

## SIRS/SEPSIS/SEPTIC SHOCK

SIRS: Two or more of the following without suspicion of AMI or CVA

- Temp > 100.4 or < 96.8 F
- RR > 20 or PaCO<sub>2</sub> < 32
- SBP < 90 or MAP < 65
- HR > 90
- WBCs > 12K, < 4K, or > 10% bands

Sepsis: SIRS with clinical suspicion for infection (PNA, cellulitis, UTI, meningitis, intra-abdominal).

Severe Sepsis: Sepsis with any evidence of end-organ damage such as

- Hypotension before fluid resuscitation
- Elevated lactic acid
- UO < 0.5 ml/kg/hr despite adequate fluid resuscitation
- Creatinine > 2 mg/dL, Bilirubin > 2 mg/dL, Platelets < 100,000/mcL, INR > 1.5 (not due to Coumadin)
- PaO<sub>2</sub>/FiO<sub>2</sub> < 250 (no PNA) or < 200 (with PNA)

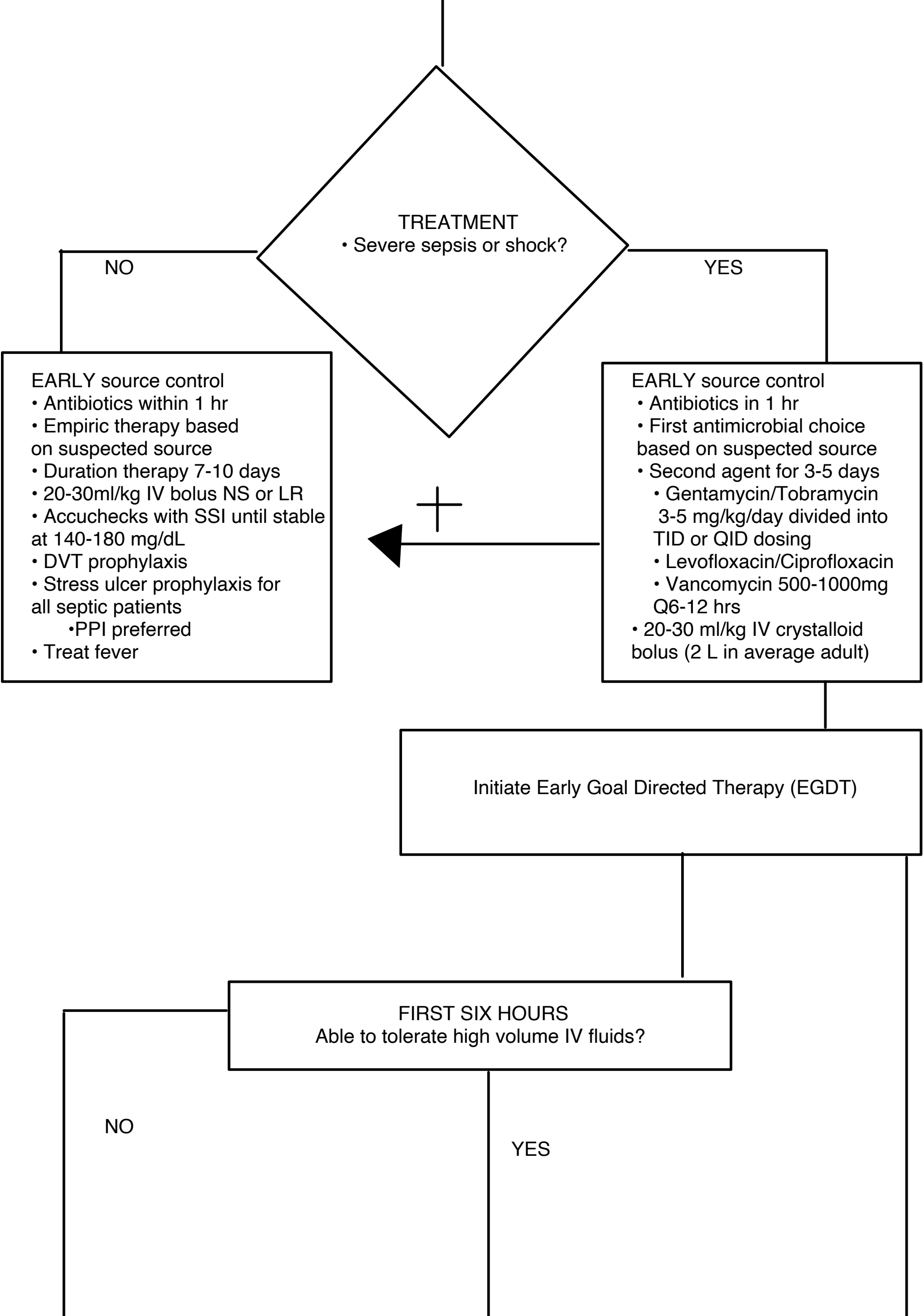
Septic Shock: Sepsis-associated hypotension despite adequate fluid resuscitation

### LABS/ASSESSMENT

- CBC with differential daily
- BMP or CMP (if shock or severe sepsis present, eval end-organ function) daily
- Lactic acid daily until normalized
- Blood cultures, preferably before first dose of antibiotics
- Urine, sputum, wound exudate cultures, chest/abd films, chest/abd/head CT, LP as indicated based on clinical suspicion.

### Initial Monitoring

- Telemetry
- BP with MAP Q15-60 min x 4 hrs and then re-evaluate
- Consider urinary catheter for accurate hourly output
- Lactic acid. If elevated and fluid resuscitation started, recheck in 2-6 hrs and calculate lactate clearance:
  - $[(\text{Initial lactic acid level} - \text{current lactic acid}) / \text{initial lactic acid}] \times 100$
  - Goal lactate clearance is  $\geq 10\%$
- ABG/VBGs for RR > 20 and/or oxygen saturation < 90% on room air or baseline for patient
- Blood cultures and cultures of any suspected source infection
- If patient is hypotensive after receiving at least 30 cc/kg crystalloid fluids:
  - Go to severe sepsis/septic shock algorithm



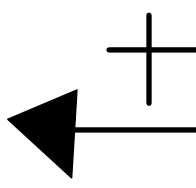
TREATMENT  
• Severe sepsis or shock?

NO

YES

- EARLY source control
- Antibiotics within 1 hr
  - Empiric therapy based on suspected source
  - Duration therapy 7-10 days
  - 20-30ml/kg IV bolus NS or LR
  - Accuchecks with SSI until stable at 140-180 mg/dL
  - DVT prophylaxis
  - Stress ulcer prophylaxis for all septic patients
    - PPI preferred
  - Treat fever

- EARLY source control
- Antibiotics in 1 hr
  - First antimicrobial choice based on suspected source
  - Second agent for 3-5 days
    - Gentamycin/Tobramycin 3-5 mg/kg/day divided into TID or QID dosing
    - Levofloxacin/Ciprofloxacin
    - Vancomycin 500-1000mg Q6-12 hrs
  - 20-30 ml/kg IV crystalloid bolus (2 L in average adult)



Initiate Early Goal Directed Therapy (EGDT)

FIRST SIX HOURS  
Able to tolerate high volume IV fluids?

NO

YES

Give discrete 500-1000 ml crystalloid IV boluses titrated to the following:

- Bedside ultrasound vena cava distensibility index < 30% preferred
- MAP > 65, this will not be as helpful once vasopressors are started
- Urine output 0.5 ml/kg/hr, often difficult in the setting of kidney disease
- CVP 8-12, this measure is affected by heart function, arrhythmia, pulmonary function, and may not be accurate.
- ScVO<sub>2</sub> is not able to be monitored here
- Lactic acid clearance only gives general information over several hours
- Best to use a combination of these measures and to be aware that patients in severe sepsis or shock will often require 6-8 L of fluid during the first six hours. Vasopressors are often started after 4 L IV crystalloids

- May substitute 5% albumin for crystalloids at a 1:1.4 ml ratio
- Consider initiating vasopressors if persistent shock after 2 L IV fluids, to meet goals
- Assess EF with echo and start inotropic agent as needed

VASOPRESSORS -dosing contained here is consistent with that used by our transfer facility. Norepinephrine and epinephrine can also be dosed in mcg/kg/min.

- Norepinephrine is first line. 4mg/250 ml for a concentration of 16 mcg/ml. Start at 0.5 mcg/min, normal range is 2-20 mcg/min until MAP  $\geq$  65. Has been used in doses as high as 30 mcg/min for refractory shock. Short-term infusion through PIV is acceptable. PRN phentolamine for infiltration.
- Vasopressin may be added at a steady dose of 0.03 units/min as a second agent if pt is requiring > 10 mcg/min of norepinephrine. No titration.
- Epinephrine is recommended as an additional, second-line agent, if unable to achieve hemodynamic goals on norepinephrine. Concentration can be 2 or 4 mcg/ml by adding 1 mg to 500 or 250 ml compatible IV solution respectively. Start at 1 mcg/min. Titrate to usual dose of 2-10 mcg/min to achieve MAP of 65. Do not infuse through a peripheral IV. Consider transfer to higher level of care.
- If MAP < 65 after fluids and norepinephrine infusion, start corticosteroid treatment.
  - Hydrocortisone 50 mg IV Q6H, specially in chronic steroid use
  - No ACTH stim test

SIX HOURS AND BEYOND  
In septic shock resuscitation

After the first six hours, a positive fluid balance begins to become associated with an increase in mortality, reaching a peak association at 72 hours. Unfortunately even with adequate initial fluid resuscitation, a septic patient may remain hypotensive. Some of the negative effects of fluids at this point include pulmonary edema, increased production and release of nitric oxide and BNP with resultant vasodilatation, disruption of the cell wall glycocalyx with resultant fluid shifts from the intravascular to interstitial space, and myocardial edema. The question then becomes... WILL MORE FLUID HELP OR HURT???

Consider causes of hypotension  
that are unresponsive to fluid resuscitation

- Septic cardiomyopathy: LVEF < 50% in the absence of cardiac disease and reversible on recovery from sepsis. Diastolic dysfunction also common
  - Inotropes: dobutamine does have vasodilating properties, but can raise BP in septic cardiomyopathy. Can also be combined with vasopressors.
  - Replete electrolytes
- Adrenal insufficiency: Depletion of adrenal hormones secondary to critical illness or chronic steroid use prior to illness
  - Hydrocortisone 50 mg IV Q6hrs
- Symptomatic anemia: Blood loss, bone marrow suppression, decreased hemopoiesis
  - Transfuse for hgb < 7