Take the Shock Out of Sepsis
Why Use Simulation?

Learning Pyramid

- Do
  - The real thing
  - Make a decision
- Say
  - Teach someone
  - Learning game
  - Discussion
- See
  - Answer a question
  - 3D Animation
  - Watch a demonstration
  - Watch a video
  - See a picture
  - See a diagram
- Hear
  - Audio Book
  - Hear a lecture
- Read
  - Read text

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Miracle on the Hudson
A Changing Landscape

- AHRQ
- Leapfrog
- CMS
- Joint Commission

- Central Line Infection
- Iatrogenic Pneumothorax
- MRSA Infection
- Heart Attack (3)
- Sepsis
- Post-op Hip Fracture
- Door-to-Balloon Time
- Post-op Respiratory Failure
- Heart Failure (4)
- Post-op Hemorrhage or Hematoma
- Death in Low-Mortality DRG
- Stroke
- ADEs
- Patient Falls
- Universal Protocol
- Surgery (3)
- Infections Due to Medical Care
- ICU Staffing
- Post-op Pulmonary Embolism or DVT

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Putting the Guidelines into Practice

Understanding the Guidelines

Standardized Metrics
Individualized Feedback

Critical Care Medicine

Guideline adoption: A slow process*

*For the complete details, see Health and Safety Committee Report of the Nursing Practice Council of the Society of Critical Care Medicine.
MSC QI Program Components

- Pre-online course knowledge assessment & confidence survey
- Online course
- Post-online course knowledge assessment & confidence survey
- Educator-facilitated didactic review of online content highlights
- Educator-facilitated review of hospital-specific policies and procedures
- Educator-facilitated simulation & debrief: 2-4 scenarios
  - Includes an element of stress and/or real patient stories
  - Process and clinical elements included
- Post-course knowledge assessment and confidence survey to ensure learning objectives are met & competency documented
Participation in a sepsis simulation training exercise resulted in Emergency Med Residents (n=20) taking more appropriate and immediate action in administering evidence-based care to patients.7

Following simulation training, participants noted improvement in confidence levels in managing patients with severe sepsis and septic shock.8
Competency Results: Sepsis Program

**Sepsis Program Test Results**

- Pre-Didactic Test Score - 63%
- Post-Didactic/Pre-Simulation Test Score - 82%
- Post-Simulation Test Score - 95%

![Histogram showing test results](image)
Confidence Results: Sepsis Program

- 45% Increase in Confidence
- 27% Increase in Consistency of Responses

Confidence in Early Identification and Treatment of Sepsis According to the Surviving Sepsis Campaign Guidelines

Pre-Simulation = 648*1*normal(x, 2.9892, 0.9508)
Post Simulation = 648*1*normal(x, 4.3287, 0.6911)
Objectives

1. **Describe the difference between sepsis, severe sepsis and septic shock**

2. **Identify signs and symptoms of SIRS**

3. **Discuss assessment findings correlated with patients who are at increased risk for sepsis (Index of Suspicion)**

4. **Identify signs and symptoms of tissue hypoxia**

5. **Identify signs and symptoms of organ dysfunction**

6. **Discuss fluid resuscitation recommendations and goals according to the Surviving Sepsis Campaign guidelines**

7. **Identify correct early identification and treatment recommendations according to the Surviving Sepsis Campaign guidelines**

8. **Discuss rationale for septic shock treatments**
• Sepsis is the leading cause of death for critically ill patients in the United States

• It is the tenth most common cause of death overall

• It accounts for 1-2% of all hospitalizations and for 25% of ICU bed utilization

• Projection for 2020 is 1,100,000 new cases of sepsis
As sepsis progresses, mortality increases

- 20% for sepsis
- 40% for severe sepsis
- Greater than 60% for septic shock
Sepsis Continuum

- **SIRS**: A physiologic response of the endocrine axis and immune systems
- **Sepsis**: SIRS + a known or suspected infection
- **Severe Sepsis**: Sepsis + acute organ dysfunction
- **Septic Shock**: Severe sepsis + refractory hypotension
Systemic inflammatory response to a variety of clinical insults

The response is manifested by two or more of the following variables:

Clinical
- HR > 90 beats/minute
- Temperature < 36°C or > 38°C
- Tachypnea > 20 breaths/minute, or PaCO₂ < 32 mmHg

Laboratory
- WBC < 4,000 or > 12,000/mm³ or > 10% immature neutrophils (Bands)
Non-Specific

- Can be caused by ischemia, inflammation, trauma, infection or a combination of insults

It must have an index of suspicion for infection

- It is not always related to infection, but it is a good indicator that an infection may be present
• Infection plus systemic manifestations of infection

• In order to identify sepsis early it is important to assess the patients history and evaluate their index of suspicion
• Extremes of age (< 10 years and > 70 years)

• Primary diseases
  - Liver cirrhosis
  - Alcoholism
  - Diabetes mellitus
  - Cardiopulmonary diseases
  - Solid malignancy
  - Hematologic malignancy
Sepsis: Index of Suspicion

- Major surgery, trauma, burns
- Invasive procedures
- Recent or prolonged hospitalization
- Prior antibiotic therapy
- Other factors such as childbirth, abortion, and malnutrition
- Neutropenia
- Immunosuppressive therapy
- Corticosteroid therapy
- Intravenous drug abuse
- Compliment deficiencies
- Absence of spleen
Sepsis: Progression

1. Infection
2. Neutrophil activation and TNF release
3. Increased micro-coagulation begins to be excessive
4. Vasodilation
5. Edema and hypovolemia
6. Damaged vascular endothelium
7. hypotension
8. Decreased tissue perfusion
9. Organ failure
Sepsis: Clinical Findings

- Massive vasodilation
- Increased capillary permeability = edema
- Decreased systemic vascular resistance
- Hypotension (further decrease in perfusion)
- Tissue hypoxia
Severe Sepsis

Sepsis plus sepsis-induced organ dysfunction or tissue hypoperfusion

Associated organ dysfunction is manifested by:

- \( \text{PaO}_2/\text{FiO}_2 < 280 \)
- Elevated lactates
- Oliguria (urine output < 0.5 ml/kg for at least 1 hour following adequate fluid resuscitation)
- Acute mental status alteration
- Hypotension – SBP < 90mmHg or a reduction in SBP of at least 40mmHg from baseline
Severe Sepsis: Clinical Findings

- Hypotension
- Lactic acidosis
- Increasing serum creatinine
- Decreasing platelet count
- Increasing PT and INR
- Extra vascular volume loading
- Increasing ventilation requirements
- Widening anion gap
- Decreasing ScvO2
- Decreasing pulse
Anion Gap

Anion Gap = [Na+] - [Cl-] - [HCO3-]
Normal value = 8 - 14 mEq/L

Anion Gap > 20 mEq/L = metabolic acidosis

Alternative formula:

AG = [(Na+) + (K+)] - [(Cl-) + (HCO3-)]

Normal value = 10 to 20 mEq/L plasma when including [K+].
Sepsis-induced hypotension persisting despite adequate fluid resuscitation

- Minimally responsive to volume loading which will actually increase lung water contents
- Treatment requires volume replacement and vasopressors
- May require hormonal stimulation
**Scv0₂ and Sv0₂**

- Indicators of the balance between oxygen delivery and consumption

- Readings are influenced by:
  - Arterial Oxygenation
  - O₂ Consumption
  - Cardiac Output
  - Hemoglobin

- Normal range:
  - Scv0₂ > 70%
  - Sv0₂ 60 – 80%
• Persistent Hypotension
• DIC
• Coma
• ARDS/Pulmonary edema
• Oliguria/azotemia
• Hypoglycemia
• Leukopenia
• Ischemia
• GI Bleeding
Impacting Mortality

• Improve recognition and rapid interventions
• Eliminate source of infection
• Evaluate and resuscitate tissue perfusion
• Replace hormone and mediators
• Appropriately support the organs
Complete within the first six hours of identification

Diagnose:
- Measure serum lactate
- Obtain blood cultures prior to antibiotic administration

Treat:
- Administer broad spectrum antibiotics within 3 hours of ED admission and 1 hour of non-ED admission
- In the event of hypotension and/or serum lactate > 4mmol/L:
  - Deliver an initial minimum of 20ml/kg of crystalloid or an equivalent
  - Apply vasopressors for hypotension not responding to initial fluid resuscitation (MAP > 65mmHg)
**Complete within the first 24 hours of identification**

- Administer low-dose steroids for septic shock in accordance with a standardized ICU policy. If not administered, document why the patient did not qualify for low dose steroids based on the standardized policy.

- Maintain glucose control: Treat blood sugar >180 and keep ~150

- Administer recombinant human activated protein C (rhAPC) [dortrecogin alfa: Xigris®] in accordance with a standardized ICU policy. If not administered, document why the patient did not qualify

- Maintain a median inspiratory plateau pressure (IPP) < 30cmH₂O for mechanically ventilated patients using lung protective strategies.
Blood pressure support

- Fluid therapy
  - Begin fluid administration immediately for sepsis related hypotension or lactate > 4mmol/L
  - Give a fluid challenge of 20ml/kg crystalloid or 300-500 ml of colloids over 30 minutes. More rapid or larger volumes may be required for sepsis induced tissue hypoperfusion
- Target a MAP of ≥ 65mmHg
- Target a urinary output of ≥ 0.5ml/kg/hr
- Consider placing a central line with oximetry capabilities
  - Target CVP 8-12 cmH₂O in non-ventilated patients and 12-15 cmH₂O in ventilated patients
  - ScvO₂ ≥70%
  - SvO₂ ≥ 65%
Blood pressure support

- Vasopressors
  - Maintain MAP $\geq \text{65mmHg}$
  - Norepinephrine and dopamine are recommended as initial vasopressors of choice
  - Vasopressin may be added to increase synergistic vasopressor effect with at lower doses of norepinephrine
**Infection Diagnosis**

- Identify source within first six hours of sepsis.
- Use physical exam, imaging and preliminary culture results to determine source.
- Obtain cultures from all pertinent sources prior to antibiotic therapy.
- Do not allow a significant delay in antibiotic administration due to obtaining cultures.
**Initial antibiotic therapy**

- Initiate broad spectrum antibiotic therapy until cultures become available.

- In the presence of severe sepsis or septic shock administration within the first hour profoundly affects mortality

- Reassess antimicrobial regimen daily

- Continue antibiotic therapy for at least 7 – 10 days
Inotropic Support

- Use IV inotropes in patients with myocardial dysfunction
  - Ejection Fraction of <50%
  - $\text{ScvO}_2 < 70\%$ in the presence of increased filling pressures or adequate fluid resuscitation
  - Known history of heart disease
**Intensive insulin therapy**

- Aim to keep blood glucose ~150 mg/dL using a validated protocol for insulin dose adjustment

- Provide a glucose calorie source and monitor blood glucose values every 1-2 hours in patients receiving IV insulin
  - Every 4 hours when stable
Xigris

rhAPC [dortrecogin alfa: Xigris®]

- Improves microcirculatory perfusion in severe sepsis by decreasing inflammation, decreasing coagulation and increasing fibrinolysis
- Replaces endogenous activated protein C
**rhAPC** [dortrecogin alfa: Xigris®]

**Guidelines**

- Adult patients with severe sepsis and low risk of death APACHE II < 20 or one organ failure should not receive Xigris®

- Consider Xigris® in adult patients with sepsis-induced organ dysfunction with clinical assessment of high risk of death APACHE II > 25 or multiple organ failure if there are no contraindications
rhAPC [dortrecogin alfa: Xigris®]

- Must be administered in an isolated lumen
- Discontinue 2 hours prior to invasive procedures or those at an inherent risk of bleeding
- Restart 12 hours after major invasive procedures or 2 hours after less invasive procedures
- Potential for antibody development
- Only good for 12 hours after preparation
Mechanical Ventilation

- The goal of low tidal volume ventilation for septic patients with acute lung injury (ALI) and acute respiratory distress syndrome (ARDS) is to reduce injurious lung stretch and release of inflammatory mediators.
- Target tidal volume of ≤6ml/kg of predicted body weight.
- Target initial upper limit of plateau pressure ≤ 30 cmH$_2$O.
- Allow PaCO$_2$ to rise above normal to minimize tidal volume and plateau pressures.
- Use peep to avoid alveolar collapse.
Additional Therapies

• Prophylaxis for DVT
• Stress ulcer prophylaxis
• Prevention of nosocomial pneumonia by elevation of head to 45 degrees
• Use daily sedation interruption to facilitate early wean and extubation
• Narrow antibiotics when appropriate
Saving Patient Lives
"Students not only learn more when online sessions are added to traditional courses, but student interaction and satisfaction improves as well."
SimSuite Sepsis Program
Pre-Online Course
Knowledge Check
Available to
Laerdal SUN Attendees
and their
Hospital Staff
Open for discussion and question