SEPSIS MANAGEMENT – SYSTEM BASED APPROACH

Delia Jervis RN
Nursing Director
Methodist Hospital of Southern California
The Surviving Sepsis Campaign (SSC) was launched in 2002 as a collaborative initiative of the European Society of Intensive Care Medicine (ESICM), the International Sepsis Forum (ISF), and the Society of Critical Care Medicine (SCCM). Its objective was, through the development and promulgation of evidence-based guidelines that facilitated the application of knowledge derived from clinical trials to bedside practice, to effect a 25% reduction in the relative risk of death from severe sepsis and septic shock.
History of Surviving Sepsis campaign

- Campaign’s history Since its inception in 2002 the Campaign has achieved several key milestones.

  - Original Stated Goal of Campaign
    To reduce mortality from sepsis by 25% in 5 years (that translates to 2009 from the date of publication of the first set of guidelines) via a 7-point agenda including: Building awareness of sepsis

    - Improving diagnosis
    - Increasing the use of appropriate treatment
    - Educating healthcare professionals
    - Improving post-ICU care
    - Developing guidelines of care
    - Implementing a performance improvement program
Phase I: Development of Awareness of Scope of the Problem

- **Late 2001/Early 2002**


- Campaign was formed by the Society of Critical Care Medicine, European Society of Intensive Care Medicine, and the International Sepsis Forum and launched at the ESICM Annual Meeting in Barcelona in Fall 2002 with presentation of plan to develop guidelines and promote sign-on to the "*Barcelona Declaration.*"

- Steering committee formed with 3 representatives from each of the 3 societies.
Phase II: Development and Publication of Guidelines

* June 2003
  * Representatives of 11 international societies convened in Windsor, UK to develop guidelines for the management of severe sepsis and septic shock.

* March and April 2004
  * Publication of guidelines in Critical Care Medicine and Intensive Care Medicine.
Phase III: Guideline Implementation, Behavior Change, and Data Collection

September 2003

* The Surviving Sepsis Campaign initiated a partnership with the Institute for Healthcare Improvement to apply their successful quality improvement techniques to treatment of sepsis. The Surviving Sepsis Campaign Bundles evolved from this collaboration.

* Education initiatives continue at critical care conferences globally.

January 2004

* Steering Committee convened to determine direction of data collection activities.

* The American College of Emergency Physicians importance to the improvement efforts was recognized and they were invited to join the Campaign.

September 2004

* Campaign presented to European clinicians at Mediterranean Critical Care School and international representatives gathered to begin development of bundles.

* Pocket guidelines and posters developed and distributed by SCCM in North America and ESICM in Europe

* Development of data collection tool initiated
November 2004

- Supplement to Critical Care Medicine including background papers for all guidelines published.

February 2005

- Regional networks established to promote collaboration in data collection and performance improvement throughout US.

December 2005

- Implementing the Surviving Sepsis Campaign, the manual for conducting the Campaign in local hospitals, was published.

January 2006

- Approximately 5000 copies of manual distributed in North America.
- Campaign session at SCCM’s 35th Critical Care Congress highlights data collection.
- Meeting of representatives from 28 countries held during SCCM Congress to begin development of an updated edition of the Surviving Sepsis Campaign guidelines.
2008

  - Performance improvement efforts continue worldwide with data collection, educational programs, and listserv collaboration.
  - International Sepsis Forum leaves Campaign to avoid any misconceptions about industry involvement.

2010

- Publication of results of 15,000 patient data set shows association of bundle compliance with 20% relative risk reduction.

2011

- Gordon and Betty Moore Foundation fund development of educational programming, research, and Campaign outreach
2012
Third edition of the Surviving Sepsis Campaign Guidelines published along with revised bundles.

R. Phillip Dellinger, MD; Mitchell M. Levy, MD; Andrew Rhodes, MB BS; Djillali Annane, MD; Herwig Gerlach, MD, PhD; Steven M. Opal, MD; Jonathan E. Sevransky, MD; Charles L. Sprung, MD; Ivor S. Douglas, MD; Roman Jaeschke, MD; Tiffany M. Osborn, MD, MPH; Mark E. Nunnally, MD; Sean R. Townsend, MD; Konrad Reinhart, MD; Ruth M. Kleinpell, PhD, RN-CS; Derek C. Angus, MD, MPH; Clifford S. Deutschman, MD, MS; Flavia R. Machado, MD, PhD; Gordon D. Rubenfeld, MD; Steven A. Webb, MB BS, PhD; Richard J. Beale, MB BS; Jean-Louis Vincent, MD, PhD; Rui Moreno, MD, PhD; and the Surviving Sepsis Campaign Guidelines Committee including the Pediatric Subgroup*

Phase IV: Reinvigoration of the Campaign

2013

* European Society of Intensive Care Medicine and the Society of Critical Care Medicine announce a reinvigoration of the Campaign with the Surviving Sepsis Campaign Declaration at SCCM’s 42nd Critical Care Congress in San Juan, Puerto Rico.

* Regulatory bodies in the United States adopt the Surviving Sepsis Campaign Bundles as mandated measures.

* The Campaign prepares to incorporate new data as they are published into the guidelines.
Each year, sepsis strikes an estimated 750,000 people in the USA alone. Sepsis is the 10th most common cause of death and is the leading cause of death for critically ill patients in the US.
Organ failure in sepsis

System-based Approaches to sepsis

**EARLY GOAL-DIRECTED THERAPY IN THE TREATMENT OF SEVERE SEPSIS AND SEPTIC SHOCK**

**EMANUEL RIVERS, M.D., M.P.H., BRYANT NGUYEN, M.D., SUZANNE HAVSTAD, M.A., JULIE RESSLER, B.S., ALEXANDRIA MUZZIN, B.S., BERNHARD KNOBlich, M.D., EDWARD PETERSON, PH.D., AND MICHAEL TOMLANOVICH, M.D., FOR THE EARLY GOAL-DIRECTED THERAPY COLLABORATIVE GROUP**

System-based Approaches to sepsis

Early-Goal Directed Therapy

INCLUSION = SEPSIS AND [BP < 90 after fluid OR Lactate > 4]

<table>
<thead>
<tr>
<th>Control</th>
<th>Intervention</th>
<th>EGDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVP 8-12</td>
<td>Fluids</td>
<td>CVP 8-12</td>
</tr>
<tr>
<td>MAP &gt; 65</td>
<td>Vasopressors</td>
<td>MAP &gt; 65</td>
</tr>
<tr>
<td>Transfusions Dobutamine</td>
<td></td>
<td>ScvO2 &gt; 70%</td>
</tr>
<tr>
<td>49% mortality</td>
<td></td>
<td>33% mortality</td>
</tr>
</tbody>
</table>

System-based Approaches to sepsis

The New England Journal of Medicine

EARLY GOAL-DIRECTED THERAPY IN THE TREATMENT OF SEVERE SEPSIS AND SEPTIC SHOCK

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Used to promote:
1. CVP > 8 as an initial target
2. Use of Svo2 monitoring and use of blood/dobutamine

## System-based Approaches to sepsis

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</thead>
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<td>33% mortality</td>
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</table>

Do whatever you normally do. Use a rigid protocol with multiple dedicated team members.

They did not control for the system of care.

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A Multidisciplinary Community Hospital Program for Early and Rapid Resuscitation of Shock in Nontrauma Patients

BEFORE (control)  AFTER (protocol)

Do what you normally do. We will be watching.


A Multidisciplinary Community Hospital Program for Early and Rapid Resuscitation of Shock in Nontrauma Patients

A Multidisciplinary Community Hospital Program for Early and Rapid Resuscitation of Shock in Nontrauma Patients

Hospital-wide impact of a standardized order set for the management of bacteremic severe sepsis

BEFORE

Do whatever it is that you normally do. We will be watching.

AFTER

All physicians, nurses, and patient care technicians in the emergency department and intensive care units received formal order set clinical education. Additionally, all hospital floor clinical nurse specialists and advance practice nurses, along with the physicians in these areas, were in-serviced on the order sets....These educational endeavors included training in sepsis pathophysiology, monitoring of central venous pressures, assessment of central venous blood oxygen saturation, and the pharmacotherapy of sepsis

1. EDUCATION
2. ORDER SET with recommendations and goals for sepsis treatment.

Hospital-wide impact of a standardized order set for the management of bacteremic severe sepsis

Four stages of Sepsis:

- Systemic Inflammatory Response Syndrome (SIRS)
- Sepsis = SIRS + proven/suspected infection
  - Persistent SIRS with proven or suspected infection
- Severe Sepsis = Sepsis + acute organ dysfunction
  - Persistent sepsis with indicators of organ dysfunction
- Septic Shock = Severe Sepsis + Refractory Hypotension
  - Sepsis/severe sepsis and hypotension that is not responsive to volume resuscitation and requires administration of vasopressors
SIRS is defined as two or more of the following variables:

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

• Laboratory
  - WBC < 4,000 or > 12,000 cells/mm³ or 10% immature neutrophils (Bands)
Infection, SiRS, Sepsis

Index of Suspicion for Infection:

- What assessment findings have been correlated to patients who are at increased risk for sepsis?

<table>
<thead>
<tr>
<th>Age Extremes (&lt;10 y and &gt;70 Y)</th>
<th>Major surgery/ trauma, burns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary diseases</td>
<td>Invasive procedures</td>
</tr>
<tr>
<td>- Liver cirrhosis</td>
<td>- Catheters</td>
</tr>
<tr>
<td>- Alcoholism</td>
<td>- Intravascular devices</td>
</tr>
<tr>
<td>- Diabetes Mellitus</td>
<td>- Prosthetic devices</td>
</tr>
<tr>
<td>- Cardiopulmonary Diseases</td>
<td>- Hemodialysis and peritoneal dialysis catheters</td>
</tr>
<tr>
<td>- Solid malignancy</td>
<td>- Endotracheal tubes</td>
</tr>
<tr>
<td>- Hematologic malignancy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Immunosuppression</th>
<th>Prolonged or recent hospitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Neutropenia</td>
<td>Prior antibiotic treatment</td>
</tr>
<tr>
<td>- Immunosuppressive therapy</td>
<td>Other factors such as childbirth, abortion, and malnutrition.</td>
</tr>
<tr>
<td>- Corticosteroid therapy</td>
<td></td>
</tr>
<tr>
<td>- Intravenous drug abuse</td>
<td></td>
</tr>
<tr>
<td>- Compliment deficiencies</td>
<td></td>
</tr>
<tr>
<td>- Absence of the spleen</td>
<td></td>
</tr>
</tbody>
</table>
### Laboratory Tests and Results in Septic Patients

<table>
<thead>
<tr>
<th>Labs</th>
<th>Normal Ranges</th>
<th>What is seen in sepsis?</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td>3.2 – 9.8 thousands/mm³</td>
<td>↑</td>
<td>Increased during inflammation but short life span</td>
</tr>
<tr>
<td>Bands</td>
<td>3-5%</td>
<td>↑</td>
<td>Immature neutrophils produced by bone marrow when inflammation is acute or continuous</td>
</tr>
<tr>
<td>PLT</td>
<td>150 - 450 thousands/mm³</td>
<td>↓</td>
<td>Become activated and consumed in the making of clots</td>
</tr>
<tr>
<td>pH</td>
<td>7.35 – 7.45</td>
<td>↓</td>
<td>Acidosis pH &lt; 7.35</td>
</tr>
<tr>
<td>pCO2</td>
<td>35 – 45 mmHg</td>
<td>↓</td>
<td>Compensation with pCO2 &lt; 5 (Blowing off CO2 with increase RR)</td>
</tr>
<tr>
<td>HCO3</td>
<td>20-28 mEq/L</td>
<td>↓</td>
<td>Metabolic acidosis HCO3 &lt;20</td>
</tr>
<tr>
<td>BE</td>
<td>-3 - 3</td>
<td>↓</td>
<td>A non-respiratory reflection of acid-base balance</td>
</tr>
<tr>
<td>Serum CO2</td>
<td>23 – 30 mmol/L</td>
<td>↓</td>
<td>Compensation by blowing off CO2</td>
</tr>
<tr>
<td>Creatinine</td>
<td>.05 – 1.5 mg/dl</td>
<td>↑</td>
<td>Possible causes include decreased perfusion (MAP), need for vasoactive therapy, and low central CVP despite aggressive fluid therapy.</td>
</tr>
<tr>
<td>Lactate</td>
<td>0.6 – 2.5 mmol/L</td>
<td>↑</td>
<td>Assessment of tissue hypo-perfusion and anaerobic metabolism</td>
</tr>
<tr>
<td>PT</td>
<td>10.1 -13.1 sec</td>
<td>↑</td>
<td>Consuming coagulation and intravascular dysfunction</td>
</tr>
<tr>
<td>INR</td>
<td>0.9 – 1.1</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Fibrinogen</td>
<td>200 – 400 mg/dl</td>
<td>↓</td>
<td></td>
</tr>
</tbody>
</table>
72yo female smoker with diabetes, HTN. Has onset of chills, followed by fever.

Later presents with dyspnea, fever to 102.7. BP of 80/40 with a HR of 125.

CXR: RUL consolidation.
Identify Sepsis as early as possible

Identify source(s) of infection and Broad Spectrum antibiotics ASAP

Identify severity: Vitals, mental status, UOP, LACTATE, other labs.

Volume and physiologic resuscitation ASAP with GOALS.

Tweak the system so these things happen FAST
Screening for Sepsis & Performance Improvement

1. Routine screening of potentially infected seriously ill patients for severe sepsis to allow early implementation of therapy (grade 1C)

2. Hospital-based performance improvement efforts in severe sepsis (UG)
### Sepsis Screening

1. **Criterion #1: SIRS**  
   Must fulfill 2 or more of the 4 below
   - **Clinical**
     - Temperature > 38°C (100.9°F) or < than 36°C (98.8°F)
     - Heart Rate greater than 90 beats per minute
     - Respiratory rate greater than 20 or PaCo2 less than 32
   - **Laboratory**
     - WBC greater than 12,000 or less than 4,000 or
     - WBC differential showing greater than 10% immature neutrophils

   □ Yes □ No  
   SIRS (Criterion I is met)  
   Notify MD

2. **Criterion #2: Sepsis**  
   The patient has proven infection or suspicion for infection.  
   Must fulfill 1 of the proven/suspicion of infection below
   - Pneumonia/ Empyema
   - Urinary Tract Infection
   - Acute Abdominal Infection
   - Meningitis
   - Skin/Soft Tissue Infection
   - Bone/ Joint Infection, wounds
   - Endocarditis
   - Other

   Index of Suspicion for infection:
   - Age Extremes
   - Invasive procedures, catheters, devices
   - Major surgery, trauma, burns
   - Prolonged or recent hospitalization
   - Primary chronic diseases
   - Prior antibiotic therapy
   - Immunosuppression
   - Other factors such as malnutrition, childbirth, etc.

   □ Yes □ No  
   Sepsis (Criteria I & 2 are met)  
   Notify MD  
   Obtain orders for Labs, tests, broad spectrum Antibiotics

3. **Criterion #3: Severe Sepsis**  
   Must fulfill 1 of the 2 below
   - Sepsis + acute organ dysfunction 1 or more signs of organ failure
   - Lactate above 4 mmol/L

   □ Yes □ No  
   Severe Sepsis (Criteria 1, 2, 3 are met)  
   Call the Rapid Response Team

4. **Criterion #4: Septic Shock**  
   (Severe Sepsis + Hypotension refractory to fluid resuscitation)
   - SBP below 90 mmHg
     - After the patient has received 30 ml/kg of crystalloids

   □ Yes □ No  
   Septic Shock  
   Call the Rapid Response Team

---

If criteria for Severe Sepsis or Septic Shock are met, implement Severe Sepsis/ Septic Shock Order set & Clinical Pathway. Notify MD.

MD Notified: __________ Date/Time __________  
RRT Notified: __________ Date/Time __________  
RRT Notified: __________ Date/Time __________

Print Name: __________ RN Signature: __________ Date/Time: __________
Initial Resuscitation Goals of Severe Sepsis

1. Goals within the 1st 6 hours of Resuscitation:
   a) Central venous pressure 8-12 mm Hgb
   b) Mean arterial pressure (MAP) ≥ 65 mm Hg
   c) Urine Output ≥ 0.5 mL/Kg/hr
   d) Central venous (superior vena cava) or mixed venous oxygen saturation 70% or 65%, respectively (grade 1C)

2. In patients with elevated lactate levels targeting resuscitation to normalize lactate (grade 2C)
Early Sepsis Identification

- Train all providers
- Vital sign alerting systems
- Laboratory alerting systems
RECOMMENDATIONS FOR MANAGEMENT OF SEVERE SEPSIS AND SEPTIC SHOCK

Early Identification of Sepsis

1. Determine presence of SIRS: SIRS is defined as two or more of the following variables:
   
   **Clinical:**
   - HR > 90 beats per minute
   - Temperature < 36°C or > 38°C
   - Tachypnea > 20 breaths per minute or PaCO2 < 32 mmHg
   
   **Laboratory:**
   - WBC < 4,000 or > 12,000 cells/mm³ or 10% immature neutrophils (Bands)

2. Determine if the patient has suspected or proven cause of infection
   - Sepsis = SIRS + proven/suspected infection

3. Assess the signs of symptoms of the patient and determine if there is acute or persistent organ dysfunction
   - Severe Sepsis = Sepsis + acute organ dysfunction

4. Sepsis/severe sepsis and hypotension that is not responsive to volume resuscitation and requires administration of vasopressors
   - Septic Shock = Severe Sepsis + Refractory Hypotension
Multiple large, observational studies have shown the time to administration of antibiotics to be strongly associated with improved survival.

No physician will recommend withholding or slowing down the time to antibiotics in a patient with severe sepsis.

Time to antibiotic is our “time to needle” or “door to balloon” metric.
Don’t be satisfied with a diagnosis of sepsis and no source.

If a source exists and is potentially removable, get the ball rolling.
Defining the severity of sepsis

- Importance of looking for organ failure is self evident.

- Identification of “shock” dramatically alters the treatment and mortality.
  - Blood Pressure, Response to Fluid, LACTATE
Lactate

Evidence is clear that Lactate levels are predictive of death

Clearance of lactate is associated with improved survival

Algorithms of care based on lactate clearance appear to work as well or better than other approaches.


Early, quantitative resuscitation goals vs. standard care have resulted in improved mortality

The effect of a quantitative resuscitation strategy on mortality in patients with sepsis: A meta-analysis 

Jones, Alan E. MD; Brown, Michael D. MD, MSc; Trzeciak, Stephen MD, MPH; Shapiro, Nathan I. MD, MPH; Garrett, John S. MD; Heffner, Alan C. MD; Kline, Jeffrey A. MD; on behalf of the Emergency Medicine Shock Research Network investigators

*Critical Care Medicine. 36(10):2734-2739, October 2008.*
Goals in resuscitation

- Initial fluid resuscitation:
  - CVP 8-12, MAP > 65, UOP 0.5 mL/kg/hr, ScVO2 70% and Lactate Clearance.

- Give enough volume to maximize stroke volume. Start with 30ml/kg in most patients. Goal?
- Give vasopressors to raise the MAP enough to maintain adequate end-organ perfusion.

- Assessment of Cardiac Function
- UOP and Lactate Clearance are nice global indicators of success.
Crystalloids are favored as the initial fluid.

Hydroxyethyl starches are likely harmful.

Albumin may have a role, particularly if a lot of fluid is given.

A lower Hb target (~7) is generally accepted.
Chronic Phase

- Monitor for and prevent recurrence of sepsis
  - VAP, CLABSI, UTI. Infection Control Practices.
- Lung Protective Ventilator Strategies
- Sedation, Daily Awakenings & Spontaneous breathing Trials
- Nutritional Support
- Early Mobilization
- Success with these measures is most likely with a multi-disciplinary approach.
System Approach – Interdisciplinary Team

- Physicians include: ED physicians, Intensivists, Pulmonologists, Internal Medicine, Infectious Diseases,
- RNs from Critical Care, ED, Med-Surg, RRT,
- Administrative Coordinator, Nursing Educator, Nursing managers & Directors
- Pharmacy, Laboratory, Radiology, Dietitian
- Performance Improvement
- Infection Control
- Care Coordination/Discharge Planning, Social Service
Clinical Pathway

* Developed by an interdisciplinary Team

* Developed protocols utilizing evidence-based and best practices

* Developed CPOE order set for Severe Sepsis & Septic Shock
Education/Training

* Physician Education: Lecture on Sepsis Management
* Sepsis education/training for ED, Critical care & Med-Surg.
* RRT staff training on Sepsis protocol and management.
* Staff training on Sepsis utilizing Simulation Lab
Next Steps

* Partnership with a local University

* Transition to Simulation Lab for staff training

* Utilization of vital signs equipment with capability for programming of Early Warning Score to facilitate early recognition & intervention
System-based strategies are effective for improving sepsis care

Processes should aim to:
- Identify patients early and identify the severity of sepsis
- Quickly administer appropriate antibiotics and source control
- Establish institutional goals for physiologic resuscitation
- Multidisciplinary chronic phase of care to ensure compliance
- System-based approach for successful implementation and for reliable & consistent practice.
QUESTIONS ?