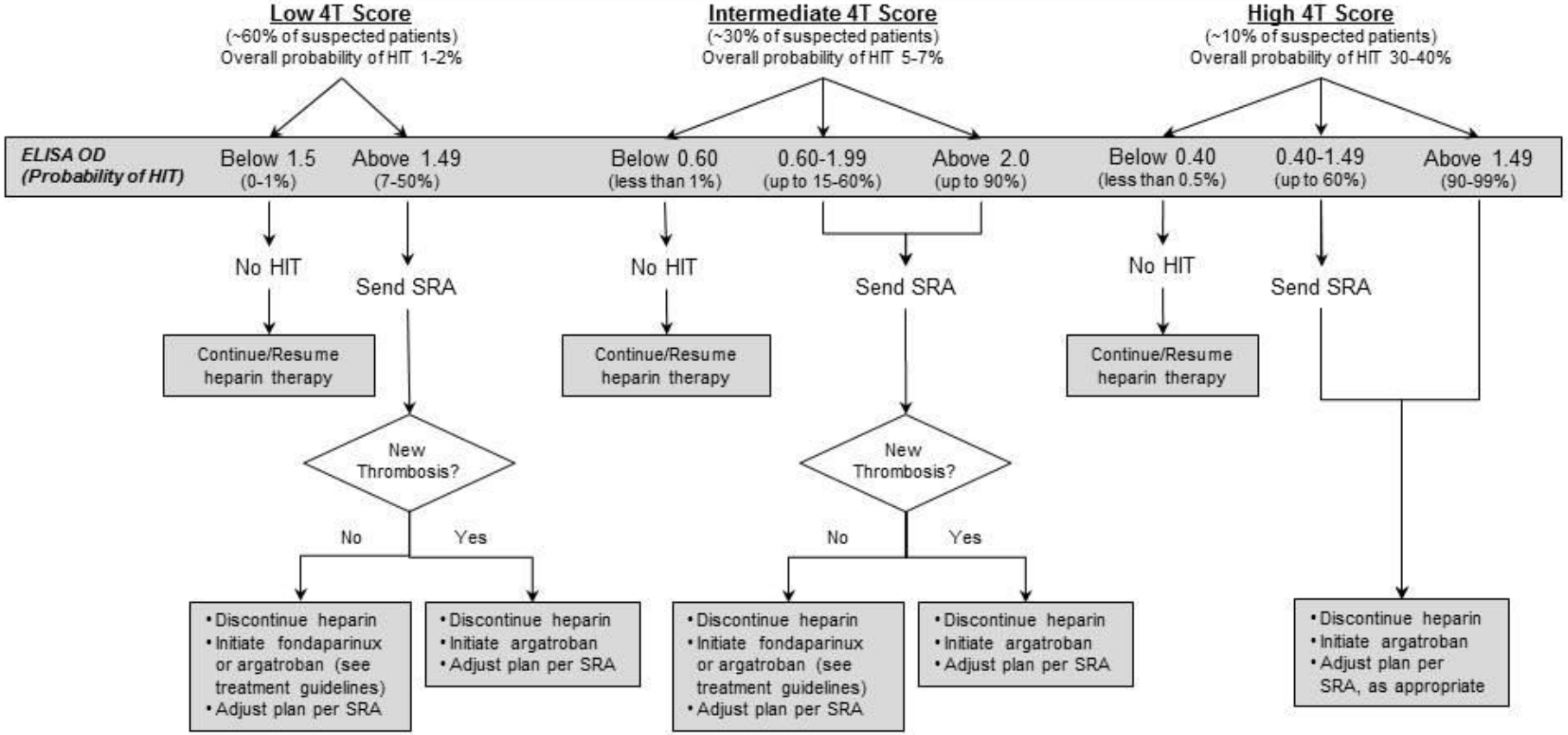
- Stop all heparin products
- Use alternate anti-coagulant
  - Argatroban start 2mcg/kg/min, adjust to aPTT 1.5-2.5X baseline
  - Bivalirudin (Angiomax) 0.15-0.2 mg/kg/hr, adjust to aPTT 1.5-2.5X baseline
  - Fondaparinux (Arixtra) 2.5mg SQ q 24h, currently off-label use

DRAFT

University of Cincinnati Medical Center | UC Health

Diagnostic Algorithm for Suspected Heparin-Induced Thrombocytopenia (HIT) in Non-Cardiac Surgery Patients

1. Calculate 4T Score in patients with suspected HIT (recommend two independent calculations with highest score considered)
2. Send Heparin-induced Antibody ELISA (reported as optical density [OD])
3. Follow the algorithm below for recommended laboratory testing and empiric therapy considerations
4. A negative Serotonin Release Assay (SRA) has a 98-99% negative predictive value; strongly consider resuming heparin therapy if SRA is negative.



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Chan CM, et al. *Chest* 2015; 148:55-61.
Linkins L-A, et al. *Blood* 2015 epub April 29 (DOI: http://dx.doi.org/10.1182/blood-2014-12-618165)
Greinacher A. *NEJM* 2015; 373:252-261.

Use considerations for darbepoetin

Patients – discuss with ICU staff and pharmacy prior to consideration

Inclusion

- Mechanical ventilation greater than 4 days with expected ICU stay greater than 7 days
- Plus one or more of the following:
    - History of CAD (excluding active ischemia), COPD, CHF, DM, cancer
    - Age greater than 55 years
    - APACHE II score greater than 20

Exclusion

- Hematocrit greater than 30%
- Current active hemorrhage
- Active Acute Coronary Syndrome
- Lack of enteral access and presence of bacteremia or septic shock precluding the administration of enteral or intravenous iron therapy
- Uncontrolled hypertension
- Uncontrolled seizures

Darbepoetin Regimen

Initial Regimen

- For all patients starting therapy according to above criteria
- Darbepoetin 100 mcg subcutaneously every week

Maintenance Regimen

- Following 4 weeks of *Initial Regimen* dosage without maintenance transfusion during past 2 weeks
    - Darbepoetin 0.45 mcg/kg subcutaneously every other week
- If maintenance transfusion required following 2 weeks of *Maintenance Regimen*, then increase Darbepoetin to 100 mcg subcutaneously every week

Iron Therapy

Enteral iron (preferred)

- Ferrous sulfate 325 mg po/per tube every 8 hours
- Vitamin C 250 mg po/per tube every 8 hours
- Multivitamin 1 tablet or 5 mL po/per tube daily

Intravenous iron

Reserved for patients (either/or):

1) Unable to receive enteral iron
2) Those with reticulocyte index LESS than 0.3 (inadequate response) following 3 weeks of darbepoetin and enteral iron combination.

Regimen

- Iron sucrose 100 mg intravenously once daily for 10 days or until enteral iron indicated, as appropriate

Laboratory Monitoring

Baseline and weekly:

- CBC
- Reticulocyte count
- Iron studies
- Ferritin

GI/Nutrition in the Critically Ill Patient

criticalcarenutrition.com – has clinical practice guidelines available for reference
Critical care patients become very catabolic, rapidly lose muscle mass, and become malnourished. Initiating early nutrition prevents further loss of lean body mass.

- If NPO and no contraindication to feeding, initiate enteral nutrition via Dobhoff (DHT) feeding tube within 24hrs. If nasogastric feeds are not tolerated, attempt NJ tube placement and check tube placement on Abdominal XRay. If unsuccessful after 2 attempts, schedule an endoscopic or fluoroscopic placement of DHT.
- If unable to tolerate enteral nutrition within 7 days of admission, or for more than 7 days during admission, consider TPN. TPN orders and renewals must be ordered prior to 12pm daily (EPaNIC 2011, NEJM)
- For ventilated patients requiring vasopressor support, full calorie tube feeds are associated with high complication rates (NUTRIREA-2)
- For ventilated patients requiring vasopressor support, calorie/protein restricted tube feeds were associated with less GI complications (including bowel ischemia) but no change in ICU discharge time
- Check ICU patient nutrition labs every Monday: Pre-albumin and Transferrin

Estimated Caloric Needs: 25-35 kCal/kg/day. Protein: 1.5-2 grams/kg/day
Burn patients < 20% TBSA: 35-30 kCal/kg/day
Burn patients > 20% TBSA: 30-35 kCal/kg/day

Ideal Body Weight (Hamwi method):	**Adjusted Body Weight:**
Men: 106 lb + 6 lb for each inch > 5 ft Women: 100 lb + 5 lb for each inch > 5 ft	(Actual BW – Ideal BW) / 4 + Ideal BW
Men: 50 kg + 2.3 kg for each inch > 5 ft Women: 45 kg + 2.3 kg for each inch > 5 ft	(Actual BW – Ideal BW) x .25 + Ideal BW

If high gastric output on residual, add motility agent
Metoclopramide (Reglan) 10mg IV q6, or
Erythromycin 250mg PO/IV q6

If patient on propofol >10mL/hr, adjust TF rate to compensate for additional kcal (1.1 lipid kcal/ml).
e.g.: Tube feed goal = 85, but propofol = 25ml/hr. New goal TF = 60ml/hr with beneprotein 2pkt BID to meet protein needs.

Stress Ulcer Prophylaxis(2024 SCCM update)

- No difference PPI vs. H_2R blocker
- Mechanical ventilation is no longer an indication for SUP
- Factors to consider for continuation: gastrojejunal anastomosis, high dose steroids, h/o GI bleed, coagulopathy, shock, chronic liver disease, GCS < 10, home treatment

TPN Calculation

- Determine daily Kcal and protein goals, round out number
- Choose amino acid amount in grams to provide adequate protein
- Subtract protein calories from total required
    - Protein kcal = gm x 4 kcal/kg
- Add lipid solution (national shortage)
    - Lipid kcal = gm x 9 kcal/kg
- Choose dextrose solution to provide remaining calories
    - Dextrose kcal = gm x 3.4 kcal/g
    - Maximum dextrose dose: 4-6 grams / kg / min
    - Dextrose should make up 50-70% of non-protein calories

Example: 47yo man in shock, Ht: 5'10", Admit Wt 81.8kg, IBW: 75.5kg BMI 25.8

- Estimated Caloric Needs: 1890-2265 kcal initially (25-30kcal/kg IBW)
- Estimated Protein Needs: 100-130gm (1.3-1.7 g/kg/ IBW)
    1. Set total calorie goal: 2000kcal initially (26kcal/kg)
    2. Set protein goal: 100g initially (~1.3g/kg)
        - Calories from protein: 100g x 4 kcal/kg = 400 kcal
    3. Subtract protein calories from total calorie goal: 2000-400 = 1600kcal
    4. Determine calories from lipid (10-15% of total calories): 2000x0.15 = 300
    5. Determine calories from Dextrose: total – kcal from protein + lipid
        - 2000 – 700 = 1300kcal
        - Calculate grams of dextrose needed to meet goal: 1300kcal/3.4 kcal/g
            - 1300/3.4 = 382g
    6. Volume of dextrose – choose stock solution
        - 50% Stock Solution: 380g/0.5 = 760ml of D50%
        - 70% Stock Solution: 380/0.7 = 542 (round to 10ml)= 540ml D70%
            - Currently used at UCMC
    7. Volume of amino acid (g/kg)
        - 10% Stock solution: 100/0.1 = 1000ml of AA10%
        - 15% Stock solution: 100/0.15 = 666ml (round to 10ml) = 670ml AA15%
            - Currently used at UCMC
    8. Volume of IV Lipids: use 100, 150, 200 and 250ml doses
        - 300kcal/2kcal per ml = 150ml
        - Do not use lipid if patient is on propofol >10mL/hr or triglycerides > 400mg/dL
    9. Determine fluid needs: If volume restricted – use 15% AA & 70% D
        - 30-35ml/kg/day
    10. Initiate TPN at 42 mL/hr, AA 50g/L, Dextrose 75 g/L, lipid 30 g/L
        - Advance TPN over 48-72h if glucose and electrolytes are normal
    11. Additives: MVI 10ml/day, Trace elements 1ml/day (CURRENTLY NATIONAL SHORTAGE)
        - MVI given on M/W/F, Addamel (trace elements) M/W/F

ADULT TUBE FEEDS										
	Kcal/mL	Protein (g/L)	CHO (g/L)	Fat (g/L)	Na/K (mEq/L)	P/Ca (mg/L)	Mag (mg/L)	Fiber (g/L)	Osmolality	H_2O (mL/L)
Fibersource HN	1.2	54	164	40	49/49	960/960	340	15.2	480	808
Isosource HN	1.2	54	156	40	49/49	960/960	340	0	510	808
Replete w/ fiber	1.0	64	124	34	38/41	800/800	280	15.2	330	832
Diabetasource AC	1.2	60	100	58.8	46/41	800/800	320	15.2	450	816
Isosource 1.5	1.5	68	176	59.2	56/60	1200/1200	420	15.2	650	764
Nutren 2.0	2.0	84	216	92	65/54	1480/1600	560	0	780	692
Novasource Renal	2.0	90.7	183	100	41/24	819/840	197	0	800	717
Nutren Pulmonary	1.5	68	100	94.8	50.8/48	1200/1200	480	0	330-450	782
Compleat	1.06	48	136	40	43/40	840/880	300	8	450	828
IMPACT Peptide 1.5	1.5	94	140	63.6	51/48	1000/1000	420	0	510	770
Peptamen 1.5	1.5	68	188	56	40/52	1000/1000	420	0	510	770
Peptamen AF	1.2	76	112	54	36/40	800/800	320	6	390	808
Peptamen VHP	1.0	92	76	38	28/36	680/680	280	4	345	840
Suplena Carb steady	1.8	45	196	96	35/29.1	717/1055	211	12.7	780	738
Vivonex RTF	1.0	50	176	11.6	30.4/31	668/668	268	0	630	848

ADULT DIET SUPPLEMENTS										
PRODUCT	**Size (mL)**	**Kcal**	**Prot (g)**	**CHO (g)**	**Fat (g)**	**Fiber**	**Na (mg)**	**K (mg)**	**P (mg)**	**Flavors**
Boost	237	240	10	41	4	0	150	460	300	V,C,S
Boost compact	125	240	10	37	6	0	150	350	200	V, C
Boost glucose control	237	250	14	23	12	3	270	260	200	V,C,S
Boost Plus	237	360	14	45	12	0	200	360	300	V,C,S
Boost VHC	237	530	22	46	30	0	280	420	250	V
Boost Breeze	237	250	9	54	0	0	80	0	150	Orange, Peach, Berry
Boost Pudding	148	230	7	32	8	0	115	250	250	V, C
Beneprotein	60	25	6	0	0	0	15	30	0	No flavor
Magic Cup	4oz.	290	9	38	11	0	110	350	0	V, C, Orange, Berry
NutraShake	4oz.	200	6	32	5	0	55	222	18	V
Diabetishield	237	150	7	030	0	0	35	0	500	Berry
Novasource Renal	237	475	21.6	43.5	0	225	225	195	19	V
Arginaid	237	25	4.5	2	0	0	030	50	0	Cherry, Orange
Nutrisource fiber	4g	15	0	4	0	30	15	10	200	No flavor
Glutasolve	22g	90	15	70	0	0	0	0	0	No flavor
Juven	237	80	8	0	0	0	0	0	0	Orange, Punch
Carnation breakfast	270	220	13	39	1	0	190	700	500	V, C, S

V=vanilla, C=chocolate, S=strawberry

Sepsis

SIRS: Systemic inflammatory response to an insult or injury, with 2 or more of following:

- Temperature > 38° C (100.4° F) or < 36 C° (96.8° F)
- Heart rate > 90 bpm
- Tachypnea > 20 breaths/min, or hyperventilation with $PaCO_2$ < 32 mmHg
- WBC count > 12,000/mm^3 or < 4000/mm^3, or > 10% bands

Infection: interaction between host and pathogen that promulgates a local or systemic host response

Sepsis: Life threatening organ dysfunction caused by a dysregulated host response to infection

Organ dysfunction = SOFA score ≥ 2, associated with in-hospital mortality > 10%

Identify patients with suspected infection likely to be septic if quickSOFA (qSOFA) ≥ 2 of:

Resp rate > 22/min, Altered mental status (GCS≤14), sBP ≤ 100mmHg

Sepsis-3 Singer M et al. JAMA 2016;315(8)801-810

Septic Shock: associated with in-hospital mortality > 40%

- Pressors required to keep MAP ≥ 65 mmHg and
- Serum lactate >2mmol/L in the absence of hypovolemia

^Sequential Organ Failure Assessment (SOFA) Score

Predicts ICU Mortality Based on Lab Results and Clinical Data

(Score<12)

SOFA Score	0	1	2	3	4
Respiratory PaO2/FiO2	>400	301-400	201-300	101-200	<100
Coagulation Platelets	>150	101-150	51-100	21-50	≤20
Liver Bilirubin (mg/dl)	<1.2	1.2-1.9	2.0-5.9	6.0-11.9	>12
Cardiovascular Hypotension	MAP>70 on no vasopressor support	MAP<70 on no vasopressor support	Dopamine<5* or any dose Dobutamine	Dopamine 5-15* or Norepinephrine ≤0.1* or Epinephrine ≤0.1*	Dopamine >15* or Norepinephrine >0.1* or Epinephrine >0.1*
CNS Glascow Coma Scale	15	13-14	10-12	6-9	<6
Renal Creatinine (mg/dl) Or UOP (ml/24hrs)	<1.2	1.2-1.9	2.0-3.4	3.5-4.9 or <500	>5.0 or <200

*mcg/kg/min

Source: Moreno R. Intensive Care Med 1999 Jul; 25(7): 686-96

Multiple Organ Dysfunction Syndrome (MODS): Presence of altered function of 2 or more organs in an acutely ill patient, such that homeostasis cannot be maintained without intervention

- CNS: Acute deterioration of mental status, with GCS < 13
- Respiratory: PaO2/FiO2 ratio <250
  - < 200 if lung is source of primary infection
  - No suggestion of volume overload (PCWP if available)
- Cardiovascular: Presence of Shock (defined above)
- Renal: one of the following:
  - < 0.5mL/kg/hr for > 1h, or
  - Increased serum creatinine > 0.5mg/dL within 24 hours of sepsis
- Coagulation: INR > 1.5; or Platelet < 80,000 or ≥ 50% plt decrease within 24 hours
- Hypoperfusion: Lactate > 4 mmol/L
- Hepatic: Elevated liver enzymes > 2x upper limit of normal

Persistent inflammation-immunosuppresion and catabolism syndrome

- Admission to ICU > 14 days
- CRP > 50µg/dL or retinol binding protein < 1mg/dL
- Total lymphocyte count < 0.80 $x10^9$/L
- Serum albumin < 3g/dL, creatinine height index <80%, or weight loss >10% during stay

Recent Trials

Early goal directed therapy - N Engl J Med. 2001 Nov 8;345(19):1368-77
Goals: CVP 8-12, pressors for MAP<65, Hct ≥30, Dobutamine if ScvO2 <70
EGDT reduced mortality (30 vs. 46%)

ARISE - N Engl J Med 2014;371:1496-506.
EGDT for critically ill pts presenting in early septic shock did not change mortality (18%)

ProMISe - N Engl J Med. 2015 Apr 2;372(14):1301-11
EGDT increased IVF, pressors, RBCs but also ICU LOS and cost; same mortality (29%)

ProCESS - N Engl J Med. 2014 May 1;370(18):1683-93
EGDT protocol did not improve mortality (21%) vs. modified protocol or usual care

Surviving Sepsis Guidelines – 2021 update

1. Administer antibiotics within 1 hour if septic shock, within 3 hours if suspect sepsis
2. Resuscitation – 30mL/kg within 3hrs w/ balanced crystalloid (SAFE 2004 NEJM)
3. Target MAP ≥ 65 mmHg if requiring vasopressors
4. Norepinephrine should be first choice vasopressor (SOAP 2010, VANISh 2016)
5. Use 200mg/day IV hydrocortisone to treat patients with septic shock if fluid and vasopressor therapy cannot achieve hemodynamic stability (APROCCHSS, ANNANE 2002, ADRENAL 2018)
6. Mechanical ventilation target 6 mL/kg predicted body weight for TV, Pplat< 30 cm H_2O
7. Obtain source control as rapidly as is practical
8. Assess for de-escalation of antimicrobials based on cultures and clinical improvement

midodrine may wean off IV pressors (MIDAS 2020)

Refractory Shock can consider ANGIOTENSINOGEN II though ATHOS3 (JAMA) – increases BP, no change in mortality

Bacterial classification

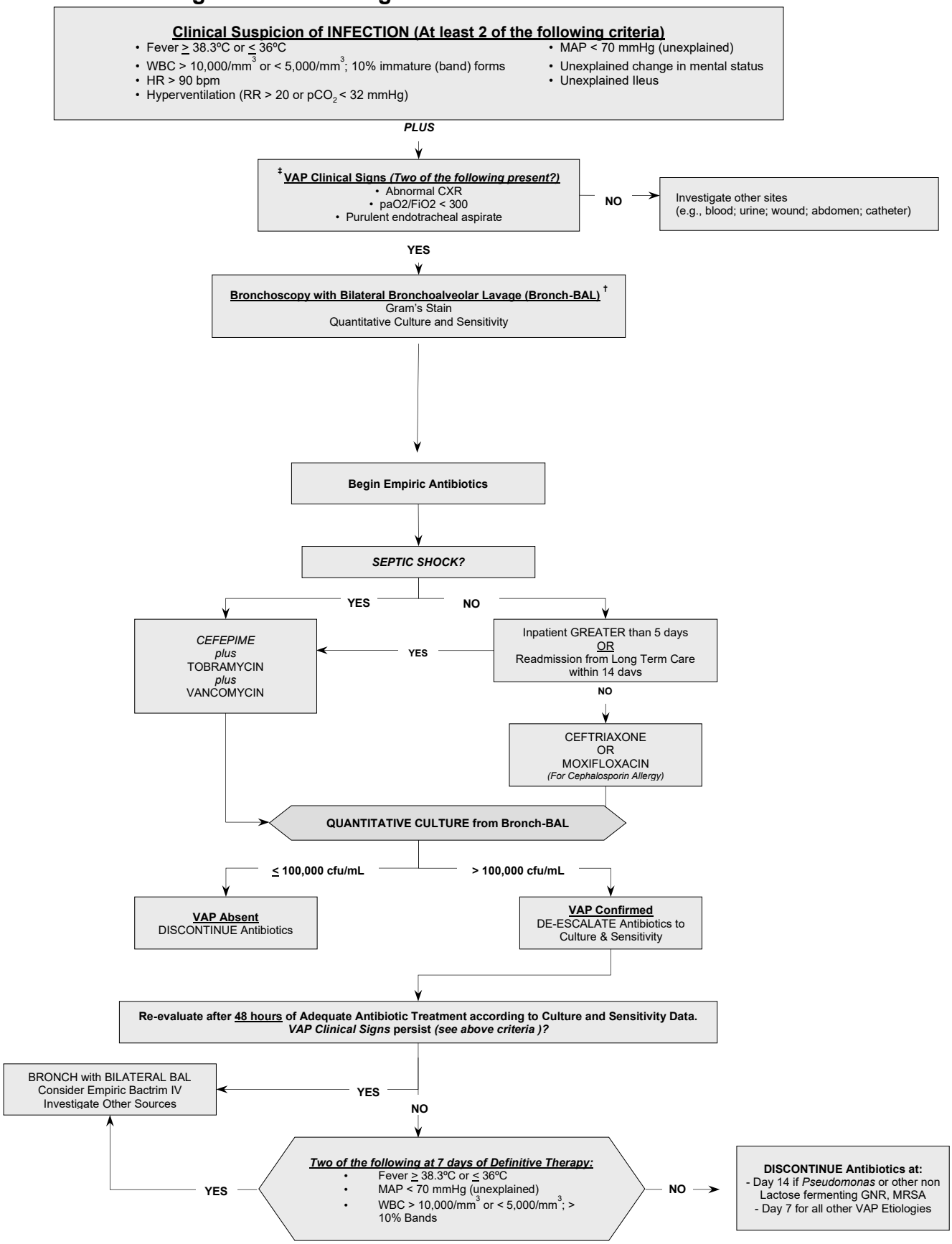
Gram -	Cocci	Anaerobic			Veillonella
		Aerobic oxidase (+)			Neisseria gonorrhoeae/meningitis Moraxella catarrhalis
	Bacilli	Anaerobic			Bacteroides fragilis / Prevotella
		Aerobic	Oxidase (+)	Lactose Fermenters	Vibrio / Pasteurella / Aeromonas
				Non-Lactose Fermenters	Pseudomonas / Campylobacter / Legionella
			Oxidase (-)	Lactose Fermenters	Enterobacteriacaea (Citrobacter; E. coli; Enterobacter; Klebsiella; Serratia)
				Non-Lactose Fermenters	Enterobacteriacaea (Morganella; Proteus; Salmonella; Shigella; Yersinia) / Acinetobacter / Stenotrophomonas
Gram +	Bacilli	Acid Fast (+)			Mycobacterium TB / avium / (Nocardia – partial acid-fast)
		Acid Fast (-)	Anaerobic		Lactobacillus / Actinomyces / Clostridium difficile / perfringens
			Aerobic		Diphtheroids (Corynebacterium) / Listeria monocytogenes / Bacillus cereus
	Cocci	Anaerobic			Peptostreptococcus / Peptococcus
		Aerobic	Clusters	Coagulase (+)	Staphlococcus aureus
				Coagulase (-)	Staphlococcus epidermidis / Saprophyticus
			Chains	β – Hemolysis	Strep Group A/B (S. pyrogenes; S. agalactiae)
				α / γ (no) Hemolysis	Strep pneumonia / Strep viridians Enterococcus faecalis / faecium

Common contaminants: Bacillus, Coag (-) Staph (non-aureus), Diphtheroids, Lactobacilli

Antibiotic Options (UCMC Antibiogram 2013)

	Ampicillin/ Sulbactam	Cefazolin	Cefepime	Piperacillin/ Tazobactam	Meropenem	Ciprofloxacin
Citrobacter freundii	0	0	100	85	93	90
Citrobacter koseri	93	98	100	100	100	98
Enterobacter aerogenes	0	0	98	86	98	98
Enterobacter cloacae	1	1	97	78	98	94
Escherichia coli	**54**	**85**	**95**	**94**	**99**	**74**
Klebsiella oxytoca	60	59	94	93	100	100
Klebsiella pneumonia	82	90	94	92	98	93
Morganella morganii	0	0	100	100	100	62
Proteus mirabilis	94	94	98	100	100	70
Serratia marcescens	4	0	100	99	97	97
Pseudomonas aeruginosa	0	0	84	88	90	80

Protocol for the Diagnosis and Management of Ventilator-Associated Pneumonia



Antibiotic Treatment Table for the Empiric Management of Ventilator-Associated Pneumonia

EARLY ONSET VAP TREATMENT (< 5 DAYS)				
ANTIBIOTIC	**DOSAGE**			Indication
	CRCL > 50 ML/MIN	**CRCL 10-50 ML/MIN**	**CRCL < 10ML/MIN**	
Ceftriaxone (Rocephin®)	2 g IV q 12 hours	2 g IV q 12 hours	2 g IV q 24 hours	• Early onset VAP
Levofloxacin (Levaquin®)	750 mg IV/PO q 24 hours	750 mg IV/PO q 24 hours	500 mg IV/PO q 24 hours	• Early onset VAP in patients with a documented cephalosporin allergy or history of anaphylaxis to penicillin
LATE ONSET VAP TREATMENT (³ 5 DAYS)				
Cefepime (Maxipime®)	2 g IV q 8 hours (Dose infused over 3 hours)	2 g IV q 12 hours (Dose infused over 3 hours)	1 g IV q 12 hours (Dose infused over 30 min)	• Indicated as initial treatment of late onset VAP • Consider intermittent administration with 2 g IV q 8 hours (infused over 30 minutes) if extended infusion not feasible (e.g., limited venous access)
Tobramycin	7 mg/kg IV q 24 hours	3 – 5 mg/kg IV ONCE Consult Clinical Pharmacist *Consider Tobramycin inhaled*	3 mg/kg IV ONCE Consult Clinical Pharmacist *Consider Tobramycin inhaled*	• Indicated as double coverage for patients with late onset VAP • Consult clinical pharmacist for aid in dosing in patients with renal impairment • **Order a tobramycin level for 3 and 10 hours post first dose**
Tobramycin Inhaled	***Not indicated***	300 mg inhaled q 12 hours	300 mg inhaled q 12 hours	• Indicated as double coverage for patients with late onset VAP that have developed acute renal insufficiency • No tobramycin levels indicated
Gram-Positive Cocci Empiric Therapy				
Vancomycin	15 mg/kg IV q 8 hours	15 mg/kg IV q 12 hours Consult Clinical Pharmacist	15 mg/kg IV ONCE Consult Clinical Pharmacist	• Indicated as initial treatment of late onset VAP
Linezolid (Zyvox®)	600 mg IV/PO q 12 hours	600 mg IV/PO q 12 hours	600 mg IV/PO q 12 hours	• Reserved for late onset VAP when at least one is met: 1. Patient has a documented vancomycin allergy or sensitivity 2. Patient had a previous course of vancomycin within 7 days 3. Patient is not improving clinically after 72 hours of vancomycin therapy.

Selected Empiric Antibiotic Regimens

***** Risk for multi-drug resistant pathogen (MDR): Current Hospitalization of 5 days or more, Antimicrobial therapy in preceding 90 days (therapeutic antimicrobial treatment ONLY), Antibiotic resistance likely in place prior to admission, Prior hospitalization for greater than 2 days in the preceding 30 days, Residence in a nursing home or extended care facility, Home infusion therapy, Chronic dialysis within 30 days, Chronic wound care, Immunosuppressive disease and/or therapy.

Pneumonia *See orderset: ICU IP HCAP/HAP/VAP Protocol* (for ICU patients)

- Ventilator associated pneumonia – 7 days
  - VAP with non-lactose fermenting gram negative bacilli, such as *Pseudomonas*– 7 - 14 days
- Community acquired pneumonia – 5 - 7 days

Bacteremia

- *Staphylococcus aureus* bacteremia – 14 days
  - MSSA – nafcillin 2grams every 4 hours IV or cefazolin 2grams every 6 hours IV
  - MRSA – vancomycin 15mg/kg every 8-12 hours
- *Coagulase*-negative *Staphylococci* bacteremia – 5-7 days
  - If not contaminant (grew from multiple sites and stick)
- Gram-negative bacilli bacteremia – 7-14 days

Fungemia

- Candida albicans: Fluconazole 800mg (12mg/kg) IV x1, followed by 400mg (6mg/kg) IV q24
  - Decrease dose by 50% if CrCl <50
- Candida glabrata or krusei: micafungin 100mg IV daily
  - PNA-fish should identify albicans vs. glabrata or krusei within the 48 hours
- Duration - 14 days after the first negative blood culture

Sinusitis

- Ocean (normal saline) nasal spray 1 spray each nare QID
- Oxymetazoline 2 sprays to each nare BID x 3 days

Intra-abdominal/ Peritonitis (empiric)

- Ciprofloxacin 400mg IV q12h and Metronidazole 500mg IV q8h
- Risk for MDR* - Piperacillin/tazobactam IV
  - < 100 kg - 3.375 grams every 8 hours (Use every 12 hours if CrCl < 20)
  - 100 – 119kg – 4.5 grams every 8 hours (Use every 12 hours if CrCl < 20)
  - > 119kg – 6.75 grams every 8 hours (Use every 12 hours if CrCl < 20)
- PCN allergy with no MDR* risk: Ertapenem 1gram every 24 hours
- PCN allergy with MDR* risk: Meropenem 500-1000mg every 8 hours
- Empiric duration – 5-7 days

Urinary Tract Infections

- Uncomplicated UTI – Women
  - Nitrofurantoin (Macrobid) 100mg BID x 5 days
    - Do NOT use if CrCl < 60
  - **Trimethoprim/Sulfamethoxazole (Bactrim)** DS BID x 3 days
    - Do NOT use if CrCl < 60
  - Cephalexin (Keflex) 500mg BID x 7 days
- Catheter associated UTI or complicated UTI – 7 days
  - IV - Ceftriaxone 2 grams every 24 hours
  - PO - Bactrim DS 2 tablets BID (Do NOT use if CrCl < 60)
  - Risk for MDR* Pathogen – Cefepime 2 grams every 24 hours
- Candiduria:
  - Asymptomatic: change foley, and re-culture post catheter removal
    - no anti-fungal treatment
  - Symptomatic or recurrent candiduria after catheter removal treat with fluconazole 200mg (3mg/kg) q24h for 5-7 days
- Non-candida fungal UTI – Micafungin 100mg every 24 hours for 5-7 days
- Do not treat asymptomatic bacteriuria in:
  - Premenopausal, nonpregnant women
  - Diabetic women
  - Elderly, institutionalized subjects
  - Persons with spinal cord injury
  - Catheterized patients while the catheter remains in situ

Antibiotic regimens for the treatment of *Clostridium difficile* infection in adults

Clinical definition	Treatment*
Nonsevere disease Supportive clinical data: White blood cell count ≤15,000 cells/mL and serum creatinine <1.5 mg/dL	
Initial episode	▪ Vancomycin 125 mg orally four times daily for 10 days, **OR** ▪ Fidaxomicin 200 mg orally twice daily for 10 days ▪ If above agents are unavailable: Metronidazole 500 mg orally three times daily for 10 days¶
First recurrence	▪ If vancomycin was used for the initial episode: • Vancomycin pulsed-tapered regimen: ○ 125 mg orally four times daily for 10 to 14 days, then ○ 125 mg orally twice daily for 7 days, then ○ 125 mg orally once daily for 7 days, then ○ 125 mg orally every 2 or 3 days for 2 to 8 weeks, **OR** • Fidaxomicin 200 mg orally twice daily for 10 days ▪ If fidaxomicin or metronidazole was used for the initial episode: Vancomycin 125 mg orally four times daily for 10 days
Second or subsequent recurrence	▪ Vancomycin pulsed-tapered regimen (outlined above), **OR** ▪ Fidaxomicin 200 mg orally twice daily for 10 days, **OR** ▪ Vancomycin followed by rifaximin: • Vancomycin 125 mg orally four times per day for 10 days, then • Rifaximin 400 mg three times daily for 20 days, **OR** ▪ Fecal microbiota transplantation$^{\Delta}$
Severe disease◇ Supportive clinical data: White blood cell count >15,000 cells/mL and/or serum creatinine ≥1.5 mg/dL	▪ Vancomycin 125 mg orally four times daily for 10 days, **OR** ▪ Fidaxomicin 200 mg orally twice daily for 10 days
Fulminant disease (previously referred to as severe, complicated *C. difficile* infection)◇ Supportive clinical data: Hypotension or shock, ileus, megacolon	▪ Enteric vancomycin plus parenteral metronidazole: • Vancomycin 500 mg orally or via nasogastric tube four times daily, **AND** • Metronidazole 500 mg intravenously every 8 hours ▪ If ileus is present, rectal vancomycin may be administered as a retention enema (500 mg in 100 mL normal saline per rectum; retained for as long as possible and readministered every 6 hours)§

Acute Kidney Injury

Adequate urine output for adults is 0.5cc/kg/hr, which is ≥ 30cc/hr in most patients

Acute kidney injury – toxic phenomenon not plasma volume or perfusion issue

Stage 1: UOP < 0.5 mL/kg/hr > 6 hours or 50-100% increase in Cr

Stage 2: UOP < 0.5 mL/kg/hr > 12 hours or 200-300% increase in Cr

Stage 3: UOP < 0.3mL/kg/hr > 24 hours, > 300% increase in Cr, or on CRRT

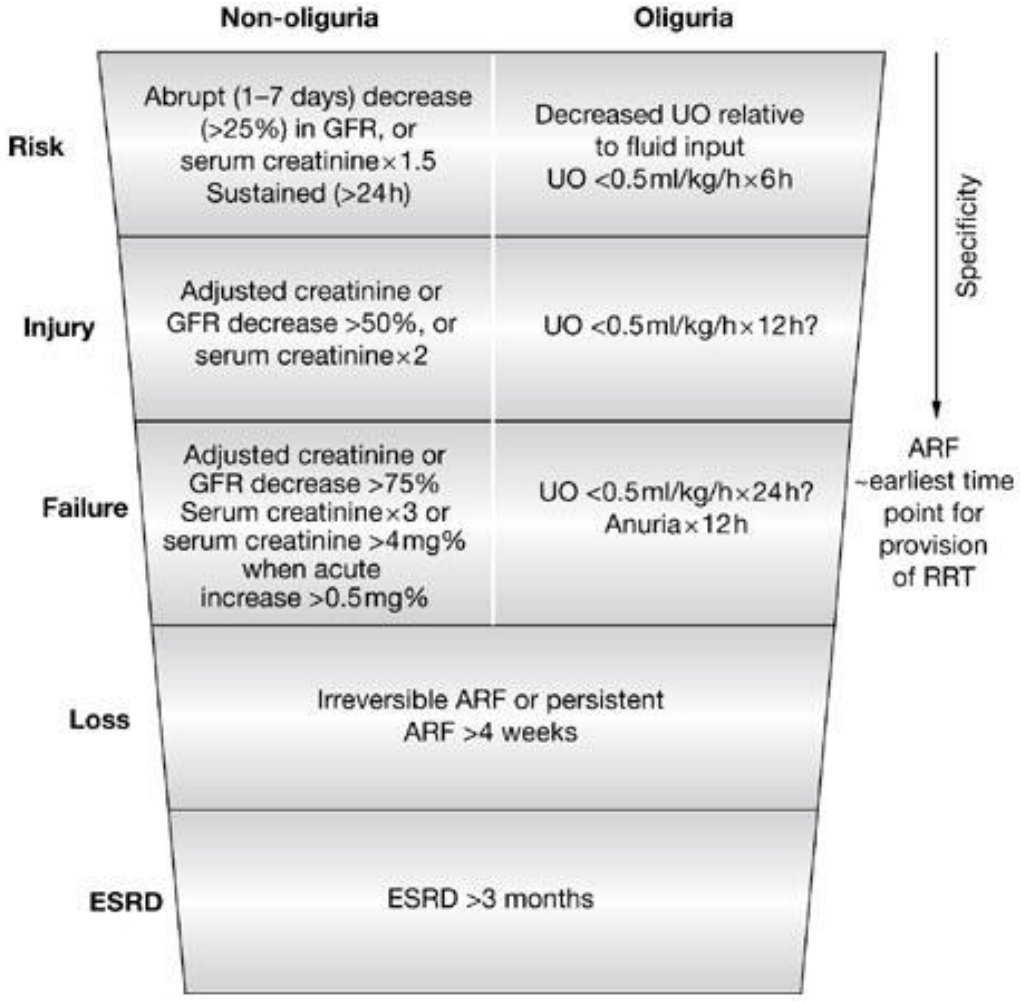
Acute renal failure – related to lack of recovery of renal function over time in setting of optimized volume status

Multiple studies show that early dialysis vs delayed vs very delayed did not benefit the patient as long as appropriately medically treated (AKIKI, AKIKI2, IDEAL ICU 2016)

RIFLE criteria of renal failure:

Three graded levels of injury (Risk, Injury, Failure) based on magnitude in elevation of either Serum Creatinine or Urine output.

Two outcome measures (Loss, ESRD).



Electrolytes

Maintenance IVF rate: (4-2-1 rule):

4cc/kg for 1st 10 kg; 2cc/kg for 2nd 10 kg; 1cc/kg beyond 20.

For adults IVF rate = 60mL/hr for 20kg + 1mL/hr for each kg over 20

HyperNa: Decrease by less than 0.5mEq/L per hour or 10mEq/L over 24 hours; give free water

HyperK: Displace plasma K with Insulin (10 units) and D50 (1 amp)

Support myocardial conduction with CaCl and $NaHCO_3$ to reverse acidosis

Reduce total body K with kayexelate (exchange Na for K, prefer PO)

HyperMg: Volume expansion and forced diuresis, or dialysis

Hyporeflexia and respiratory compromise if severe

HyperCa: Fluid resuscitation followed by furosemide diuresis

HyperCa crisis esp if Ca>14

Primarily associated with malignancy or primary hyperparathyroidism

HyperPO_4: Start binding agent, volume expansion and forced diuresis, or dialysis

Low electrolytes

- common after resuscitation, diuresis
- replete according to Electrolyte Replacement Protocol (see **Drug Dosage section**)

Renal Tubular Acidosis

Definition: blood more acidic than it should be, urine less acidic than it should be

Check Na, K, Cl levels in urine and serum K to help identify the disorder

Types of RTA

Type 1: Distal RTA

Causes – sickle cell, hyperparathyroidism, hyperthyroidism, hepatitis, renal allograft rejection, chronic UTI and obstructive uropathy

Normal anion gap metabolic acidosis, hypokalemia, hypocalcemia, hyperchloremia

Tx: alkali therapy with bicarbonate

Type 2: Proximal RTA

Causes – Fanconi syndrome, inherited nutrient disorders, ifosfamide, acetazolamide

Phosphaturia, glycosuria, proteinuria

Tx – alkali therapy with bicarbonate

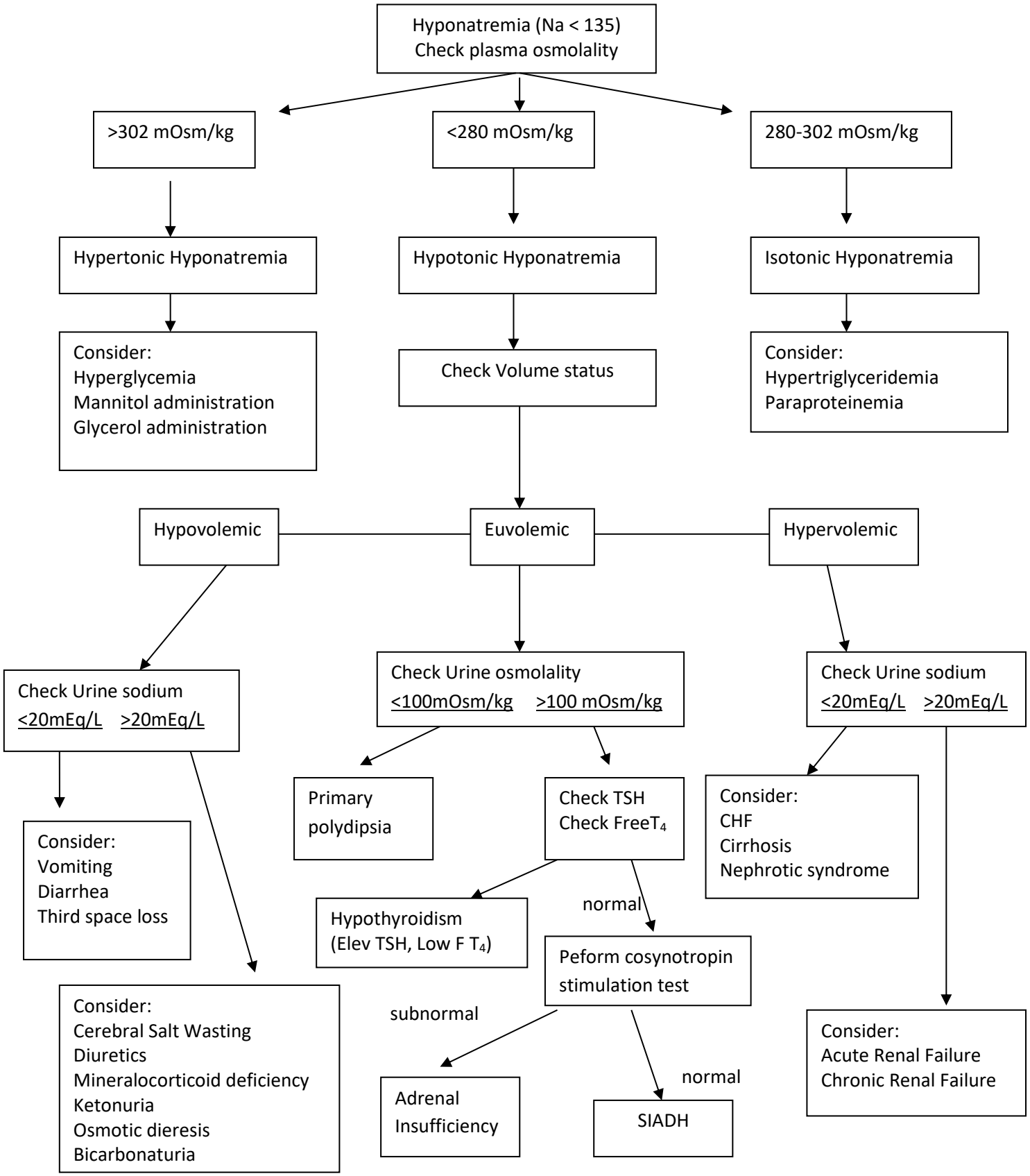
Type 3: Combination of Types 1 and 2

Type 4: Hyperkalemic RTA

Causes – low aldosterone or lack of renal response to aldosterone, diuretics, ACEi, ARBs, NSAIDs, immunosuppressive drugs

Mild (normal anion gap) metabolic acidosis, hyperkalemia

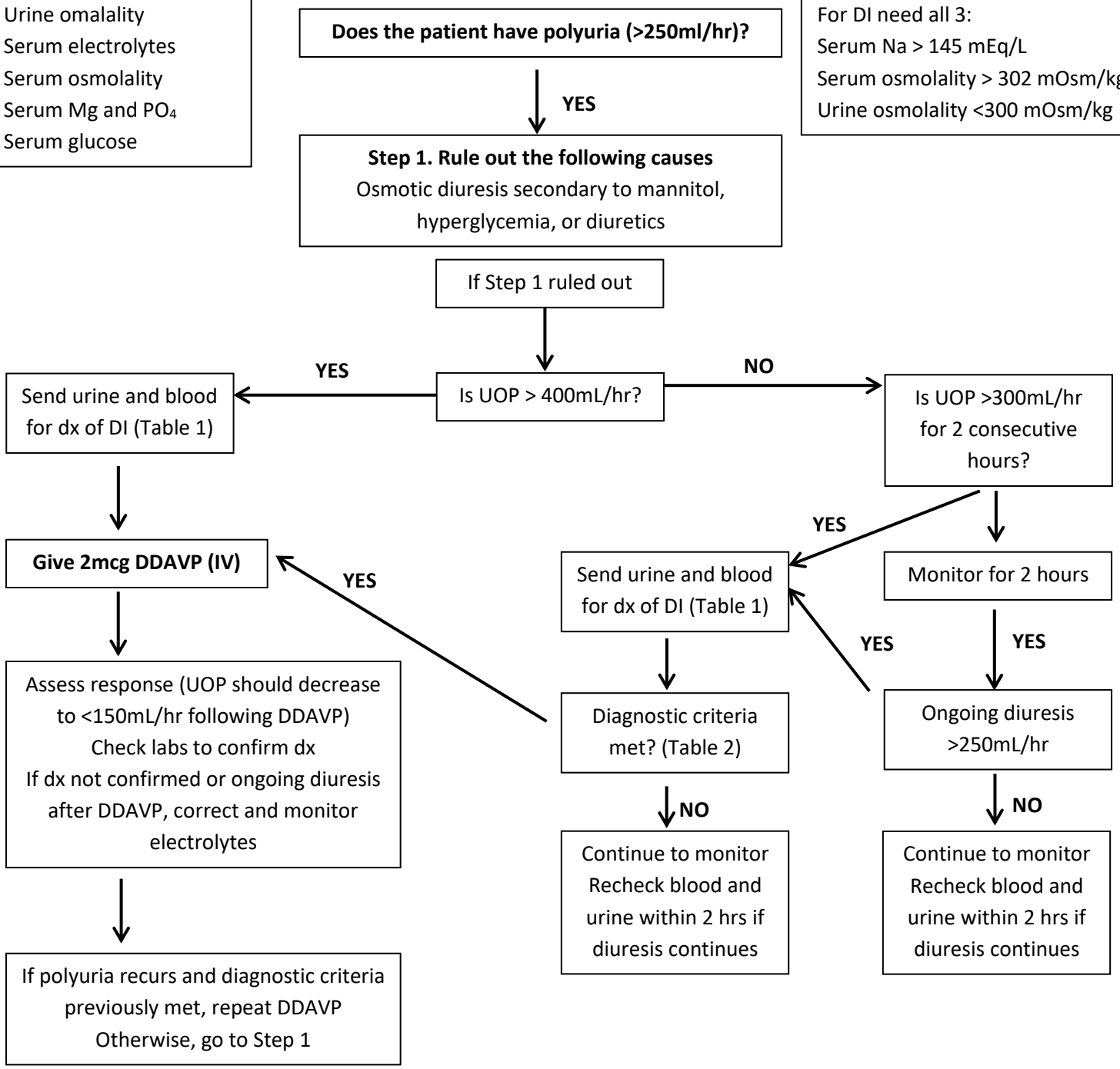
Hyponatremia Diagnostic workup



Diabetes Insipidus

Table 1. Diagnostic tests
Urine omalality
Serum electrolytes
Serum osmolality
Serum Mg and PO_4
Serum glucose

Table 2. Diagnostic criteria
For DI need all 3:
Serum Na > 145 mEq/L
Serum osmolality > 302 mOsm/kg
Urine osmolality <300 mOsm/kg



Insulin Infusion Protocol
(Not for Diabetic Ketoacidosis or Hyperosmolar Hyperglycemic Syndrome)

Discontinue all previous insulin orders and antidiabetic medication orders

Make all possible IVPB in non-dextrose containing solutions

Initiate insulin infusion of Regular Insulin: 100 units/100 mL of NS
Check or indicate Goal Blood Glucose (BG) = ☐ 110-180 mg/dL

Obtain: Blood glucose and potassium prior to initiation if not already done. Obtain phosphate and magnesium for cardiac patients.

Initiating the Infusion:

- **Algorithm 1**: Start here for most patients.
- **Algorithm 2**: Start here for patients s/p CABG, s/p solid organ transplant or islet cell transplant, receiving glucocorticoids, or patients with diabetes receiving greater than 80 units/day of insulin as an outpatient.
- **No patients should be initiated on algorithms 3, 4**

Evaluating Trends & Using Algorithms

- Move right or left only one algorithm per BG check. Subtract current BG reading from previous BG reading for the change in BG.

BG in goal range:

- If BG has decreased greater than or equal to 100 mg/dL in one hour, move **LEFT** one algorithm and use appropriate rate from table
- If BG has decreased less than 100 mg/dL in one hour, maintain patient within current algorithm and adjust rate until patient is in goal range for 4 hours
- Once patient is within goal range for 4 hours, do NOT adjust rate unless BG exits goal range

BG above goal range:

- If BG has not decreased by at least 60 mg/dL, move **RIGHT** one algorithm and use appropriate rate from table
- If BG has decreased by 60-100 mg/dL, stay within current algorithm and use appropriate rate from table
- If BG has decreased greater than or equal to 100 mg/dL in one hour, move **LEFT** one algorithm and use appropriate rate from table

Hypoglycemic event OR BG below goal range

- Turn off insulin infusion. Treat hypoglycemia if BG less than 70mg/dL. Re-check BG in 15 minutes.
- Move **LEFT** one algorithm and use appropriate rate from table when BG returns to goal range.

Algorithm 1		Algorithm 2		Algorithm 3		Algorithm 4	
BG	Units/hr	BG	Units/hr	BG	Units/hr	BG	Units/hr
Less than 70 = Hypoglycemia (See Treatment of Hypoglycemia) 70-109: Off x 15 minutes and recheck BG							
110-120	0.5	110-120	1	110-120	2	110-120	3
121-140	0.8	121-140	1.5	121-140	2.5	121-140	4
141-160	1.2	141-160	2	141-160	3	141-160	5.5
161-180	1.5	161-180	2.5	161-180	4	161-180	7
181-210	2	181-210	3	181-210	5	181-210	9
211-240	2.5	211-240	4	211-240	6	211-240	12
241-270	3	241-270	5	241-270	8	241-270	16
271-300	3.5	271-300	6	271-300	10	271-300	20
301-330	4	301-330	7	301-330	12	301-330	24
331-360	4.5	331-360	8	331-360	14	>330	28
>360	6	>360	12	>360	16		

Patient Monitoring:

☑ Check BG every 1 hour until it is within **goal** range for 4 hours. Then decrease BG checks to every 2 hours. ALWAYS resume hourly checks if BG exits goal range. Hourly monitoring may be indicated for critically ill patients having medical or surgical procedures even if they have stable BG.

TPN/ Enteral feeding:

☑ If TPN/ Enteral feeding is stopped or significantly reduced, decrease insulin infusion by 50% for 1 hour. Then, use algorithm table & instructions to determine subsequent rate changes **AND** check BG every 1 hour x 4 hours.

Treatment of Hypoglycemia (Blood glucose less than 70 mg/dL) - **Turn off insulin infusion AND**

A. If patient can take PO, and the blood glucose is between 50 and 70 mg/dL, give 15 grams of fast acting carbohydrate (4 oz fruit juice/non diet soda) If the blood glucose is below 50 mg/dL give 30 grams of fast acting carbohydrate on first attempt to correct the hypoglycemia. If further attempts are necessary, revert to 15 grams of carbohydrate.
B. If patient cannot take PO; Awake: $D_{50}W$ – 25 ml (1/2 amp) IV push, Not awake (i.e. sedated): $D_{50}W$ –50 ml (1 amp) IV push
C. Check finger stick glucose every 15 minutes and repeat above until blood glucose is greater than 70 mg/dL.

Notify the Provider:

- ☑ For any BG increase greater than 100 mg/dL from a stable baseline
- ☑ For 2 consecutive BG decreases of greater than 100 mg/dL
- ☑ For any hypoglycemia which results in loss of consciousness **OR** does not resolve within 20 min of implementing the hypoglycemia protocol above
- ☑ Failure of algorithm 4 (Consider Endocrine consult)

General Guidelines:

- ► **Start insulin infusion for ICU patients when BG greater than 140mg/dL**. Start insulin infusion for acute care patients when ordered. Transportation off unit: Ensure that glucose will continue to be monitored and insulin adjusted.
- ► For ICU patients, when mechanical ventilation is discontinued, consider targeting BG 100-180 mg/dL
- ► Transition to Subcutaneous insulin when patient is ready to eat (See "Transition Guidelines" section).
- ► Patients may not receive insulin by more than one route (i.e. IV/ Subcutaneous) except at transition off IV insulin or by order of an endocrine consult team.

Transition Guidelines:

CONSULT Diabetes NOW OR ENDOCRINE SERVICE FOR TRANSITION RECOMMENDATIONS ON:

- Patients with Type I DM, insulin-requiring cystic fibrosis, pancreatitis, high-dose glucocorticoids, s/p pancreatectomy, on home insulin pump treatment
- Patients with unstable BG/ insulin infusion rates OR unexpectedly high insulin requirements

WHEN TO TRANSITION:

- For ICU patients, consider transition to Subcutaneous insulin when the patient is medically stable, tolerating PO intake or receiving stable enteral nutrition and BG in Goal Range x 6 hours.

HOW TO TRANSITION:

- DO NOT DISCONTINUE INSULIN INFUSION UNTIL 2 HOURS AFTER BASAL SUBCUTANEOUS DOSE GIVEN
- Appropriate Basal Subcutaneous insulin dose can be given at any time of day

Nursing Documentation:

► Document on flow sheet each hour or every other hour BG check:

- Insulin infusion rate
- Algorithm, under IV Titration Parameters
- Glucose – POCT

General Guidelines for Intravenous Insulin therapy:

Potential Indications for Insulin Infusions

Diabetes Care, Volume 33, Supplement 1, January 2010

- Prolong fasting in Type 1 diabetes
- Critical illness of any kind
- Major surgical procedures
- Organ transplantation
- TPN therapy
- Labor and delivery
- Myocardial infarction

Standard drip: 100 units/100 ml 0.9% NaCl via an infusion device.

Determining Goal Blood Glucose:

- 100-150 mg/dL or 100-180 mg/dL (Recommended for majority of critically ill patients)
  - Finfer S, et al. N Engl J Med. 2009;360:1283-1297.
  - Consensus: Inpatient Hyperglycemia, Diabetes Care. 2009; 32(No. 6)
  - Consensus: Inpatient Hyperglycemia, Endocr Pract. 2009; 15(No. 4)

Intravenous Fluids:

- Most patients will need 5-10 gm of glucose per hour (e.g. D_5W at 100-200 ml/hr or equivalent (TPN, enteral feeds, etc)
- Some patient populations will have contraindications to intravenous fluids containing dextrose, attempt to feed these patients as soon as appropriate to supply caloric substrate

Initiating the Infusion: Start insulin infusion for ICU patients when BG greater than 140mg/dL.

- **Algorithm 1**: Start here for most patients.
- **Algorithm 2**: Start here for patients s/p CABG, s/p solid organ transplant or islet cell transplant, receiving glucocorticoids, or patients with diabetes receiving greater than 80 units/day of insulin as an outpatient.
- **No patients should be initiated on algorithms 3, 4**

Converting a patient from an insulin infusion to subcutaneous insulin therapy

- Determine the insulin requirements for the last 24 hours. If the infusion rate of the insulin has fluctuated be conservative with your estimation.
- Using Computerized Physician Order Entry, use the Basal, Bolus, Correction Subcutaneous Insulin Therapy computerized order set to place patient orders. If not using Computerized Physician Order Entry, use a preprinted form for Basal, Bolus, Correction Subcutaneous Insulin Therapy.
- The Basal dose should be 40% of the insulin requirements for the last 24 hours using either glargine (Lantus) or NPH insulin.
- If the patient is eating, the Bolus dose should be 40% of the insulin requirements for the last 24 hours divided by 3 and given prior to meals as either regular or aspart (Novolog) insulin.
- Correction insulin is intended to correct for glucose levels that are not adequately treated with basal and bolus insulin
- If a patient is on continuous tube feedings, administer bolus every 6 hours. In this situation regular insulin is preferred.

Studies to consider

NICE SUGAR 2009

Leuven I/II

Critical Illness-Related Corticosteroid Insufficiency (CIRCI)

* **For septic shock not responsive to fluids and moderate to high dose vasopressors**
* **Check a 250ug cosyntropin stimulation test (delta less than 9ug/dL in 60 min cortisol may diagnose CIRCI)**
* **Start hydrocortisone 100mg q8 hours and continue for ≥ 3 days**

Guidelines from the Society of Critical Care Medicine (Inten Care Med 2017)

- No recommendation regarding whether to use delta cortisol (change in baseline cortisol at 60 min <9ug/dL) after 250ug cosyntropin administration or a random plasma cortisol of <10ug/dL for diagnosis of CIRCI
- Recommend against using plasma free cortisol or salivary cortisol to diagnose CIRCI
- Suggest the use of 250ug ACTH stimulation test rather than the hemodynamic response to hydrocortisone for the diagnosis of CIRCI (low quality evidence)
- Recommend against using corticosteroids in adult patients with sepsis *without* shock
- Suggest using corticosteroids in patients with septic shock not responsive to fluid therapy and moderate to high dose vasopressor therapy
- Recommend if using corticosteroids for septic shock to use a long course and low dose (hydrocortisone <400mg/day for ≥ 3 days) rather than high dose short course

Management of Traumatic Brain Injury

Consult with Neurosurgery prior to initiation of ANY orders

Intracranial pressure monitors are placed in patients with abnormal GCS ≤8.

- Bolt (Intraparenchymal, ICP monitor)
- Ventriculostomy (EVD), can drain CSF

Cerebral Perfusion Pressure (CPP) = MAP – ICP; Goal: ≥ 65mmHg

ICP Management: Goal ICP ≤ 20

- Mechanical Measures: HOB 30° if T/L spine clear, check C-collar for excessive tightness, head neutral position
- Respiratory Measures: Keep $PaCO_2$ 35-40
- Sedation / Analgesia: titrate for effect, supplement with enteral agents
    - Minimize stimulation (no baths, lights off)
    - Treat symptoms of withdrawal or anxiety
    - Sedation: Propofol (Max 50 mcg/kg/min), midazolam, lorazepam, dexmedetomidine
    - Analgesia: Fentanyl (Max 200 mcg/hr), morphine, dilaudid
    - Monitor for effect on CPP
- Hyperosmotic therapy. Choose one agent and continue that agent alone until treatment fails, at that time consider the other agent as alternative osmotic therapy.
    - 3% Hypertonic saline (HTS) infusion protocol for goal Na of 145-155 mEq/L, usually run 30-40 cc/hr
        - 7.5% HTS 250 mL IV bolus
        - 23.4% HTS 30 mL IV bolus, (aka “salt bomb”)
    - Mannitol boluses of 0.25 – 1.0 gm/kg. Do not give if serum Osm≥ 320 mOsm/kg
        - May need urine replacement fluids, monitor volume status
- CSF drainage
    - Initial: Drain 5mL of CSF if ICP ≥ 20 for 5 min
    - Aggressive: Drain 10 ml of CSF if ICP > 20 for 5 min
- Hyperventilation
    - Initial: moderate hyperventilation for goal $PaCO_2$ = 30-35 mmHg
    - Aggressive: maximum hyperventilation for goal $PaCO_2$ = 25-30 mmHg up to 15 minutes
- Maximal Level Interventions
    - Surgical Decompression
    - Neuromuscular blockade
        - Vecuronium 1 mg/kg/hr, titrate to TOF = 2
    - Barbituate coma with EEG for burst suppression monitoring
        - Load dose 15 mg/kg pentobarbital IV load over 30-60 minutes
        - Then 15 mg/kg pentobarbital IV over 3 hours
        - Then 1.5 mg/kg/hr continuous infusion
        - Check serum pentobarbital level at 24h

Cerebral Perfusion Pressure (CPP) Management:

- If ICP > 20, treat ICP
- If ICP < 20, treat MAP
    - May need pressors, even if normotensive, to maintain CPP
    - Levophed (Norepinephrine), titrate for CPP ≥ 65

Glasgow Coma Scale

Eye response

1. No eye opening
2. Eye opening in response to pain stimulus.
3. Eye opening to speech.
4. Eyes opening spontaneously

Verbal response:

1. No verbal response
2. Incomprehensible sounds. (Moaning but no words.)
3. Inappropriate words. (Speaks words but no sentences.)
4. Confused. (The patient responds to questions coherently but there is some confusion.)
5. Oriented. (Patient responds coherently and appropriately to questions)

Motor response:

1. No motor response
2. Decerebrate posturing accentuated by pain (extensor response: adduction of arm, internal rotation of shoulder, pronation of forearm and extension at elbow, flexion of wrist and fingers, leg extension, plantarflexion of foot)
3. Decorticate posturing accentuated by pain (flexor response: internal rotation of shoulder, flexion of forearm and wrist with clenched fist, leg extension, plantarflexion of foot)
4. Withdrawal from pain (Absence of abnormal posturing)
5. Localizes to pain (Purposeful movements towards painful stimuli; e.g., brings beyond midline)
6. Obeys commands

RANCHO LOS AMIGOS SCALE

Level I - No Response.
Patient does not respond to external stimuli and appears asleep.

Level II - Generalized Response.
Patient reacts to external stimuli in nonspecific, inconsistent, and nonpurposeful manner with stereotypic and limited responses.

Level III - Localized Response.
Patient responds specifically and inconsistently with delays to stimuli, but may follow simple commands for motor action.

Level IV - Confused, Agitated Response.
Patient exhibits bizarre, nonpurposeful, incoherent or inappropriate behaviors, has no short-term recall, attention is short and nonselective.

Level V - Confused, Inappropriate, Nonagitated Response.
Patient gives random, fragmented, and nonpurposeful responses to complex or unstructured stimuli - Simple commands are followed consistently, memory and selective attention are impaired, and new information is not retained.

Level VI - Confused, Appropriate Response.
Patient gives context appropriate, goal-directed responses, dependent upon external input for direction. There is carry-over for relearned, but not for new tasks, and recent memory problems persist.

Level VII - Automatic, Appropriate Response.
Patient behaves appropriately in familiar settings, performs daily routines automatically, and shows carry-over for new learning at lower than normal rates. Patient initiates social interactions, but judgment remains impaired.

Level VIII - Purposeful, Appropriate Response.
Patient oriented and responds to the environment but abstract reasoning abilities are decreased relative to premorbid levels.

Hypertonic saline protocol

Infuse through a central line. Infusion via a peripheral line requires the order of an attending / fellow.

CHECK APPROPRIATE LEVEL

□ **Level 1: -Patients with *ACUTE (less than 72 hrs)* hyponatremia: Goal Sodium: 135 to 146 mEq/L**
**** Serum sodium must not rise by more than 12 meq in 24 hours ****
**** Donot use in chronic (more than 72 hours) hyponatremia ****
**** Donot use in patients with chronic alcoholism or on medications causing chronic hyponatremia (e.g carabamazepine) ****

Baseline sodium BELOW 125 mEq/L -Start 3% sodium chloride IV 35 mL/hour.
Baseline sodium Below 130 mEq/L -Start 3% sodium chloride IV at 30 mL/hour.

Labs: If sodium LESS than 147 mEq/L, then draw **sodium** (NOT EP1) every 6 hours
If sodium GREATER than 146 mEq/L, then draw **sodium** (NOT EP1) every 4 hours

If Sodium is:	**Treatment**
LESS than 125 mEq/L	Increase rate by 10 mL/hour to maximum rate of 60 mL/hour.
125 to 132 mEq/L	Increase by 5 mL/hour to maximum rate of 60 mL/hour.
133 to 138 mEq/L	Maintain infusion
GREATER than 138 mEq/L	Decrease rate by 5 mL/hour
GREATER than 140 mEq/L	Decrease rate by 10 mL/hour
GREATER than 143 mEq/L	Hold infusion and restart at 20 mL/hour ONLY when sodium is BELOW 140 mEq/L -Donot restart if sodium has increased by more then 1 meq per hour (e.g 145 to 160 in 6 hours). Restart on physician order.
GREATER than 145 mEq/L	Do not restart until ordered by physician (attending or fellow)

☐ **Level 2: -Patients at high risk for raised ICP: Goal Sodium: 140 to 150 mEq/L**

Baseline sodium BELOW 134 mEq/L -Start 3% sodium chloride IV with 150 ml bolus then at 30 mL/hour.
Baseline sodium 134 to 139 mEq/L -Start 3% sodium chloride IV at 30 mL/hour.
Baseline sodium ABOVE 139 mEq/L -Start 3% sodium chloride IV at 25 mL/hour

Labs: If sodium LESS than 150 mEq/L, then draw **sodium** (NOT EP1) every 6 hours
If sodium GREATER than 150 mEq/L, then draw **sodium** (NOT EP1) every 4 hours
If the sodium is GREATER than 153 mEq/L also draw **osmolality with sodium** as above.

If Sodium is:	**Treatment (Give all bolus doses over 30 mins)**
LESS than 135 mEq/L	Increase rate by 10 mL/hour to maximum rate of 60 mL/hour. If at 60 mL/hour, give 200 mL bolus of 3% NaCl x 1
135 to 139 mEq/L	Increase by 5 mL/hour to maximum rate of 60 mL/hour. If at 60 mL/hour, give 150 mL bolus of 3% NaCl x 1
140 to 147 mEq/L	Maintain infusion
GREATER than 147 mEq/L	Decrease rate by 5 mL/hour
GREATER than 150 mEq/L	Decrease rate by 10 mL/hour
GREATER than 155 mEq/L	Hold infusion and restart at 20 mL/hour ONLY when sodium is BELOW 150 mEq/L -Donot restart if sodium has increased by more then 1 meq per hour (e.g 145 to 160 in 6 hours). Restart on physician order.
GREATER than 160 mEq/L	Do not restart until ordered by physician (attending or fellow)

☐ **Level 3: -Patients with increased ICP: Goal Sodium: 145 to 155 mEq/L**

Baseline sodium BELOW 137 mEq/L -Start 3% sodium chloride IV with 250 ml bolus then at 50 mL/hour.
Baseline sodium 137 to 140 mEq/L -Start 3% sodium chloride IV with 150 ml bolus then at 45 mL/hour.
Baseline sodium ABOVE 140 mEq/L -Start 3% sodium chloride IV at 40 mL/hour.

Labs: If sodium LESS than 150 mEq/L, then draw **sodium** (NOT EP1) every 6 hours
If sodium GREATER than 150 mEq/L, then draw **sodium** (NOT EP1) every 4 hours
If the sodium is GREATER than 153 mEq/L also draw **osmolality with sodium** as above.

If Sodium is:	Treatment (Give all bolus doses over 30 mins)
LESS than 135 mEq/L	Increase by 10 mL/hour to maximum rate of 90 mL/hour. If at 90 mL/hour, give 250 mL bolus of 3% NaCl x 1
135 to 144 mEq/L	Increase by 5 mL/hour to maximum rate of 90 mL/hour. If at 90 mL/hour, give 150 mL bolus of 3% NaCl x 1
145 to 152 mEq/L	Maintain infusion
GREATER than 152 mEq/L	Decrease rate by 5 mL/hour
GREATER than 155 mEq/L	Decrease rate by 15 mL/hour
GREATER than 159 mEq/L	Hold infusion for 4 hours and restart at 50% of previous rate. -Donot restart if sodium has increased by more then 1 meq per hour (e.g 145 to 160 in 6 hours). Restart on physician order.
GREATER than 163 mEq/L	Hold infusion, recheck sodium every 4 hours and restart at 20 mL/hour ONLY when sodium is BELOW 156 mEq/L -Donot restart if sodium has increased by more then 1 meq per hour (e.g 150 to 165 in 4 hours). Restart on physician order.
GREATER than 166 mEq/L	Do not restart until ordered by physician (attending or fellow)

□ **Level 4: -Patients with refractory ICP: Goal Sodium: 150 to 160 mEq/L**

Baseline sodium BELOW 137 mEq/L -Start 3% sodium chloride IV with 250 ml bolus then at 70 mL/hour.
Baseline sodium 137 to 140 mEq/L -Start 3% sodium chloride IV with 150 ml bolus then at 60 mL/hour.
Baseline sodium ABOVE 140 mEq/L -Start 3% sodium chloride IV at 50 mL/hour.

Labs: If sodium LESS than 150 mEq/L, then draw **sodium** (NOT EP1) every 6 hours
If sodium GREATER than 150 mEq/L, then draw **sodium** (NOT EP1) every 4 hours
If the sodium is GREATER than 153 mEq/L also draw **osmolality with sodium** as above.

If Sodium is:	Treatment (Give all bolus doses over 30 mins)
LESS than 140 mEq/L	Increase by 10 mL/hour to maximum rate of 130 mL/hour. If at 130 mL/hour, give 250 mL bolus of 3% NaCl x 1
140 to 148 mEq/L	Increase by 5 mL/hour to maximum rate of 130 mL/hour. If at 130 mL/hour, give 150 mL bolus of 3% NaCl x 1
149 to 155 mEq/L	Maintain infusion
GREATER than 155 mEq/L	Decrease rate by 10 mL/hour
GREATER than 158 mEq/L	Decrease rate by 20 mL/hour
GREATER than 161 mEq/L	Hold infusion for 8 hours and restart at 50% of previous rate. -Donot restart if sodium has increased by more then 1 meq per hour (e.g 145 to 160 in 6 hours). Restart on physician order.
GREATER than 163 mEq/L	Hold infusion, recheck sodium every 4 hours and restart at 20 mL/hour ONLY when sodium is BELOW 157 mEq/L -Donot restart if sodium has increased by more then 1 meq per hour (e.g 150 to 165 in 4 hours). Restart on physician order.

GREATER than 166 mEq/L	Do not restart until ordered by physician (attending or fellow)

□ Weaning 3% Sodium Chloride.

Labs: During weaning the serum sodium should only be drawn 8-16 hours after starting the wean and 8 – 16 hours after discontinuing the infusion

3% sodium chloride infusion rate	Weaning protocol
100 ml/hour or GREATER	75 mL/hour for 12 hours then 50 mL/hour for 12 hours then 30 mL/hour for 12 hours then 10 mL/hour for 12 hours and stop
60 ml/hour or GREATER	45 mL/hour for 8 hours then 20 mL/hour for 8 hours then 10 mL/hour for 8 hours and stop
45 ml/hour or GREATER	25 mL/hour for 8 hours then 15 mL/hour for 8 hours and then 5 mL/hour for 8 hours and stop
30 ml/hour or GREATER	20 mL/hour for 8 hours then 10 mL/hour for 8 hours then 5 mL/hour for 8 hours and stop
BELOW 30 ml/hour	10 mL/hour for 8 hours then 5 mL/hour for 8 hours and stop

Tables for Pain and Sedation Evaluation

Glasgow Coma Scale / Pediatric GCS (verbal adjustment)

Eye opening	Best verbal	Best Motor	Pedi verbal
4- Spontaneous	5 - Oriented, appropriate	6 - Obeys commands	5- Smiles, follows, interacts, oriented to sounds
3- Open to speech	4 - Confused	5 - Localizes	4-Cries, consolable, inappropriate
2- Open to pain	3 - Inappropriate words	4 - Withdraws	3- inconsistent consolable, moaning
1- No response	2 - Incomprehensible sounds	3 - Decorticate flexion	2- inconsolable, agitated
	1 - No response	2 - Decerebrate extension	1- No response
		1 - No response	

Behavioral Pain Scale

Item	Description	Score
Facial expression	Relaxed	1
	Partially tightened (e.g., brow lowering)	2
	Fully tightened (e.g., eyelid closing)	3
	Grimacing	4
Upper limb movements	No movement	1
	Partially bent	2
	Fully bent with finger flexion	3
	Permanently retracted	4
Compliance with ventilation	Tolerating movement	1
	Coughing but tolerating vent most of time	2
	Fighting ventilator	3
	Unable to control ventilation	4

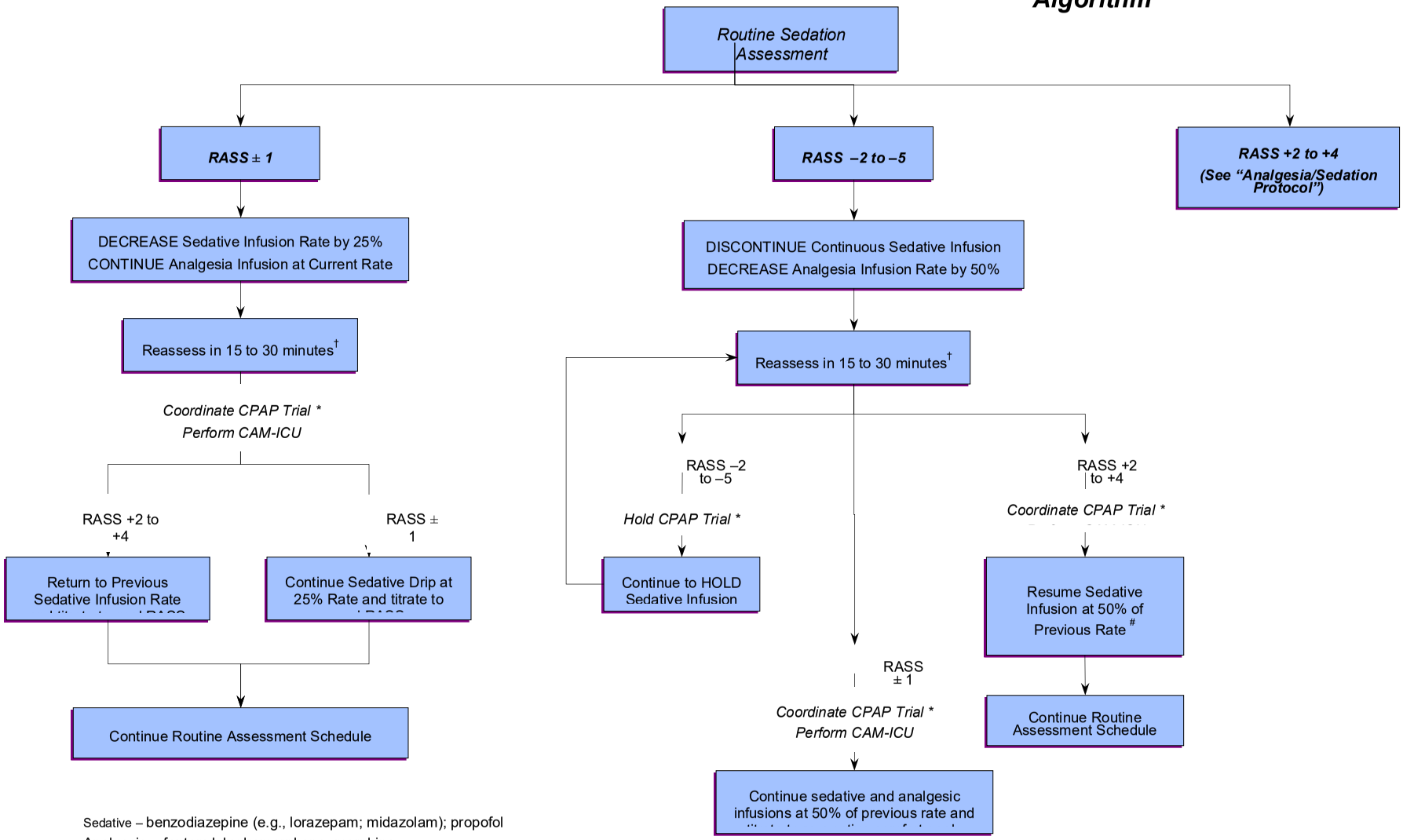
Richmond Agitation and Sedation Scale (RASS)

Score	Term	Description	
+ 4	Combative	Overtly combative, violent, immediate danger to staff	
+ 3	Very agitated	Pulls or removes tube(s) or catheter(s); aggressive	
+ 2	Agitated	Frequent non-purposeful movement; fights ventilator	
+ 1	Restless	Anxious but movements not aggressive or vigorous	
0	Alert and calm		
-1	Drowsy	Not fully alert, but as sustained awakening (eye-opening/contact) to *voice* (>10 sec)	VERBAL STIMULATION
-2	Light sedation	Briefly awakens with eye contact to *voice* (<10 sec)	
-3	Moderate sedation	Movement or eye opening to *voice* (but no eye contact)	
-4	Deep sedation	No response to voice, but movement or eye opening to *physical* stimulation	PHYSICAL STIMULATION
-5	Unarousable	No response to *voice* or *physical* stimulation	

Confusion Assessment Method –CAM- ICU Worksheet

Feature 1: Acute Onset or Fluctuating Course	**Positive**	**Negative**
Is the pt different than his/her baseline mental status? OR Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation scale (i.e., RASS), GCS, or previous delirium assessment?	**Either question Yes**	**No**
Feature 2: Inattention. Positive if score < 8. If patient unable to perform this test, move to Feature 3.	**Positive**	**Negative**
Letters Attention Test (Enter 'NT' if not tested) Directions: Say to the patient, *"I am going to read you a series of 10 letters. Whenever you hear the letter 'A,' indicate by squeezing my hand."* Read letters from the following letter list in a normal tone 3 seconds apart. **S A V E A H A A R T** **Errors are counted when patient fails to squeeze on the letter "A" and when the patient squeezes on any letter other than "A."**	**Score (out of 10):** **_____**	
Feature 3: Altered Level of Consciousness Present if the actual RASS score is anything other than alert and calm (zero)	**Positive**	**Negative**
Feature 4: Disorganized Thinking. Positive if combined score is < 4	**Positive**	**Negative**
Yes/No Questions -- Patient earns 1 point for each correct answer 1. Will a stone float on water? 2. Are there fish in the sea? 3. Does one pound weigh more than two pounds? 4. Can you use a hammer to pound a nail? **Errors are counted when the patient incorrectly answers a question.** **Command** – Patient earns 1 point if able to successfully complete task. Say to patient: "Hold up this many fingers" (Hold 2 fingers in front of patient). "Now do the same thing with the other hand" (Do not repeat number of fingers) *If pt is unable to move both arms, for 2nd part of command ask patient to "Add one more finger" **An error is counted if patient is unable to complete the entire command.**	**Combined number of errors** **_____ of 5**	
Overall CAM – ICU **Feature 1 *plus* 2 <u>and</u> either 3 *or* 4 present = CAM-ICU positive**	**Criteria Met →**	**CAM-ICU positive (Delirium present)**
	Criteria not met →	**CAM-ICU Negative (no delirium)**

Routine Titration and Wake-up Algorithm



Sedative – benzodiazepine (e.g., lorazepam; midazolam); propofol

Analgesia – fentanyl; hydromorphone; morphine

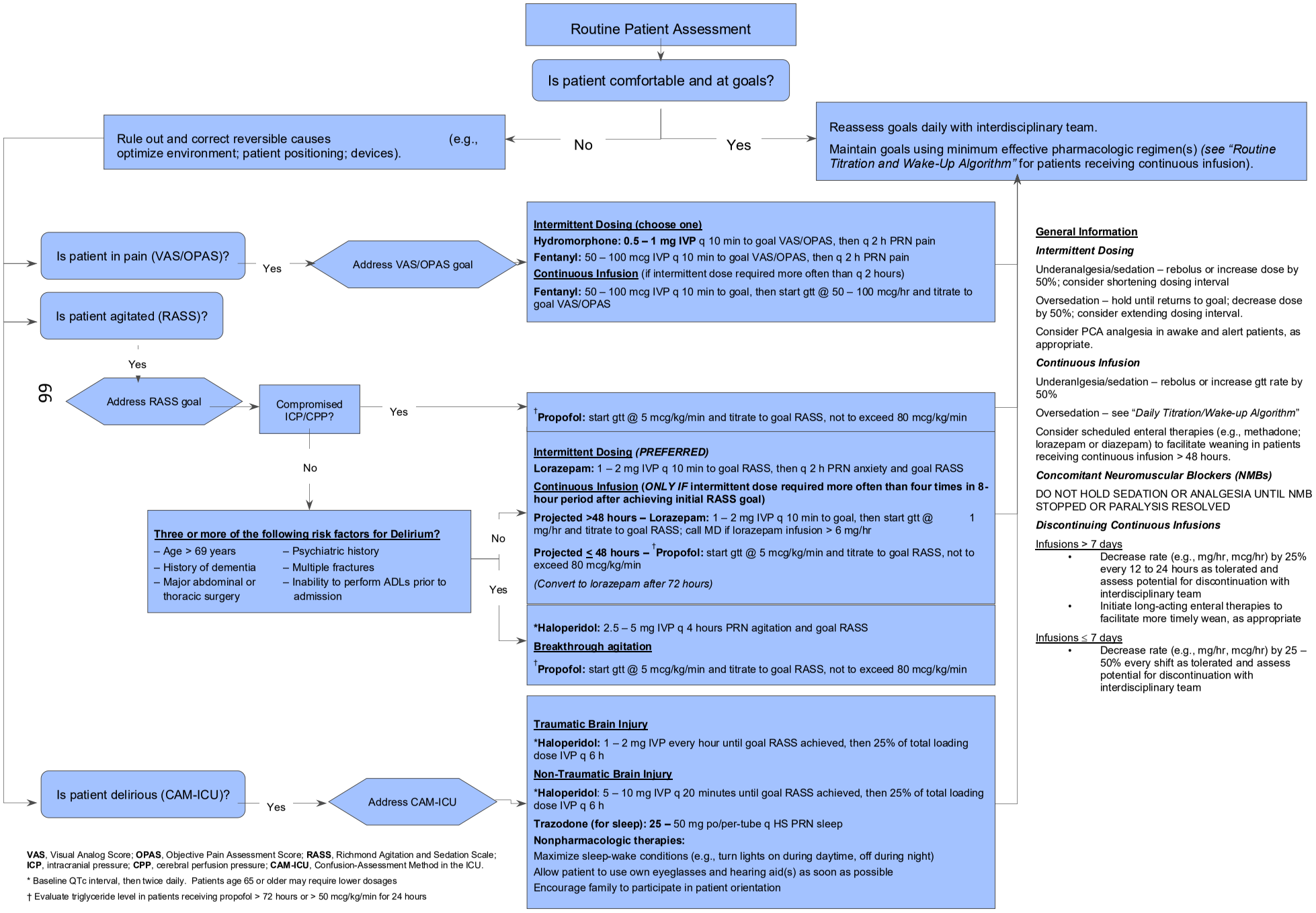
† Assessment should be done in 15 minutes for propofol and 30 minutes for benzodiazepine

* If applicable per Respiratory Therapist and Physician orders

\# Reinitiate sedation therapy to achieve goal RASS per protocol

Protocol for Analgesia, Sedation, and Anti-Delirium Therapy in Mechanically Ventilated Critically Ill Adults

Modified from Jacobi J, et al. 2002 SCCM Sedation and Analgesia Guidelines. *Crit Care Med* 2002; 30: 119-141.



General Information

Intermittent Dosing

Underanalgesia/sedation – rebolus or increase dose by 50%; consider shortening dosing interval

Oversedation – hold until returns to goal; decrease dose by 50%; consider extending dosing interval.

Consider PCA analgesia in awake and alert patients, as appropriate.

Continuous Infusion

Underanlgesia/sedation – rebolus or increase gtt rate by 50%

Oversedation – see "*Daily Titration/Wake-up Algorithm*"

Consider scheduled enteral therapies (e.g., methadone; lorazepam or diazepam) to facilitate weaning in patients receiving continuous infusion > 48 hours.

Concomitant Neuromuscular Blockers (NMBs)

DO NOT HOLD SEDATION OR ANALGESIA UNTIL NMB STOPPED OR PARALYSIS RESOLVED

Discontinuing Continuous Infusions

Infusions > 7 days

- Decrease rate (e.g., mg/hr, mcg/hr) by 25% every 12 to 24 hours as tolerated and assess potential for discontinuation with interdisciplinary team
- Initiate long-acting enteral therapies to facilitate more timely wean, as appropriate

Infusions ≤ 7 days

- Decrease rate (e.g., mg/hr, mcg/hr) by 25 – 50% every shift as tolerated and assess potential for discontinuation with interdisciplinary team

VAS, Visual Analog Score; **OPAS**, Objective Pain Assessment Score; **RASS**, Richmond Agitation and Sedation Scale; **ICP**, intracranial pressure; **CPP**, cerebral perfusion pressure; **CAM-ICU**, Confusion-Assessment Method in the ICU.

* Baseline QTc interval, then twice daily. Patients age 65 or older may require lower dosages

† Evaluate triglyceride level in patients receiving propofol > 72 hours or > 50 mcg/kg/min for 24 hours

Alcohol Withdrawal Syndrome Protocol for Non-Mechanically Ventilated Patients*

*Patients with traumatic brain injury are excluded

Surgical Intensive Care Unit

CIWA-Ar assessment

- Rally pack IV X 3 days
- Multivitamin 1 tab po qday

Total CIWA-Ar Score

≥ 10

< 10 → See "*Maintenance Control*" Box

Initial Control

Type-C Symptoms (Delirium) Subtotal ≥ 3 AND CAM-ICU(+)? — Yes → Haloperidol 5-10 mg IVP every 30 minutes PRN until Type-C Subtotal is < 3.

Call MD if Type-C Subtotal remains ≥3 after total of 30 mg of haloperidol.

CIWA-Ar < 10? — Yes / No

No

Type-A Symptoms (CNS) Subtotal ≥ 4 AND RASS ≥ +2? — Yes → CIWA-Ar < 10? — Yes / No

No

Only for patients with no evidence of ongoing blood loss

Type-B Symptoms (Adrenergic) Subtotal ≥ 3? — Yes → Clonidine 0.1 mg po/per-tube every 1 hour until Type-B Subtotal < 3 OR SBP <140; DBP < 90 mmHg.

If Type-B Subtotal remains ≥ 3 AND SBP > 140; DBP > 90 after 3 doses of above, then administer clonidine 0.2 mg po/per-tube every 1 hour until until Type-B Subtotal < 3 OR SBP <140; DBP < 90 mmHg.

* Hold parameters for all clonidine orders SBP < 100 of DBP < 60 mmHg.

CIWA-Ar < 10? — Yes / No

No → **Return to top of "*INITIAL CONTROL*" and call MD**

Maintenance Control

Maintenance CIWA Assessment

CIWA-Ar every 1 hour for initial 24 hours then every 4 hours thereafter.

If Total CIWA-Ar ≥10 at any time, then do CIWA-Ar every 1 hour.

If Total CIWA-Ar is <10 for 2 consecutive hours, then do every 4 hour assessment.

CIWA Assessment

- < 10 → Continue Maintenance CIWA Assessment
- 10 to 20
- > 20 → Return to "*Initial Control*" Box

10 to 20:

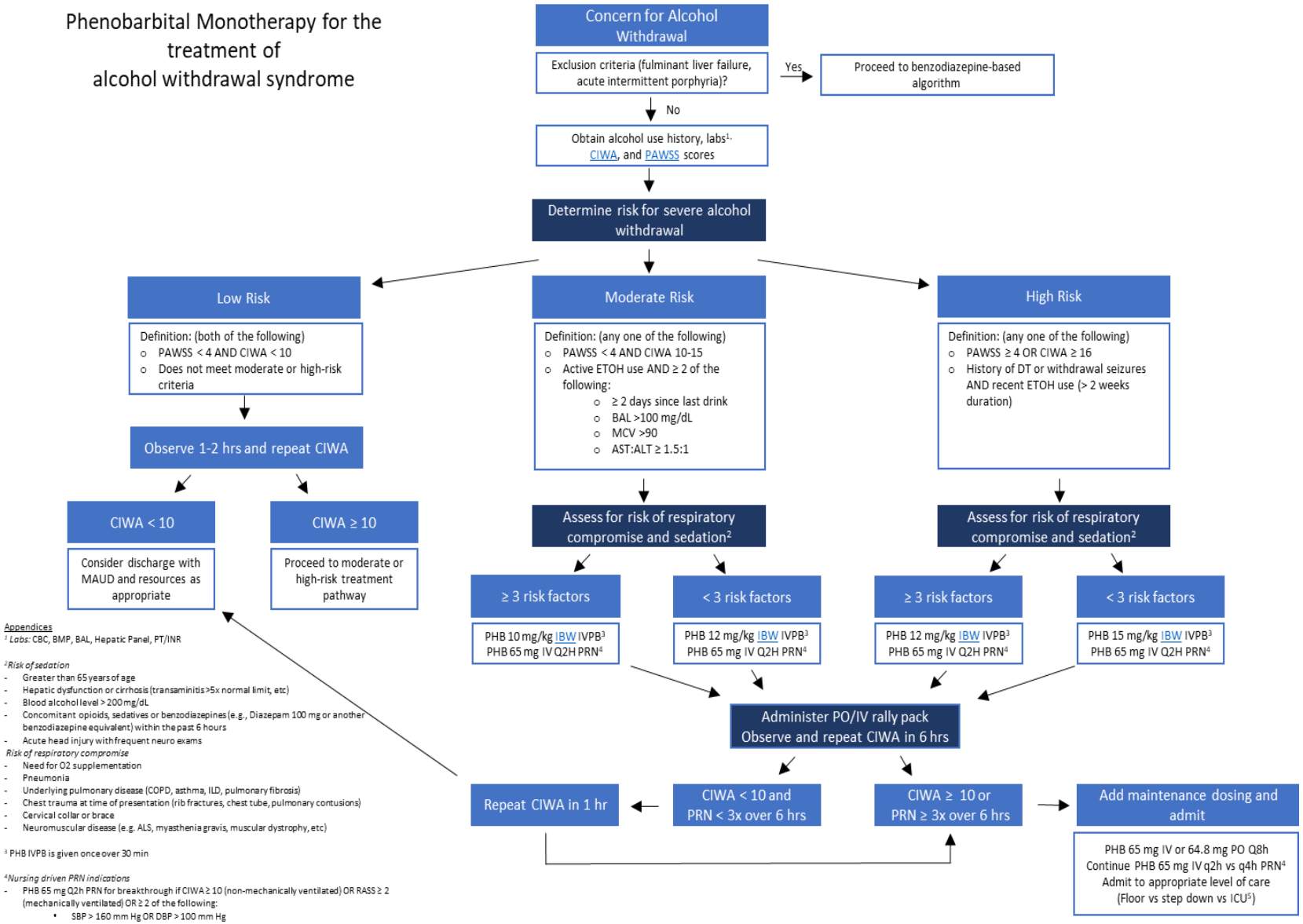
- Delirium Symptoms: Haloperidol 5-10 mg IVP PRN for Type-C Subtotal ≥ 3 per CIWA and CAM-ICU (+). Check bedside QTc interval every 12 hours.
- CNS Excitation Symptoms: Lorazepam 2 mg IVP PRN for Type-A Subtotal ≥ 4 per CIWA and RASS ≥ +2.
- Adrenergic Hyperactivity Symptoms: Clonidine 0.1 mg po/per-tube if Type-B Subtotal is ≥ 3 per CIWA.

  * If ≥ 0.6 mg clonidine required in previous 24 hours, schedule clonidine 0.1 mg po/per-tube every 8 hours.

  * Hold parameters for all clonidine orders SBP < 100 of DBP < 60 mmHg.

Continue Maintenance CIWA Assessment

Phenobarbital Monotherapy for the treatment of alcohol withdrawal syndrome



Appendices

[1] *Labs:* CBC, BMP, BAL, Hepatic Panel, PT/INR

[2] *Risk of sedation*
- Greater than 65 years of age
- Hepatic dysfunction or cirrhosis (transaminitis >5x normal limit, etc)
- Blood alcohol level > 200 mg/dL
- Concomitant opioids, sedatives or benzodiazepines (e.g., Diazepam 100 mg or another benzodiazepine equivalent) within the past 6 hours
- Acute head injury with frequent neuro exams

Risk of respiratory compromise
- Need for O2 supplementation
- Pneumonia
- Underlying pulmonary disease (COPD, asthma, ILD, pulmonary fibrosis)
- Chest trauma at time of presentation (rib fractures, chest tube, pulmonary contusions)
- Cervical collar or brace
- Neuromuscular disease (e.g. ALS, myasthenia gravis, muscular dystrophy, etc)

[3] PHB IVPB is given once over 30 min

[4] *Nursing driven PRN indications*
- PHB 65 mg Q2h PRN for breakthrough if CIWA ≥ 10 (non-mechanically ventilated) OR RASS ≥ 2 (mechanically ventilated) OR ≥ 2 of the following:
  - SBP > 160 mm Hg OR DBP > 100 mm Hg
  - HR > 110
  - Diaphoresis, tremors, hallucinations or significant agitation
- **If admitting, consider q4h PRN for floor admission. Patients requiring q2h PRN require stepdown/ICU admission.**

[5] *ICU Criteria*
- Intubation
- Severe altered mental status
- Recurrent seizures
- Hyperthermia
- Other ICU criteria

Legend
PAWSS: Prediction of Alcohol Withdrawal Severity Scale
CIWA: Clinical Institute Withdrawal Assessment
BAL: Blood Alcohol Level
PHB: Phenobarbital
MAUD: Naltrexone and Acamprosate
IBW: Ideal Body Weight

Pain, Agitation, Delirium Studies

ABC (GIRARD 2008)

Patient randomized to sedation break + sbt vs SBT

Fewer mech ventilation days, decrease ICU los, improved 90 day mortality

Self extubation (not requiring reintubation) was higher in intervention group

Kress 2000 (SLEAP 2012 did not find this, though, SLEAP is highly debated as it has a different set of protocols, primarily nursing driven)

Found daily sedation breaks while mechanically ventilated resulted in decreased mech ventilation days, icu length of stay, and fewer diagnostic scans to assess for mental staus.

No change in mortality/hospital los

No increase in incident for self extubation/self removal of lines

NONSEDA

No sedation vs light sedation

No benefit; not feasible as the study had 1:1 nurse to patient

MENDS

Precedex vs Lorazepam in mechanically vented patients

Precedex resulted in less days in delirious and closed to goal RASS

SEDCOM

Precedex vs Midazolam in mechanically vented patients

Precedex results in earlier extubation, less ICU delirium, fewer delirium days

MENDS2

SPICE III

Precedex vs Propofol in mechanically vented patients

No benefit of one drug vs the other

SPICE III found greater adverse outcomes in precede group – no mortality risk

Pandharipande 2006

Shows Lorazepam was associated with transition to delirium in the ICU

Midazolam patients were underpowered

MIND-USA 2018

Assessed for the role of scheduled antipsychotics (Haldol, ziprasidone, or placebo) scheduled for hypoactive/hyperactive delirium in the ICU. Showed no benefit in scheduling

Devlin 2010

Used scheduled quetiapine in ICU delirium, showing patients scheduled had benefit of less time in a delirious state

DNR, Comfort Care, Withdrawal of Life Sustaining Treatment, Brain Death

Family meetings and discussion regarding DNR status, comfort measures and withdrawal of support should be led by either the ICU fellow or attending, or the primary service fellow or attending.

Do Not Resuscitate (DNR) status

This is a medical decision, not a family decision, although the family should be fully informed of the medical plan of care prior to its institution. DNR orders must be signed by an attending within 24h of being placed in the chart.

DNR means that in the event of cardiovascular collapse, no CPR will be performed, i.e. no chest compressions and no medications will be pushed. It does NOT mean that care will be discontinued.

Comfort Care

All medications will be discontinued that are not needed for the patients comfort (sedation, analgesics, enteral nutrition)

Has a separate order set in EPIC and remember to ensure that CODE STATUS is changed

Withdrawal of support

Discontinuation of life support in the form of ventilators, pressors, IVF, and nutrition.

Neurologic determination of death ("brain death"): irreversible loss of all brain function determined by:

- Clinical assessment – verify unconscious state, absent brainstem reflexes:
    - Response to central painful stimulation at 3 Supraclavicular locations (supraorbital, TMJ pressure, nares reflex, anterior axillary fold pressure, upper trapezius squeeze)?
    - Pupillary response to light
    - Ocular movements with oculocephalic (Doll's eyes)
    - Vestibulo-ocular (cold caloric) reflexes
    - Corneal reflex to tactile stimulus
    - Facial muscle movement to noxious stimuli
    - Pharyngeal reflex – gag
    - Tracheal reflex - cough
- Apnea, CO_2 > 60 mmHg or rise >20mmHg from baseline, and pH < 7.3 on apnea test
- Cerebral Blood Flow study demonstrating no flow if unstable for Apnea Test
- CANNOT be determined if patient is hypothermic (<36°), intoxicated, hypotensive, on paralytics or sedating medications

Apnea test:

- Pre-oxygenate patient with 100% FiO2. Assure that PCO_2 is normal, pulse oximetry is being monitored and BP is checked at least every 2 min.
- Disconnect patient from the ventilator and passively oxygenate with 2 L/min of oxygen via a catheter placed in the airway. Closely observe the patient for spontaneous ventilation. Be prepared for a BP drop.
- After 10 min, an ABG should be obtained. If pCO_2 > 60 or increased > 20 from baseline and pH < 7.3, apnea has been established and the patient may be declared brain dead. Otherwise continue with apnea test.
- If oxygen saturation drops during apnea testing, increase oxygen flow and apply PEEP by occluding the endotracheal tube with tape.
- If patient becomes hemodynamically unstable during apnea test, terminate test and confirm brain death with adjunct study (cerebral blood flow scan, EEG)

Comfort Measures and Withdrawal of Life Support (Non-brain dead patient)

1. Death occurs as a consequence of the underlying disease. The goal of comfort care is to relieve suffering and not to hasten death.
2. Comfort care is a medical procedure that requires the same degree of physician participation and quality assurance as any other medical procedure.
3. When one life sustaining treatment is withheld, strong consideration should be given to withdrawing other life sustaining treatments and changing the goals of care to comfort.
4. Actions solely intended to hasten death are morally unacceptable (for example, administering a high dose of potassium or a paralytic drug).
5. Any dose of analgesic or anxiolytic medication may be reasonably used in order to relieve suffering, even if the medication has the potential to hasten death. Although concerns about hastening death with medications are understandable, it is important to remember that patients can develop tolerance to medications so that unusually high doses may be necessary to adequately relieve suffering.
6. Clinicians should be extremely sensitive to the difficulties in assessing suffering in critically ill patients and should be wary of under-treating discomfort when life-sustaining treatment is withdrawn. When determining the need for medication, the following signs should be assessed and documented in the medical record: tachypnea, tachycardia, diaphoresis, grimacing, accessory muscle use, nasal flaring and restlessness.
7. Patients should not have life support withdrawn while receiving paralytic drugs as these will mask signs of discomfort. Life support can be withdrawn from patients after paralytic drugs have been stopped as long as clinicians feel that patient has sufficient motor activity to demonstrate discomfort.
8. Cultural and religious views influence the perspectives of patients and family members regarding life-sustaining treatment. These issues should be discussed with patients and family members, and efforts should be taken to accommodate various perspectives. Social workers, spiritual care providers, palliative care consultants, and/or cultural mediators from Interpreter Services are available to help address these issues.

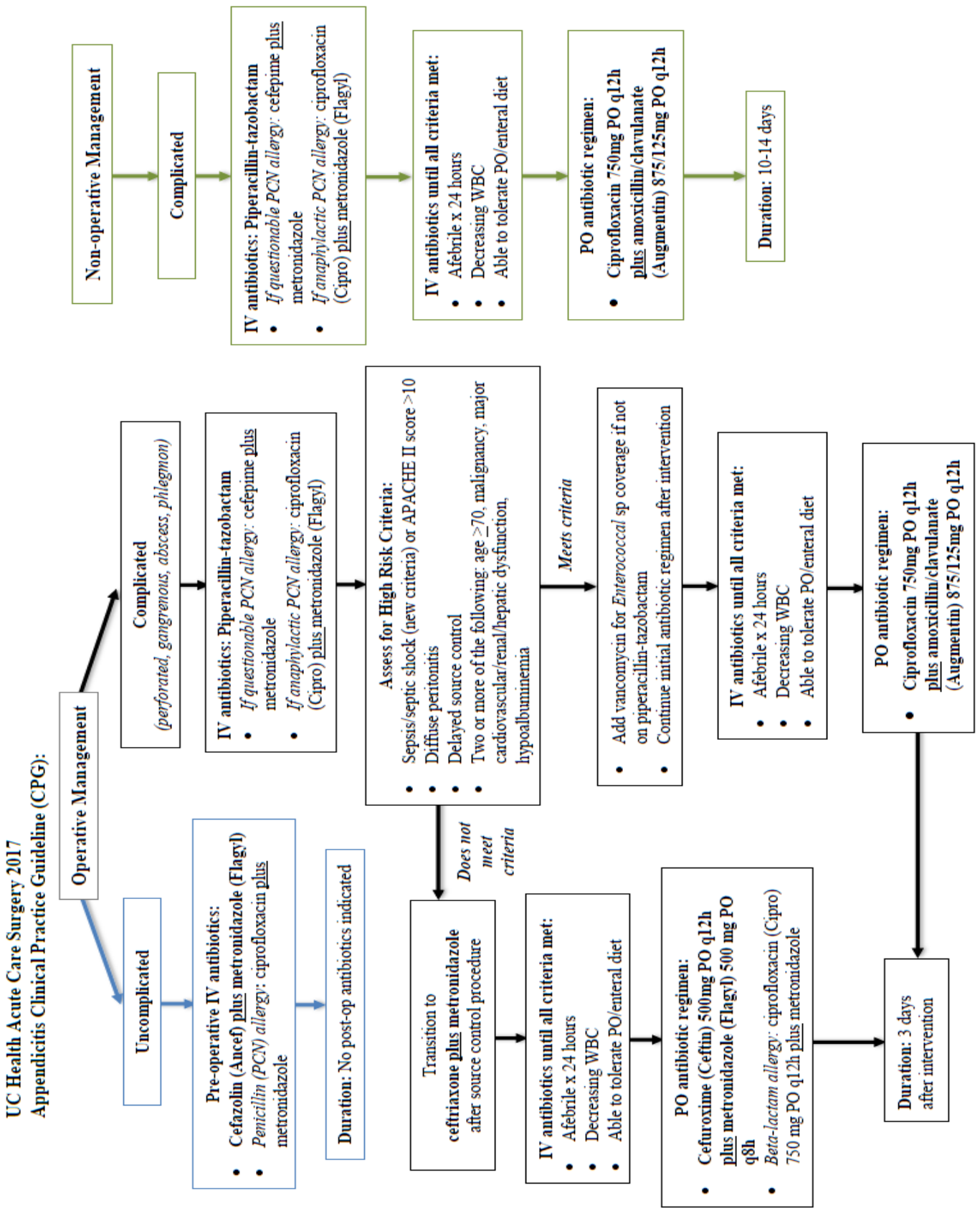
Before proceeding with the comfort care order set, the following steps should be done:

1. Notification of Life Center if not already done. 513-558-5555
2. Review the patient's advanced directives.
3. Identify power of attorney or next of kin.
4. Initiate discussions with the patient and/or family/power of attorney. The primary team (chief or attending), SICU team (fellow/attending) and SICU RN should be present. Items that should be addressed include: a) whether or not full withdrawal or simply no escalation of care measures will be initiated, b) does the family wish to be present at the time of death?—if so, it may be beneficial to minimize oxygen and vent settings rather than proceeding with full extubation unless the family is extremely comfortable with this scenario.
5. Completion of comfort measures form.
6. Notification of Office of Decedent Affairs
7. Request for chaplain or other emotional support staff if necessary.
8. Note written in chart that the documents the rationale and plan of care for procedure.
9. Initiate COMFORT CARE order set.
10. Notify Coroner of death 513-946-8700

ROUTINE POST-OP PROTOCOLS BY SURGICAL SERVICE

***These are meant as a general guide and should be followed only if patient clinical status allows.**
***Also subject to changes based on primary service and Attending preference.**

ACUTE CARE SURGERY PROTOCOLS



Appendicitis CPG:

Pregnant Patients:

Attempt MRI for initial evaluation, but if the delay is going to be prohibitive from onset of symptoms or available radiologists do not feel comfortable reading the MRI, perform a CT scan with IV/ PO contrast instead. **Ultrasound has poor results at UCMC

- Pregnancy considerations:
  - Cefazolin, piperacillin/tazobactam, meropemen, metronidazole = category B
  - Ciprofloxacin = category C

ADDITIONAL INFORMATION:

-Fetal loss 1/30 negative laparotomies

-Fetal mortality is 5% or less with non-perforated appendicitis

-Fetal mortality increases to 20% if the appendix perforates

<500mGy—pregnant women showed no increase in poor pregnancy outcomes

100mGy—estimated to increase the rate of future childhood cancer by 0.1%

Risk to fetus is considered to be negligible at less than 50mGy

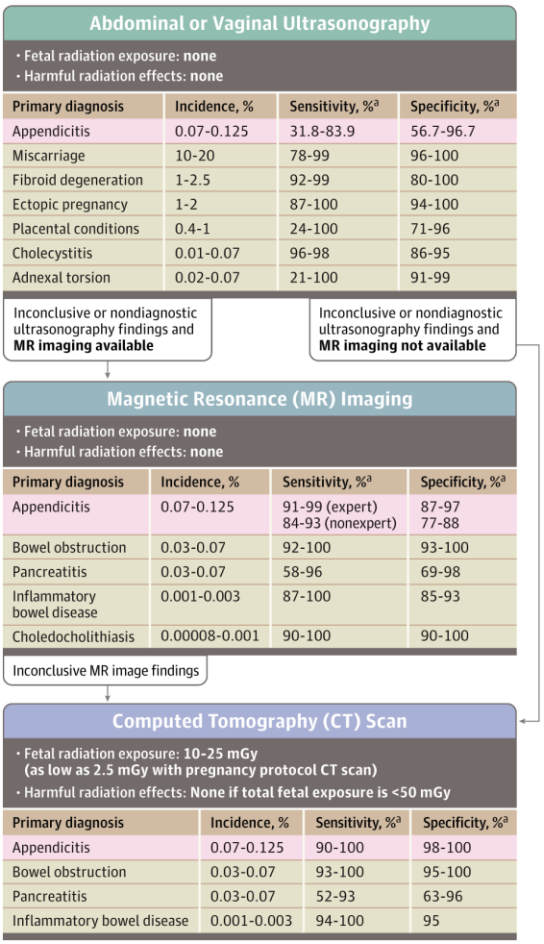
Average CT of Abdomen and pelvis gives between 10 and 25 mGy to the fetus

Large Retrospective Cohort Study: Mothers exposed to major vs. not exposed.

5,590 mothers exposed to major radiation - 1.13 cancers per 10,000 person-years

1,829,927 Not exposed to radiation had - 1.56 cancers per 10.000 person-years

	Exposed Mothers	Unexposed Mothers
N	5,590	1,829,927
Timing of Exposure	41% were <14 weeks	
Type of Exposure	70% were CT scans and 23% of those were to the abdomen or pelvis	
Cancers Diagnosed in Children	1.13cancers/10,000 person years (4)	1.56 cancers/10,000 person yrs (2,539)
Stillbirth Rate	0.65%	0.84%
Rate of Chromosomal Anomalies	0.13%	0.11%
Rate of Congenital Anomalies	3.9%	3.7%



JAMA 2019 322(5):455-456

Acute Care Surgery Protocol for Acute Cholecystitis

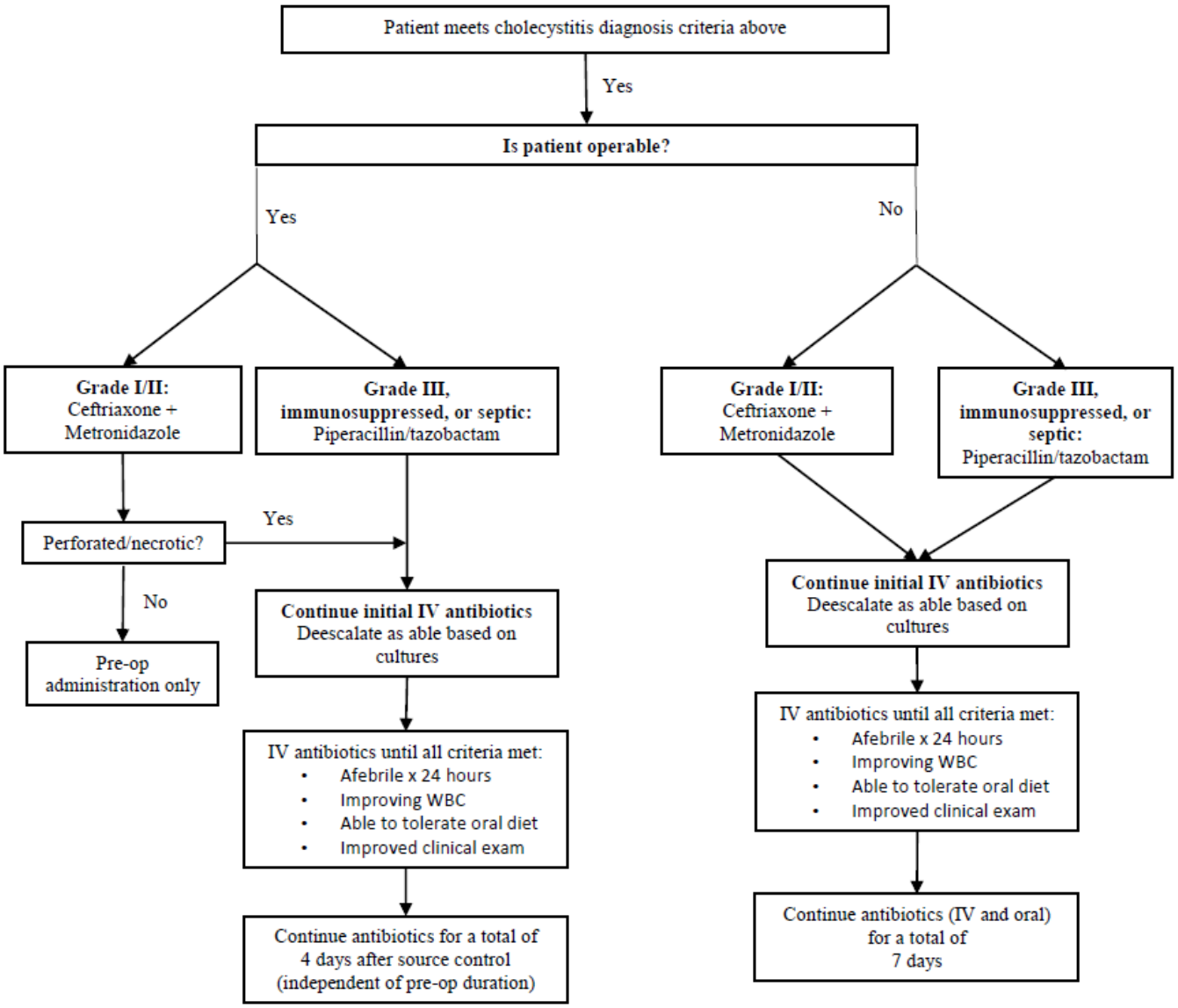
Acute Cholecystitis Diagnosis:

Classic definition - Three out of four of the following signs/symptoms:

- Abdominal pain in right upper quadrant
- Murphy's sign
- Leukocytosis
- Temperature > 38° C

PLUS ultrasonographic evidence (distended gallbladder, gallstones with thickened or edematous gallbladder wall, pericholecystic fluid collections)

However – increased prevalence of CT scan use and inaccuracies at our institution with ultrasound in defining acute cholecystitis mean that many cases will not meet this. Consideration for defining acute cholecystitis should include clinical judgement, presence of stones and/or imaging with inflammation about gallbladder and duration of symptoms.



PO antibiotics (no culture data)

Grade I/II perforated/necrotic

- Cefuroxime 500 mg q12h + metronidazole 500 mg q8h
- *PCN Allergy: ciprofloxacin 750 mg q12h + metronidazole 500 mg q8h*

Grade III/immunosuppressed/septic

- Ciprofloxacin 750 mg q12h + amoxicillin/clavulanate 875/125 mg q12h

Adjust cefuroxime, ciprofloxacin, amoxicillin/clavulanate for age, weight, renal function

PCN Allergic Patients:

Grade I/II

- **Any reaction:** Ciprofloxacin + Metronidazole

Grade III/immunosuppressed/septic

- **Non-anaphylactic:** Cefepime + Metronidazole + Vancomycin
- **Anaphylactic:** Meropenem + Vancomycin

Developed 12/2015; Revised 6/2017, 2/2018

Acute Care Surgery Protocol for Adhesive Small Bowel Obstruction

Adhesive small bowel obstruction (ASBO):

- (+) History of abdominal surgery
- (+) Persistent clinical and radiological signs/symptoms of obstruction without strangulation, peritonitis, or complete mechanical obstruction
- ASA score I-III
- No active inflammatory bowel disease
- No obstructed hernias
- No history of "hostile abdomen" or "dense adhesions" on previous operative report
- No history of hyperthyroidism or iodine allergy

If suspected ASBO, obtain abdominal and pelvis CT with IV and PO contrast:

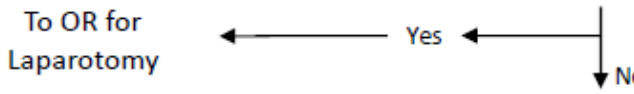
Signs of intestinal ischemia: continuous abdominal pain/peritoneal irritation, tachycardia (HR > 90 bpm), hypotension (SBP < 90mmHg), fever (T > 100.4 °F), metabolic acidosis (pH < 7.2), leukocytosis (WBC > 12,000/mm³)

- OR -

Mesenteric edema AND lack of feces sign in small bowel AND obstipation (no stool/flatus x 24 hours)

- OR -

Incarcerated hernia, closed loop obstruction, portal vein gas

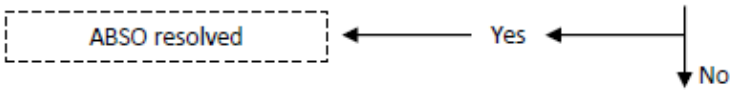


Insert nasogastric tube

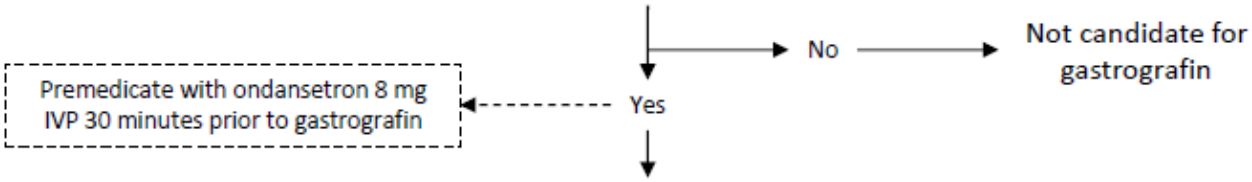
Nasogastric decompression for at least 2 hours

Obtain KUB to evaluate contrast location from abdomino-pelvic CT

If contrast progressed to colon:



Bedside RN swallow evaluation without evidence of aspiration?



Administer Gastrografin 120 mL (1 bottle)

- Via NG tube after complete suctioning of gastric contents for at least two hours (not for patients without NG tube)
- Flush with 20 mL of water
- Clamp for <u>four hours</u> after administration, then resume NG to low continuous wall suction

Repeat KUB after gastrografin administration at 0600 the following AM

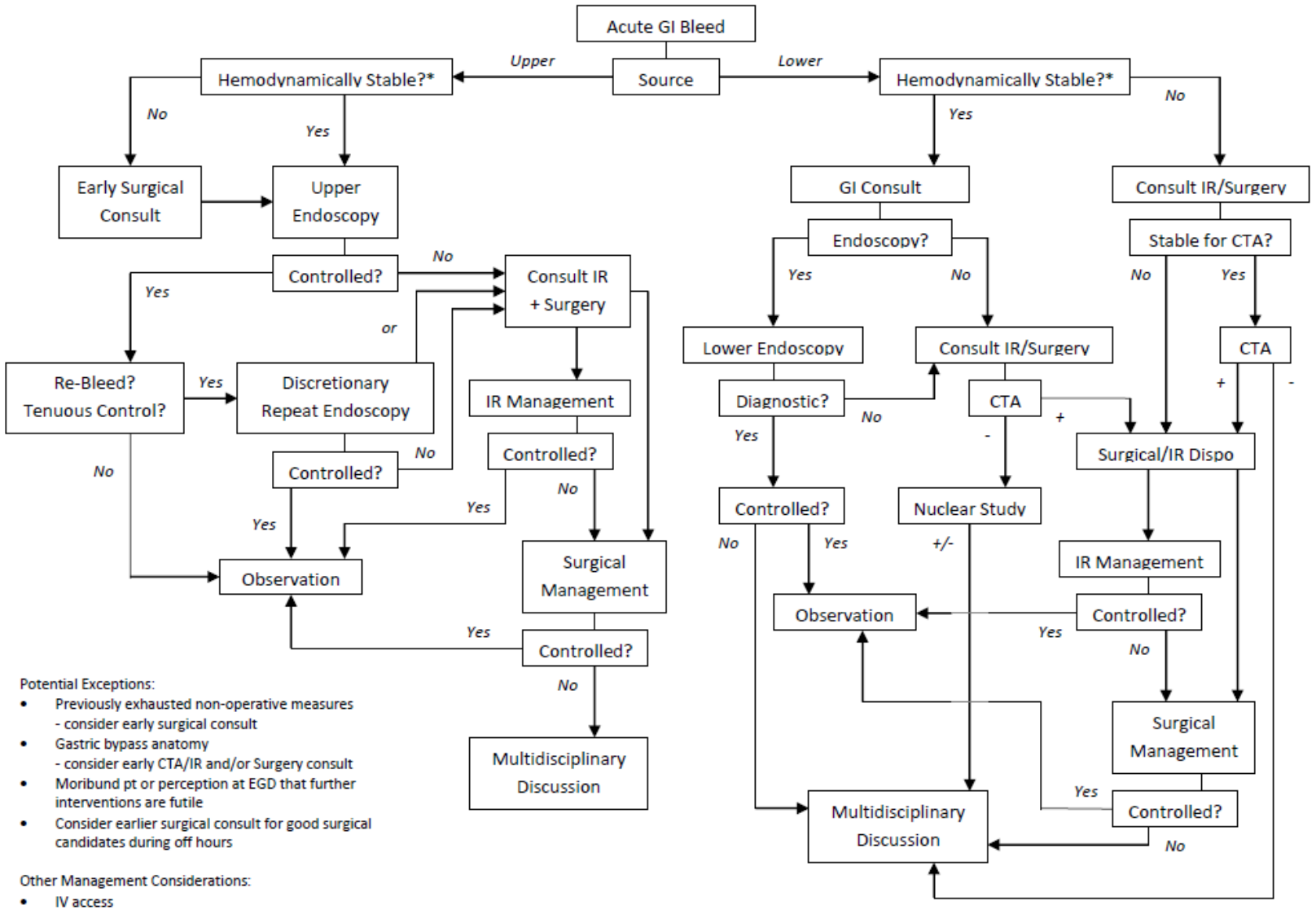
If contrast progressed to colon:

Yes
Pull NG and initiate clears

No
To OR for Laparotomy

UCMC Guidelines for Acute GI Bleed (Draft 4)

Note: Surgical Consult for all patients unstable or in ICU setting



Potential Exceptions:

- Previously exhausted non-operative measures
  - consider early surgical consult
- Gastric bypass anatomy
  - consider early CTA/IR and/or Surgery consult
- Moribund pt or perception at EGD that further interventions are futile
- Consider earlier surgical consult for good surgical candidates during off hours

Other Management Considerations:

- IV access
- Anticoagulant reversal (INR at time of endoscopy)
- Type and screen
- NGT, PPI, H pylori tx for UGI

*Hemodynamic stability per the primary team's discretion

Draft 3 (2/23/2018)
ZW, JM, RC

THORACIC SURGERY PROTOCOLS

Esophagectomy Pathway

POD#0

- Chest tube to -10 cmH_2O suction
- NG to low intermittent wall suction, flush with 30mL H_2O q8hrs
- Sign over bed: Do Not Manipulate NG tube
- D5LR@ 100 mL/hr
- Epidural
    - Hypotension: 500mL bolus if sBP<90 and UOP <25mL/hr x 2hrs
    - Do not give >500mL or turn off epidural without calling Thoracic team
- Ancef and Flagyl x 24 hours
- Heparin 5000 units subQ q8 hours
- Metoprolol 5mg IV q6hrs, hold for HR<60 or sBP<100
- Toradol 15-30mg IV q6hrs x 48hrs unless >75yo or Cr >1.5
- NPO

POD#1

- Chest tube to water seal
- Cont NG to low intermittent wall suction, flush with 30mL H_2O q8hrs
- May start reglan and Pepcid
- D/C antibiotics
- Ice chips 1 cup q8hrs

POD#2

- Consider transfer to floor
- Cont chest tube to water seal
- Cont NG to low intermittent wall suction, flush with 30mL H_2O q8hrs
- D5 ½ NS + 20mEq KCl @ 75mL/hr
- Cont ice chips 1 cup q8hrs

POD#3

- Start ½ strength tube feeds at 20 mL/hr via J tube

POD#4

- D/C NG if output <600mL/day
- Convert metoprolol, reglan, pepcid to per J tube
- Increase tube feeds by 20 mL/hr at ½ strength

POD#5

- Thin barium swallow study
    - If negative, start clears
- D/C epidural
- Cont to advance tube feeds

POD#6

- Advance to full liquid diet

POD#7

- D/C chest tube if output <300 mL/day
- PO metoprolol, pepcid, and reglan
- Advance to mechanical soft diet

REID SERVICE PROTOCOLS

Pancreaticoduodenectomy (Whipple) and Total Pancreatectomy W/O islet cell txp Pathway
Pancreatic resection (Berne, Frey, Beger, Puestow, Distal) Pathway

Postop (evening)

- SICU
- Ice chips, popsicles, hard candy
- NS or LR IVFs
- PCA
- Tylenol 1g IV q8hrs (for 24 hours)
- ASA 300mg rectal (if vein graft)
- Ice Pack to incision
- Out of bed to chair

POD#1

- Transfer to floor
  - Change to 5% dextrose IVFs and decrease
  - Robaxin (500-750mg IV q 8hours), +/- toradol (if appropriate, 15mg q6h scheduled)
  - Pantoprazole 40mg IV
  - Zosyn for 24h (ask attending for longer duration w/ stent)
  - Prokinetics (erythromycin or reglan)
  - Ambulate ≥ 3 times
  - Check drain amylase
    - Remove drain if <300 (per surgeon)
  - Physical therapy consult (if needed)
  - Lovenox Insurance test claim
  - Remove NG tube (unless high output or high concern for aspiration)
  - Sips of clears

POD#2

  - Decrease 5% dextrose IVFs
  - Remove foley
  - Ambulate ≥ 7 times
  - Clear liquid diet (non-carbonated)
  - Senna-S BID
  - d/c SC heparin, change to Lovenox 40mg subq daily (evening administration)

POD#3

  - IMPACT AR TID
  - Decrease 5% dextrose IVFs
  - Diuresis with Lasix, if needed
  - Ambulate ≥ 12 times
  - Check drain amylase
    - Remove drain if < 150
  - Dulcolax suppository (if no bowel function yet)
  - d/c SC heparin, change to Lovenox 40mg subq daily (if not already done)

POD#4

  - Low fat diet
  - Creon (1 tab with snacks, 2 with meals)
  - TKO 5% dextrose IVFs
  - Transition to oral pain meds

Total/Completion pancreatectomy <u>with</u> islet cell transplant Pathway

POD#0

- FSBS q1 hour
- NG to continuous low wall suction
- NPO
- J tube clamped
- JP drains to bulb suction, strip q8 hours
- LR and D5LR 50:50 mix @ 120 mL/hr
- Insulin gtt (goal glucose 80-120) – **DOES NOT STOP UNTIL TRANSITION TO LANTUS POD#3**
- Ancef, Flagyl x 24 hours post-op
- Heparin 5000 units subcutaneous q8 hours
- Epidural +/- PCA

POD#1

- Cont NG to LWS
- NPO
- Flush J tube 10mL water q8 hours
- LR and D5LR 50:50 mix @ 100 mL/hr
- Check LFTs until normalizing
- Nexium 40 mg IV qday

POD#2

- Cont NG and J tube care, NPO as per POD#1
- Change to ½ NS + 20 mEq KCl @ 100 mL/hr
- D/C JP if output not bilious

POD#3

- D/C NG
- Sips of clears and ice chips
- J tube feeds with Diabetasource ½ strength @ 20 mL/hr
- D/C TLC and place PIV
- D/C medial JP drain if JP to serum amylase ratio <3:1
- ½ NS + 20 mEq KCl @ 75 mL/hr
- Consult Endocrine for Lantus and Regular insulin recommendations
- Give Lantus per Endocrine recommendations at 2100, stop insulin gtt at 2200 and change to FSBS q6 hours

POD#4

- Consider transfer to floor
- Diabetic clear liquid diet
- Increase J tube feeds to Diabetasource ½ strength @ 40 mL/hr
- Hold heparin dose after midnight for epidural removal on POD#5
- Diabetes educator consult, begin diabetic teaching
- Cont Lantus qHS, Regular insulin q6h scheduled and Regular SSI q6h

POD#5

- Advance diet as tolerated to diabetic diet
- Increase tube feeds to goal if not taking po, or D/C tube feeds if tolerating diet
- D/C epidural
- D/C foley
- Saline lock IVF
- Change nexium to 40mg PO daily
- Change to Humalog qACHS as well as SSI, and FSBS qACHS

POD#6

- Change J tube feeding to full strength (if needed)
- Start oxycodone/acetaminophen 5-325 1-2 po q4 hours prn pain

Transplant service protocols

Liver Transplant

POD#0

- Labs q6h x 24 hrs: CBC, BMP, LFT, INR, Fibrinogen, ABG, Lactate, Ca, Mg, Phos
- IVF: 1/2NS if Na > 140, NS if Na < 140 at 50-125 mL/hr
- HOLD SQ heparin until POD#1
- IV abx continue for total 48 hours post-op
- Anti-fungal prophylaxis per protocol (Nystatin, Diflucan)
- Immunosuppression: methylprednisolone taper, Cellcept, possible Prograf
- Protonix, Insulin gtt
- Goals: Hgb > 7, CVP < 10, MAP > 65, SBP >120
- Lines: Swan-Ganz catheter, TLC x2, A-line, JP x2, Foley
- NG/OG – d/c after extubation unless Roux-en-Y reconstruction

POD#1

- Labs q12h x 24hrs: CBC, BMP, LFT, INR, Fibrinogen, ABG, Lactate, Ca, Mg, Phos
- Liver US
- If extubated, start clear liquid diet and PT/OT
- IVF: decrease as po intake increases
- Start SQ heparin
- Transition off insulin gtt
- IV abx continue for 24 hours post-op
- Start bowel regimen (Senna-S)
- D/C A-line, TLC x 1 and Foley

POD#2

- Labs qday: CBC, BMP, LFT, INR, Fibrinogen, Lactate, Ca, Mg, Phos
- D/C INR and lactate checks once normalized
- Check daily prograf levels
- Advance diet, PT/OT
- D/C IV abx
- Start ID prophylaxis – Valcyte, Bactrim
- PO analgesia
- D/C lateral JP
- Consider transfer to floor 8CCP

POD#3 and 4

- Cont qday labs and Prograf levels
- Cont diet and PT/OT
- Cont SQ heparin, bowel regimen, immunosuppression and ID prophylaxis

POD#5

- Liver US
- Cont labs, diet, PT/OT, meds
- D/C medial JP

Pancreas transplant

POD#0

- Labs daily: CBC, Renal, amylase, lipase
- NPO, NG remains in x 3 days or until return of bowel function
- Glucose checks q1hr x 24 hours, q2hr x 24 hours, q4hrs x 24 hours then qAC & HS or q6hr if NPO
- **No IVF with dextrose**
- **No insulin to be ordered**
- NS @ 150ml/hr + replacements of 2/3 previous hour UOP if >300 with NS and 1/2NS alternating on hourly basis
- Heparin gtt at 500units/hour without bolus started 6 hours post-op x 48 hours total
- IV abx continue x 5 days total
- Fluconazole prophylaxis
- Immunosuppression: methylprednisolone taper, Antithymocyte globulin dose #1, Cellcept
- Omeprazole
- Goals: CVP > 14, SBP > 130-140
- Lines: TLC, A-line, JP x1, Foley

POD#1

- Labs daily: CBC, Renal, amylase, lipase
- NPO, NG remains in x 3 days or until return of bowel function
- Glucose checks q2hr x 24 hours
- D/C replacements if indicated and start NS @ 200mL/hr
- Cont heparin gtt x 48 hours total
- Cont IV abx x 5 days total and fluconazole prophylaxis
- Immunosuppression: cont methylprednisolone taper, Antithymocyte globulin dose #2, Cellcept
- Start Prograf is creatinine < 4 or down by at least 50% and order AM trough levels
- D/C arterial line

POD#2

- Labs daily: CBC, Renal, amylase, lipase, AM prograf trough
- NPO, NG remains in x 3 days or until return of bowel function
- Glucose checks q4hr x 24 hours
- Change to MIVF without dextrose
- D/C heparin gtt after 48 hours total and start ASA 325 mg daily
- Cont IV abx x 5 days total and fluconazole prophylaxis
- Immunosuppression: cont methylprednisolone taper, Antithymocyte globulin dose #3, Cellcept, Prograf as appropriate
- Consider antiviral/antibacterial prophylaxis (need CMV, EBV status)
- May transfer to 8CCP on telemetry

POD#3

- Labs daily: CBC, Renal, amylase, lipase, AM prograf trough
- D/C NG and advance diet
- Glucose checks q6hr if NPO or qAC/HS if diet advanced

- MIVF, ASA 325mg qday
- Cont IV abx x 5 days total and fluconazole prophylaxis
- Immunosuppression: cont methylprednisolone taper, Antithymocyte globulin dose #4, Cellcept, Prograf
- D/C foley
- Send JP amylase once eating before removing

POD#4

- Labs daily: CBC, Renal, amylase, lipase, AM prograf trough
- Advance diet, Transition to po narcotics
- Glucose checks q6hr if NPO or qAC/HS if diet advanced
- MIVF, ASA 325mg qday
- Cont IV abx x 5 days total and fluconazole prophylaxis
- Immunosuppression: cont methylprednisolone taper, Antithymocyte globulin dose #5, Cellcept, Prograf
- D/C JP if tolerating diet and without change in output

POD#5

- Labs daily: CBC, Renal, amylase, lipase, AM prograf trough
- Advance diet
- Glucose checks q6hr if NPO or qAC/HS if diet advanced
- ASA 325mg qday
- D/C IVF and IV abx
- Fluconazole prophylaxis
- Immunosuppression: cont methylprednisolone taper, Cellcept, Prograf
- D/C TLC when thymo done
- Discharge planning

Kidney transplant – Living Donor

POD#0

- Labs: daily CBC, renal
- Start diet 6 hours post-op unless peritoneum opened
- NS 150mL/hr + replacements of 2/3 previous hour UOP if > 300mL/hr
    - Replace with NS and ½NS alternating on hourly basis
- Start subcutaneous heparin in evening
- IV abx for 24hrs total
- Immunosuppression: methylprednisolone/prednisone taper, thymo dose #1 completed, Cellcept
- Dopamine at 3mcg/kr/hr, titrate up to 8mcg/kg/hr to keep SBP>110
- Goals: CVP 8-12 (bolus if <5), SBP>110
- Lines: TLC, A-line, JP, Foley

POD#1

- Labs: daily CBC, renal
- Advance diet as tolerated
- Pend to floor (8CCP)
- Restart home meds
- D/C replacements after 10AM and start NS 150ml/hr x8hrs then decrease to 100mL/hr
- D/C IV abx
- Transition to po analgesia
- Immunosuppression: cont methylprednisolone taper, Cellcept, Thymo dose #2
    - Start Prograf if creat < 4 or down by at least 50% and order AM trough levels
- D/C dopamine
- Start pantoprazole
- D/C A-line

POD#2

- Labs: daily CBC, renal, Prograf trough (6AM on 6NW, 8AM in SICU)
- Advance diet
- D/C IVF
- Cont subcutaneous heparin
- Bowel regimen – miralax
- Immunosuppression – cont steroid taper, Cellcept, possible Thymo dose #3
- Consider ID prohylaxis – need CMV/EBV status of donor/recipient
- Nystatin
- POSSIBLE D/C foley – check with transplant fellow and check post-void residual

POD#3

- D/C TLC once Thymo complete
- D/C JP 4 hours after foley out
- Discharge planning

Kidney transplant – Deceased Donor

POD#0

- Labs: daily CBC, renal; q6h potassium if elevated
- Start diet 6 hours post-op unless peritoneum opened
- NS 50mL/hr + replacements of previous hour UOP
    - Replace with NS and ½NS alternating on hourly basis
- Start subcutaneous heparin in evening
- IV abx for 24hrs total
- May start PCA once extubated
- Immunosuppression: methylprednisolone/prednisone taper, thymo dose #1 completed, Cellcept
- Consider Dopamine at 3mcg/kr/hr, titrate up to 8mcg/kg/hr to keep SBP>110
- Start pantoprazole
- Goals: CVP 8-12 (bolus if <5), SBP>110
- Lines: TLC, A-line, JP, Foley

POD#1

- Labs: daily CBC, renal; DSA per protocol if high risk
- Advance diet as tolerated
- Assess need for hemodialysis
- Consider pend to floor (8CCP)
- Restart home meds
- D/C IVF if anuric
- D/C IV abx
- Transition to po analgesia
- Immunosuppression: cont methylprednisolone taper, Cellcept, Thymo dose based on CD3 levels
- D/C dopamine
- D/C A-line

POD#2

- Labs: daily CBC, renal
- Advance diet
- Consider biopsy if renal function and UOP not optimal
- Cont subcutaneous heparin
- Bowel regimen – miralax
- Immunosuppression – cont steroid taper, Cellcept, Thymo dose based on CD3 levels
- Consider ID prohylaxis – need CMV/EBV status of donor/recipient
- Nystatin

POD#3

- D/C TLC once Thymo complete
- D/C foley – check with fellow, check PVR
- D/C JP 4 hours after foley out
- Discharge planning

Burn service protocols

Burn Resuscitation – for patients with ≥15% TBSA 2nd and 3rd degree burns

Parkland formula: 4 ml x weight in kg x % TBSA burn, ½ in first 8 hours

ISR formula: 2 ml x weight in kg x % TBSA burn, ½ in first 8 hours; adjust by hourly UOP

Rule of Tens (Joint Theater Trauma System CPG)

- if patient 40-80 kgs
  10ml/hr x %TBSA
- if patient > 80kg, add 100mL/hr LR for each 10 kg > 80 kg

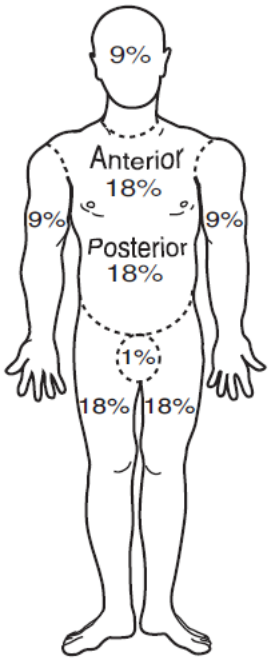
ATLS (version 10) supports starting at 2 ml x weight in kg x % TBSA burn

- Avoid fluid boluses
- Increase or decrease LR by 25% per hour to maintain UOP 30-50mL/hr
- Patients who receive > 6ml/kg/%TBSA burn in first 24 hours have increased complications
- At 12 hours calculate projected 24 hour resuscitation
  - If > 6mL/kg/%TBSA initiate 5% albumin for 48 hours by following calculation
  - 5% albumin volume = (*mL) x %TBSA burned x preburn weight in kg
    - If % TBSA burn 30-49 *mL = 0.3, 50-69 = 0.4, ≥ 70 = 0.5
- If persistently oliguric despite goal CVP 8-10, consider early CRRT
- If hypotensive despite goal CVP 8-10, add norepinephrine

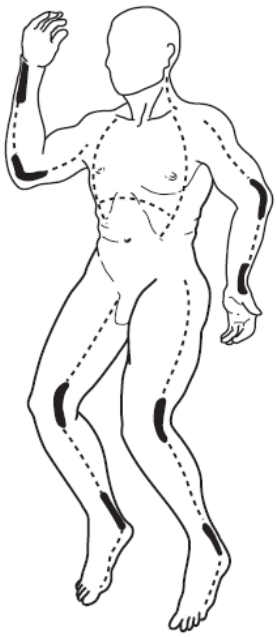
Dressings – d/w Plastics burn service

- Sulfamylon cream to ears BID
- Bacitracin to face QID
- Consult ophtho for potential eye burns – Bacitracin and Erythromycin ointment QID
- Bacitracin and adaptic to 2nd degree burns
- Silvadene to 3rd degree burns

Rule of 9s



Escharotomy sites



ICU DRUGS DOSAGE GUIDE

Pain Treatment

Opioids

- All opioids should be equally effective as long as given in equivalent doses. See below for comparison of opioid analgesics

Opioid	Potency	Equivalent Dose		IV onset	Duration (hr)	Active Metabolite	Clearance
		IV	PO				
Morphine	1	10mg	30mg	5-10	3-6	Y	Renal
Hydromorphone	5	2mg	6mg	5-15	3-6	N	
Fentanyl	100	100mcg	-	1-2	1-2	N	
Oxycodone	1.5	-	20mg	15-30	4-6	N	
Codeine	0.14	-	200mg	30-60	3-6	Y	Renal
Methadone	1	10mg*	10mg*	30-60	6-48	N	

***These doses are based on single administrations and should not be used to convert between a patient taking a different opioid other than methadone, as methadone has unpredictable and dose-dependent potency changes.**

Common dosing regimens:

- Oxycodone 5-15 mg q 3-6 hrs
- Percocet (5/325) 1-2 tab q4-6 hrs
- Norco (hydrocodone-acetaminophen) (5/325 or 7.5/325 or 10/325) 1-2 tablets q4-6 hrs
- Fentanyl continuous infusion 50 – 200 mcg/hr, titrate to BPS = 4; develop tolerance after 4-5 d
- Morphine continuous infusion: start at 2 mg/hr, titrate to BPS = 4
- Dilaudid continuous infusion: start at 0.5mg/hr, titrate for BPS 4-5

Opioid antidote:

- Naloxone: 0.2 – 0.4 mg IV/IM push (up to 2mg)
    - May have to re-dose if the opioid half-life is longer than naloxone half-life (typically 1-2 hours)
    - Adverse effect: flash pulmonary edema

Non-Opioid Analgesics

- NSAIDs – nonselective competitive inhibition of cyclooxygenase (COX), can reduce opioid requirements
    - Oral – Ibuprofen 600 – 800mg every 4-6 hours OR Naproxen 500mg q12 hours
    - IV – Ketorolac 30mg once or every 6 hours for maximum of 3 days
        - Use 15mg in patients < 50kg or geriatric patients
        - Don't use if CrCl < 30
    - Preferred agents for bone pain
    - Adverse Effects
        - GI bleed, bleeding secondary to platelet inhibition, development of renal insufficiency
        - Avoid in asthma and aspirin sensitivity
- Acetaminophen
    - In combination with an opioids produces a greater analgesic effect than higher doses of the opioid alone
    - Useful in relieving mild pain or discomfort and can be used as an antipyretic
    - Caution for hepatotoxicity
        - Max dose 4 grams per day (3 grams if geriatric or liver dysfunction)
- Neuropathic pain
    - Gabapentin(Neurontin) 100 – 1200mg TID (titrate up, side effect – sedation)
    - Pregabalin (Lyrica) 50 -100mg BID to TID
    - Duloxetine 30 – 60mg daily
- Muscle related pain
    - Methocarbamol 500-1000 every 6-8 hours
        - Reduce dose if IV in patients with renal insufficiency (acute or chronic)

Oral morphine milligram equivalent conversion table

Opioid (strength in mg except where noted)	**MME Conversion Factor**
Buprenorphine, transdermal patch (MCG/HR)	12.6
Buprenorphine, tablet or film	30
Buprenorphine, film (MCG)	0.03
Codeine	0.15
Fentanyl, buccal/SL tabet or lozenge/troche (MCG)	0.13
Fentanyl, film or oral spray (MCG)	0.18
Fentanyl, nasal spray (MCG)	0.16
Fentanyl, transdermal patch (MCG/HR)	7.2
Hydrocodone	1
Hydromorphone	4
Meperidine	0.1
Methadone	3
Morphine	1
Opium	1
Oxycodone	1.5
Oxymorphone	3
Tapentadol	0.4
Tramadol	0.1

Anticoagulation

Prophylaxis

- **Unfractionated Heparin (UFH)** 5000 units twice or three times daily
    - Non-ambulatory medical patients
- **Low Molecular Weight Heparin (LMWH)**

General Surgery (Low-moderate risk)	Enoxaparin 40 mg SUBCUT daily
General Surgery/Trauma (High risk)	Enoxaparin 30 mg SUBCUT q 12 h
Hip or Knee Arthroplasty	Enoxaparin 30 mg SUBCUT q 12 h or 40 mg SUBCUT daily
Hip Fracture	Enoxaparin 30 mg SUBCUT q 12 h or 40 mg SUBCUT daily
Medical Prophylaxis when Severely-Restricted Mobility during Acute Illness	Enoxaparin 40 mg SUBCUT daily
Obese Patients 125 kg or above	Enoxaparin 40 mg SUBCUT q 12 h
Bariatric Surgery	BMI ≤ 50 kg/m2: Enoxaparin 40 mg SUBCUT q 12 h BMI > 50 kg/m2: Enoxaparin 60 mg SUBCUT q 12 h
Renal dysfunction (CrCl less than 30 mL/min or SrCr > 1.8 g/dL)	Enoxaparin 30 mg SUBCUT daily

Therapeutic

INDICATION	ENOXAPARIN* Round doses according to guidelines below	*HEPARIN, unfractionated (UFH)*
General Dosing (PE, DVT)	1 mg/kg SUBCUT q 12 h	Bolus = 80 units/kg IV (maximum = 10,000 units) Infusion = 18 units/kg/hr (no maximum)
Atrial Fibrillation	1 mg/kg SUBCUT q 12 h	
Active Thrombosis in Cancer (PE, DVT) Patients up to 200 kg	1 mg/kg SUBCUT q 12 h	
Active Thrombosis in Patients with Renal Dysfunction Estimated CrCl under 30 mL/min; includes Patients on Dialysis	Unfractionated heparin	
Active Thrombosis in Obese Patients 125 - 200 kg	1 mg/kg SUBCUT q 12 h	
Active Thrombosis in Super Obese Patients greater than 200 kg	Unfractionated heparin	
Acute Coronary Syndrome – Managed via PCI	***≥ 75 Years of Age*** 0.75 mg/kg SUBCUT every 12 hours; do NOT use an initial IV bolus ***< 75 Years of Age and Received Prior Enoxaparin*** 1 mg/kg SUBCUT every 12 hours. If the last SUBCUT dose was given 8-12 hours earlier or if only 1 dose was given, consider an enoxaparin IV bolus of 0.3 mg/kg at the time of PCI ***< 75 Years of Age and Has NOT Received Prior Enoxaparin*** 1 mg/kg SUBCUT every 12 hours. Consider an enoxaparin IV bolus of 0.5-0.75 mg/kg at the time of PCI If thrombolytic or GpIIb/IIIa Inhibitor given, initiate enoxaparin between 15 min before and 30 min after	Bolus = 60 units/kg IV (maximum = 4000 units) Infusion = 12 units/kg/hr (maximum = 1000 units/hr)
Acute Coronary Syndrome – Conservative Management of Non-ST-Elevated MI and Unstable Angina	***Patients < 75 Years of Age*** 1 mg/kg SUBCUT q 12 h Max of 100 mg for the first 2 doses only then use actual body weight for future doses ± 30 mg IV bolus (given at the same time as the first SUBCUT dose) depending on patient-specific factors ***Patients ≥ 75 Years of Age*** 0.75 mg/kg SUBCUT q 12 h Max 75 mg for first 2 doses only then use actual body weight for future doses If thrombolytic or GpIIb/IIIa Inhibitor given, initiate enoxaparin between 15 min before and 30 min after	

Anticoagulation

Therapeutic

- Unfractionated heparin (UFH)
  - Advantages: Short elimination half-life; protamine sulfate antidote; generally preferred when rapid reversibility of anticoagulation is indicated; can be used in patients with renal dysfunction; can be stopped within hours of a procedure; pTT monitoring for efficacy
  - Disadvantages: Requires hospitalization for IV infusion; numerous lab draws required for monitoring; can take many hours to achieve therapeutic anticoagulation; unclear maximum dosing recommendations in obese patients.
- Enoxaparin
  - Advantages: Subcutaneous injection instead of continuous IV infusion; routine lab monitoring not required; immediate therapeutic anticoagulation within 3-5 hrs; can be used for outpatient therapy.
  - Disadvantages: Unclear dosing recommendations regarding use in patients with renal dysfunction; no proven reversal agent; longer duration of action (more difficult prior to procedures); expensive.
  - Anti Xa Monitoring: In patients with trauma, pregnancy, cancer, renal dysfunction, obesity (weight >150 kg), monitor antifactor Xa levels
    - Draw level 4 h after SUBCUT dose
    - Therapeutic range for enoxaparin anti-factor Xa is 0.6-1 unit/mL

THERAPEUTIC ANTICOAGULATION THERAPY WITH ENOXAPARIN (LOVENOX) 1 MG/KG SUBCUTANEOUSLY EVERY 12 HOURS			
Patient Weight (actual, in kg)	Rounded Dose (mg)	Dose (mL)	Syringe (mg)
30-34	30	0.3	30
35-44	40	0.4	40
45-54	50	0.5	60
55-64	60	0.6	60
65-74	70	0.7	80
75-84	80	0.8	80
85-94	90	0.9	100
95-104	100	1	100
105-114	105	0.7	120
115-124	120	0.8	120
125-134	135	0.9	150
135-154	150	1	150
155-164	160	1.6	Two 80 mg syringes
165-174	170	1.7	100 mg + 80 mg syringes
175-184	180	1.8	100 mg + 80 mg syringes
185-200	200	2	Two 100 mg syringes

Cardiovascular

Pressors and Inotropes

Agent	Receptor	Dose	Note
Dopamine	DA_1, DA_2	<5 µg/kg/min "renal dose"	Increases MAP or contractility resulting in increased BP, **may be used for bradycardia**
	β,	5-10 µg/kg/min	AE: tachycardia, angina, gangrene of extremities
	α	>10 µg/kg/min Dose should not exceed 20 µg/kg/min	Alternative to NE in septic shock if low risk tachyarrhythmia
Norepinephrine (Levophed)	α-1 (90%) β-1 (10%)	2-20 mcg/min (max 200)	**1st line in septic shock or other distributive shock states** 2nd line in most shock syndromes Small amount inotropy AE: peripheral hypoperfusion and tissue necrosis
Epinephrine	β-1, β-2 (50%) α-1 (50%)	5 - 20 µg/min	**1st line in anaphylaxis. cardiac arrest, cardiac surgery** 2nd line/add on in septic shock Inotropic activity Decreases intestinal blood flow Increased risk for tachyarrhythmia
Phenylephrine (Neosynephrine)	α-1 (100%)	20-200 mcg/min	Alternative use in septic shock AE: Reflex bradycardia, impaired end organ perfusion, HA
Vasopressin	V-1	0.04 units/min	**Not first line agent: used for physiologic replacement** Use if increasing pressor requirement or unable to wean pressors
Dobutamine *Racemic mixture- contains α-1 agonist	β-1 β-2	2-20 µg/kg/min	**1st line cardiogenic shock** **1st line inotrope in septic shock** after crystalloid AE: tachycardia, myocardial ischemia, arrhythmias
Milrinone	PDE-III inhibitor	0.375-0.75 µg/kg/min Renal dose: start at 0.25 µg/kg/min	**1st line cardiogenic shock** AE: thrombocytopenia, tachycardia, hypotension, angina

Antiarrhythmics

- Amiodarone
  - IV Load 150mg/10min, then 1 mg/min x 6 h
  - Followed by maintenance 0.5 mg/min x 18 h
  - Associate with less hypotension than diltiazem
- Diltiazem
  - IV load 0.25 mg/kg, may repeat 0.35 mg/kg IV after 15 min
  - IV maintenance: 5-15 mg/hr
  - Use caution in patients with known low ejection fraction or potential sx of heart failure
  - AE = hypotension. Better rate control compared to amiodarone
- Esmolol
  - IV load 500 mcg/kg over 1min, may cause hypotension
  - IV maintenance: 50-200 mcg/kg/min
  - Little effect on SBP, B1 selective (HR only)
- Metoprolol
  - IV load 5 mg IV x 3 doses, 2 min apart; 1mg IV metoprolol = 5mg PO metoprolol
  - Maintenance: 100-400 mg/day PO/NJ in 2-4 divided dose

Cardiovascular

Antihypertensive (IV/PO)

- Amlodipine (Norvasc)5-10 mg po q 24h
- Captopril 6.25-50 mg po q8h
- Carvedilol (Coreg) 3.125-25mg po q12h
- Clonidine 0.1-0.3 mg po q4-8h (max 0.6 mg in 24 hours)
- Diltiazem 30-90 mg po q6 (max dose 320 mg in 24 hours)
    - Converting IV drip to PO: ([rate(mg/hr) x 3] + 3) x 10 – divided every 24 hours
- Enalapril 0.625-1.25 mg IV q6h (avoid in renal failure)
- Hydralazine 10-20 mg IV q6h
- Labetalol 5-20 mg IV q 4 hours
    - Infusion: initiate 1 mg/min titrate for goal SBP
    - PO: 100-400mg q 6-8 hours (max 2400 mg/day)
- Lisinopril 10-40 mg po q12-24h (max 40mg/day)
- Metoprolol 5 mg IV q 4-6h, 12.5-100mg po q6
    - 1mg IV metoprolol = 5mg PO metoprolol
- Nicardipine IV infusion start 2.5-5 mg/h, increase to max 15 mg/h
- Nifedipine 30-180 mg q day
    - Do NOT use IR formulation in the setting of severe hypertension, Can cause dramatic and unpredictable drops in SBP.
- Propranolol 10-80 mg po q6-8h

Diuretics

- Furosemide (titrate to goal urine output)
    - Bolus: 10-40mg IV/po q6h-12h
    - Infusion: 1-10mg/hr (doses not to exceed 80 mg/hr)
    - Patients may have variable response based on home diuretic use
    - IV to PO Conversion: 10mg of IV furosemide = 20mg PO furosemide
- Acetazolamide 250mg (IV/PO) x 1
    - Do not give pH < 7.35 as drug will dump HCO_3 from the kidney (watch C02)
- Torsemide 5 – 20 mg (IV/PO) daily
- Metolazone 2.5 – 10mg daily (PO)

Drug Withdrawal

EtOH

See Order Sets: GEN IP ALCOHOL WITHDRAWL NON-ICU (aka ETOH)
ICU IP ALCOHOL WITHDRAWL SYNDROME ORDER (aka ETOH abuse)

- All patients: PO/IV Rally pack (thiamine 100mg/MVI/Folic acid 1mg) x 3 days
- CIWA > 10 AND CAM +
    - Haloperidol 5-10mg IVP every 30 minutes PRN
    - Check bedside QTc interval every 12 hours
- CIWA > 10 AND RASS > 2
    - Lorazepam 2mg IVP every 15 minutes PRN
- CIWA > 10 AND adrenergic symptoms (SBP > 140/DBP > 90 AFTER 3 doses of lorazepam
    - Clonidine 0.2mg PO/FT every 6-8 hours (hold if SBP < 100 of DBP < 60 mmHg)
- Consider adjuncts including dexmetatomodine

Electrolyte Replacement Protocol (ICU SPECIFIC)

Not for use in patients with renal failure (serum creatinine greater than 1.8 mg/dL or urine output less than 0.5 mL/kg/hr over last 4 hrs) or those receiving continuous renal replacement therapy or dialysis

Phosphorus (range 2.5 – 4.5 mg/dL)

Oral replacement with K-Phos Neutral 250 mg tablet Weight-Based Dosing Table

- Each tablet contains 8 mmol Phosphate and 1.1 mEq Potassium
- Do not administer is patient's serum potassium > 5 mEq/dL

Phosphorus level (mg/dL)	Weight (kg)		
	≤ 69	70 – 100	> 100
1.8 – 2.9	3 tablets total	4 tablets total	5 tablets total
< 1.7	4 tablets total	5 tablets total	6 tablets total

Sodium Phosphate IV (NaPhos) Weight-Based Dosing Table

- Infusion rate – Central line: 7.5 mmol/hr; Peripheral line: 5 mmol/hr

Phosphorus level (mg/dL)	Weight (kg)				
	< 50	50 – 69	70 – 89	90 – 109	> 110
1.8 – 2.9	15 mmol	20 mmol	25 mmol	30 mmol	35 mmol
< 1.7	30 mmol	40 mmol	50 mmol	60 mmol	70 mmol

Potassium (range 3.5 – 5.3 mg/dL)

Level	PO diet or tube feeds ≥ to 20 mL/hr	NPO or tube feeds < 20 mL/hr
4 – 4.3	20 mEq KCl PO/PT/FT once	20 mEq KCl IVPB over 1 hour (central line) or over 2 hours (peripheral line) once
3.7 – 3.9	40 mEq KCl PO/PT/FT once	40 mEq KCl IVPB over 2 hours (central line) or over 4 hours (peripheral line) once
3.4 – 3.6	60 mEq KCl IVPB over 3 hours (central line) or over 6 hours (peripheral line) once	
3 – 3.3	80 mEq KCl IVPB over 4 hours (central line) or over 8 hours (peripheral line) once	
< 3	80 mEq KCl IVPB over 4 hours (central line) or over 8 hours (peripheral line) once Notify physician and recheck potassium 2 hours after infusion	

Magnesium (range 1.5 – 2.5 mg/dL)

Oral replacement with Magnesium Oxide 400 mg tablets (consider below IV replacement with PO supplementation if serum magnesium < 1 mg/dL)	
2.1 – 2.3	400 mg PO/FT BID x 4 doses
1.8 – 2	400 mg PO/FT q8h x 6 doses
1.4 – 1.7	800 mg PO/FT BID x 4 doses
1 – 1.3	800 mg PO/FT q8h x 6 doses
IV replacement with Magnesium Sulfate	
2.1 – 2.3	2 gm Magnesium Sulfate IVPB over 2 hours once
1.8 – 2	4 gm Magnesium Sulfate IVPB over 4 hours once
1.4 – 1.7	6 gm Magnesium Sulfate IVPB over 6 hours once
1 – 1.3	8 gm Magnesium Sulfate IVPB over 8 hours once
< 1	10 gm Magnesium Sulfate IVPB over 10 hours once

Calcium (range for ionized calcium 4.5 – 5.3 mg/dL)

- DO NOT GIVE CALCIUM if phosphorus is greater than 6 mg/dL
- Check ionized calcium if serum calcium is less than 7 mg/dL

Oral replacement with Calcium Carbonate (for asymptomatic hypocalcemia only)	
Calcium level 7.5 – 8.4, Ionized calcium 3.8 – 4.5	2000 mg (4 tablets) PO/FT x1
Calcium level 7 – 7.4, Ionized calcium 3.8 – 4.5	2000 mg (4 tablets) PO/FT x2
IV replacement with Calcium Gluconate (via central or peripheral; may be given IV in patients with PO access when patients have symptomatic hypocalcemia, or asymptomatic hypocalcemia with an ionized calcium of less than 3 mg/dL)	
Ionized level less than 4.5	6 grams IVPB x 1 via peripheral or central IV line over 3 hours
IV replacement with Calcium Chloride: (for use via central IV line only may be given IV in patients patients with PO access when patients have symptomatic hypocalcemia, or asymptomatic hypocalcemia with an ionized calcium of less than 3 mg/dL)	
Ionized level less than 4.5	2 grams IVPB x1 via central IV line over 2 hours

Endocrine

Glucose control

See Order Sets: GEN IP BBS (BASAL/BOLUS CORRECTION) INSULIN ORDERS

- Includes recommendations for basal insulin
    - NPH (lasts 12 hours; BID dosing)
    - Insulin glargine (lasts 24 hours; once daily dosing)
- Includes sliding scale options (low, medium, high correction)
    - NPO and tube feeds – use insulin regular every 6 hours
    - Eating – use insulin lispro TID and HS

See ordersets: GEN IP INSULIN INFUSION PROTOCOL

- ICU ONLY: For patients requiring > 80 units/day or 2 consecutive glucose levels > 200 in the ICU
- When transitioning from an insulin drip to basal bolus correction (BBC)
    - Calculate how much insulin the patient required in 24 hours (total daily insulin dose)
    - (total daily insulin dose / 2) = empiric dose reduction to avoid hypoglycemia
    - (empiric dose reduction/2) = basal dose (either once daily glargine or divided into two doses as NPH)
    - Remainder can be separated out into lispro with meals or covered with a sliding scale option

DKA/HHS

See ADA statement on hyperglycemic crisis

- DKA: Insulin infusion: 0.1 units/kg/hour until anion gap normalized
    - May have to add D5NS or D10 if glucose drops too rapidly
- HHS: Insulin infusion: 0.05 units/kg/hour
    - Watch that Na doesn't drop > 2 mEq/hr (max 12 mEq/day)
    - Watch glucose doesn't drop > 50 mEq/hr – stop insulin when glucose in 300s

Sepsis-related adrenal insufficiency

- If measuring cortisol level, send prior to dose administration
- Start Hydrocortisone 50 mg IV q6h or 100mg IV q8h
- Consider adding fludrocortisone 50 mcg PO/FT q24h

Gastrointestinal

Prophylaxis

- Major risk factors: mechanical ventilation (positive pressure) and coagulopathy
- No needed if on gastric feeds
    - Famotidine 20mg IV/PO/FT q12h
    - Esomeprazole 20-40mg IV/FT q 12-24h or omeprazole 20-40 mg PO q 12-24h

UGI bleed

- Esomeprazole drip: 80 mg bolus, then 8mg/h IV x72h

Motility

- Metoclopramide 10mg IV/PO/FT q6h x 3 days
- Erythromycin 250mg IV q6h

H pylori

- Clarithromycin 500 mg PO/NJ q 12h, and amoxicillin 1gm PO/NJ q12h, and esomeprazole/omeprazole IV/FT 20mg BID x 10 days

Bowel regimen

- Sennosides 8.6 mg one tab po/NJ q12h
- Docusate (Colace) 100mg po/NJ q12h
- Bisacodyl (Dulcolax) 10mg PR/PO q24h
- Polyethylene glycol (Miralax) 17g (1 pkt) qday
- Psyllium (Metamucil) 1-2 pkt q 8-24h
- Enemas
    - Fleet's enema
    - S.M.O.G. enema
    - Soap Suds Enema

Clostridium difficile Associated Diarrhea (CDAD)

See UC Health CDAD Treatment Guidelines (formulary website)

	Disease Characteristics	**First Episode**	**First Recurrence**	**Second Recurrence**	**Third/Subsequent Recurrence**
Initial episode, mild or moderate	Leukocytosis with a white blood cell count of 15,000 cells/mL or lower, serum creatinine level less than 1.5 times the premorbid level	Metronidazole, 500 mg PO q8 x 10–14 days	Metronidazole, 500 mg PO q8 x 10–14 days	Vancomycin, 125 PO q6 x 10–14 days, followed by PO vancomycin taper.	Initiate pharmacologic management per risk and severity stratification ID/GI/Surgery consult STRONGLY recommended
Initial episode, severe	Leukocytosis with a white blood cell count of 15,000 cells/mL or higher, serum creatinine level greater than or equal to 1.5 times the premorbid level, , age > 60 years	Vancomycin, 125 PO q6 x 10–14 days **SURGERY CONSULT**	Vancomycin, 125 PO q6 x 10–14 days	Vancomycin, 125 PO q6 x 10–14 days, followed by PO vancomycin taper.	
Initial episode, severe, complicated	Hypotension or shock, complete/partial ileus, megacolon, significant abdominal distension, admission to ICU for CDAD diagnosis, AMS, fever > 38.5 C, WBC > 30,000 cells/mL, serum lactate < 2.2 mmol/L, end organ dysfunction (ex-mech. vent., renal failure)	Metronidazole 500 mg q8 IV, plus vancomycin 500mg PO q6 x 10-14 days. Complete ileus: can add vancomycin enemas **SURGERY CONSULT**	Metronidazole 500mg IV q8 plus vancomycin 500mg PO q6 x 10-14 days. Complete ileus: can add vancomycin enemas	Metronidazole 500mg IV q8 plus vancomycin 500mg PO q6 x 10-14 days, followed by PO vancomycin taper. Complete ileus: can add vancomycin enemas	

Neurologic

Anticonvulsant

- Fosphenytoin
    - Loading dose = 20 mg/kg IV x1 (round to nearest 50-100mg), infusion not to exceed 150 mg/min (slower infusion times acceptable and associated with fewer adverse effects)
    - Maintenance 4-6 mg/kg/day IV/PO divided q12h or q8h
- Levetiracetam (Keppra) 500-1000mg every 12 hours IV/PO
- Seizures: Lorazepam 2-4 mg IV, repeat to total 0.1 mg/kg
- Status Epilepticus (neurology consult - drugs titrated to burst suppression on EEG)
    - Midazolam:0.2 mg/kg bolus every 5-10 min. 0.05 mg/kg/hr infusion
    - Propofol: 5 mcg/kg/min load for 5 min; 5-80 mcg/kg/min infusion
    - Pentobarbital: 5mg/kg load, 1-5mg/kg/hr infusion

Awakening medication

- Methylphenidate 5-10 mg at 0500, 1300
- Amantadine 100mg PO at 0500 and 1300
- Bromocriptine (PO/IV) 5-10mg at 0500 and 1300
- Modafinil 100mg PO at 0500

Elevated ICP

See Order Sets: ICU HYPERTONIC SOD 3% PROTOCOL (CENTRAL ACCESS)

ICU HYPERTONIC SOD 2% PROTOCOL: (PERIPHERAL ACCESS)

- Hypertonic Saline: 23.4% 30mL IV over 15-30 min bolus via central line only ("Salt Bomb")
- 2% or 3% hypertonic saline at a rate per ICU protocol (see above)
- Mannitol: 0.25-1 g/kg q3-6h

Paralytics

- Patient MUST HAVE SECURE AIRWAY
- Titrate to Train of Four (TOF)= 2 out of 4

Paralytic	Onset (min)	Initial dose	Infusion dose	
Succinylcholine (RSI)	0.5-1	0.3-1.5 mg/kg	-	Contraindicated in hyperkalemia, rhabdomyolysis, found down, burns
Vecuronium	2.5-3	0.08-0.1 mg/kg	0.8-1.7 mcg/kg/min	Caution in renal impairment
Cisatracurium	1.2 -2	0.1-0.2 mg/kg	0.5-10 mcg/kg/min	Use if renal/hepatic impairment
Rocuronium (RSI)	2-3	0.6-1.2 mcg/kg	0.05-0.1 mcg/kg/min	Use if found down, burns, renal dysfunction for induction/RSI

Respiratory

Albuterol 2.5-5 mg Neb q 4-6 h and PRN
Ipratropium 0.5 mg neb q4-6h, for COPD/emphysema, not effective PRN

Sedation/Agitation/Delirium

See ordersets: SICU IP ANALGESIA, SEDATION AND ANTI-DELERIUM THERAPY

Delirium (CAM +)

- Haloperidol 5-40 mg IM/IV q2h prn CAM +
  - Check bedside QTc interval every 12 hours
- Seroquel 25-200mg q8-12h
- Risperidone 0.5-2 mg po q8-12h

Agitation (RASS >2)

- Lorazepam 2-4mg IVP every 4-6h PRN for RASS >2 AND CAM –

Sedation

Titrate to desired RASS, wean by 10%/shift once stable

Sedative	**Onset (min)**	**Half-life**	**Active Metab.**	**Intermit. Dose**	**Infusion Dose**
Diazepam	2-5	2-20 hr	Yes	2-10mg	-
Lorazepam	5-20	8-15 hr	No	1-4mg	1-4mg/hr
Midazolam	2-5	3-11 hr	Yes	2-5mg	1-5mg/hr
Propofol	1-2	20-30 min	No	-	5-80 mg/kg/min
Dexmedetomidine	30	2-2.5 hr	No	1mcg/kg over 10 min **bolus****	0.2-1.5 mcg/kg/hr
Ketamine	20-49 (sec)	<2.5 hr	Yes	1-4.5 mg/kg over 1 min **bolus**	2-10 mcg/kg/min
Etomidate	30 (sec)	<2.5 hr	No	0.3 mg/kg **bolus**	-

** Usually do NOT bolus dexmedetomidine - bolus associated with hypotension and possible hypertension.

Benzodiazapine Antidote:

Flumazenil: 0.2 mg IV over 15sec. Repeat q1 min to 1 mg total

Specific Drug Protocols

Found on formulary website: Intranet→Caregivers→Hospitals and Clinics Formulary

Prothrombin Concentrate Complex (PCC)
Factor VII
Heparin Induced Thrombocytopenia (HIT)
Albumin

Useful Equations

Anion Gap: $Na - (Cl^- + HCO_3)$ (Normal = 12 ± 2)

Osmolality: 2xNa + Glucose/18 + BUN/2.8

Free Water Deficit (L): [0.6 x weight (kg) x (Patient Na – 140 Normal Na)] / 140

Fractional Excretion of Sodium (FeNa): Urine Na x Serum Creatinine / Urine Cr x Serum Na

< 1% pre-renal, > 2% ATN

Estimated Creatinine Clearance: [(140 - age) x kg (x 0.85 women)] /72 x Serum Creatinine (mg/dL)

24h Urine: Ur Cr x Ur Vol (mL) / Serum Cr x time (min)

Oxygen delivery $DO_2 = [1.39 \times Hgb \times SaO_2 + (0.003 \times PaO_2)] \times CO$

Cardiac Output CO = HR x stroke volume

Current Trauma / ICU Research Projects

Contact Trauma Research: 558-6223

ACTIVELY RECRUITING:

TROOP/bioTROOP: Trauma Resuscitation with Low-Titer Group O Whole Blood or Products

Compare the effectiveness of low-titer group O whole blood and component therapy in critically injured patients requiring large-volume blood transfusions. Patients are randomized into either arm (whole blood or component) upon eligibility. bioTROOP will collect biospecimens during the first 7 days post-injury period from enrolled TROOP patients. This is used to evaluate the impact of either arm on the mechanisms that regulate hemostasis and adverse clinical outcomes.

REVIVE: Reducing Exsanguination Via In-Vivo Expandable Foam

To demonstrate safety, effectiveness and benefit-risk profile of ResQFoam for the in-hospital treatment of emergent, exsanguinating, intraabdominal hemorrhage resulting in Class III or IV hemorrhagic shock due to trauma when emergent laparotomy is needed.

HAEMONETICS: Agonist TEG Transfusion Parameters

Correlating blood products given to coagulation testing across two blood analyzers (TEG 6s & TEG 5000) at different timepoints in three populations: trauma injuries, liver transplants, and cardiac surgeries.

DARS: Detecting Asynchrony and Risk of Aspiration

To determine the impact of in-hospital transport on the incidence and severity of asynchrony. Intubated patients going to CT are closely monitored for a period before, during, and after transport to record vitals and ventilator settings.

EIT: Electrical Impedance Tomography Guided Ventilator Liberation during TCTs

Observational psychological analysis of subjects participating in a TCT on the pathway to ventilator liberation. The goal is to characterize TCT success with the analysis of EIT derived parameters that represent the distribution and characteristics of the subject.

DRIVE: Invasive Mechanical Ventilation Strategies Domain

The purpose of this study is to determine which ventilation strategy helps patients in acute hypoxic respiratory failure. Each patient that qualifies will be randomized to one of two treatment arms and placed on specific ventilator settings until the patient is no longer in hypoxemic respiratory failure or 28 days of ventilation, whichever comes first.

OPTIMIZE: Optimization of Beta-lactam Dosing in Critically Ill Patients with Suspected or Documented AMR Infections with Cystatin C

To characterize the pharmacokinetic (PK) profiles of meropenem and cefepime in critically ill patients with suspected Gram-negative infections.

Morbidity and Mortality Reporting

1. **Go to http://intranet.uchealth.com/Pages/home.aspx**

2. **Log in with EPIC login and password**
3. **At the bottom center is a row of applications, there is an icon that says "ICU M&M"**

4. **Once you click it, it loads the report, open and add the details as appropriate**

5. **Click Save**

CONSULT CONTACT INFORMATION

Page Operator 584-7243		**Anesthesia STAT 584-3333**	
TRAUMA STAFF 508-1014		**EMERGENCY AIRWAY / TRAUMA STAT 584-4444**	
Primary/Consult services		**SICU contact numbers**	
Medicine	0901	POD 1	584-1470,584-2036
Geriatrics	0902	POD 2	584-2037, 584-1471
Neurology	0904	POD 3	584-1088, 584-1089
SICU	0905	POD 4	584-8015
OB	0906	POD 5	584-1182 to 1186
Ortho	0907	Waiting area	584-7860
Plastics	0909	SICU/Trauma conf room	584-1088
General surgery	0911		
Urology	0914	CT resident	269-4657
ENT	0915, 0923	CT Chest reads	584-0633
OMFS	0916	CT Abd reads	584-2788
Gynecology	0918	CT Head reads	584-6376
Hand	0919	Fluoro/Xray techs	584-0638
Ophtho	0922	MRI	584-1095
Psych	0222	IR/Angio	584-0602, 584-0792
Neurocritical Care	820-0074	Echo/Vascular lab	584-5147
Pain Service	7246 (pager)	Anesthesia	519-1111
SICU Personnel		Blood bank	584-7888
PharmD		Endoscopy	584-6731, 584-6717
		TPN	584-1690
Liz (Nutrition)		Pharmacy ICU	584-7674
Joe (Nutrition)	249-9443	Lab	584-3700
Social Work (Shelby)	584-7321		
Social Work (Tasha)	584-8019	Research Team	558-6223
Charge RN	**584-5445**	Coroner	946-8700