Sepsis and care bundles

August 12, 2015

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Vice President, Quality and Patient Safety
OhioHealth Riverside Methodist Hospital
Objectives

- To briefly describe the pathogenesis of sepsis
- To understand the evidence supporting the elements of the “bundles”
- To consider how to begin improvement work
- To appreciate alternative approaches/bundles to improve outcomes
The Pathogenesis of Sepsis

**Infectious Agents**
- Endotoxin/LPS
- Lipopeptides
- Lipoteichoic acid
- DNA
- Flagellin

**Susceptible Host**
- Co-morbidities
  - Age
  - Genetic polymorphisms

**Response to Stimulus**
- Inflammation
- Immunosuppression
- Coagulopathy
- Mitochondrial dysfunction
Sepsis = malignant disseminated inflammation

- Malignant = uncontrolled, unregulated, self-sustaining
- Disseminated = widespread changes which are usually cell-to-cell interactions
- Inflammatory = exaggerations of normal inflammatory response

**Pro-inflammatory**
- TNF-α
- IL-1β
- IL-6
- IL-8

**Anti-inflammatory**
- MIF
- HMGB1
- IL-10
- Apoptotic cells
- Cortisol
- Cholinergic pathways
Sepsis = malignant disseminated inflammation

- Vasodilation
- Increased vascular permeability
- Endothelial damage
- Coagulation abnormalities
- Microvascular dysfunction
- Impaired tissue oxygenation
- Mitochondrial dysfunction

Pro-inflammatory:
- TNF-α
- IL-1β
- IL-6
- IL-8
- MIF
- HMGB1

Anti-inflammatory:
- IL-10
- Apoptotic cells
- Cortisol
- Cholinergic pathways
- • Anergy
- • Secondary infections

**Pro-inflammatory**

**Anti-inflammatory**
The Surviving Sepsis Campaign bundle

TO BE COMPLETED WITHIN 3 HOURS:

1. Measure lactate level
2. Obtain blood cultures prior to administration of antibiotics
3. Administer broad-spectrum antibiotics
4. Administer 30ml/kg crystalloid for hypotension or lactate \( \geq 4 \) mmol/L

“Time of presentation” is defined as the time of triage in the emergency department or, if presenting from another care venue, from the earliest chart annotation consistent with all elements of severe sepsis or septic shock ascertained through chart review.

http://www.survivingsepsis.org/bundles/Pages/default.aspx

Revised April 2015
SSC Results

- Bundle Compliance (%) for Site Quarter:
  - Quarter 1: 10.9%
  - Quarter 8: 31.3%

Graph showing bundle compliance over site quarters with significance noted as p<0.01 compared to site quarter 1.
SSC Results

Hospital mortality 37.0% → 30.8% by 2 years
NNT = 16.1
The Surviving Sepsis Campaign: Results of an international guideline-based performance improvement program targeting severe sepsis  *Crit Care Med* 2010; 38: 367-74

Table 5. Risk-Adjusted impact of bundle targets on hospital mortality

<table>
<thead>
<tr>
<th>Bundle Target</th>
<th>Population</th>
<th>n</th>
<th>OR</th>
<th>p</th>
<th>OR</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure lactate</td>
<td>All&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15,022</td>
<td>0.86</td>
<td>&lt;.0001</td>
<td>0.97</td>
<td>0.90, 1.05</td>
<td>.48</td>
</tr>
<tr>
<td>Obtain blood cultures before antibiotics</td>
<td>All&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15,022</td>
<td>0.70</td>
<td>&lt;.0001</td>
<td>0.76</td>
<td>0.70, 0.83</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Commence broad-spectrum antibiotics</td>
<td>All&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15,022</td>
<td>0.78</td>
<td>&lt;.0001</td>
<td>0.86</td>
<td>0.79, 0.93</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Achieve tight glucose control</td>
<td>All&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15,022</td>
<td>0.65</td>
<td>&lt;.0001</td>
<td>0.67</td>
<td>0.62, 0.71</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Administer drotrecogin alfa</td>
<td>Multiorgan failure&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8733</td>
<td>0.90</td>
<td>.26</td>
<td>0.84</td>
<td>0.69, 1.02</td>
<td>.07</td>
</tr>
<tr>
<td>Administer drotrecogin alfa</td>
<td>Shock despite fluids&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7854</td>
<td>0.91</td>
<td>.30</td>
<td>0.81</td>
<td>0.68, 0.96</td>
<td>.02</td>
</tr>
<tr>
<td>Administer low-dose steroids</td>
<td>Shock despite fluids&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7854</td>
<td>1.06</td>
<td>.18</td>
<td>1.06</td>
<td>0.96, 1.17</td>
<td>.24</td>
</tr>
<tr>
<td>Demonstrate CVP ≥8 mm Hg</td>
<td>Shock despite fluids&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7854</td>
<td>1.08</td>
<td>.10</td>
<td>1.00</td>
<td>0.89, 1.12</td>
<td>.98</td>
</tr>
<tr>
<td>Demonstrate Scv&lt;sub&gt;O&lt;/sub&gt;₂ ≥70%</td>
<td>Shock despite fluids&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7854</td>
<td>0.94</td>
<td>.24</td>
<td>0.98</td>
<td>0.86, 1.10</td>
<td>.69</td>
</tr>
<tr>
<td>Achieve low plateau pressure control</td>
<td>Mechanical ventilation&lt;sup&gt;d&lt;/sup&gt;</td>
<td>7860</td>
<td>0.67</td>
<td>&lt;.0001</td>
<td>0.70</td>
<td>0.62, 0.78</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>2008-10</td>
<td>“Relative waste reduction”</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>-------------------------------------</td>
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<td>---------</td>
<td>----------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Eligible for later bundle elements</strong>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid resuscitation</td>
<td>75%</td>
<td>71%</td>
<td>5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vasopressors</td>
<td>63%</td>
<td>35%</td>
<td>44%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVP and ScvO2 monitoring</td>
<td>64%</td>
<td>29%</td>
<td>55%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inotropes and RBC transfusions</td>
<td>59%</td>
<td>13%</td>
<td>78%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucocorticoids</td>
<td>63%</td>
<td>21%</td>
<td>67%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lung protective ventilation</td>
<td>43%</td>
<td>14%</td>
<td>67%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*By diagnosing severe sepsis and providing atbx, blood cultures and lactate measurement at very high rates

Antibiotics – No time to waste

• Every hour in delay of appropriate atbx = 7.6% lower survival
• Median time to appropriate atbx = 6h

Shock to Effective Antibiotic Time and Mortality in Septic Shock*

*Assuming 130,000 septic shock cases per year

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>%Mortality</th>
<th>% of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>26.7</td>
<td>26.8</td>
</tr>
<tr>
<td>&gt;2-3</td>
<td>36.1</td>
<td>9.0</td>
</tr>
<tr>
<td>&gt;3-4</td>
<td>36.6</td>
<td>7.8</td>
</tr>
<tr>
<td>&gt;4-6</td>
<td>46.8</td>
<td>12.8</td>
</tr>
<tr>
<td>&gt;6-12</td>
<td>62.3</td>
<td>18.8</td>
</tr>
<tr>
<td>&gt;12</td>
<td>83.1</td>
<td>24.9</td>
</tr>
</tbody>
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Adapted from Kumar et al. Crit Care Med 2006; 34: 1589-96.
Shock to Effective Antibiotic Time and Mortality in Septic Shock

Adapted from Kumar et al. *Crit Care Med* 2006; 34: 1589-96.

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<td>26.8</td>
</tr>
<tr>
<td>&gt;2-3h</td>
<td>36.1</td>
<td>9.0</td>
</tr>
<tr>
<td>&gt;3-4h</td>
<td>36.6</td>
<td>7.8</td>
</tr>
<tr>
<td>&gt;4-6h</td>
<td>46.8</td>
<td>12.8</td>
</tr>
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<td>18.8</td>
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<td>&gt;12h</td>
<td>83.1</td>
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*Assuming 130,000 septic shock cases per year
Door to Balloon Time and Mortality in STEMI*

*Assuming 400,000 STEMIs per year

<table>
<thead>
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<th>Time</th>
<th>% Mortality</th>
<th>% of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2h</td>
<td>4.9</td>
<td>8</td>
</tr>
<tr>
<td>&gt;2-3h</td>
<td>5.2</td>
<td>23.5</td>
</tr>
<tr>
<td>&gt;3-4h</td>
<td>6.5</td>
<td>21.1</td>
</tr>
<tr>
<td>&gt;4-6h</td>
<td>6.7</td>
<td>21.6</td>
</tr>
<tr>
<td>&gt;6-12h</td>
<td>6.9</td>
<td>17.3</td>
</tr>
<tr>
<td>&gt;12h</td>
<td>5.5</td>
<td>8.5</td>
</tr>
</tbody>
</table>

Adapted from Cannon et al. JAMA 2000; 283: 2941-7.
### Door to Balloon Time and Mortality in STEMI*

<table>
<thead>
<tr>
<th>Door to Balloon Time (h)</th>
<th>% Mortality</th>
<th>% of Patients</th>
</tr>
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<tr>
<td>0-2h</td>
<td>4.9</td>
<td>8</td>
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<td>17.3</td>
</tr>
<tr>
<td>&gt;12h</td>
<td>5.5</td>
<td>8.5</td>
</tr>
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</table>

*Assuming 400,000 STEMIs per year

By getting door-to-balloon times of <2h for ALL STEMI patients, we would save 4775 lives per year. (13 people a day)

Adapted from Cannon et al. JAMA 2000; 283: 2941-7.
Shock to Effective Antibiotic Time and Mortality in Septic Shock*

*Assuming 130,000 septic shock cases per year

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>% Mortality</th>
<th>% of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2h</td>
<td>26.7</td>
<td>26.8</td>
</tr>
<tr>
<td>&gt;2-3h</td>
<td>36.1</td>
<td>9.0</td>
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<td>83.1</td>
<td>24.9</td>
</tr>
</tbody>
</table>

Adapted from Kumar et al. *Crit Care Med* 2006; 34: 1589-96.
By getting shock-to-antibiotic times of <2h for ALL septic shock patients, we would save \textbf{32,360 lives per year.}

(89 people a day)
(3.7 people an hour)
(3.5 times the effect of STEMI intervention)

Adapted from Kumar et al. \textit{Crit Care Med} 2006; 34: 1589-96.
Addressing circulation in sepsis

• Why is circulation affected in sepsis?
  – Dehydration
  – Loss of vascular tone
  – Loss of endothelial integrity
  – Shunting
  – Occlusion
  – Decreased cardiac output

• How is circulation addressed in sepsis?
  – Replete intravascular volume
  – Vasopressors
HEART

VEINS

ORGANS

ARTERIES
STEP 1: Make sure the pump is full (volume depletion)
Volume Resuscitation

Assess for Volume Depletion
• History
• Exam - Organ perfusion – skin, brain, kidneys
• Measure intravascular pressures – arterial, central venous

Administer a “Fluid Challenge”
• 1000mL crystalloid OR 500mL colloid
• Intravenous over 30 minutes

See what happens
• Blood pressure
• Central venous pressure
• Urine output
• Heart rate
Intravenous fluids in recent studies of septic shock

<table>
<thead>
<tr>
<th></th>
<th>Hour 0 to 6</th>
<th>Hour 6 to 72</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>EGDT</td>
<td>Usual care</td>
</tr>
<tr>
<td>ProCESS</td>
<td>2805 ml</td>
<td>2279 ml</td>
</tr>
<tr>
<td>PROMISE</td>
<td>1750 ml</td>
<td>1500 ml</td>
</tr>
<tr>
<td>ARISE</td>
<td>1547 ml</td>
<td>1374 ml</td>
</tr>
</tbody>
</table>
STEP 1: Make sure the pump is full (volume depletion)

STEP 2: Make the train is on a fast track (vascular tone)
# A Comparison of Dopamine and Norepinephrine in the Treatment of Septic Shock

<table>
<thead>
<tr>
<th></th>
<th>Dopamine</th>
<th>Norepinephrine</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU mortality</td>
<td>50.2%</td>
<td>45.9%</td>
<td>1.19 (0.98 – 1.44)</td>
</tr>
<tr>
<td>Hospital mortality</td>
<td>59.4%</td>
<td>56.6%</td>
<td>1.12 (0.92 – 1.37)</td>
</tr>
<tr>
<td>6mon mortality</td>
<td>63.8%</td>
<td>62.9%</td>
<td>1.06 (0.86 – 1.31)</td>
</tr>
<tr>
<td>12mon mortality</td>
<td>65.9%</td>
<td>63.0%</td>
<td>1.15 (0.91 – 1.46)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vasopressor-free days</td>
<td>12.6</td>
<td>14.2</td>
<td>0.007</td>
</tr>
<tr>
<td>RRT-free days</td>
<td>12.8</td>
<td>14.0</td>
<td>0.07</td>
</tr>
<tr>
<td>ICU-free days</td>
<td>8.1</td>
<td>8.5</td>
<td>0.43</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>24.1%</td>
<td>12.4%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Skin ischemia</td>
<td>6.5%</td>
<td>4.1%</td>
<td>0.09</td>
</tr>
<tr>
<td>Arterial occlusion</td>
<td>2.7%</td>
<td>2.4%</td>
<td>0.12</td>
</tr>
</tbody>
</table>

NEJM 2010;362:799-89
Some comments about lactate

- Marker of anaerobic metabolism
- Elevated level associated with death in multiple studies
  - >4mmol/L most common threshold (if in mg/dl, divide by 9 to convert)
  - Improvement associated with better outcomes
- Can be venous, don’t have to remove tourniquet
- On ice if measuring >30min after drawn
  - (increases 0.3 mmol/L vs when on ice)
- Normal bicarb doesn’t exclude high lactate
- Low levels doesn’t mean you shouldn’t worry
How do you get started?
PDSA/DMAIC

Define

ACT
Plan the next cycle
Decide whether the change can be implemented

PLAN
Define the objective questions and predictions. Plan to answer the questions (who? what? where? when?) Plan data collection to answer the questions

Measure

STUDY
Compile the analysis of the data
Compare data to predictions
Summarize what was learned

DO
Carry out the plan
Collect the data
Begin analysis of the data

Control

Improve

Analyze
Which of these is sepsis?

1. Confusion, cough, nausea
2. Fever, shortness of breath, chest pain
3. Abdominal pain, lightheadedness, diarrhea
4. Rash, leg swelling, anorexia
5. Tachycardia, chills, sweating
Can we identify these patients?
Seymour et al. JAMA 2010; 304(7):747-54.

• 166,908 non-trauma, non-cardiac arrest patient encounters by King County EMS (except Seattle), 2002-6
  – Over 66,000 encounters excluded for no vital signs documented in field

• Critical illness occurred in 5%
  – **Severe sepsis (61%)**
  – Need for mechanical ventilation (48%)
  – Death during hospitalization (35%)
Can we identify these patients?
Seymour et al. JAMA 2010; 304(7):747-54.

<table>
<thead>
<tr>
<th>Points</th>
<th>Age</th>
<th>RR</th>
<th>SBP</th>
<th>HR</th>
<th>SaO2</th>
<th>GCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>&lt;45</td>
<td>12-23</td>
<td>&gt;90</td>
<td>&lt;120</td>
<td>≥88</td>
<td>15</td>
</tr>
<tr>
<td>1</td>
<td>≥45</td>
<td>&lt;12, 24-35</td>
<td>≤90</td>
<td>≥120</td>
<td>&lt;88</td>
<td>8-14</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>≥36</td>
<td></td>
<td></td>
<td></td>
<td>&lt;8</td>
</tr>
</tbody>
</table>

All vital signs are initial out-of-hospital measurements documented by first-arriving emergency medical services responder.

If you used a cut-point of ≥4 to trigger triage to a regional referral center for critical care services,

• 3.2% of those going to nonreferral center would be transported and 36% of these would develop critical illness
• 4.4% of those with a score <4 would develop critical illness
A focus on antibiotics: Not all orders are created equal

- ROUTINE – will be scheduled for next *usual* scheduled administration time.
  - QD = 9am
- NOW – will be prepared in usual queue then delivered with next scheduled delivery and administered when it arrives
- STAT – prints on different printer, different color paper, prepped immediately, immediately delivered to unit
Order Priority Comparisons

- Mean Time from MD to Pharmacy:
  - STAT: 13.6 minutes
  - Now/Routine: 48.8 minutes
  - Routine: 72.7 minutes

- Mean Time from Pharmacy to Patient:
  - STAT: 166.7 minutes
  - Now/Routine: 202.8 minutes
  - Routine: 190.2 minutes
Affecting the emergency response to sepsis: Antibiotics

- Education
- Automatic triggers
- Decision support

- Processes
- Structures

- Sepsis onset
- ABX order
- ABX administration

- ABX order time (Clinician Action)
- ABX order to administration time (System Response)
- Sepsis to ABX administration time (Performance measure)
Is there any situation in which you are giving antibiotics for an infection in which you want the initial dose delayed?

Maybe we should focus on time from order to administration?
Median time to antibiotics (min) in septic shock
Is the SSC the only approach?
Effect of a rapid response system for patients in shock on time to treatment and mortality during 5 years

Sebat et al  CHEST 2007; 35: 2568-2575

HYPOTENSION (low BP)
OR
Normal BP with 3 of following:
Mental status change, cool extremities, RR≥20, Low urine output, Elevated lactate, Fever

Fluid Bolus (over 10-15 min)
1000mL if ED
250mL if ward

Reassess for Presence of Criteria

ACTIVATE TEAM
Effect of a rapid response system for patients in shock on time to treatment and mortality during 5 years
Sebat et al  CHEST 2007; 35: 2568-2575

HYPOTENSION (low BP)
OR
Normal BP with 3 of following:
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43% of patients with septic shock (46% “hypovolemic”)

ACTIVATE TEAM
Effect of a rapid response system for patients in shock on time to treatment and mortality during 5 years


40.0%

NNT = 4

11.8%

Unadjusted Mortality
Mortality Observed / Expected Mortality APACHE III
Median Time to 3 Most Rapid Interventions p<0.001
Among septic shock patients, mortality decreased from 50% to 10%
NNT = 2.5

Or 80% of prior deaths were due to lack of the shock team!
Septic shock: A multidisciplinary response team and weekly feedback to clinicians to improve the process of care and mortality


FOCUS ON RESUSCITATION BUNDLE ONLY

1/1/07 – 12/28/07

**Education**
- Training of RNs
- MD education
- Bedside references
- Order set

12/29/07 – 2/26/08

**Daily auditing & Weekly feedback**
- Daily auditing of all treated patient
- Weekly reporting of compliance to ICU and ED

9/27/08 – 9/30/09

**Sepsis Response Team**
- 24/7 team
- ICU MDs
- ICU RN
- Pharmacist
- RT
- Vascular access tech
- Unit secretary
- Rad tech

BELIEVE IN WE OhioHealth
### Septic shock: A multidisciplinary response team and weekly feedback to clinicians to improve the process of care and mortality


<table>
<thead>
<tr>
<th>Bundle Element</th>
<th>Education</th>
<th>Feedback</th>
<th>Response team*</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactate**</td>
<td>75.4%</td>
<td>91.2%</td>
<td>97.0%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Blood cultures</td>
<td>87.7%</td>
<td>93.0%</td>
<td>97.7%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Antibiotics (1h)**</td>
<td>77.2%</td>
<td>83.8%</td>
<td>91.0%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>IV Fluids</td>
<td>57.1%</td>
<td>64.1%</td>
<td>76.2%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Vasopressors</td>
<td>93.0%</td>
<td>94.0%</td>
<td>89.1%</td>
<td>0.046</td>
</tr>
<tr>
<td>RBCs</td>
<td>82.5%</td>
<td>86.3%</td>
<td>85.6%</td>
<td>0.40</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>35.8%</td>
<td>55.6%</td>
<td>61.6%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>All 7 elements</strong></td>
<td><strong>12.7%</strong></td>
<td><strong>37.7%</strong></td>
<td><strong>53.7%</strong></td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Response team only called in 43% of eligible patients

**Compliance associated with mortality (p<0.05)
Septic shock: A multidisciplinary response team and weekly feedback to clinicians to improve the process of care and mortality


<table>
<thead>
<tr>
<th>Bundle Element</th>
<th>Education</th>
<th>Feedback</th>
<th>Response team*</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>30.3%</td>
<td>28.7%</td>
<td>22.0%</td>
<td>0.029</td>
</tr>
</tbody>
</table>

After risk-adjustment, compared to education period odds of dying were:

- Feedback – 1% higher (p=0.95)
- Response team – 35% lower (p=0.023)

Or 27% of patients dying were because of lack of Response Team (versus education approach)
Emergency Department Sepsis Screening and Action Tool

Sepsis is a time critical condition. Screening, early intervention and immediate treatment saves lives. This tool should be applied to all adult patients who are not pregnant who have a suspected infection or their clinical observations are outside of normal limits.

1. Are any 2 of the following present?

Temperature  > 38.3°C or < 36°C
Respiratory rate  > 20 per minute
Heart rate  > 90 per minute
Acute confusion/ reduced conscious level
Glucose  > 7.7 mmol/l (unless DM)

Sepsis not present now.
Treat to standard protocols.
Review with WCC

Sepsis present
Inform responsible clinician.
Begin hourly observations.
Reassess for severe sepsis hourly*.
Ensure bloods for markers of severe
Respiratory rate > 20 per minute
Heart rate > 90 per minute
Acute confusion/reduced conscious level
Glucose > 7.7 mmol/l (unless DM)

Sepsis present
Inform responsible clinician.
Begin hourly observations.
Reassess for severe sepsis hourly*.
Ensure bloods for markers of severe sepsis are sent*.
Monitor urine output
Consider life threatening sepsis mimics e.g. Asthma.

2. Could this be an infection?
For example:
Pneumonia
Urinary Tract Infection
Abdominal pain or distension
Meningitis
Cellulitis/septic arthritis/infected wound

Red Flag Sepsis
This is a time critical condition, immediate action is required. Assume sepsis present.

3. Is any red flag present?
Systolic B.P < 90 mmHg or MAP < 65 mmHg
Lactate > 2 mmol/l
Heart rate > 130 per minute
Respiratory rate > 25 per minute
Oxygen saturations < 91%
Responds only to voice or pain/unresponsive
Purpuric rash

Sepsis Six
1. High-flow oxygen.
2. Blood cultures and consider source control.
3. Intravenous antibiotics.
4. Intravenous fluid resuscitation.
5. Check haemoglobin and serial lactates.
6. Hourly urine output measurement.
Record the time each of these actions is completed. All actions should be completed as soon as possible but always within 60 minutes.

Communication:
Inform patient/family (if conscious) on what is happening and why.
The Sepsis Six – to be delivered within 1 hour

3 Investigations
- Blood cultures
- Measure lactate
- Measure urine output

3 Treatments
- High-flow oxygen
- IV antibiotics
- Fluid challenge

...and Identify Severe Sepsis and Septic Shock

Daniels et al. Emerg Med J 2010
Systematically Raising Suspicion and Simplifying Intervention

- MEWS score every 4 hours
  - Trigger if >4

- Sepsis Team (nursing-led)

- SBAR Communication to MD

- WBC > 14

Bedside RN
- New SIRS
- Suspected infection

"Sepsis Six"

Daniels et al. Emerg Med J 2010
**Do you want a Sepsis 6 Nurse?**

<table>
<thead>
<tr>
<th></th>
<th>% patients</th>
<th>Sepsis 6 Achieved (1h)</th>
<th>Resuscitation Bundle Achieved (SSC – 6h)</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis 6 Nurse</td>
<td>25.4%</td>
<td>82.6%</td>
<td>72.9%</td>
<td>25.5%</td>
</tr>
<tr>
<td>No Sepsis 6 Nurse</td>
<td>74.6%</td>
<td>23.9%</td>
<td>23.4%</td>
<td>38.4%</td>
</tr>
</tbody>
</table>

NNT 7.8

So, presuming 567 patients per year
One could conclude a 24/7 program could save 73 lives a year – that’s one person saved every 5 days AT THAT HOSPITAL

Or one-third of patients dying, die because of lack of a Sepsis 6 Nurse!
Summary

• This won’t be easy
• There is no cookbook for improving care
• Resuscitation bundle elements (in some form) are associated with better outcomes
• You need to understand your problems before developing solutions
• We are partners with you in this journey