

Sepsis and Septic Shock

Overview of Sepsis and Septic Shock

Sepsis is a life-threatening condition caused by a dysregulated host response to infection, leading to organ dysfunction. Septic shock is a subset of sepsis with profound circulatory, cellular, and metabolic abnormalities, resulting in a higher risk of mortality (up to 40%). Sepsis is a leading cause of inpatient mortality, with an estimated 270,000 deaths annually in the U.S. (CDC, 2023). Hospitalists play a critical role in early recognition, rapid intervention, and coordination of care to improve outcomes. This guide provides a comprehensive overview of sepsis and septic shock, including pathophysiology, risk factors, clinical presentation, diagnostic studies, complications, treatment strategies, hospitalist implications, and includes tables and clinical scenarios for practical application.

Pathophysiology

Infection Trigger: Sepsis begins with an infection (bacterial, viral, fungal, or parasitic) that triggers an immune response.

Immune Dysregulation: Pro-inflammatory cytokines (e.g., IL-1, TNF- α) and anti-inflammatory mediators cause systemic inflammation, endothelial dysfunction, and microvascular thrombosis.

Organ Dysfunction: Reduced tissue perfusion leads to hypoxia, mitochondrial dysfunction, and organ failure (e.g., AKI, ARDS, encephalopathy).

Septic Shock: Persistent hypotension (MAP <65 mmHg) despite fluids, requiring vasopressors, with lactate >2 mmol/L, indicating cellular hypoperfusion.

Risk Factors

Patient Factors:

- **Age:** >65 years or <1 year (weaker immune response).
- **Immunosuppression:** HIV/AIDS, cancer, chemotherapy, transplant recipients, chronic steroids.
- **Chronic Diseases:** Diabetes, CKD, cirrhosis, COPD.

Hospital-Related:

- **Invasive Devices:** Central lines, urinary catheters, ventilators (increase infection risk).
- **Recent Surgery:** Post-op infections (e.g., intra-abdominal).
- **Prolonged Hospitalization:** Nosocomial infections (e.g., MRSA, Pseudomonas).
- Infection Source:
 - Pneumonia, UTI, intra-abdominal infections, skin/soft tissue infections (e.g., cellulitis, necrotizing fasciitis).

Clinical Presentation

Symptoms and Signs:

- **General:** Fever ($>38^{\circ}\text{C}$) or hypothermia ($<36^{\circ}\text{C}$), chills, fatigue, altered mental status (confusion, delirium).
- **Cardiovascular:** Tachycardia (HR >90 bpm), hypotension (SBP <90 mmHg or MAP <65 mmHg), cool/clammy extremities (shock).
- **Respiratory:** Tachypnea (RR >20 /min), hypoxia (SpO₂ $<90\%$), respiratory distress.
- **Renal:** Oliguria (<0.5 mL/kg/h), AKI (Cr rise >0.5 mg/dL).
- **Neurologic:** Confusion, decreased GCS, seizures (severe cases).
- **Skin:** Warm/flushed (early), mottled/cyanotic (late), petechiae (meningococemia), cellulitis/necrosis.

Sepsis-3 Criteria (2016):

Sepsis: Suspected infection + organ dysfunction (SOFA score increase ≥ 2 points: e.g., PaO₂/FiO₂ <300 , Cr >2 mg/dL, GCS <13).

Septic Shock: Sepsis + persistent hypotension requiring vasopressors (MAP <65 mmHg) + lactate >2 mmol/L after fluid resuscitation.

qSOFA (Quick SOFA) for Rapid Screening:

≥ 2 of: RR ≥ 22 /min, SBP ≤ 100 mmHg, GCS <15 (indicates high risk of poor outcome).

Diagnostic Studies

Labs:

- **CBC:** Leukocytosis ($>12,000/\mu\text{L}$) or leukopenia ($<4,000/\mu\text{L}$), thrombocytopenia ($<100,000/\mu\text{L}$).

- **Lactate:** >2 mmol/L (sepsis), >4 mmol/L (septic shock), marker of hypoperfusion.
- **Procalcitonin:** >0.5 ng/mL (supports bacterial infection, guides antibiotic duration).
- **Blood Cultures:** 2 sets (aerobic/anaerobic) from separate sites, before antibiotics.
- **Urine Culture:** If UTI suspected (pyuria, bacteriuria).
- **CRP/ESR:** Elevated (non-specific inflammation).
- **CMP:** Cr (AKI), bilirubin (liver dysfunction), electrolytes (hypokalemia, hyponatremia).
- **Coagulation:** INR, D-dimer (DIC: INR >1.5, D-dimer >2,000 ng/mL).
- **ABG:** Hypoxemia (PaO₂ <60 mmHg), metabolic acidosis (pH <7.35, HCO₃ <22 mEq/L).

Imaging:

- **CXR:** Pneumonia (consolidation), ARDS (bilateral infiltrates).
- **CT Abdomen/Pelvis:** Intra-abdominal source (e.g., abscess, perforation).
- **CT Chest:** If PE suspected (VTE as coexisting condition).
- **Ultrasound:** Focused assessment (e.g., gallbladder for cholangitis, kidneys for pyelonephritis).

Other Tests:

- **Sputum Culture:** If pneumonia suspected.
- **Wound Culture:** For skin/soft tissue infections.
- **Lumbar Puncture:** If meningitis suspected (e.g., neck stiffness, GCS <15).
- **Echocardiogram:** If endocarditis suspected (new murmur, embolic phenomena).

Complications

- **Acute Kidney Injury (AKI):** 30-50% incidence, due to hypoperfusion, nephrotoxins (e.g., vancomycin).
- **Acute Respiratory Distress Syndrome (ARDS):** 20-40% incidence, bilateral infiltrates, PaO₂/FiO₂ <300 mmHg.
- **Disseminated Intravascular Coagulation (DIC):** 10-15% incidence, INR >1.5, fibrinogen <150 mg/dL, bleeding/thrombosis.
- **Multi-Organ Failure (MOF):** 20-30% incidence, affects kidneys, lungs, liver, heart (mortality >50%).
- **Secondary Infections:** Nosocomial (e.g., VAP, C. difficile), due to prolonged antibiotics, ICU stay.
- **Long-Term:** Post-sepsis syndrome (cognitive impairment, fatigue, 50% readmission within 6 months).

Treatment Strategies

General Principles (Surviving Sepsis Campaign 2021):

- **Early Recognition:** Use qSOFA for screening, confirm with SOFA score.
- **Source Control:** Remove infected devices (e.g., catheters), drain abscesses, debride necrotic tissue.
- **Supportive Care:** ICU if septic shock, mechanical ventilation for ARDS, RRT for AKI.

Specific Treatments:

- Antibiotics:
 - **Empiric (within 1h):**
 - **Broad-spectrum:** Vancomycin 15 mg/kg IV q12h (MRSA) + piperacillin-tazobactam 4.5 g IV q6h (Gram-negatives, anaerobes).
 - **Add if High Risk:** Meropenem 1 g IV q8h (ESBL), micafungin 100 mg IV daily (fungal suspicion).
 - **De-escalation:** Narrow based on cultures (e.g., de-escalate to ceftriaxone for E. coli UTI).
 - **Duration:** 7-10 days (longer for deep infections, e.g., endocarditis: 4-6 weeks).
- Fluids:
 - **Initial:** NS/LR 30 mL/kg IV within 3h (e.g., 2 L for 70 kg patient).
 - **Titrate:** Goal RAP 8-12 mmHg, monitor for overload (crackles, SpO₂ <90%).
- Vasopressors:
 - **First-Line:** Norepinephrine 5-20 µg/min IV (target MAP >65 mmHg).
 - **Add if Refractory:** Vasopressin 0.03 units/min IV (reduces norepinephrine dose).

Supportive Therapies:

Steroids: Hydrocortisone 200 mg/day IV (if refractory shock, ongoing debate per 2021 guidelines).

Ventilation: Low tidal volume (6 mL/kg IBW) for ARDS, PEEP 8-12 cmH₂O.

RRT: For AKI with uremia (BUN >100 mg/dL), hyperkalemia (K⁺ >6.5 mEq/L), or severe acidosis (pH <7.2).

Monitoring:

Lactate q4-6h (goal <2 mmol/L within 24h).

Blood cultures q48h until negative.

SOFA score daily (assess organ dysfunction).

Neuro checks q4h (encephalopathy).

Hospital Medicine Implications

Early Recognition:

Screen all patients with infection using qSOFA (≥ 2 prompts further workup).

Sepsis Bundle (1h):

Blood cultures, lactate, antibiotics, fluids (30 mL/kg), vasopressors if MAP < 65 mmHg.

Consultations:

- **ID:** For source identification, antibiotic selection if necessary or complicated.
- **ICU:** For septic shock, ARDS, MOF.
- **Surgery:** For source control (e.g., abscess drainage, debridement).

Monitoring:

- **Vitals** q1h (HR, BP, RR, SpO₂).
- **Urine output** q1h (goal > 0.5 mL/kg/h).
- **Labs** q6-12h (lactate, Cr, CBC, INR).
- Discharge Planning:
 - **Antibiotics:** Transition to PO (e.g., levofloxacin 750 mg PO daily).
 - **Follow-Up:** ID, primary care within 1 week.
 - **Education:** Teach signs of recurrence (fever, dyspnea), medication adherence.

Table: Diagnostic Criteria and Key Findings in Sepsis

Parameter	Sepsis	Septic Shock	Diagnostic Tests
Definition	Infection + SOFA ≥ 2	Sepsis + vasopressors + lactate > 2 mmol/L	Blood cultures, lactate, SOFA score
Vital Signs	Fever ($> 38^{\circ}\text{C}$), tachycardia (> 90 bpm)	Hypotension (MAP < 65 mmHg), tachypnea	qSOFA (RR ≥ 22 , SBP ≤ 100 , GCS < 15)
Labs	Lactate > 2 mmol/L, procalcitonin > 0.5 ng/mL	Lactate > 4 mmol/L, INR > 1.5	CBC, CMP, D-dimer, ABG
Imaging	CXR: Infiltrates (pneumonia)	CT: Source (e.g., abscess)	CXR, CT abdomen/chest

Parameter	Sepsis	Septic Shock	Diagnostic Tests
Complications	AKI, ARDS	MOF, DIC, death	Monitor Cr, PaO2/FiO2, INR

Table: Hospitalist Management Checklist for Sepsis

Task	Sepsis	Septic Shock	Monitoring	Consults
Initial Stabilization	Blood cultures, lactate, antibiotics	Fluids (30 mL/kg), norepinephrine	Vitals q1h, lactate q4-6h	ID, ICU
Antibiotics	Vancomycin + piperacillin-tazobactam	Add micafungin if fungal risk	Cultures q48h, procalcitonin	ID for de-escalation
Supportive Care	Oxygen, fluids	Ventilation (ARDS), RRT (AKI)	Urine output q1h, SOFA daily	Surgery for source control
Follow-Up	Transition to PO antibiotics	Monitor for secondary infections	Labs q12h, neuro checks	ID, primary care

Clinical Scenarios

Scenario 1: Elderly Male with Sepsis from Pneumonia

Presentation: A 75-year-old male with COPD presents with fever, cough, and confusion. Exam shows T 39°C, BP 110/70 mmHg, HR 120 bpm, RR 24/min, SpO2 88% on room air, GCS 14, lung crackles.

Diagnostic Workup: qSOFA 2 (RR 24, GCS 14), lactate 2.5 mmol/L, CXR: Right lower lobe consolidation, sputum culture: Streptococcus pneumoniae, labs: WBC 18,000/μL, Cr 1.8 mg/dL (baseline 1.0), SOFA score 3 (Cr, GCS, PaO2/FiO2).

Diagnosis: Sepsis (pneumonia source) → qSOFA 2, SOFA ≥2, lactate >2 mmol/L.

Management: Admit to medicine (sepsis). Start vancomycin 15 mg/kg IV q12h + piperacillin-tazobactam 4.5 g IV q6h. Fluids (NS 2 L over 3h). Oxygen 4 L/min (SpO2 94%). Consult ID: De-escalate to ceftriaxone 1 g IV daily (culture result). Monitor lactate q6h (decreases to 1.5 mmol/L), Cr q12h. After 5 days, afebrile, discharged on cefpodoxime 400 mg PO BID with ID follow-up.

Scenario 2: Middle-Aged Female with Septic Shock from UTI

Presentation: A 50-year-old female with diabetes presents with fever, dysuria, and hypotension. Exam shows T 38.5°C, BP 85/50 mmHg, HR 130 bpm, RR 26/min, SpO2 92% on 2 L/min, GCS 15, flank tenderness.

Diagnostic Workup: qSOFA 3 (RR 26, SBP 85, GCS 15), lactate 4.2 mmol/L, urine culture: E. coli, labs: WBC 20,000/ μ L, Cr 2.5 mg/dL, INR 1.6, SOFA score 5 (Cr, BP, lactate).

Diagnosis: Septic shock (UTI source) → qSOFA 3, lactate >4 mmol/L, vasopressor need.

Management: Admit to ICU (shock). Blood cultures, lactate, fluids (NS 2 L over 3h), norepinephrine 10 μ g/min IV (MAP 70 mmHg). Antibiotics: Meropenem 1 g IV q8h (ESBL risk). Consult ID: De-escalate to ceftriaxone (susceptible). Monitor lactate q4h (decreases to 1.8 mmol/L), Cr q12h. After 7 days, BP stable, discharged on cefuroxime 500 mg PO BID with ID follow-up.

Scenario 3: Young Male with Sepsis and Intra-Abdominal Abscess

Presentation: A 35-year-old male with recent appendectomy presents with fever, abdominal pain, and confusion. Exam shows T 39.5°C, BP 100/60 mmHg, HR 110 bpm, RR 22/min, SpO2 94% on room air, GCS 14, abdominal tenderness.

Diagnostic Workup: qSOFA 2 (RR 22, GCS 14), lactate 3.0 mmol/L, CT abdomen: 5 cm pelvic abscess, blood cultures: E. coli, labs: WBC 16,000/ μ L, Cr 1.5 mg/dL, SOFA score 3 (Cr, GCS).

Diagnosis: Sepsis (abscess source) → qSOFA 2, SOFA \geq 2, lactate >2 mmol/L.

Management: Admit to medicine (sepsis). Start vancomycin + piperacillin-tazobactam. Consult surgery: IR drainage of abscess. Fluids (NS 1.5 L). Monitor lactate q6h (decreases to 1.2 mmol/L), blood cultures q48h (negative). After 5 days, afebrile, discharged on levofloxacin 750 mg PO daily with surgical follow-up.

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