

# Surviving Simulated Sepsis

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*A case for simulation and discussion of the surviving sepsis guidelines*

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## **ABSTRACT**

This is an educational resource intended to provide the information and materials necessary to run an original simulated case suitable for training small to medium-sized groups of medical students and residents. This case is one of several designed by the staff of the Uniformed Services University in collaboration with staff from Walter Reed Army Medical Center, and is currently in use at the Walter Reed Medical Simulation Center.

This simulated case involves a patient presenting to the emergency department (ED) with signs and symptoms consistent with systemic inflammatory response syndrome (SIRS). The trainee is responsible for proper assessment, diagnosis, and management as the patient progresses from SIRS to sepsis, severe sepsis, and ultimately septic shock. Pauses for discussion are interspersed throughout the scenario, typically after important decision points, to illustrate and emphasize key learning objectives. Short slide sets are included with the case to facilitate these discussions.

**I. TITLE:** “Surviving Simulated Sepsis”

**II. AUDIENCE:** Medical students and resident physicians

**III. LEARNING OBJECTIVES:**

**A. Primary Learning Objectives.**

1. List the criteria for the diagnosis of SIRS, sepsis, severe sepsis and septic shock.
2. Demonstrate a guidelines-based approach to the management of a patient with severe sepsis or septic shock
3. Define early goal directed therapy
4. Demonstrate proper use of vasopressors
5. Outline principles of initial antibiotic coverage

**B. Secondary Goals**

1. Outline the pathophysiology of septic shock.
2. Articulate the clinical importance of determining bacterial species and site of infection.

**C. Critical Actions**

1. Obtain pertinent history and perform appropriate physical examination.
2. Systematically assess airway, breathing, and circulation.
3. Order appropriate laboratory studies, radiographic imaging, etc.
4. Interpret lab results, chest x-ray, and electrocardiogram
5. Identify unstable vital signs and symptoms.
6. Administer early goal directed therapy.
7. Utilize appropriate vasopressors to treat refractory hypotension.
8. Perform brief sign-out during patient turnover to new team.
9. Complete admission order writing exercise.

**IV. ENVIRONMENT:**

**A. Sim Lab:**

Room will resemble a standard patient room in an emergency department.

**B. Manikin:**

A high fidelity simulation manikin in street clothes will be positioned in the bed with head raised. No leads, lines, or tubes of any kind will be attached to the manikin at the start of the simulation.

**C. Props:**

A cardiac monitor with leads, blood pressure cuff, pulse oximeter, and supplemental oxygen by either nasal cannula or facemask will be available for use. A medicine cart with a full set of vasoconstrictors, ACLS medications, and medicines necessary for sedation, rapid sequence intubation, and analgesia will also be provided. A code cart with defibrillator and other necessary equipment such as laryngoscopes and endotracheal tubes will be present.

### **D. Audiovisual:**

A two monitor set-up will be used. One screen will be dedicated to displaying continuous cardiovascular/respiratory/ hemodynamic monitoring, while the other will be available for reviewing educational slide shows as well as ECGs, chest x-rays, and laboratory studies.

## **V. PARTICIPANT ROLES:**

### **A. Trainees:**

1. **Emergency Medicine Physician:** One student or resident will act as the primary ED physician and will manage the initial evaluation and patient care during the first half of the case.
2. **Critical Care Physician:** A second trainee will assume care of the patient following a simulated transfer to the intensive care unit.
3. **Miscellaneous Roles:** Other students and residents will function as secondary physicians, nurses, technicians, and support staff at the direction of the primary physicians. Roles may vary depending on the number of students and/or residents participating. All trainees will participate in discussion, answer questions, and complete the order writing exercise.

### **B. Instructor:**

This individual, preferably a staff physician or upper level resident, will manage the overall flow of the case by prompting necessary actions and explanations from trainees and providing timely feedback. In addition, the facilitator will be responsible for reviewing and elaborating on the short slide sets, moderating discussion, and answering any clinical questions which may arise from trainees during the case.

### **C. Operator:**

One person who is familiar with the simulator software should be designated to control the technical aspects of the simulation, preferably from a concealed location. The operator will be responsible for triggering action-based responses from the manikin and monitors during the case. Depending on setup, the operator may also be necessary for advancing slides and providing the “voice” of the manikin.

### VI. CASE NARRATIVE PART I: The Emergency Department

#### A. Initial History:

1. Situation (to be introduced by facilitator): The patient is a 70 year old female presenting to the emergency department because she “feels sick”. She was transported to the emergency department via shuttle from the nursing home where she resides.
2. Chief Complaint: “I feel awful and I can’t stop coughing.”
3. History of Present Illness:
  - a. Onset: “I started feeling bad three days ago and have been feeling worse and worse. I keep on coughing up green stuff and I have chills all the time. This morning (3 hrs ago) when I woke up I tried to stand up and felt like I was going to pass out.”
  - b. Associated Symptoms: “I feel worn out, I ache all over, and I barely have the strength to get out of bed.”
4. Past Medical History: “Only high blood pressure”
5. Medications: “I take a water pill every day, and that’s all.”
6. Allergies: None
7. Family History: No significant family history.
8. Social History: No history of alcohol, tobacco, or drug abuse.

#### B. Initial Physical Exam:

1. Vital Signs: Weight 72kg, Temperature 102.1°F, Heart Rate 108, Blood Pressure 92/54; Respiratory Rate 24; Pulse Oximetry 94% on room air
2. General Appearance: Thin female appearing her stated age, awake, alert, and oriented to person, place, and time. Patient appears pale, but is not in any acute distress.
3. HEENT: Head appears normocephalic and atraumatic. Pupils are equal, round, and reactive to light. Extraocular movements are intact. Ears appear normal with tympanic membranes clear and intact. Mucus membranes of mouth and nose are moist and appear normal.
4. Cardiovascular: Patient is mildly tachycardic with regular rhythm. No murmurs, rubs, or gallops are heard on auscultation. Carotid pulse is palpable and no carotid bruit or jugular vein distention is noted.
5. Pulmonary: Auscultation reveals diffuse ronchi (one side more prominent than the other), without wheezes or crackles. Mild dullness to percussion at bases bilaterally.
6. Abdomen: Normoactive bowel sounds on auscultation. Abdomen is soft, non-distended, and non-tender. No masses or hepatosplenomegaly are noted on palpation
7. Extremities: Full range of motion in all extremities. No clubbing, cyanosis, or edema of upper or lower extremities is noted. A weak radial

pulse is palpable, but dorsalis pedis and posterior tibial pulses are non-palpable.

8. Neurologic: Cranial nerves II-XII are intact bilaterally. Patient has normal strength, sensation, and reflexes in all extremities.
9. Dermatologic: Skin appears pale with 4-5 second capillary refill. No rashes or lesions of any kind are noted.

### B. Pause for Discussion

Time should be allotted at this point to ask the learner's what they might be thinking about the case they have been presented. Instructors should probe the learners to discuss an initial assessment and plan. Feedback should be limited from the instructor/ facilitator to allow for the learners to initiate workup and interventions below. This would also be an appropriate time to discuss end of life issues and code status with learners.

### D. Initial Workup and Interventions:

1. Airway and Breathing: Trainee will have found airway and breathing to be adequate by taking a history from the patient.
2. Circulation: Continuous cardiovascular monitoring should be started as well as lines to include 2 large bore (18G or larger) peripheral IV's or a central venous line under ultrasound guidance, and a foley catheter to monitor urine output. These measures can be notionalized for time constraints.
3. IV Fluid: Roughly 1000cc of crystalloid per 30min will be sufficient to maintain blood pressure. If no IV fluid is given patient will become progressively more hypotensive. Goal fluid in over the first 24 hours is 6 to 10 Liters of crystalloid. This should be performed with boluses using a pressure bag with frequent clinical re-assessments to ensure adequate tissue perfusion and urine output. Excessive fluid will cause pulmonary edema and worsening respiratory status at the discretion of the facilitator.
4. Laboratory studies: (see Appendix B: part II)
  - a. Complete Blood Count: White blood cell count 19.1, Hemoglobin 13.0, Hematocrit 38.2, Platelet count 214
  - b. Manual differential: Neutrophils 91%, Lymphocytes 6%, Monocytes 2%, 8 Bands, 2 Segs
  - c. Basic Metabolic Panel: Sodium 140, Potassium 4.5, Chloride 110, Bicarbonate 12, Urea Nitrogen 29, Creatinine 1.4, Glucose 96
  - d. Urinalysis: No urine returned following placement of foley catheter.
  - e. ABG: pH 7.30, PaCO<sub>2</sub> 31, PaO<sub>2</sub> 62, HCO<sub>3</sub> 14
  - f. Cultures: The following cultures/gram stains should be obtained but trainee will be informed that results are pending: Blood, sputum, and urine.
  - g. Other labs: Lactate 4.7

5. Other Studies: (see Appendix B: Part I).
  - a. Chest X-ray: Increased opacification in right lower lobe
  - b. ECG: Sinus tachycardia, left axis deviation

### E. Discussion:

The exercise will follow a format to allow for pauses during critical “teachable moments.” Ideally placed when trainees are struggling or when a critical action is completed successfully or missed.

1. Following initial administration of IV fluids the scenario will be paused for a brief discussion of “Early Goal Directed Therapy” (see Appendix A: Slide Set 1.1)
2. The trainee acting in the role of ED Physician will be asked to consider disposition and subsequently to give a brief sign out to the trainee acting in the role of Critical Care Physician. Following this sign out the scenario will be paused for a discussion of “The Spectrum of Sepsis” (see Appendix A: Slide Set 1.2)

## VII. CASE NARRATIVE PART II: The Intensive Care Unit

### A. Order Writing Exercise:

Each trainee will be given a blank admission order template (see Appendix C: Part I) and asked to “admit the patient to the ICU”. A sample completed order set is included with this case for reference (see Appendix C: Part II)

### B. Situation:

The trainee will be informed that the patient is now arriving in the ICU from the emergency department having “decompensated during transit”.

### C. Evaluation:

1. Vital Signs: Temperature 101.9°F, Heart Rate 108, Blood Pressure 78/42, Respiratory Rate 24, Pulse Oximetry 92%
2. General Condition: Patient now very pale and obtunded, Glasgow Coma Scale = 8 (opens eyes to pain, incomprehensible speech, withdraws from pain).
3. Physical Exam: Otherwise unchanged from initial presentation

### D. Interventions:

1. Airway and breathing: Given acute change in mental status and low GCS, airway and breathing should be reassessed per Basic Life Support protocol. If trainee neglects to evaluate the patient’s airway and breathing then oxygen saturation will drop (O<sub>2</sub> Sat 82%), and patient will become simultaneously tachypneic (RR 36) and bradycardic (HR 45). Trainee should identify appropriate actions including providing supplemental oxygen, bag-valve mask ventilation, and/or intubation as necessary.

2. Circulation: IV fluid resuscitation should be continued using boluses and monitoring perfusion parameters. A central line should be placed under ultrasound guidance if not yet performed. A vasoconstrictor should be started immediately via the central line. An arterial catheter should be placed for continuous hemodynamic monitoring. The patient will show some improvement but remain hypotensive despite initiation of pressors. Stress dose steroids should then be considered. Discussion should emphasize that this is a controversial intervention. The blood pressure and heart rate should stabilize if the trainees suggest additional pressors or up titration of dosing after a simulated period of time passes (suggest 1-2 hours). The scenario will then be paused for a brief discussion of “Hemodynamics” (see Appendix A: Slide Set 2.1)
3. Antibiotics: Once the patient is hemodynamically stable, the trainee should be asked to consider antibiotic coverage if not already addressed during the order writing exercise, and to elaborate on reasons for choice of type, dosage, and route. Broad spectrum antibiotic coverage should include one drug with proven effectiveness against methicillin resistant *S. aureus*, and one or two antipseudomonal agents. Trainee will be asked to formulate a plan of action should the patient remain febrile with elevated white blood cell count 3 days after beginning antibiotics. Appropriate actions include repeat cultures from all lines, fungal culture of sputum, and CT scans to rule out abscess. A brief discussion on “targeting the infection” will follow (see Appendix A: Slide Set 2.2).
4. Continued Plan of Care: Speciation and sensitivities of cultures with subsequent adjustment of antibiotic regimen should be addressed, as well as prophylaxis against stress ulcers and venous thromboembolic disease if not discussed earlier during order writing exercise.

### **E. Discuss Sepsis Care Bundles or Protocols:**

Near the end of the exercise, the facilitator should lead a brief discussion on the importance of sepsis care bundles. These are essentially protocols that many institutions follow to ensure that adequate patient monitoring is accomplished and re-enforces benchmarks or screening tools to ensure early detection and intervention should a patient’s condition worsen. There are many different protocols as discussed in the literature and a representative example to review with the learners is provided in the slide set under appendix C. A recent review by Barochia et al. demonstrated a significant survival benefit when these protocols or bundles are used.

## **VIII. DEBRIEFING:**

### **A. Summary:**

A very brief closing discussion will summarize the “Surviving Sepsis Guidelines” as well as the strength and quality of each recommendation (see Appendix A: Slide Set 2.3).

### B. Evaluation:

This case is not designed to be used as a tool for formal evaluation though it may be modified for such use. The case was conceived not as an examination but as an “interactive lecture” on how to evaluate and treat septic shock.

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## X. REFERENCES:

Dellinger RP, Levy MM, Carlet, JM, et al: Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock: 2008 [published correction appears in *Crit Care Med* 2008; 36:1394 –1396]. *Crit Care Med* 2008; 36:296 –327.

Rivers E, Nguyen B, Havstad S, et al: Early goal-directed therapy in the treatment of severe sepsis and septic shock. *N Engl J Med* 2001; 345:1368-77.

Choi PT, Yip G, Quinonez LG, Cook DJ: Crystalloids vs. colloids in fluid resuscitation: a systematic review. *Crit Care Med* 1999; 27:200-10.

Hollenberg SM, Ahrens TS, Annane D, et al: Practice parameters for hemodynamic support of sepsis in adult patients: 2004 update. *Crit Care Med* 2004; 32:1928-48.

Garnacho-Montero J, Garcia-Garmendia JL, Barrero-Almodovar A, et al: Impact of adequate empirical antibiotic therapy on the outcome of patients admitted to the intensive care unit with sepsis. *Crit Care Med* 2003; 31:2742-51.



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Hemann BA, Mikita JA, Hall NM

Anname D, Bellissant E, Bollaert PE, et al: Corticosteroids in the treatment of severe sepsis and septic shock in adults: a systematic review. *JAMA* 2009; 301:2362-75.

Bernard GR; Vincent JL; Laterre PF, et al: Efficacy and safety of recombinant human activated protein C for severe sepsis. *N Engl J Med* 2001; 344:699-709.

Daniel De Backer D, Biston P, Devriendt J, et al: Comparison of Dopamine and Norepinephrine in the Treatment of Shock *N Engl J Med* 2010;362:779-89.

Barochia AV, Cui X, Vitberg D, Suffredini AF, et al: Bundled Care for Septic Shock: An Analysis of Clinical Trials. *Critical Care Medicine* 2010; 38: 668-78.