Evaluation & Rx of Sepsis/Septic Shock in Adults: Managing the Silent Killer: CODE SEPSIS

Suraj Achar, MD, FAAFP

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Learning Objectives

1. Recognize the presentation of sepsis and the tools that aid in early detection and diagnosis.

2. Understand the evolution of the management of sepsis and review the current mandate performance measures.

3. Implement evidence-based protocols for initial resuscitation and infection management.

4. Establish protocols for hemodynamic support and adjunctive therapy.

5. Understand the evidence supporting other supportive/adjunctive measures.

Audience Engagement System
Sepsis: Definition

Clinical syndrome
physiologic, biologic, and biochemical abnormalities
2nd to dysregulated inflammatory response to infection.

Sepsis and the inflammatory response that ensues → multiple organ dysfunction syndrome & death

Incidence increasing?

- Better detection
- Advancing age, immunosuppression, and multidrug-resistant infection
  - ≥65 years of age (60 to 85 percent)
  - >during the winter → increased prevalence of respiratory infections
- African Americans
Statistics

- **1.7 million** adults in America develop sepsis.
- **270,000** Americans die as a result of sepsis.
- **1 in 3** patients who die in a hospital have sepsis.

**CDC Vital Signs**

Making Health Care Safer
Think sepsis. Time matters.

Sepsis is a complication caused by the body’s overwhelms and life-threatening response to infection. It can lead to tissue damage, organ failure, and death. Sepsis is difficult to diagnose. It happens quickly and can be confused with other conditions early on. Sepsis is a medical emergency. These signs: When signs of sepsis are recognized and treated, lives are saved. Healthcare providers are the critical link to preventing, recognizing, and treating sepsis.

**Healthcare providers:**
- **Prevent infection:** Follow infection control requirements (e.g., hand hygiene) and ensure patients receive recommended vaccinations. (e.g., pneumococcal).
- **Educate patients and their families:** Stress the need to prevent infections, manage chronic conditions, and seek care if signs of serious infection or sepsis are present.
- **Think sepsis:** Note sepsis signs and symptoms to identify and treat patients early.
- **Act fast:** If sepsis is suspected, order tests to determine if an infection is present, administer IV fluids, and start antibiotics. Other medical care should be immediately. Document antibiotics dose duration and provider.
- **Monitor patient management:** Check patient progress frequently. Reassess antibiotic therapy after 48 hours or sooner if change therapy is needed. Be sure the antibiotic type, dose, and duration are correct.

**Want to learn more?** [CDC.gov/vitalsigns/sepsis]
Continuum

**Invasion of sterile tissue by organisms** → **bacteremia** → **Sepsis**

**septic shock** → **multiple organ dysfunction syndrome (MODS)** → **Death (10-50%)**

Pathogens

- **Gram -> Gram - -> fungal**
  - ↑Gram Neg

- ~ 1/2 (culture negative sepsis)
  - >acute organ dysfunction and mortality.
Early Sepsis?
Sequential (Sepsis-related) Organ Failure Assessment score (SOFA)

- **Respiratory Rate**: ≥22/Minute
- **Altered Mentation**
- **Systolic Blood Pressure**: ≤100 MMHG

Multiple organ dysfunction syndrome
(progressive organ dysfunction in an acutely ill patient → homeostasis not maintained without intervention)

- Respiratory – Partial pressure of arterial oxygen (PaO₂)/fraction of inspired oxygen (FiO₂) ratio
- Hematology – Platelet count
- Liver – Serum bilirubin
- Renal – Serum creatinine (or urine output)
- Brain – Glasgow coma score
- Cardiovascular – Hypotension and vasopressor requirement
Systemic inflammatory response syndrome: Fallen out of favor → non infectious

- autoimmune disorders, pancreatitis, vasculitis, thromboembolism, burns, or surgery.

<table>
<thead>
<tr>
<th>Finding</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>&lt;36 °C (96.8 °F) or &gt;38 °C (100.4 °F)</td>
</tr>
<tr>
<td>HR</td>
<td>&gt;90/min</td>
</tr>
<tr>
<td>RR</td>
<td>&gt;20/min or PaCO2 &lt; 32 mmHg (4.3 kPa)</td>
</tr>
<tr>
<td>WBC</td>
<td>&lt;4x10⁹/L (&lt;4000/mm³), &gt;12x10⁹/L (&gt;12,000/mm³), or 10% bands</td>
</tr>
</tbody>
</table>

qSOFA < sensitivity but > specificity for sepsis vs SIRS criteria

Patients in ED with suspected infection

qSOFA vs SIRS
Clinical Phenotypes? retrospective analysis of sepsis datasets that comprised over 20,000 patients


<table>
<thead>
<tr>
<th>Type</th>
<th>Clinical</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>Low dose vasopresor</td>
<td>5%</td>
</tr>
<tr>
<td>Beta</td>
<td>Older +chronic illness &amp; CRF</td>
<td>13%</td>
</tr>
<tr>
<td>Gamma:γ</td>
<td>Inflammation + Pulmonary disease</td>
<td>24%</td>
</tr>
<tr>
<td>Delta:Δ</td>
<td>Liver dysfunction and shock</td>
<td>40%</td>
</tr>
</tbody>
</table>

Poll Question #1

Which factor leads to the greatest risk of sepsis?

A. Obesity
B. Diabetes
C. Malignancy
D. Age >65
E. Community acquired pneumonia
F. Previous hospitalization in the last 3 months
Other important risk factors

**Bacteremia**: study of 270 blood cultures, 95% of + blood cultures associated with sepsis, or septic shock

**ICU admission**: ~50% (ICU) patients + nosocomial infection → intrinsically at high risk for sepsis

**Immunosuppression** – Comorbidities that depress host-defense (eg, renal failure, hepatic failure, AIDS, asplenism)

**Genetic factors**: defects of antibody production, or < T cells, phagocytes, natural killer cells, or complement

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**Symptoms and signs**

- (SBP) <90 or MAP < 65mmHg or drop of 40mmHg
- Temperature >38.3 or <36ºC
- HR > 90
- Tachypnea → RR >20 breaths/minute.

**Signs of end-organ perfusion:**
- Warm, flushed skin → cool due to redirection of blood flow to core organs
- ↓capillary refill, cyanosis, or mottling may indicate shock
- altered mental status, obtundation or restlessness
- oliguria or anuria
- Ileus or absent bowel sounds → end-stage sign of hypoperfusion.
Tachypnea?

No hypoxia - compensatory respiratory alkalosis for metabolic acidosis (lactic acidosis)

with hypoxia

- Pneumonia or ARDS
- Pulmonary edema
- Pulmonary embolism

Labs: non specific

- WBC
  - > 12,000 microL\(^{-1}\) or <4000 micro
  - NI WBC with > 10% bands
- Hyperglycemia (plasma glucose >140 mg/dL with no DM)
- C-reactive protein > 2 SD
Acute oliguria (urine output <0.5 mL/kg/hour for at least two hours despite adequate fluid resuscitation)

Creatinine increase >0.5 mg/dL

[INR] >1.5

Thrombocytopenia (platelet count <100,000 microL⁻¹).

Hyperbilirubinemia (plasma total bilirubin >4 mg)

> serum lactate (eg, >2 mmol/L): manifestation of organ hypoperfusion

Biomarkers: (1,3 beta-D-glucan, galactomannan, procalcitonin)

• 1,3 beta-D-glucan assay:
  • retrospective study
  • Non validated
• Procalcitonin > CRP
  • Procalcitonin: global OR 15.7 (95% CI 9.1-27.1) in meta-analysis of 25 studies with 2,966 patients
  • CRP had global OR 5.4 (95% CI 3.2-9.2) in meta-analysis of 15 studies with 1,322 patients
**Not required**

**Imaging** — no radiologic signs that are specific

**Microbiology** — The identification of an organism is highly supportive of the diagnosis of sepsis but is not necessary. (~50% neg CNS)

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**Mortality**

- Sepsis was ≥10%
- Septic shock ≥40%
  - lower in younger patients (<44 years) without comorbidities (<10 percent)
Sepsis vs Septic Shock

- Hypotension MAP < 65 mm Hg
- Lactate level of > 2 mmol/L (18 mg/dL)
- Despite adequate fluid resuscitation.

Long-term prognosis —

- ↑ Risk of death after hosp D/C (up to 20 percent) also ↑ risk of further sepsis & recurrent hospital admissions (up to 10 percent are readmitted)
- Most deaths occur within the first six months but the risk remains elevated at two years
Poll Question #2

What is a host risk factor that increases mortality the most?

A. Failure to develop a fever
B. Leukopenia (a white blood cell count less than 4000/mm$^3$)
C. A platelet count <100,000/mm$^3$
D. hyperchloremia (Cl ≥110 mEq/L) at 72 hours after ICU admission
E. Inability to clot: hypocoagulability using standard and functional levels of fibrinogen

Other risk factors

- (ICU) admission
- a nosocomial infection
- advanced age
- Immunosuppression
- previous hospitalization (in particular hospitalization associated with infection)
- community-acquired pneumonia
- Genetic defects
Clinical issues with sepsis

- **Origin**
  - UTI < abdominal, pulm < unknown

- **Type of infection**
  - MRSA > non-candidal fungus > candida, MSSA > pseudomonas = polymicrobial infections

- **Early administration of antimicrobial**

- **Restoration of perfusion**

Common infections can lead to sepsis.

Among adults with sepsis:

- **35%** had a lung infection (e.g., pneumonia)
- **25%** had a urinary tract infection (e.g., kidney infection)
- **11%** had a type of gut infection
- **11%** had a skin infection

Know the signs and symptoms of sepsis.

- Shivering, fever, or very cold
- Extreme pain or discomfort
- Clammy or sweaty skin
- Confusion or disorientation
- Short of breath
- High heart rate

Children!

Suspect even if all criteria are not present

1729 children

- Only 2/3 met criteria for sepsis/septic shock
- petechiae and purpura in a child with hemodynamic instability,
- fever, cough, and hypoxemia in a patient with leukocytosis and pulmonary infiltrates on chest radiograph.

Meningococcal infection less common with vaccines

Charlotte Cleverley-Bisman, with sepsis from a meningococcal bloodstream infection
SIRS in children

Temp (no change >38 or < 36)

Tachycardia
- > 2 SD for age
- children < 1 yo, bradycardia HR < 10%

RR
- > 2 SD of nl based on age

Pediatric definitions

Sepsis — SIRS in the presence of suspected or proven infection constitutes sepsis.

Severe sepsis
- cardiovascular dysfunction
- acute respiratory distress syndrome (ARDS), or
- dysfunction in two or more other organ systems

Septic shock –
- sepsis with cardiovascular dysfunction that persists despite the administration of ≥40 mL/kg of isotonic fluid in one hour
- adult definition for septic shock includes lactate >2 mmol/L (>18 mg/dL)
### Pediatric SIRS vital signs & lab values

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Tachycardia</th>
<th>Bradycardia</th>
<th>RR</th>
<th>Leukocyte count (leukocytes x 10^3/mm^3)</th>
<th>SBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn: 0 days to 1 week</td>
<td>&gt;180</td>
<td>&lt;100</td>
<td>&gt;50</td>
<td>&gt;34</td>
<td>&lt;59</td>
</tr>
<tr>
<td>Neonate: 1 week to 1 month</td>
<td>&gt;180</td>
<td>&lt;100</td>
<td>&gt;40</td>
<td>&gt;19.5 or &lt;5</td>
<td>&lt;79</td>
</tr>
<tr>
<td>Infant: 1 month to 1 year</td>
<td>&gt;180</td>
<td>&lt;90</td>
<td>&gt;34</td>
<td>&gt;17.5 or &lt;5</td>
<td>&lt;75</td>
</tr>
<tr>
<td>Toddler and preschool: &gt;1 to 5 years</td>
<td>&gt;140</td>
<td>n/a</td>
<td>&gt;22</td>
<td>15.5 or &lt;6</td>
<td>&lt;74</td>
</tr>
<tr>
<td>School age child: &gt;5 to 12 years</td>
<td>&gt;130</td>
<td>n/a</td>
<td>&gt;18</td>
<td>&gt;13.5 or &lt;4.5</td>
<td>&lt;83</td>
</tr>
<tr>
<td>Adolescent and young adult: &gt;12 to &lt;18 years</td>
<td>&gt;110</td>
<td>n/a</td>
<td>&gt;14</td>
<td>&gt;11 or &lt;4.5</td>
<td>&lt;90</td>
</tr>
</tbody>
</table>

### Pediatric stages

![Sepsis Steps Diagram](image_url)

**SIRS**
- T: >100.4°F < 96.8°F
- RR: >20
- HR: >90
- WBC: >12,000 <4,000
- >10% bands
- PCO2 < 32 mmHg

**Sepsis**
- 2 SIRS + Confirmed or suspected infection

**Severe Sepsis**
- Signs of End Organ Damage
- Hypotension (SBP <90)
- Lactate >4 mmol

**Septic Shock**
- Severe Sepsis with persistent:
- Signs of End Organ Damage
- Hypotension (SBP <90)
- Lactate >4 mmol

*Slides Courtesy of Curtis Merritt, D.O.*
Signs

Tachycardia (sensitive not specific)

BP stable until the very end!

Warm Shock
- Cap RF <$1 sec
- Bounding pulse
- Warm/dry ext
- > 40mmHg pulse pressure

Cold Shock
- Delayed capillary refill (>2 seconds)
- Diminished pulses
- Mottled or cool extremities

Risk factors for septic shock in children

< 1 one month

Serious injury (e.g., major trauma, burns, or penetrating wounds)

Chronic debilitating medical condition
- Static encephalopathy with quadriplegia and
- Frequent aspiration pneumonia, uncorrected congenital heart disease
- Short gut syndrome

Immunosuppression
- Malnutrition
- Sickle cell disease and other disease with splenic dysfunction
- Chemotherapy

Large surgical incisions

In-dwelling vascular

Urinary tract abnormalities with frequent infection
Virus mimickers of sepsis

- adenovirus, respiratory syncytial virus (RSV)
- Human metapneumovirus
- Dengue shock syndrome
- Pandemic H1N1 influenza strain

Poll Question #3

What are the risk factors for Fungal infection in children?

A. Malignancy or other immunocompromising medical conditions
B. Indwelling vascular catheters
C. Prolonged neutropenia (>4 to 7 days)
D. Recent broad-spectrum antibiotic use
E. All of the above
IMMEDIATE EVALUATION AND MANAGEMENT

Stabilize respiration
02 sat $\to$ intubation

Establish venous access
Multiple IV $\to$ central

Initial investigations
CBC, CMP, and coagulation studies including D-dimer level
serum lactate (e.g., $>2$ mmol/L)
severe sepsis and follow the therapeutic response
Cultures
Procalcitonin?

INITIAL RESUSCITATIVE THERAPY

- Aggressive administration of intravenous fluids (IVF)
  - crystalloids or NS $\to$ 30 mL/kg (actual body weight)
  - Start by 1 hour, finish by 3rd hour
- Empiric antibiotic therapy $\to$ 1st hour

Poll Question #4

Does early goal directed therapy (EGDT) result in mortality reduction?
- central venous oxyhemoglobin saturation (ScvO$_2$) $\geq$ 70 percent
- central venous pressure (CVP) 8 to 12 mmHg
- mean arterial pressure (MAP) $\geq$ 65 mmHg
- urine output $\geq$ 0.5 mL/kg/hour
- ProCESS [9], ARISE [10], and ProMISE [11] and two meta-analyses

A. Yes
B. No

Poll Question #5

Which, if any, of the IVF resuscitative fluids added to NS will ↓ mortality?

A. Albumin
B. Hydroxyethyl starch (HES)
C. Pentastarch
D. Balanced salt solutions (Lactated Ringer’s or Isolyte)
Intravascular hypovolemia: severe in sepsis

• Rapid, large volume infusions of IVF (30 mL/kg)
  • Indicated unless significant pulmonary edema
  • Well-defined (e.g., 500 mL), rapidly infused boluses
  • Access hemodynamic response +/- pulmonary edema before & after each bolus.

Delay of Antibiotics by 1 hour → ↑ mortality?

1. Yes
2. No

  • Retrospective analysis of over 17,000 patient with sepsis and septic shock, delay in first antibiotic administration was associated with increased in-hospital mortality with a linear increase in the risk of mortality for each hour delay in antibiotic administration
  • Similar results were reported in an emergency department cohort of 35,000 patients
### Association Between Time to First Antibiotic and Mortality: Crit Care Med 2014 Aug;42(8)

<table>
<thead>
<tr>
<th>Time to First Antibiotic</th>
<th>Hospital Mortality</th>
<th>Adjusted Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 hours</td>
<td>32%</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>28.1%</td>
<td>1.07 (95% CI 0.97-1.18)</td>
</tr>
<tr>
<td>2-3 hours</td>
<td>28.6%</td>
<td>1.14 (95% CI 1.02-1.26)</td>
</tr>
<tr>
<td>3-4 hours</td>
<td>29.8%</td>
<td>1.19 (95% CI 1.04-1.35)</td>
</tr>
<tr>
<td>4-5 hours</td>
<td>32.5%</td>
<td>1.24 (95% CI 1.06-1.45)</td>
</tr>
<tr>
<td>5-6 hours</td>
<td>36.6%</td>
<td>1.47 (95% CI 1.22-1.76)</td>
</tr>
<tr>
<td>&gt; 6 hours</td>
<td>39.6%</td>
<td>1.52 (95% CI 1.36-1.7)</td>
</tr>
</tbody>
</table>

**Outcome of inappropriate antibiotics to start**

- A prospective cohort study of 2124 patients showed that inappropriate antibiotics were surprisingly common (32 percent).
- Inappropriate antibiotics were associated with a markedly increased mortality rate (34% vs. 18%) when compared to appropriate antibiotics.
What antibiotics to choose?

- broad spectrum therapy with one or more antimicrobials to cover all likely pathogens.
  - eg, carbapenem, piperacillin-tazobactam
  - Gram +/ Gram Neg/ Fungal and maybe viruses (influenza)

MRSA

hospitalized patients, but also in community dwelling individuals without recent hospitalization

vancomycin (adjusted for renal function)

alternative agents to vancomycin (eg, daptomycin for non-pulmonary MRSA, linezolid)
Pseudomonas? (vancomycin+)

NO
- A 3rd generation (eg, ceftriaxone or cefotaxime) or 4th generation cephalosporin (cefepime), or
- A beta-lactam/beta-lactamase inhibitor (eg, piperacillin-tazobactam, ticarcillin-clavulanate), or
- A carbapenem (eg, imipenem or meropenem)

Yes
- Antipseudomonal cephalosporin (eg, ceftazidime, cefepime), or
- Antipseudomonal carbapenem (eg, imipenem, meropenem), or

Invasive fungal infections: Risk Factors
- Neutropenia +
- Surgery
- parenteral nutrition
- prolonged antimicrobial treatment or hospitalization (especially in the intensive care unit)
- Chemotherapy
- Transplant
- chronic liver or renal failure
- Diabetes
- major abdominal surgery
- vascular devices
- septic shock or multisite colonization with Candida spp.
Poll Question #6

Does Empiric Rx with antifungals help?

A. Yes  
B. No

Evidence against Empiric Rx with Antifungal

- In a meta-analysis of 22 studies (most often comparing fluconazole to placebo, but also using ketoconazole, anidulafungin, caspofungin, micafungin, and amphotericin B), untargeted empiric antifungal therapy did not reduce all-cause mortality

- Critically-ill patients ventilated > 5d, empiric antifungal treatment (mostly fluconazole) was not associated with a decreased risk of mortality or occurrence of invasive candidiasis

- (EMPIRICUS) of 260 non-neutropenic critically-ill patients with Candida colonization (at multiple sites), multiple organ failure, and ICU-acquired sepsis, empiric treatment for 14 days with micafungin did not result in improved infection-free survival at 28 days
• **Monitoring catheters**
  - arterial catheter may be inserted if blood pressure is labile, sphygmomanometer readings are unreliable,
  - **CWP**
    - large volumes of fluids or vasopressors are anticipated
    - peripheral access is poor
    - central venous pressure (CVP) or the central venous oxyhemoglobin saturation (ScvO₂) are chosen as methods of monitoring the hemodynamic response
  - Pulmonary artery catheters (PACs) should **not** be used in the routine management (no evidence of improved survival)

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Poll Question #7

What should be the target for Mean Arterial Pressure (MAP)?

A. 65 to 70 mmHg (low target MAP)
B. 80 to 85 mmHG (high target MAP)
Lactate Clearance: initial lactate – lactate >2 hours later)/initial lactate] x 100
- Potential marker
- Lactate rise is not good (perfusion?)

ABG
- AA gradient worsening
- Pulmonary edema from excessive fluid resuscitation
- Pneumothorax from central catheter placement
- ARDS
- PE

CBC/Chem
- Hyperchloremia should be avoided → switch to low chloride-containing (ie, buffered) solutions if happens

SEPTIC FOCUS IDENTIFICATION <12 hrs
- Sample acquisition (cultures or further diagnostic samples [eg, bronchoalveolar lavage, aspirating fluid collections or joints])
- Imaging (eg, computed tomography, ultrasonography)
- If invasive Candida or Aspergillus infection is suspected, serologic assays for 1,3 beta-D-glucan, galactomannan, and anti-mannan antibodies
Source control < 6-12 hrs

- Undrained foci of infection may not respond to antibiotics
- Remove potentially infected vascular access devices
  - *(after other vascular access has been established)*
- Removing other infected implantable devices/hardware
  - *(when feasible,)*
- Abscess drainage
  - *(including thoracic empyema and joint)*
- Percutaneous nephrostomy
- Soft tissue debridement or amputation
- Colectomy
  - *(e.g., for fulminant *Clostridium difficile*-associated colitis)*
- Cholecystostomy

Pts who fail initial therapy

- Remain hypotensive despite adequate fluid resuscitation
- Develop cardiogenic pulmonary edema

**Norepinephrine > dopamine**

- Decreased mortality → less arrhythmia
- Vasopressin: preferred if worsening tachycardia could be a problem
  - Lack beta adrenergic effects
- Dopamine (DA): those with bradycardia?
Poll Question #8

Which is most correct about additional therapies?

A. Guidelines recommend against the routine use of glucocorticoids in patients with sepsis
B. Inotropic therapy is warrant in those who fail to respond to adequate fluids and vasopressors and have normal cardiac output
C. RBC transfusions should be considered if hemoglobin was ≤9 g/dL
D. All of the above are helpful additional therapies

PATIENTS WHO RESPOND TO THERAPY

- Deescalate fluid resuscitation
  - Hours to days
  - Fluids can be harmful in some cases
  - Cardiogenic and noncardiogenic pulmonary edema (ie, acute respiratory distress syndrome [ARDS])

- Deescalate Antibiotics
  - culture and susceptibility results return → narrow
  - Culture Negative:
    - (improved vital signs), laboratory and imaging data, and a fixed course of broad-spectrum therapy (eg, 3 to 5 days).
    - use of procalcitonin to limit antibiotic use? (evidence limited)
  - Most helpful in CAP
Supportive therapies

- Blood product infusion
- Nutrition
- Stress ulcer prophylaxis
- Neuromuscular blocking agents
- VTE prophylaxis
- Intensive insulin therapy
- External cooling or antipyretics
- Mechanical ventilation, sedation, weaning

Blood products (40% receive them)

- **RBC**
  - hemorrhagic shock
  - Acute anemia with inadequate oxygen delivery
  - Cool vasoconstricted skin
  - obtundation or restlessness
  - oliguria or anuria
  - lactic acidosis
  - Hemoglobin concentration of <7 to 8 g/dL, depending on patient characteristics

- Erythropoietin: not evidenced based
- Plasma products
- Platelets
Summary:

Sepsis → dysregulated inflammatory response to an infectious insult

- Infection (invasion of sterile tissue by organisms) → bacteremia (bacteria in the blood) → sepsis → septic shock → multiple organ dysfunction syndrome (MODS) → death

Sepsis → (sepsis-related) organ failure assessment (SOFA) score

Septic shock:

- circulatory, cellular, and metabolic abnormalities despite adequate fluid resuscitation
- require vasopressors to maintain a mean arterial pressure (MAP) ≥65 mmHg and have a lactate >2 mmol/L (>18 mg/dL).

Practice Recommendations

- Secure airway → correcting hypoxemia
- vascular access → early administration of fluids and antibiotics
- Testing
  - Labs
    - serum lactate, ABG,
    - blood cultures (aerobic and anaerobic) from two distinct venipuncture sites and from all indwelling vascular access devices
    - cultures from easily accessible sites (e.g., sputum, urine)
  - imaging of suspected sources (can be delayed)
### Summary: Optimum Care

<table>
<thead>
<tr>
<th>Empiric broad spectrum IV antimicrobials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guide fluid management</td>
</tr>
<tr>
<td>• mean arterial pressure 65 mmHg to 70 mmHg</td>
</tr>
<tr>
<td>• urine output ≥0.5 mL/kg/hour</td>
</tr>
<tr>
<td>Vasopressors if no response in 3 hrs</td>
</tr>
<tr>
<td>Identify and control source within 6-12 hours</td>
</tr>
<tr>
<td>If responsive reduce fluids +/- vasopressors</td>
</tr>
</tbody>
</table>

### Questions

**Suraj Achar MD**

**Professor UCSD School of medicine**

**Department of Family Medicine and Public Health**
Questions