Acute Respiratory Distress Syndrome	
Definition	Acute respiratory failure not fully explained by cardiac etiology or fluid overload ▪ Excludes patients w/ perinatal pulmonary disease ▪ CXR w/ pulmonary infiltrates (does not have to be bilateral) ▪ Increased oxygenation index
Pathogenesis	• No unifying pathophysiology for ARDS - can be direct injury (pneumonia, traumatic contusion) or indirect (systemic inflammation from sepsis) • Overall, insult causes alveolar cell damage filling of airspaces w/ exudate. Over ~3 weeks, granulation tissue formation occurs which leads to remodeling and fibrosis • Alveolar collapse leads to V/Q mismatch
Clinical Presentation	• Respiratory distress out of proportion to underlying disease • Hypoxemia • Decreased lung compliance
Diagnostic Studies	• Chest XR: commonly see bilateral infiltrates, although not required for diagnosis • ABG: high A-a gradient • PaO2 to FiO2 ratio is < 300
Treatment	Lung protective ventilatory strategies: reduce ventilator-induced lung injury ▪ Maintain TV 4-6cc/kg, use PEEP to improve oxygenation (continue increasing PEEP if FiO2 above 0.6). Target SpO2 88-94% (wean if >98%), keep FiO2 < 0.6 ▪ Permissive hypercapnia (pH 7.15-7.30), PaCO2 60s

Shock	
Definition	Metabolic demands of body>delivered oxygen to tissues ▪ Oxygen delivery (DO2) = content of arterial oxygen (CaO2) x cardiac output (CO) ▪ CaO2 = (1.34 x **Hgb** x % **O2 Sat**) + (0.003 x PaO2) ▪ CO = **SV** x **HR**, SV determined by preload, afterload, and contractility.

Type of Shock	Causes	Physiology	Findings	Treatment
Hypovolemic	Dehydration Hemorrhage Osmotic diuresis Third-spacing fluid Burns	Not enough fluid in vasculature → decreased preload & CVP → low CO → decr. O_2 delivery	Dry mucous membranes, oliguria, weak pulses w/ delayed capillary refill	Fluid resuscitation, stop fluid losses if possible (e.g. treat bleeding). Rapid transfusion protocol if hemorrhage Rapid infuser in ICUs, ED, OR

Shock continued on next page →

Shock

Type of Shock	Causes	Physiology	Findings	Treatment
Distributive	Septic shock Anaphylactic shock (anaphylaxis & septic shock cause vasodilation & cap. permeability) Neurogenic shock (loss of sympathetic innervation to vascular tone)	Poor tone & leaking of vasculature → low SVR → relative hypovolemia/ preload, low DBP. Contractility may be depressed later in sepsis presentation, CVP will vary.	Pounding pulses & brisk capillary refill if capillaries are leaky→ warm extremities (** not always true in pediatric septic shock) Low DBP (especially neurogenic) Widened pulse pressure.	Vasopressors (new guidelines are epinephrine for "cold" and norepinephrine for "warm," may also see dopamine and vasopressin) *Anaphylactic: EPI *Neurogenic: NE
Cardiogenic	Arrhythmias; Myocarditis; CHF; Cardiomyopathy; Trauma; **Cardiac tamponade; **Pulmonary embolism	Poor contractility or ability to relax → Ineffective systolic output → Decreased cardiac output w/ initial low CVP and high SVR	Weak pulses w/ narrow pulse pressure due to low systolic blood pressure; Pallor; Cold extremities; Delayed capillary refill; **Signs of heart failure (respiratory distress, hepatomegaly, JVD)**	LIMIT fluid resuscitation (5-10cc/ kg); Inotropic agents (low dose dopamine, or epinephrine, less commonly dobutamine); Can consider milrinone if BP normal to decrease afterload
	**Obstructive causes of shock that affect the heart's ability produced adequate cardiac output	Pulmonary embolism, cardiac tamponade	Tamponade - Pulsus paradoxus or electrical alternans, narrow pulse pressure w/ increased diastolic	Specific to underlying cause.

Labs

VBG w/ Lactate
- Assess pH and bicarb to determine degree of metabolic acidosis due to anaerobic metabolism - note, bicarb on blood gas is calculated based on the pH and pCO2 - obtain chemistry to measure directly
- Increased lactate associated w/ inadequate tissue O2 delivery in shock states (but can also be elevated if not cleared appropriately, for example in liver failure)

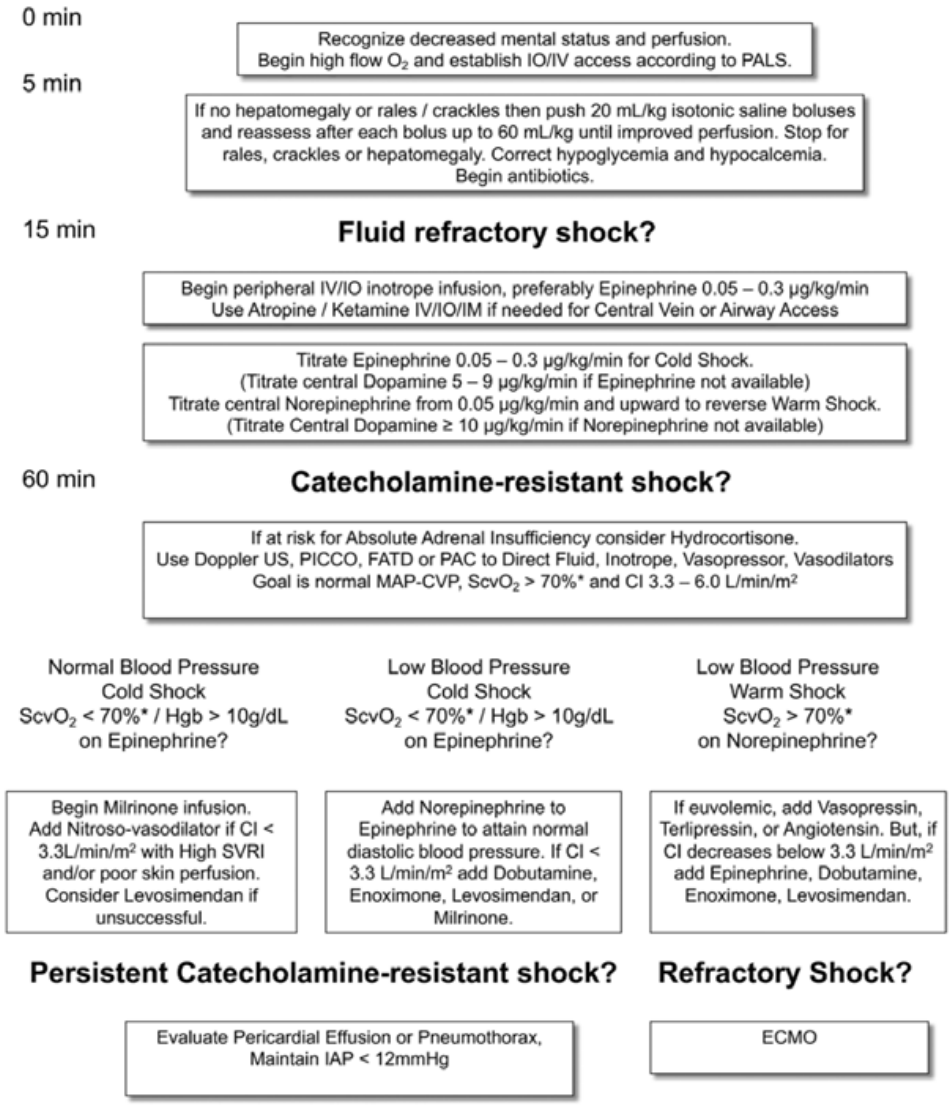
Mixed venous saturation (ScvO2) / arterial-venous o2 difference
- Normal is 70-75%, low in earlier shock (inadequate delivery for utilization), high is concerning for organ dysfunction (impaired o2 utilization by cells due to injury (usually a bad sign)
- Only interpretable from central line terminating in distal SVC, preferably RA; not useful from peripheral VBG
- True pulmonary arterial saturation (SvO2) no longer routinely utilized

CBC and Blood Culture
- WBC count to assess infection
- Hemoglobin to assess adequacy of oxygen carrying

Chem 10 w/ LFTs
- Chemistry to assess solutes (Na, K, Cl, gluc), bicarb, renal function (BUN/Cr), intravascular volume status (BUN:Cr ratio)
- LFTs to assess liver damage

Shock

Septic Shock Treatment Algorithm



Davis AL, Carcillo JA, Aneja RK et al. American College of Critical Care Medicine clinical practice parameters for hemodynamic support of pediatric and neonatal septic shock. Critical care medicine. 2017 Jun 1;45(6):1061-93.

Consideration: There are times when blood products may be indicated in acute resuscitation if there are abnormal hemoglobin/hematocrit values but generally crystalloid is used over colloid and there is no benefit to albumin over crystalloid.