Early Detection and Treatment of Severe Sepsis

Patient Care Team Education
June 2013
Surviving Sepsis and Septic Shock

- Mortality rates associated with sepsis
  - 30-50% for severe sepsis
  - 50-60% for septic shock
- Severe sepsis is the leading cause of death in the non-coronary ICU
- Sepsis kills approximately 1,400 people worldwide every day
- 2013 NYS DOH issues a mandate for all hospitals to produce clinical care guidelines for evidence-based recognition and treatment of sepsis.
  - Adult and Pediatric treatment protocols for both ED and inpatient.
  - Education of hospital staff: Physician/Resident, RN, Pharm, Laboratory.
  - Data submission for public reporting of outcomes.
Severe Sepsis Recommendations

Adult and Pediatric Evidence-based Studies

1. Early Detection
2. Early Treatment
   • Sepsis Resuscitation Bundle
3. Monitor reliability and outcomes

Literature is available upon request!


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Objective: To provide an update to the “Surviving Sepsis Campaign Guidelines for Management of Severe Sepsis and Septic Shock,” last published in 2008.

Design: A consensus committee of 68 international experts representing 30 international organizations was convened. Nominal groups were assembled at key international meetings for those committee members attending the conference. A formal conflict of interest policy was developed at the onset of the process and enforced throughout. The entire guidelines process was conducted independent of any industry funding. A stand-alone meeting was held for all subgroup heads, co- and vice-chairs, and selected individuals. Teleconferences and electronic-based discussion among subgroups and among the entire committee served as an integral part of the development.

Methods: The authors were advised to follow the principles of the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system to guide assessment of quality of evidence from high (A) to very low (D) and to determine the strength of recommendations as strong (1) or weak (2). The potential drawbacks of making strong recommendations in the presence of low-quality evidence were emphasized. Some recommendations were ungraded (U). Recommendations were classified into three groups: 1) those directly targeting severe sepsis; 2) those targeting general care of the critically ill patient and considered high priority in severe sepsis; and 3) pediatric considerations.

Results: Key recommendations and suggestions, listed by category, include: early quantitative resuscitation of the septic patient during the first 6 hours after recognition (1C: blood cultures

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Note: The full text of the guidelines is available upon request.
Defining the septic picture

- **SIRS (Systemic inflammatory response syndrome):** The clinical syndrome that results from a deregulated inflammatory response or to a noninfectious insult.

- **Sepsis:** SIRS that is secondary to infection that has been diagnosed clinically. Positive cultures add to the validity but are not required for the diagnosis.

- **Severe Sepsis:** Sepsis plus at least one of the signs of hypoperfusion or organ dysfunction that is new, and not explained by other known etiology of organ dysfunction.

- **Septic Shock:** Severe sepsis associated with refractory hypotension (BP<90/60) despite adequate fluid resuscitation and/or a serum lactate level >4.0 mmol/L.
• Q1: Suspected infection - clinical judgment to determine if there is a new potential site of infection.

• Q2: Signs of SIRS – two signs and symptoms of SIRS based on vitals and recent lab results.

• Q3: Organ dysfunction – often discovered by an abnormal serum lactate value.
**Adult Sepsis/Severe Sepsis Criteria**

**SIRS:**
- Hyperthermia >38.3°C or Hypothermia <36°C
- Tachycardia >90 bpm
- Leukocytosis (>12,000 µL-1) or Leukopenia (<4,000 µL-1) or >10% bands
- Acutely Altered Mental Status
- Tachypnea >20 bpm
- Hyperglycemia (>120 mg/dl) in the absence of diabetes

**Signs of hypoperfusion or organ dysfunction:**
- Hypotension (<90/60 or MAP <65)
- Areas of mottled skin or capillary refill >3 seconds
- Disseminated intravascular coagulation (DIC)
- Acute renal failure or urine output <0.5 ml/kg/hr for at least 2 hours
- Cardiac dysfunction
- Lactate >2
- Creatinine >2.0 mg/dl
- Platelet count <100,000
- Hepatic dysfunction as evidenced by Bilirubin >2 or INR >1.5
- Acute lung injury or ARDS
Pediatric Sepsis/Severe Sepsis Criteria

**SIRS:**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Heart Rates, Beats/Min</th>
<th>Respiratory Rate</th>
<th>Leukocyte Count</th>
<th>Hypotension, mm Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 days to 1 wk</td>
<td>&gt;180</td>
<td>&gt;60</td>
<td>&gt;34</td>
<td>&lt;59</td>
</tr>
<tr>
<td>1 wk to 1 mo</td>
<td>&gt;180</td>
<td>&gt;50</td>
<td>&gt;19.5 OR &lt;5</td>
<td>&lt;75</td>
</tr>
<tr>
<td>1 mo to 1 yr</td>
<td>&gt;180</td>
<td>&gt;35</td>
<td>&gt;17.5 OR &lt;5</td>
<td>&lt;75</td>
</tr>
<tr>
<td>3-6 yrs</td>
<td>&gt;140</td>
<td>&gt;30</td>
<td>&gt;15.5 OR &lt;6</td>
<td>&lt;75</td>
</tr>
<tr>
<td>6-12 yrs</td>
<td>&gt;130</td>
<td>&gt;20</td>
<td>&gt;13.5 OR &lt;4.5</td>
<td>&lt;83</td>
</tr>
<tr>
<td>13 to &lt;18 yrs</td>
<td>&gt;110</td>
<td>&gt;20</td>
<td>&gt;11 OR &lt;4.5</td>
<td>&lt;90</td>
</tr>
</tbody>
</table>

**Signs of hypoperfusion or organ dysfunction:**

- Hypotension < 5th percentile for age or systolic BP < 2 SD below normal age for age
- Need for vasoactive drug to maintain BP in normal range (dopamine >5 μg/kg/min or dobutamine, epinephrine at any dose)
- Two of the following:
  - Unexplained metabolic acidosis: base deficit > 5.0 mEq/L
  - Increased arterial lactate > 2 times upper limit of normal
  - Oliguric: urine output <0.5 mL/kg/hr
  - Prolonged capillary refill: > 5 secs
  - Core to peripheral temperature gap > 3°C
  - PAO₂/FIO₂ <300 in absence of cyanotic heart disease or preexisting lung disease
  - PaCO₂ >65 torr or 20 mm Hg over baseline PaCO₂
- Proven need for >50% FiO₂ to maintain saturation ≥ 92%
- Need for nonelective invasive or noninvasive mechanical ventilation
- Glasgow Coma Score ≤11
- Acute change in mental status with a decrease in Glasgow Coma Score ≥3 points from abnormal baseline
- Platelet count < 80,000/mm³ or a decline of 50% in platelet count from highest value recorded over the past 3 days (for chronic hematology/oncology patients)
- International normalized ratio >2
- Serum creatinine ≥ 2 times upper limit of normal for age or 2-fold increase from baseline creatinine
- Total bilirubin ≥4 mg/dL (not applicable for newborn)
- ALT 2 times upper limit of normal for age
Resuscitation Bundle

3-hour and 6-hour Bundle Division

• **3-hour Bundle** – Actions to be taken within the first 3 hours of resuscitation from initial recognition for adults and within 60 minutes from initial recognition for pediatric patients.

• **6 – hour Bundle** – Actions to be taken within the first 6 hours of resuscitation from initial recognition for adults and within 60 minutes from initial recognition for pediatric patients.
  ✓ Two treatment track – invasive or non-invasive
  ✓ Track followed is based on the criticality and initial response to hemodynamic measures.
Resuscitation Bundle

3-hour Bundle

- Serum lactate measured within 3 hours of presentation in adults
- Blood cultures obtained prior to antibiotic administration; additional cultures to determine potential site of infection
- Early and appropriate broad-spectrum antibiotic administration
  - within 3 hour for ED presentation.
  - within 1 hour for floors/ICU presentation.
- In the event of hypotension and/or a lactate >4 mmol/L, deliver a minimum of 30 ml/kg of fluids in adults.
  - a minimum of 20mL/kg of fluids in children.
Resuscitation Bundle

6-hour Bundle

- Vasopressor therapy for persistent hypotension (MAP <65 in adults) despite initial fluid administration
- Re-measure lactate if the initial value was elevated

- Invasive
  ✓ A central venous catheter capable of measuring CVP

- Non-invasive
  ✓ Contraindications for invasive track
  ✓ Trending of lactate levels to gauge fluid response
2011 SBUMC Resident survey reveals a significant confidence deficit regarding the recognition of an infectious process.
1. **Emergency Medicine**

   - Triage screens for a potential infection and flag any patient suspected.
   - Physicians order the Fever/Sepsis panel for any suspicion, including a serum lactate.
   - Patients are reviewed based on a monthly lactate report and screened for further review by CQI.

2. **Inpatient Floors/ICU**

   - All Rapid Response Team (RRT) calls evaluate the patient for severe sepsis during their assessment.
   - Current roll-out of a Cerner based Sepsis Alert which screens patients’ vitals and lab results for SIRS criteria. If found, an alert is fired to the nurse requesting any suspicion of infection.
   - Automatic serum lactates are ordered and physician notification based on initial nursing response.
   - Patients are reviewed based on a weekly report for all suspected infections with an abnormal lactate result (≥2.0mmol/L).

     - Lactate values >4.0mmol/L are reported as critical values, require an MICU consult in the ED, and include a prompt for follow-up a lactate to gauge appropriate resuscitation.

     - Sepsis (Med/Surg) Powerplan includes suggested vitals and labs, interventions, infusions, and antibiotic regimen based on suspected source control.

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**! Exclusion Criteria!**

1. Patients for whom the interventions in the protocol are clinically contraindicated.
2. Patients with advance directives in place which preclude any of the protocol interventions.
3. Patients for whom the patient or surrogate decision maker declined or is unwilling to consent to such interventions.
Electronic Screening for Severe Sepsis

Upon suspicion of sepsis, the Sepsis (MARS) tool, which contains early goal-directed therapy with therapeutic elements of the sepsis protocol, is used.

Early recognition and timely treatment can improve the outcome of severe sepsis. These steps should all be part of the presentation with further training.

Resuscitation

1. Serum lactate measurement. For all patients, especially if there is a history of sepsis, lactate measurement is recommended to gauge proximate organ perfusion.
   - Lactate results ≥ 2.0 are concerning.
   - Lactate results ≥ 2.2 are concerning.
   - Lactate results ≥ 4.0 are concerning.

2. Blood cultures should be drawn.

3. Timely antibiotic administration within 2 hours. Broad-spectrum antibiotics with coverage for probable pathogens should be initiated.

4. In the event of hypotension, deliver a minimum of 500 mL of packed red blood cells (PRBCs) within a minimum of 1 hour.

5. For persistent hypotension despite initial fluid administration, increase MPA to 60 mm Hg.

6. Monitor until patient achieves goal (MAD 40-45 mm Hg).
Sepsis Alert Recognition

- Mandatory fields answered by the RN, including notification and comments regarding their decision.
- Physician notification
- Generates serum lactate draws based on initial Med Admission PowerPlan orders.
- Includes suggestions of Sepsis Powerplan use for treatment.
Physician Rounding List Alert Icon
Hospital Staff Involvement

• Imperative diagnostic testing for early recognition relies on resulting laboratory values and microbiology outcomes, including the serum lactate level, our definitive red flag for a patient presenting a septic picture. Timeliness is essential!

• Once recognized, early antibiotic treatment or regimen adjustment is also essential. Floors have one hour from recognition to administration, while the ED is given three hours from triage. Pyxis availability, order approval and delivery each play a vital role in early administration.

• Information Technology provide monthly reporting and any necessary adjustments to these alerts and sepsis prompts.
Sepsis Reports

- Resuscitation and mortality data is reported on monthly dashboards for the ICU Steering Committee, Patient Safety, and Emergency Medicine.
- Specific Case reports are reviewed at respective service level POD meetings each month for opportunities with feedback given to Physicians and Nursing.
- Sepsis Alert roll-out is monitored by weekly alert compliance feedback accompanied by weekly phone calls with IT, Unit staff, and CQI facilitators and analysts.
<table>
<thead>
<tr>
<th>Name</th>
<th>Encounter</th>
<th>Hospital Admit</th>
<th>Presentation Date</th>
<th>Presentation Unit</th>
<th>15NS Admit</th>
<th>RRT Called</th>
<th>Lactate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2/4/2012 12:30 PM</td>
<td>2/5/2012 2:00:00 AM</td>
<td>15S</td>
<td>2/4/2012 6:52:00 PM</td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Blood Culture Collected</th>
<th>Culture collected prior to presentation</th>
<th>2/4/2012 12:40:00 PM</th>
<th>Time to BC collection:</th>
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<tbody>
<tr>
<td>Abx</td>
<td>Yes</td>
<td>2/5/2012 7:20:00 AM</td>
<td>Piperacillin/Tazobactam (Zosyn)</td>
</tr>
<tr>
<td>Hypotensive?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluids Given</td>
<td>Yes</td>
<td>Total Fluid 5.0 L</td>
<td>Goal: Minimum of 30 ml/kg for hypotension on a lactate &gt;3 mmol/L</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Alert Date</th>
<th>RN Suspected Sepsis</th>
<th>Unanswered</th>
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<tbody>
<tr>
<td>2/3/2012 4:28:00 AM</td>
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**Synopsis** 83yo M admitted from ED to 15S. Acim diagnosis: AMS, Tachy, dehydration, hep C. ED lactate = 3.1, repeat = 2.2. Fluids administered and 1 dose ceftiraxone given. From 02:00 of 2/5, patient with multiple bouts of hypotension [73/68], no urine output. 2L fluids administered before 4AM. Lactate ordered at 3:29 = 7.6. Next set of vital signs at 4:17 fires sepsis alert for HR, RR and m-centered temp of "93.6C." Alert goes unanswered. RRT called at 04:23. Additional 3L fluids admin. Zoyn and Yance ordered, not started until after 7AM. WBC jumps from 11 to 25 by 9AM. Pt transferred to MICU for CL placement and pressors. Repeat lactate that evening results at 4.1. Returns to 15N on 2/7, but back to MICU on 2/8 on BIPAP, pass intubation. Patient passes away 2/11 after code blue.

**Discharge Date** 2/11/2012 9:02:00 PM  Status: Deceased
Stony Brook Medicine - Decreasing Sepsis Mortality

Overall Sepsis Mortality Rate (per 100 discharges)

20.03 - 25% Reduction from Baseline

18.03 - Further 10%

14.00 - Current Target

Nearly a 50% decrease in sepsis mortality since the start of the initiative.
Severe Sepsis Treatment Reliability and Mortality

- SBUMC has seen significant decrease in Mortality for ED presentations ...

...In-patient units have been decreasing since May-12 due to increased recognition and early treatment

**Early recognition is key!**

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</thead>
<tbody>
<tr>
<td>Resuscitation Bundle (First Four Elements)</td>
<td>≥ 95%</td>
<td>70.8%</td>
<td>72.7%</td>
<td>89.5%</td>
<td>82.1%</td>
<td>87.0%</td>
<td>90.3%</td>
<td>89.7%</td>
<td>94.1%</td>
<td>91.3%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>60.0%</td>
</tr>
<tr>
<td>Serum lactate within 6 Hrs</td>
<td>≥ 95%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>96.4%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
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<tr>
<td>Blood Culture before Antibiotics</td>
<td>≥ 95%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>92.9%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>98.6%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>96.6%</td>
<td>100%</td>
</tr>
<tr>
<td>Antibiotic Compliance</td>
<td>≥ 95%</td>
<td>79.2%</td>
<td>72.7%</td>
<td>89.5%</td>
<td>96.4%</td>
<td>91.3%</td>
<td>96.3%</td>
<td>93.1%</td>
<td>94.1%</td>
<td>98%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>60.0%</td>
</tr>
<tr>
<td>Fluids and Vasopressors for hypotension or elevated lactate</td>
<td>≥ 95%</td>
<td>86.7%</td>
<td>100%</td>
<td>100%</td>
<td>94.7%</td>
<td>92.8%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>95.2%</td>
<td>100%</td>
<td>100%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Lactate Clearance &gt;10% within 6 hours of initial lactate &gt;4.0 mmol/L</td>
<td>50.0% (12)</td>
<td>50.0% (14)</td>
<td>62.5% (8)</td>
<td>83.3% (13)</td>
<td>71.4% (14)</td>
<td>69.2% (13)</td>
<td>50.0% (18)</td>
<td>85.7% (7)</td>
<td>86.7% (15)</td>
<td>100.0% (1)</td>
<td></td>
<td></td>
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<tr>
<td>Sepsis Mortality Rate (per 100 discharges)</td>
<td>≤ 14.00</td>
<td>8.33</td>
<td>31.82</td>
<td>15.79</td>
<td>3.57</td>
<td>17.39</td>
<td>22.22</td>
<td>13.79</td>
<td>17.69</td>
<td>12.72</td>
<td>16.67</td>
<td>13.67</td>
<td>15.89</td>
<td>16.67</td>
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<tr>
<td>Running Sepsis Mortality Rate (per 100 discharges)</td>
<td>≤ 14.00</td>
<td>13.22</td>
<td>15.38</td>
<td>14.58</td>
<td>12.99</td>
<td>13.60</td>
<td>15.48</td>
<td>15.79</td>
<td>14.92</td>
<td>15.44</td>
<td>16.69</td>
<td>15.89</td>
<td>14.00</td>
<td>13.44</td>
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<tr>
<td>Floor ICU - 12-Month Running Sepsis Mortality Rate (per 100 discharges)</td>
<td>≤ 14.00</td>
<td>19.57</td>
<td>20.00</td>
<td>17.54</td>
<td>15.87</td>
<td>17.39</td>
<td>18.67</td>
<td>16.67</td>
<td>16.67</td>
<td>18.06</td>
<td>18.92</td>
<td>18.92</td>
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Stony Brook Medicine

Medicine Floors Quarterly Outcome Reports

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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</thead>
<tbody>
<tr>
<td>Annual Case # (includes RRT screens)</td>
<td>15</td>
<td>15</td>
<td>22</td>
<td>58</td>
</tr>
<tr>
<td>Mortality Rate</td>
<td>26.7%</td>
<td>20.0%</td>
<td>22</td>
<td>10.3%</td>
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<tr>
<td>Sepsis Bundle - First 4 Measures Compliance</td>
<td>73.3%</td>
<td>66.7%</td>
<td>45.5%</td>
<td>67.2%</td>
</tr>
<tr>
<td>Lactate Ordered within 6 hours</td>
<td>93.3%</td>
<td>93.3%</td>
<td>90.9%</td>
<td>98.3%</td>
</tr>
<tr>
<td>Blood Cultures Collected Before Antibiotics</td>
<td>100.0%</td>
<td>93.3%</td>
<td>86.4%</td>
<td>91.4%</td>
</tr>
<tr>
<td>Antibiotics within 1 hour of presentation</td>
<td>80.0%</td>
<td>93.3%</td>
<td>86.4%</td>
<td>84.5%</td>
</tr>
<tr>
<td>Adequate fluid delivery for hypotension and/or a lactate &gt;=4.0, Vasopressors for persistent hypotension</td>
<td>88.9%</td>
<td>55.6%</td>
<td>30.0%</td>
<td>63.2%</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th></th>
<th>2009-2011</th>
<th>2012</th>
<th>p-value</th>
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<tbody>
<tr>
<td>Case #</td>
<td>52</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Mortality Rate</td>
<td>28.8%</td>
<td>10.3%</td>
<td>0.018</td>
</tr>
<tr>
<td>stDEV</td>
<td>35.2</td>
<td>9.78</td>
<td></td>
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</tbody>
</table>

Exclusions include all cases made comfort care within 24h. Other patients screened positive by the floor may be attributed to the ED and not be present in the floor rates.


By clicking the button below, you attest that you have viewed this presentation and have understood all its contents.

After clicking the button, you will be returned to the Orientation website.