Sepsis at the Hospital System Level
One Sepsis Journey

Alan Whippy, MD
Medical Director of Quality and Safety
The Permanente Medical Group

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Kaiser Permanente Northern California

KP’s Integrated Model

- Kaiser Foundation Health Plan
- Kaiser Foundation Hospitals
- Permanente Medical Group

Membership
3.4 million

Facilities
21 hospitals

Employees
64,000

Physicians
7,169
10,000 Foot View
### At the Heart of Hospital Mortality

<table>
<thead>
<tr>
<th>Condition 2011</th>
<th># Admissions</th>
<th>Mortality Rate</th>
<th># Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI</td>
<td>5,254</td>
<td>3.5%</td>
<td>183</td>
</tr>
<tr>
<td>Sepsis</td>
<td>18,746</td>
<td>10%</td>
<td>1,926</td>
</tr>
</tbody>
</table>
Why Sepsis?

We miss it
We underestimate it
We under treat it
We cause it
Understanding the Landscape

Malignant intravascular inflammation

Causing cytopathic tissue hypoxia

- Shock
- Quiet Shock
- ? Pending Shock
Why Sepsis?

No Sepsis on Admission

138,319

Sepsis*

18,746

42%

47%
Paradigm Shift

We need a systems approach to sepsis like
AMI
Stroke
Trauma
Goals of KP Sepsis Program

1. Find and Name it
2. Stratify it
3. Treat it early
4. Prevent it
Construction

Mortality Diagnostic
Spring 08

Sepsis Design Team

Pilot

Sepsis Summit
Nov 08

Learn and Improve

[Image of a bridge with text]
25% Mortality Rate

3.5% Admission Rate
Risk-adjusting hospital inpatient mortality using automated inpatient, outpatient, and laboratory databases. Escobar GJ, Greene JD, Scheirer P, Gardner MN, Draper D, Kipnis P.

Risk-adjusting hospital inpatient mortality using automated inpatient, outpatient, and laboratory databases.

Escobar GJ, Greene JD, Scheirer P, Gardner MN, Draper D, Kipnis P.
Crude Hospital Mortality

2007

931 fewer deaths/yr
330 fewer pts/day

2009 2010 2011 2012
What Every Hospital Was Asked to Do

Develop Teams

Adopt Algorithms

Plan Handoffs

Measure & PDSA

Tools and Equipment

Train

Collaborate! Collaborate! Collaborate!
1. Frontline Engagement

2. Scripted Processes

3. Reliable Execution

4. Organizational Learning

5. Scientific Change Process

6. Clear Communication

Model for a Learning Organization

Source: T Clemmer LDS Hospital
1. Frontline Engagement

Leadership Alignment

MD Champion, Improvement Advisor, Elephant

Teams

Deliberate Practice
World View

ER  ICU  Everything Else
All ED patients with infection are screened for SIRS at triage.

- CBC, Lactate, BC
- Consider IV fluids and ABX

- SBP ≤ 90?
  - yes: 20 ml/kg fluid bolus in 1st hr
  - no: SBP > 90

- Lactate high?
  - ≤ 2: Document Sepsis
  - ≥ 4: Document Severe Sepsis (Time Zero)

- SBP ≤ 90: Document Septic Shock (Time Zero)

- Aggressive IV fluid resuscitation
  - Early ABX
  - Repeat lactate in 3-6 hrs
  - Document Severe Sepsis

Early Goal Directed Therapy
Getting Lactates

% of Blood Cultures in ED with Lactate Test

- 2009-01: 50%
- 2009-05: 60%
- 2009-09: 70%
- 2010-01: 80%
- 2010-05: 90%
- 2010-09: 100%
- 2011-01: 100%
- 2011-05: 100%
- 2011-09: 100%
- 2012-01: 100%
- 2012-05: 100%
- 2012-09: 100%

Lactates on ED Blood Cultures

- Jun 2008: 55%
Identify at triage if suspected infection and 2 SIRS criteria

- $T^\circ < 96.8 \ (36.0)$ or $> 100.4 \ (38.0)$
- HR $> 90$
- RR $> 20$
- WBC $> 12K$ or $< 4K$ or $> 10\%$ bands
- OR Altered LOC

**SUSPECTED SEPSIS**

**DOCUMENT SIRS**

**20 ml/kg fluid bolus in 1st hr**

- SBP $\leq 90$?
  - yes
  - no

- Lactate high?
  - $< 2$
  - $\geq 2$

**Document Sepsis**

**Document Severe Sepsis**

**Document Severe Sepsis (Time Zero)**

**EGDT**

- Aggressive IV fluid resuscitation
- Early ABX
- Repeat lactate in 3-6 hrs

**EGDT Goals from Time Zero**

1. Start Antibiotic in 1 hr
2. First CVP or ScvO2 within 2 hrs
3. CVP $\geq 8-12$ within 6 hrs
4. MAP $\geq 65$ within 6 hrs
5. ScvO2 $\geq 70$ within 6 hrs
6. Repeat lactate is lower than initial lactate w/in 3-12 hrs

**Early Recognition**

- CBC, Lactate, BC
- Consider IV fluids and ABX

**Early Goal**

- CVP $\geq 8-12$
- MAP $\geq 65$
- ScvO2 $\geq 70$
- Repeat lactate 3-12 hrs

**Directed Therapy**

- If Hct low, transfuse to 30
- Norepinephrine
- Dobutamine

**Kaiser Permanente**
3. Reliable Execution

- Diagnosis
- ABX started IV Fluid
- Time Zero
- 1 hour
- 2 hours
- Central Line Placed
- MAP CVP ScvO₂ at Goal
- 6 hours
- Lactate Clearance
- 6-12 hours

The Golden Hours
3. Reliable Execution

EGDT Bundle July 2009 to Dec 2011

21 Hospital Success rates
Web-based EGDT Tracking System

**SEPSIS EGDT DATA ENTRY**

Clarity Last Updated: 08/23/2010 04:22

<table>
<thead>
<tr>
<th>MRN</th>
<th>NAME OF PATIENT</th>
<th>PRESENTED TO ED</th>
<th>DATE AND TIME PT LEFT ED</th>
<th>DISCHARGE DATE</th>
<th>D/T OF DX OF SEPSIS (TIME ZERO)</th>
<th>FACILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>08/23/2010 16:51</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

***This record is currently read-only***

**Lactate Tests**

<table>
<thead>
<tr>
<th>DRAWN TIME</th>
<th>RESULT TIME</th>
<th>RESULT</th>
<th>ISTAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/23/2010 17:45</td>
<td>08/23/2010 18:41</td>
<td>2.00</td>
<td>No</td>
</tr>
</tbody>
</table>

**Systolic Blood Pressure**

- Admit Source:
  - Age: 67
  - Presented to ED: 08/23/2010 16:51

- Did the patient have thrombocytopenia or coagulopathy documented as a reason for central line delay? No

- Clinician judgment to do EGDT? No

- First lactate drawn: No

- Date and time first lactate was drawn: 08/23/2010 18:41

- Semi-automated.
- Identifies and allows review of yesterday’s ED cases
Collaboration and Learning

- Co-locate BC and lactate
- Sepsis Alerts
- Velcro Clock
- Critical lab calls
- RRT lactate FU
- RRT lactate screens
- EGDT in OR
In the last 12 months we had 45% fewer deaths than in the first year for this population.
Pre-Intervention: Average Mortality 44.8%

Post intervention: Average Mortality 24.5%

2.0 liters (1.2-3.4 liters)

5.0 liters (3.8-7.2 liters)

Trzeciak Chest 2006, 129:225-235
Shapiro Crit Care Med 2006, 34;1025-1032
Jones, Chest 2007, 132:425-432
Micek, Crit Care Med 2006, 34:2702-2713
The Tale of a Thousand Lines

We’ve reviewed over 4000 EGDT cases

4 Pneumothoraces
0 BSI

Lives lost due to central line

Mortality 27\rightarrow 18\%

Lives saved by EGDT
Model for a Learning Organization

1. Frontline Engagement
2. Scripted Processes
3. Reliable Execution
4. Organizational Learning
5. Scientific Change Process
6. Clear Communication

Source: T Clemmer LDS Hospital
Early Line Placement Matters

<table>
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<th>MAP Goal Met</th>
<th>CVP Goal Met</th>
<th>ScvO2 Goal Met</th>
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<tbody>
<tr>
<td>CL after 2 hrs</td>
<td>75%</td>
<td>53%</td>
<td>30%</td>
</tr>
<tr>
<td>CL before 2 hrs</td>
<td>86%</td>
<td>87%</td>
<td>60%</td>
</tr>
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</table>

Data from Q3 2009, KPNC
Outcome by Bundle Completion, 2010-2012YTD

21.6
15.9
0
5
10
15
20
25

incomplete bundle
complete bundle

Patients do better if we do better
What if the BP is Normal?
Lactate > 4 mMol / L

"Quiet Shock" Mortality

MAP > 100
- EGDT

All Patients
- Control

Donnino et al. Chest 2003 124: 90S
4. Organizational Learning

“Quiet” Shock

EGDT Survival Trends

Those with normal BP benefit even more
Mortality and Intermediate Lactate Clearance
(Q2'12, 1495 Admissions)

- Overall Mortality: 9%
- Mortality Without Lactate Clearance: 15%
- Mortality With Lactate Clearance: 8%
Intermediate lactate Raw and O/E Mortality Trends

2009 2010 2011 2012

Raw Mortality

O/E Mortality

E. Organizational Learning

Improved Survival
Work in Progress

- EGDT in OR
- Pediatric Sepsis pilots
- Research projects
- Intermediate lactate bundle??
- Electronic Early Warning System development
- Delirium prevention; long term functional and cognitive outcomes
- Reducing HA sepsis: CDI, HAP, SSI programs
Coordinated by Design