Healthcare-associated infections are one of top 10 leading causes of death in the U.S. The US Centers for Disease Control and Prevention (CDC) estimates that 1.7 M patients experience a hospital-acquired infection each year.

- Hospitals have invested considerable resources in methods to reduce hospital-acquired infections (HAI’s) – screening, hand washing, isolation, etc. However, prevention measures often fail.
- The clinical and economic impact of an infection can be far greater if the patient becomes septic. Effective measures to prevent sepsis and to diagnose and manage these patients are critical to decrease mortality and reduce hospital costs.
The Landscape of Healthcare-Associated (HCA) Infections

- Healthcare system is evolving to an increased use of outpatient procedures and long-term care

**Diagram:**

- Hospital or Acute care setting
- Outpatient facility
- Long-term-care facility
- Home care

Many long-term-care facilities now experience infection rates comparable to those in acute hospital settings
Outbreaks are common

Raising the bar for Health care

- Recent shift in health care with patient safety becoming a priority, and quality care delivered using evidence based practice and expectation.
- IHI Collaborative 5 Million Lives Campaign
- CMS Measures (New changes October 2008)
- Joint Commission National Patient Safety Goals
- Media coverage of high profile
Changing Vantage Points

- Infection are no longer considered inevitable consequences of treating older, sicker or uninsured patients.
- Now we hear terms like “zero tolerance”, “pursuing perfection”, “irreducible minimum”, “lean”, and “six sigma”
- The idea is to aim for perfection rather than match the benchmarks set by (NHSN, APIC, SHEA)
- PHLB adopted the Lean concept in 2009

“A pessimist sees the difficulty in every opportunity; an optimist sees the opportunity in every difficulty.” Winston Churchill

A General Overview

- Our hospital launched a program the second quarter of 2007, guided by the Institute for Healthcare Improvement (IHI), to improve the care and safety of our critical ill patients.
- Our ICU implemented a Severe Sepsis and Septic Shock order set that includes all components of the Sepsis Resuscitation and Sepsis Management Bundles
ADULT SEVERE SEPSIS/SEPTIC SHOCK ORDERS SET

Goals
1. Early identification and initial therapy for severe sepsis/septic shock patient.
2. Increase central venous pressure (CVP) to 8-12 mm Hg with IV fluids prior to initiating a vaspressor if patient or ventilator may need CVP of 15 mm Hg.
3. Maintain mean arterial pressure (MAP) greater than 65 mm Hg (or alternately SBP greater than 90 mm Hg) with vasopressor support if unable to achieve with fluid resuscitation.
4. Maintain central venous O₂ sat (SvO₂) at greater than or equal to 70% via venous blood gas. If PA catheter placed, keep mixed venous saturation (SmvO₂) greater than or equal to 65%.
5. Achieve/maintain adequate oxygen delivery to tissues with sepsis/resuscitation bundle (goals 1-4) within 6 hours and complete sepsis management bundle within 24 hours of initiating order set.

O₂ Therapy
- O₂ by NC/face/mask/ bipap/ventilator to keep O₂ sat greater than 92%
- Check O₂ Sat by pulse oximetry continuously.

Blood Transfusion
- Consent for blood transfusion If Hct less than 24% and Hbg less than 8Gm/dl transfuse 2 units PRBC.

Vasopressors
- Dopamine (400 mg in D 5W 250 ml) start at 5 mcg/Kg/min max of 20 mcg/Kg/min
- Norepinephrine/Levophed 4 mg/D 5W 250 mL start at 2 mcg/min titrate to max of 20 mcg/min.
- Start vassopressor if (MAP greater than 65mmHg or SBP greater than 90 mmHg) if not achieved with fluids.

Diagnostic Tests
- Obtain ABG
- UA, Urine C&S
- 12 lead EKG
- Sequential pneumatic compression boots continuously
- Fragmin 5000 IU SQ daily
- Protonix 40 mg IVP daily or
- Pepcid2 0mgIVq12hrs
- Acucheck q 6 hrs (if indicated)
- MRI (if present) G/S and C/S specify location
- Wound  (if present) G/S and C/S
- Sputum /endotracheal asp.  G/S and C&S
- CBC, CMP, Mg, Phos, Liver function test, PT, PTT, Type and screen, MI panel
- Lactic acid

Antibiotic Orders
- Source: Meningitis
- Decadron 10mg IV every 6 hours for 2 days PLUS Vancomycin 1gm IV every 12 hours then per pharmacy (if MRSA is suspected)
- Vancomycin 1 gm IV x 1 then per pharmacy (if MRSA is suspected)
- Azithromycin 500 mg IV every 24 hours (if atypical pathogens are suspected)
- Aztreonam 1 gm IV every 8 hours PLUS Levaquin 750 mg IV every 24 hours PLUS Tobramycin 2mg/kg IV x 1, then per pharmacy
- Aztreonam 1 gm IV every * hours PLUS Tobramyxcin 2mg/Kg IV x 1 then per pharmacy
- Flagyl 500 mg IV every 6 hours (if anaerobes are suspected)
- Levaquin 750 mg IV every 24 hours PLUS Ceftriaxone 1 gm IV every 24 hours
- Zosyn 4.5 gm IV every 6 hours PLUS Tobramycin 2mg/kg IV x 1, then per pharmacy PLUS
- Rocephin 2 gm IV every 12 hours PLUS Ampicillin 2gm IV every 4 hour
- Zosyn 4.5 gm IV every 6 hours PLUS Tobramycin 2mg/kg IV x 1, then per pharmacy PLUS
- Source: Unknown origin of infection, complicated UTI/pyelonephritis, abdominal/pelvic infections, and deep soft-tissue infections.
- Antibiotics dosing shall be adjusted by pharmacy based on renal function (Clcr).

Medications
- Start insulin drip protocol for BS
- Tylenol 650 mg rectaly or G/tube  every 6 hours PRN  temperature greater than or equal to 100.4 o F
- HHN/Inline treatment with Albuterol/Atrovent unit dose Q 4
- Peptic ulcer disease
- Proton pump inhibitor
- Small bowel ileus
- Sequential pneumatic compression boots continuously
- Symptomatic control of pain
- Opioid analgesics
- Fragmin 5000 IU SQ daily
- For patients with severe or unknown allergic reaction to PCN and/or Cephalosporins
- Vancomycin 1 gm IV x 1, then per pharmacy (if MRSA suspected)
- Aztreonam 1 gm IV every PLUS Levaquin 750 mg IV every 24 hours PLUS Tobramycin 2mg/kg IV x 1, then per pharmacy
- Vancomycin 1 gm IV x 1 then per pharmacy (if MRSA suspected) PLUS Aztreonam 1 gm IV every PLUS Tobramyxcin 2mg/Kg IV x 1 then per pharmacy PLUS
- Zosyn 4.5 gm IV every 6 hours PLUS Tobramycin 2mg/kg IV x 1 then per pharmacy PLUS
- Source: Unknown origin of infection, complicated UTI/pyelonephritis, abdominal/pelvic infections, and deep soft-tissue infections.
- Antibiotics dosing shall be adjusted by pharmacy based on renal function (Clcr).

Other IV fluid_______0.9NS_______LR_____
- IV _______________ at ____ml/hr
- IV ________________ then
- IV, Normal Saline 1 liter  bolus x 1 follow with
PHLB-Mortality Rate from Severe Sepsis/Septic Shock
2007 to 2011

Percent Distribution

Bundle Implementation
Re-evaluation ER Participation

PHLB-Rate National Rate
The Burden of Severe Sepsis

U.S. Sepsis Statistics
* Severe sepsis is reported in 2.26 cases per 100 hospital discharges and one in five admissions to the ICU. 1
* Of the 750,000+ severe sepsis cases each year in the U.S., an estimated 215,000 (28.6%) patients die. 1
* Mortality associated with severe sepsis has been reported as high as 30 to 50%. 2

Sepsis is Costly

- Severe sepsis accounts for an estimated 40% of all ICU expenditures, totaling $16.6B in the U.S. alone. 1
- The average length of stay and cost per case is 19.6 days and $22,100 respectively. 2
- The cost of treating an ICU patient with sepsis is six times greater than that of treating a patient without sepsis. 3

Sepsis: Leading cause of death in non-coronary ICUs

Opportunity Knocks

- What if a series of interventions could markedly reduce the risk of Sepsis mortality?
- What if those interventions were already readily available in hospitals?
- What if all of those interventions were done all the time on each patient?
If Sepsis is an Infectious Disease, why aren’t we trying to prevent it?

Early Recognition is a Challenge

- 2% of all admissions – 20-25% of all mortality
- 60% from the ED, 40% from in-house pts.

No Diagnostic Test

- ↑ Lactate means shock
- Mental status changes often only early sign
PHLB-Mortality Rate from Severe Sepsis/ Septic Shock 2007 to 2011

Lean evaluation

Re-evaluation DR Participation

ISSUE

BACKGROUND/MEASUREMENT

CURRENT CONDITION

COUNTERMEASURES

IMPLEMENTATION PLAN

PROBLEM ANALYSIS
The Emergency Room

- Implemented a “Sepsis Alert” screening tool in the Emergency Department.
- Instituted ED chart review of patients admitted with a sepsis diagnosis to monitor compliance.
- Gave feedback to ED staff and physicians.
- ED staff and physician were educated to the Sepsis Resuscitation Bundle. Intensivists assisted the ED as needed.
- Initiated sepsis resuscitation (lactates, blood cultures, antibiotics, fluid resuscitation).

PACIFIC HOSPITAL OF LONG BEACH

ED Algorithm

CVP

- Less than 6 mmHg: Norepinephrine
- 6 to 12 mmHg: Volume expansion
- Greater than 12 mmHg:
  - Sats less than 70%: PRBCs
  - Sats greater than 70%:
    - Hct less than 30:
      - Volume expansion
    - Hct greater than 30:
      - Dobutamine

MAP

- Less than 8 mmHg: Norepinephrine
- 8 to 12 mmHg: Volume expansion
- Greater than 12 mmHg:
  - Sats less than 70%: PRBCs
  - Sats greater than 70%:
    - Hct less than 30:
      - Volume expansion
    - Hct greater than 30:
      - Dobutamine

Goal Achieved

Disclaimer: This is a clinical template and clinicians should use judgment for individual patient encounters.
Sepsis Bundle: Antibiotic Selection Clinical Pathway

<table>
<thead>
<tr>
<th>Suspected Source of Infection</th>
<th>Antigens Antibiotics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td>Vancomycin per clinical pharmacy consult.</td>
</tr>
<tr>
<td></td>
<td>Piperacillin/tazobactam 3.375 gram IV q8h</td>
</tr>
<tr>
<td>Meningitis</td>
<td>Ampicillin/sulbactam 1 gram IV q6h</td>
</tr>
<tr>
<td></td>
<td>Piperacillin/tazobactam 3.375 gram IV q8h</td>
</tr>
<tr>
<td></td>
<td>Tobramycin—dosing per clinical pharmacy consult.</td>
</tr>
<tr>
<td>Urinary Tract</td>
<td>Ciprofloxacin 100 mg IV q24h</td>
</tr>
<tr>
<td></td>
<td>Piperacillin/tazobactam 3.375 gram IV q8h</td>
</tr>
<tr>
<td></td>
<td>Amoxicillin 2 gram IV q8h, PDK per clinical pharmacy consult.</td>
</tr>
<tr>
<td>Staph/Firmicutes resistant (MRSA)</td>
<td>Vancomycin per clinical pharmacy consult.</td>
</tr>
<tr>
<td></td>
<td>S. aureus 600 mg IV q24h</td>
</tr>
<tr>
<td></td>
<td>Daptomycin 6 mg/kg q24h</td>
</tr>
<tr>
<td></td>
<td>Blood 1 gram IV q8h per urgent care ordered</td>
</tr>
<tr>
<td>Bloodstream Infection</td>
<td>Flucloxacillin 2gm IV q6h, DDD 1.5 DDD</td>
</tr>
<tr>
<td></td>
<td>V. parvula 2 gm IV q24h + tobramycin</td>
</tr>
<tr>
<td></td>
<td>Ceftriaxone 1 gm IV q24h + Azithromycin 500 mg IV q24h</td>
</tr>
<tr>
<td></td>
<td>Ceftriaxone 1 gm IV q24h + Levofloxacin 750mg IV q24h</td>
</tr>
<tr>
<td></td>
<td>Ceftriaxone 1gm IV q24h + Azithromycin 500 mg IV q24h</td>
</tr>
<tr>
<td></td>
<td>Ceftriaxone 1 gm IV q24h + Pipeline/tazobactam 4.5 gm IV q6h</td>
</tr>
<tr>
<td></td>
<td>Vancomycin per clinical pharmacy consult.</td>
</tr>
<tr>
<td></td>
<td>Piperacillin/tazobactam 4.5 gm IV q8h. May add vancomycin if there is a risk of MRSA.</td>
</tr>
<tr>
<td></td>
<td>Piperacillin/tazobactam 4.5 gm IV q6h + tobramycin. May add vancomycin if there is a risk of MRSA.</td>
</tr>
</tbody>
</table>

Intensive Care Unit (ICU):

- Ceftriaxone 1 gm IV q24h + Levofloxacin 750mg IV q24h
- Levofloxacin 750mg IV q24h + Clindamycin 600 mg IV q8h
- Ceftriaxone 1gm IV q24h + Pipeline/tazobactam 4.5 gm IV q6h + tobramycin
- Vancomycin per clinical pharmacy consult.

Medical Floor:

- Ceftriaxone 1gm IV q24h + Azithromycin 500mg IV q24h
- Ceftriaxone 1gm IV q24h + Pipeline/tazobactam 4.5 gm IV q8h
- Ceftriaxone 1gm IV q24h + pipeline/tazobactam 4.5 gm IV q6h +/- tobramycin. May add vancomycin if there is a risk of MRSA.

Surgical Site Infection:

- Ceftriaxone 1gm IV q24h + Azithromycin 500mg IV q24h
- Ceftriaxone 1gm IV q24h + Pipeline/tazobactam 4.5 gm IV q8h
- Ceftriaxone 1gm IV q24h + Pipeline/tazobactam 4.5 gm IV q6h + tobramycin. May add vancomycin if there is a risk of MRSA.

Community Acquired Pneumonia:

- Ceftriaxone 1gm IV q24h + Azithromycin 500mg IV q24h
- Ceftriaxone 1gm IV q24h + Pipeline/tazobactam 4.5 gm IV q8h
- Ceftriaxone 1gm IV q24h + Pipeline/tazobactam 4.5 gm IV q6h + tobramycin. May add vancomycin if there is a risk of MRSA.

Hospital-acquired Pneumonia / Hospital-acquired Pneumonia / Pneumonia associated with Hospital-acquired Pneumonia:

- Ceftriaxone 1gm IV q24h + Azithromycin 500mg IV q24h
- Ceftriaxone 1gm IV q24h + Pipeline/tazobactam 4.5 gm IV q8h
- Ceftriaxone 1gm IV q24h + Pipeline/tazobactam 4.5 gm IV q6h + tobramycin. May add vancomycin if there is a risk of MRSA.
Antibiotic Utilization

Inappropriate Antimicrobial Treatment
Has Been Associated With Elevated Mortality Rates in a Variety of Different Infections

- Appropriate
- Inappropriate

ICU Patients, Septicemia, Severe Sepsis/Septic Shock, BSI-ICU, CA-BSI, VAP

Adapted from multiple patient populations and studies; definition of inappropriate antimicrobial treatment differed among studies.
* Statistically significant difference.
What does it take to improve?

Will

Ideas

Execution

Change Packages & Ideas from Peers

Testing, implementing and spreading at the hospital – PDSA cycles

Your commitment

Role of Leadership

Committed: Staff cannot improve without supportive leadership.

Set the standard: “This is how we will practice”

Resources: Make time to work on testing

Share data: to motivate staff for change
Me and What Army?

- Form... a team (include a diverse staff)
- Identify... a project champion
- Identify... a process owner

Making your case to your CEO-COO-CFO-CNO

Misunderstanding True “Infectionomics”

Central Line Associated Bloodstream Infections

\[ n = 54 \text{ Patients} \]

\begin{tabular}{l|c|c}
& Average Reimbursement per Case & Average Cost per Case & Average Loss per Case \\
\hline
64,894 & 91,733 & ($26,839) \\
\end{tabular}

“The negative impact on operating margins was driven by greater increases in hospital expenses, 43% of which were attributable to the treatment of the CLABs or its complication.”
### Potential impact of EGDT-Your Hospital

<table>
<thead>
<tr>
<th>Hospital's Total discharges per year</th>
<th>Hospital Specific data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Numbers of Severe Sepsis Patients (based on 2.26% Incidence)</td>
<td>=Total Hospital Discharges per year x 2.26%</td>
</tr>
<tr>
<td>Estimated Severe Sepsis Patients Treated (based on 51.2% compliance rate)</td>
<td>=Estimated Number of Severe Sepsis Patients x 51.2%</td>
</tr>
<tr>
<td>Potential Lives Saved (15.4% EGDT mortality based on 46% relative reduction in mortality rate of 28.6%)</td>
<td>=(Number of treated Severe Sepsis patients x 28.6% - Number of Treated Severe patients x 15.4% EGDT mortality rate)</td>
</tr>
<tr>
<td>Potential Cost Reduction (based on 27% reduction)</td>
<td>=Number of Treated Severe Sepsis patients x 5,882</td>
</tr>
</tbody>
</table>

Knowing is not enough......

Johann Wolfgang von Goethe