Sepsis

The Imperfect Storm

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Montana ACP Chapter Meeting, Helena
September 9, 2016
Disclosure Information/My Background

- I have no financial relationships to disclose
- I won’t discuss off label or investigational drug use.
- I’ll do my best to speak generically

- General Internist/Hospitalist
- QI Consultant United Hospital 12/05-11
  - Mortality Reduction Project
  - Leader, Sepsis Project
  - ED Sepsis Studies 2007-08
  - ICU Sepsis Study

- Medical Director, Hospital Medicine, United Hospital 2/11-1/15
  - Med. Dir. For Quality, Medicine Services, and Medical Education 2/15-9/15
  - Sepsis QI Med. Dir. 9/15-2016
  - Allina Health (11 hospitals) Sepsis Leadership Team 2014-16
IHC-IMCP Severe Sepsis Screening Tool

1. Is the patient's history suggestive of a new infection?
   a. Pneumonia/empyema
   b. UTI
   c. Acute abdominal infection
   d. Meningitis
   e. Skin/soft tissue inflammation
   f. Bone/joint infection
   g. Wound infection
   h. Catheter or device infection
   i. Endocarditis
   Yes/No

2. Are any of the following signs or symptoms of infection present?
   a. Hyperthermia > 38.4 C
   b. Hypothermia < 36 C
   c. Chills with rigors
   d. Tachycardia > 90 bpm
   e. Tachypnea > 20 bpm
   f. SBP < 90 or MAP < 65
   g. Headache with stiff neck
   h. WBC > 12,000 – or – <4,000
   i. Band forms >10%
   Yes/No

If the answer is 'Yes' to both question 1 and 2, Suspicion of Infection is Present:
1. Obtain: Vital Signs, CBC with Diff, BMP, Lactate, Bilirubin, PT-PTT, Blood Cultures (need for question 3)
2. At physicians discretion obtain: UA, Chest X-ray, Amylase, Lipase, LFT< CT, ABG

3. Are any of the following organ dysfunction criteria present at a site remote from the site of the infection that are not considered to be chronic conditions?
   □ Acutely altered mental status
   □ SBP < 90 or MAP < 65 mmHg
   □ SpO₂ < 90% on room air or on supplemental O₂
   □ Creatinine > 2.0 mg / dl or Urine Output < 0.5 ml/hour for > 2 hours
   □ Bilirubin > 2 mg / dl
   □ INR > 1.5
   □ Platelet Count < 100,000
   □ Lactate > 2 mmol / liter
   Yes/No

If Suspicion of Infection is Present and there is any Organ Dysfunction Present patient meets the criteria for SEVERE SEPSIS and should be entered into the Severe Sepsis Bundle pathway.
Focus

• The imperative of early recognition and treatment
• Lessons from novel cases
• Driving quality improvement in community hospitals
Septic Patients Don’t Complain of Sepsis. They often have other explanations for signs and symptoms.
ER  11/23/05, 0905hr

57 y/o woman with one week Hx of flu-like illness- N&V, body aches. Husband found her lying on the floor by the bed. No fall.

Exam- Weak, lethargic, confused.

T-97.5, BP-83/51,79/50,84/52, P-113, O2 Sat-98%-2L, no RR (T-101.9 at MN)

Large left breast mass with axillary adenopathy
Labs

WBC-11.8, diff- 61N, 25B, 8Meta, 2Myelo
Toxic granulation, HB- 12, Plts-27
Na-127, K-2.9, CL-95, CO2-21
BUN/CR- 49/1.2, T.Bili-4.5, elevated LFT’s
CXR- neg
How many organs are down?

A. None
B. 1
C. 2
D. 3
E. 4
Severe Sepsis Mortality Increases With Number of Organ Failures

Hematologic Dysfunction (Mortality by Change in Platelet Count)

Severe sepsis mortality predictors (Baseline to Day 1)
Population-based outcomes observed in severe sepsis patients

- > 150,000/mm³ to > 150,000/mm³: 25% (N=465)
- 150,000/mm³ to ≤ 100,000/mm³: 63% (N=24)
- > 150,000/mm³ to ≤ 50,000/mm³: 85% (N=13)

Data on file, Eli Lilly and Company. XIG20060921A.
**Diagnosis**
- Metastatic Breast Cancer
- Dehydration
- Hypotension
- Hypokalemia
- Hyponatremia

**Treatment**
- 1-2 L NS
- ABX & IVF resuscitation >15 hrs.
After onset of hypotension in septic shock, how much does mortality rise for every hour delay in ABX?

A. 2.4%
B. 4.3%
C. 7.6%
D. 12.2%
Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock.

- Effective antimicrobial administration within the 1st hour of documented hypotension was associated with increased survival in patients with septic shock.

- Each hour of delay over the next 6 hours was associated with an average decrease in survival of 7.6% (range 3.6-9.9%)

Complications

• Day 3 – ARDS- Ventilator support
• Day 5 – Acute Renal Failure- dialysis
• Day 8 – Bacterial Endocarditis, Staph. A.
• Day 12 – Stroke, Quadriplegia
• Day 15 – Subarachnoid Hemorrhage
• Day 21 – Expired

Lessons?
  – Don’t use distracting diagnoses to explain away septic findings
  – Keep necrotic tumor and SBE in mind when a source isn’t obvious.
Definitions

Sepsis-1 ACCP/SCCM Chest 1992; 101:1644-55
confirmed infection + 2 SIRS
Severe Sepsis: Sepsis + organ dysfunction, hypoperfusion, or hypotension
Septic Shock:  Sepsis + low BP despite adequate IVF + hypoperfusion
MODS: Multiple Organ Dysfunction Syndrome

Sepsis-2 SCCM International Sepsis Definitions Conference 2001
No new definitions introduced.  A list of signs and symptoms added to diagnostic criteria
Including MAP<70 for “sepsis” and MAP<60 for Septic shock

Sepsis-3  Third International Consensus Definitions for Sepsis and Septic Shock, JAMA 2016 315(8)801-810
The task force concluded the term severe sepsis was redundant.  Sepsis = severe sepsis.  SIRS are out.
SOFA ≥2 is in (Quick SOFA)= 2/3: RR≥22, SBP<100, altered MS (Mortality>10%).  Septic shock= Vasopressor
requirement to keep MAP>65 AND lactate >2 in the absence of hypovolemia (Mortality>40%).
SIRS criteria show dynamic variation in the same patient

Box 1. SIRS (Systemic Inflammatory Response Syndrome)

Two or more of:
- Temperature >38°C or <36°C
- Heart rate >90/min
- Respiratory rate >20/min or $\text{Paco}_2$ < 32 mm Hg (4.3 kPa)
- White blood cell count >12 000/mm³ or <4000/mm³ or >10% immature bands

From Bone et al. ⁹

Chest 1992; 101:1644-55
False negative sepsis screen (Sepsis with <2 SIRS)*

- Total ED patients with sepsis = 234
- Total false neg. = 20/234 = 8.5%
- 15/20 had low SBP <95 on presentation
- 3 septic shock
- 13 severe sepsis
- 4 sepsis unspecified (mild)
- Take home message: organ dysfunction trumps SIRS

*United Hospital 2007-8 ED QI sepsis studies
What is Sepsis? (New definition)

• Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection.

• Organ dysfunction can be identified as an acute change in total SOFA score $\geq$ 2 points consequent to infection.
What is Sepsis?

- A **systemic reaction** to infection beyond the tissue site of microbial invasion.
- Mediated by microbial toxins and/or the immune system mediated proteins (cytokines) that cause cellular damage to the host.
- Widespread vascular endothelial damage that causes **fluid extravasation** and **microthrombosis**.
- Leads to shock and multiple organ failure.
Endothelial injury causes extravasation = capillary leak

100M Arterioles

10B Capillaries = 25,000? Conservative est.
25,000 miles would stretch around the earth
Novel Cases
Lessons
Don’t bet against sepsis

Jumping to conclusions
ED 9/24/10 1248 hrs

- 87 y/o woman from NH with weakness, nausea, anorexia, hematochezia, and pain “all over”. 1 mo Hx intermittent diarrhea since adm for UTI and cellulitis. 23 lb wt loss on metolazone. No dysuria. Recent INR-5 on warfarin.

- PMH: PPM, CHF, DM II, cecal AVM’s, A.fib, CKD

- Exam: T 97.5 P 78-123 RR-16 SBP 79-100, lethargic. tongue dry. Melenotic heme+ stool.
Labs

• WBC 15.6, hgb 11.5, platelets 282. UA 10-25 RBC, 100-300 WBC and positive leukocyte esterase. glucose 368. INR 1.1. CMP remarkable for Cr- 2.16 (1.07). Lactate 1.3.

• 1 BC drawn

• CXR neg

• EKG- A-V paced rhythm @ 99
Diagnosis

1. GI bleeding with intermittent diarrhea and history of antibiotic use, raising concern for C. difficile colitis.
2. Positive screen for severe sepsis with SIRS criteria in addition to low blood pressure and ARF in the ED.
3. Pyuria, possible urinary tract infection.
4. Chronic nausea and anorexia with weight loss.
5. CAD.
6. History of CHF, compensated, now with a negative chest x-ray.
7. Hx A. Fib with recent anticoagulation
Treatment

• 1 L NS in ED, SBP up to 129/64, 105/58
• D51/2NS+20KCL@ 75cc/hr
• PPI
• Empiric metronidazole for suspected C. diff.

• “+screen for severe sepsis with 1 Systolic blood pressure<90 and ARF, but I think C. Diff is more likely so will hold antibiotics for now”
Hospital course day 2-4

- feels very weak. BP dropped to 53/35. HR 150's. RRT called.
- A. Fib/RVR
- Hgb 10.7, WBC 22.7 (15.6), Cr-2.12, CXR neg, C. diff neg. Lactate 1.4
- 500 cc NS
- 2nd BC, piperacillin/tazobactam + vanco
- Transferred to ICU on pressors with ScvO2 38%
- recovers until Afib/RVR treated with diltiazem and drops BP
- Elects comfort care and expires
A strong sepsis culture

Shares their failures
Learns to treat the possibility of sepsis sooner rather than later
Late for Early Goal Directed Therapy

How to fund a sepsis study
ED 11/09  2100 hrs.  

SIRS vs qSOFA

• 77 y/o man re-admitted from TCU with fever, cough, hypoxia, nausea, chest and abdominal pain.

• T-101.3, BP-103/54, P-91, RR-18, O2 sat 84% RA, scattered rhonchi.  Wt 60 kg

• WBC- 27.6, CXR- small right lung infiltrates, small right effusion, CMP nl.  Plts nl.  CO2-23

• Diagnosis- pneumonia, recent rib Fx’s, Hx of CHF (EF 20%) and COPD on Pred.  5 mg/d
Hospital Course- day 1 *A bet against sepsis*

- Treatment- moxifloxacin. No sepsis OS used, no IVF, no lactate, no INR, no BC’s, no vanco, no steroid boost

- Disposition- 3300 @ 0145 hrs

- 0800- BP drops to 69/44, 1 L NS IV, then 100 cc/hr, “patient does not appear septic at this time”. BP normalizes. Lactate 1.7
Day 2 11/30

- 1100 hrs, “looks clinically better”, “wants to go home”, BP drops 75/54, P-97, 500 cc NS given.
- WBC 33,300.
- CO2-19
Day 3 *Too late for EGDT?*

- WBC 26.5 with 24% bands
- 1213 hrs- BP 61/46, 1 L NS IV, BP normalizes, increased SOB
- CXR – extensive infiltrate RUL
- 1930 hrs- transferred to ICU (70.5 hrs)
- Dx Septic Shock
- Lactate 2.5, CO2-19, ScvO2 73%
- 2015 BC + linezolid and imipenem
Day 4 *The runaway train*

- INR 1.7-2.4, lactate 1.7 to 7.7, ScvO2 67%
- CO2- 20 to 12
- Cardiac arrest after bronchoscopy
- Respiratory failure intubated
- Acute Renal Failure (Cr. 67 to 1.33)
Day 5 Expires

- BAL +H1N1 and MRSA
Perspective on where to put resources

- Unrecognized mortality of septic shock in ED = 28%
  - Recognized = 15%

- Nosocomial C. diff infection mortality = 5.7%

- Risk of death from a surgical site infection after surgery.
  - 2% incidence x 3% mortality = .06%

- Risk of death from CL-BSI after central line placement.
  - $1.65/1000 = .0017 \times 27\%$ mortality = .045%
Unlock Shock

“It was like an explosion in my chest”
69 y/o man who woke up at about 0200 with sudden onset of chest pain, SOB, and his “T-shirt was wringing wet”. Pain was sharp, pleuritic, stabbing with pressure in the left chest, 10/10, "like an explosion in my chest."

Paramedics: “Pale and diaphoretic”. BP 60/35, P-61, Resp. labored at 20

15 min later BP 134/66, P-111. 1 NTG enroute with significant BP drop and nausea, SOB, increased CP, near syncope and extreme diaphoresis.
PMH

- DM II (A1C 7.8 this adm.)
- CAD  s/p MI 9/2007 with 1 stent
- CHF with ischemic CM, EF 25% to 45% after
- BiV ICD/Pacer* 3/8/11
- Afib
- CVA 12/2010
- HTN
- DJD  s/p left TKA 12 days ago
- CKD, stage 3, last Cr 1.65
- Hyperlipidemia
- Obesity

Meds

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<tr>
<td>Norvasc</td>
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<td>Cordarone</td>
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<td>Aldactone</td>
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*
ED 0606 hrs

- Generalized body aches. “States that he had a coughing spell, and after that, he immediately began hurting in his ribs, and was very SOB.” ED RN

- BP 67/44, P-60*, Resp. 18, T-97.4, O2 sat 96% RA, 132 kg

Diagnostics

- EKG- AV Paced rhythm
- CXR- 3 lead pacemaker, otherwise negative
- WBC-21.9 11% bands, 3% metas, 3% myelos and slight toxic granulation, Hgb-8.9 (10.5-9 days earlier), Plts-413, INR-4.1
- CMP normal except Na-133, Cr 2.5(1.65), Alb-3, BS-279
- Organ dysfunctions?
Organ Dysfunctions?

A. 1  
B. 2  
C. 3  
D. 4
Severe Sepsis Mortality Increases With Number of Organ Failures


Number of Organ Dysfunctions

Mortality %

- One: 21%
- Two: 44%
- Three: 65%
- Four or More: 76%
What could this be?

- **Shock**
  - Hypovolemic
    - Hemorrhagic
    - Fluid loss
  - Cardiogenic
    - Cardiac
    - Extra-cardiac (Obstructive)
  - Distributive (Vasodilatory)
  - Combined (Septic)

- **A-** Pulmonary Embolus
- **B-** Acute MI
- **C-** Septic Shock
- **D-** Internal Hemorrhage
What else do you want to do?

• Diagnostics
  – Troponins x3 and CK Mb normal
  – BC’s
  – Lactate- 1.2 to 1.4
  – RBC Type and Screen
  – Venous doppler legs negative

• Treatment
  – Central line placement in ED
  – 2500 cc NS given (about 20 cc/kg)
  – Pipperacillin/tazobactam
ICU 0953 hrs

• Intensivist
  – 1. Acute onset of left chest pain, probably chest wall pain, as it is tender in that part of his chest.
  – 3. Hypotension that, by process of elimination, is sepsis. He has an improvement in his echocardiogram, a negative VQ scan, and a negative EKG.
    – Source of sepsis is completely unclear.

• 1245 BP 72/49, ScvO2- 55%, dobutamine and nor-epi started, vasopressin added
Next day

- SBP 101-160 on pressors
- Diagnostics
  - ScvO2- 56%(!)
  - INR-6.8
  - WBC- 21
  - Hgb- 5.1, repeated 4.8
  - Cr 2.87
- CT abd and pelvis without contrast
POSTOPERATIVE DIAGNOSIS  Spontaneous rupture of spleen.

“Immediately upon entering the peritoneal cavity, a large amount of old blood was encountered. This old blood was suctioned out. Approximately four liters of old blood was removed from the peritoneal cavity. Examination of the spleen revealed evidence of a spontaneous rupture.”
Lessons?

• When coming up empty think about what could be lurking on the other side of the diaphragm.

• Progressive shock without a definitive Diagnosis: Check serial Hgb’s.

• Supertherapeutic INR on warfarin could reflect bleeding with coagulation factor consumption

• Leukocytosis and left shift might not be infection
  – Stress response, leukemoid reaction, myeloproliferative disorder, chronic leukemia
S/P SBO and lysis of adhesions

You won’t want to miss this case
Direct Adm from clinic 5/7/12

• 67 y/o man admitted with a 2 day Hx of abdominal pain, nausea and vomiting. He presented to his clinic where a CT Abd showed a high grade SBO.

• PMH – Hypercholesterolemia, Left Herniorrhaphy x 2, cervical bone spur

• Habits – 40 pk/yr past smoker, ETOH none

• Meds- ASA, diclofenac, niacin

• Exam - BP 111/72 | Pulse 85 | Temp 98.7 °F | Resp 16
Abd – soft, distended, slightly tender throughout
Day of Adm

- CT - Moderately high-grade mechanical small-bowel obstruction with the appearance most suggestive of an adhesion in the left mid abdomen posteriorly at the level of the proximal ileum.

- Clinic labs “reviewed, they include hemoglobin of 19 g/dl, hematocrit of 55”

- Surgeon – “Will treat this patient with IV fluids and bowel rest and careful observation.”

- D5 ½ NS + 20 KCL @ 125/hr (No bolus)
Next Day

- WBC-6.2, Hgb-18.2, Plts-188, Cr-1.16, Lytes nl, BS-149
- NG placed.
- SBFT - marked dilatation of the entire jejunum and ileum to the level of the right lower quadrant.
- 2051 hrs- To OR for exploratory lap for SBO, lysis of adhesion, and Witzel gastrostomy. “The bowel was dilated and looks ischemic but is viable.”
POD #1 5/9

- VSS on morphine PCA
- WBC-7, Hgb-19.1, Plts-204, Cr-1.24, lytes nl
- 1838 hrs- Rapid Response nurse notified of patient's Heart rate increase, increase in sweating and pain
- 1900-Hospitalist called for clamminess, increased pain, and decreased saturations. Response: Patient will continue to be monitored and assessed.
- 1913- RRT- diaphoretic and tachycardic after getting out of bed. Very painful with movement. 4L NC and SATs are 90 - 93%. RR-20. HR 103, SR. 25mg MS day shift, 11mg this shift. MS seems not to be effective. Surgery called for dilaudid order. BP 126/59, HR 107.

- (UO 125 cc 0800-2300 = 125 cc/15 hr = 8.3 cc/hr)
What could be wrong?

A. PE
B. Cryptic Shock
C. Volvulus
D. Severe Sepsis
E. C & E
SIRS?

qSOFA? (2/3)
Altered MS
SBP≤100
RR≥22

0806 (16 hrs)
78/54
Is this Shock?  How about Cryptic Shock?

• Re: Severe Sepsis, “Although the classic presentation is of florid shock with frank hypotension, fever, and elevated WBC, many patients can present with "cryptogenic shock" (shock without hypotension) with more subtle signs of vital organ compromise.” –Angus JAMA 4/13/2011.

• “The time from ED arrival to meeting criteria for severe sepsis (lactate ≥4) or septic shock (refractory hypotension) ranged from 0-17 hrs. This supports the concept of “cryptic shock”. Septic patients with significant systemic hypoperfusion may initially present with normal or high BP and may require a few hrs before fluid refractory hypotension occurs.” - Nguyen CCM 2007
POD #2- Early AM 5/10

• 0020 hrs. RRT and HO called to assess patient due to tachycardia and abd pain. Abd dressing saturated with serosanguinous drainage. Abd was firm and tender with hypoactive bowel sounds.

• BP-130/80, Pulse-113, Temp-98.3 °F, Resp 20. O2 sat 90% on 5L. Abdomen is somewhat distended, unclear if changed. Patient reports it's improved. O2 sat 87% 6L

• WBC-24, Hgb-18.8, Plts-191, Cr-1.8(1.16), CO2-20 (28)

• BC’s, Lactate, ABG’s, 1 L NS bolus, transfer to ICU
More workup

- 0250 hrs. BC’s x 2, Lactate- 5.6, 7.35/35/75 10L.
- 0300 transfers to ICU. BP 108/72, HR 101, RR28
- 0400 CXR - Small amount of infiltrate or atelectasis.
  - Sepsis OS, Ciprofloxacin and metronidazole
- Abd XR- Non-specific air-fluid levels. Gas in the rectosigmoid region. Prominent loop of bowel RLQ, probably colon.
- AM BP 75/63, HR 98, CR 3.2 (1.2), INR 1.7, CO2 16
  - Surgeon “Pt in septic shock, will explore”
Serum Lactate as a Predictor of Mortality in Emergency Department Patients with Infection

- Prospective cohort study, urban ED
- 1,278 consecutive patients
- Inclusion criteria: ≥18 years, serum lactate level obtained, admission with infection-related diagnosis

<table>
<thead>
<tr>
<th>Lactate (mmol/L)</th>
<th>0-2.4</th>
<th>2.5-3.9</th>
<th>≥4.0</th>
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</thead>
<tbody>
<tr>
<td>28-day in-hospital mortality, %</td>
<td>4.9</td>
<td>9.0</td>
<td>28.4</td>
</tr>
<tr>
<td>Death within 3 days, %</td>
<td>1.5</td>
<td>4.5</td>
<td>22.4</td>
</tr>
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</table>

Number of Organs Down?

- **1\textsuperscript{st}-** O2 Sat < 90% RA or on O2- *Respiratory (10L O2)*
- **2\textsuperscript{nd}-** Lactate > 2.2 mmol/L- *Metabolic (5.6)*
- **3\textsuperscript{rd}-** Cr > 1.6 or UO < 20 cc/Hr for >2 Hrs- *Renal (1.8-3.2)*
- **4\textsuperscript{th}-** SBP < 90 or MAP <65 – *Cardiovascular (78/54)*
- **5\textsuperscript{th}-** INR > 1.5; >3.5 on Coumadin- *Hematologic (INR 1.7)*
  - Plts down to 106
Severe Sepsis Mortality Increases With Number of Organ Failures

Number of Organ Dysfunctions

Preoperative Diagnosis:
- Acute abdomen

Postoperative Diagnosis:
- Necrotizing fasciitis

Procedures:
- Exploratory laparotomy with debridement of abdominal wall muscle
- “The fascia was necrotic. The muscle was necrotic all the way up to the chest wall to the nipple level and all the way back to the spine”
ICU Postop

• 1409 Comfort Care, 1530 Expires
• BC’s + CLOSTRIDIUM PERFRINGENS
• Abd fluid-CB, KP, ENC, SA, Tissue-CB, EB, SA, ENC, AS
  – mixed anaerobes

Autopsy

• Extensive necrosis of the abdominal wall consistent with necrotizing fasciitis.
• Distal small bowel necrosis without evidence of perforation
Performance Improvement

• “...guidelines do not have a high impact on bedside healthcare practitioner performance. In order to change bedside behavior, protocols and performance improvement programs with audit and feedback are needed.”

Driving QI in a community hospital

Campaigning for help. You can’t be a one man show. Planting seeds for a sepsis culture. Prepare for a long journey.
Sepsis Care Improvement Plan

Sepsis Teams
- Guidance Team
- Project Team
- MD Advisory Team
- Sepsis Monitoring + Feedback

Idea Creation
- Direction, resources, and remove barriers
- QI – PDSA, Mgt Handoff
- Expert resources for BOP
- Workbench Report, sepsis list, Chart review, feedback, data collection, EGDT monitoring
- MD Leader- RN Sepsis Coordinators

Non-ICU Hospital
- Workbench Report
- Find Pts with sepsis
- SBAR
- Sepsis Code: RRT, MD, Pharmacy, RT, ICU RN
- Care Feedback

ED
- Sepsis Code
- EGDT Protocol
- Care Feedback
- MD-RN Leaders

ICU
- EGDT Monitoring
- CCC sepsis report
- Care Feedback
- MD-RN Leaders

Sepsis conference
Sepsis Leader’s Mtg
- Identify barriers for PT
RN Presentations
MD Presentations
Sepsis Newsletter
Mortality Rate all patients

*with Sepsis Annotations*

United Hospital
Overcome your fear of exposing dirty laundry
QI is more about recovering from failure than achieving success
How we started

- Reviewed the admitting Dx of 928 admissions thru the ED from Jan. 8th-31th, 2007.
- Selected 510 cases that had the potential for sepsis.
- Applied a sepsis chart review screening tool, and if positive, reviewed for study parameters
- Presented findings to medical staff using recognition and treatment failures (and successes)
What We Found

32% of all admissions (294 Patients) were for infection
13.6% of all admissions (125 Patients) were septic
1% were septic shock

Infection Frequencies of all ED admissions from Jan 8 to Jan 31, 2007

- No Infection: 68%
- Infection without Sepsis: 18%
- Sepsis Unspecified: 5%
- Severe Sepsis: 1%
- Septic Shock: 8%
Recognition - about 50%

Recognition Rate of Septic Patients Presenting to ED

- #Septic Recognized: 45%
- #Septic Unrecognized: 55%
Treatment

• 51% of septic patients received antibiotics within 3 hours of ED arrival.
• 39% of septic patients received adequate fluids within 6 hours of ED arrival.
• 28% of septic patients had a sepsis order set used in the ED.
• 24% of septic patients for whom MRSA screening was indicated were screened.
• 41% of septic patients had $\geq 2$ blood cultures.
• 46% of septic patients had serum lactates.
## Recognition ED Sepsis Studies

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<th>Year</th>
<th>ED</th>
<th>PMD</th>
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<td>2007</td>
<td>45%</td>
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<td>2008</td>
<td>36%</td>
<td>28%</td>
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% Sepsis Recognition of Septic Patients Seen by 19 ED Physicians

March 2008 ED Sepsis Study
March 2008 ED Sepsis Study
Mortality of Septic Shock Pts w/wo Sepsis Order Set 2007 and 2008 studies

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<th>Order Set</th>
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<td>Mortality</td>
<td>43%</td>
<td>83%</td>
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<td>N=14</td>
<td>6/14</td>
<td>5/6</td>
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2007 and 2008 studies
Mortality of Severe Sepsis Pts w/wo Sepsis Order Set 2007 and 2008 Studies

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<tbody>
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<td>N=30</td>
<td>1/30</td>
</tr>
<tr>
<td>N=47</td>
<td>5/47</td>
</tr>
<tr>
<td>1/30 N=30</td>
<td>5/47 N=47</td>
</tr>
</tbody>
</table>

Mortality 3% 11%
Mortality Unchanged

2008
• Overall - 9%
• Sepsis unspec. - 2%
• Severe Sepsis - 9%
• Septic Shock - 55%

2007
• Overall - 7%
• Sepsis unspec. - 3%
• Severe Sepsis - 7%
• Septic Shock - 56%
UH ICU Sepsis Study 2009-12

- Focused on Septic shock with ICU stay
- Screened every ICU patient for septic shock by chart review
- Measured 6 Hr. Bundle compliance
- Measured sepsis OS use
- Measured MD recognition – ED MD’s, hospitalists, Intensivists
- Mortality
- MD specific feedback quarterly/ ED monthly
- Monthly report to Critical Care Committee
- Collected teaching cases for presentation
Mortality and Sepsis Recognition running total to Sept 2012 (N=671 Septic Shock Pts.)

- **ED MD:**
  - Recognized: 84% (75% 2010)
  - Mort. Rec.: 28%
  - Mort. Unrec.: 15%

- **Intensivist:**
  - Recognized: 76% (72% 2010)
  - Mort. Rec.: 27%
  - Mort. Unrec.: 20%

- **Hospitalist:**
  - Recognized: 79% (77% 2010)
  - Mort. Rec.: 25%
  - Mort. Unrec.: 20%
Financials

N recognized = 179   N unrecognized = 32

ED Patients Admitted with Septic Shock
Disch Dates: 11/1/09 - 4/30/12

ED Patients Admitted with Septic Shock
Disch Dates: 11/1/09 - 4/30/12
Orderset Usage with Mortality thru April 2011, Oct-Dec 2011, Jan-Sept 2012
(N=24 month)
N=671

<table>
<thead>
<tr>
<th></th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order Set</td>
<td>21%</td>
</tr>
<tr>
<td>No Order Set</td>
<td>28%</td>
</tr>
</tbody>
</table>

N=546, N=125

33%
6 hour Bundle Compliance & mortality total study to date thru March 2011, Oct-Dec 2011, Jan-Sept 2012

6 hr Resuscitation Bundle Compliant %

- N=24
- N=55
- N=61
- N=63
- N=70
- N=66
- N=71
- N=75
- N=73
- N=90

% Mortality

- N=71
- N=75
- N=73
- N=90
6 Hr Bundle compliance and mortality

• Mortality:
• Total Mortality: 151/671 = 23%
• 6 hr Bundle: compliant: 12/83 = 14%
  non-compliant: 139/588 = 24%
• NNT = 24% - 14% = 10% = 1 / 0.1 = 10 patients
• We have to treat 10 patients with a successful bundle to save 1 life
6 hour Bundle Compliance with Mortality thru April 2011, Oct-Dec 2011, Jan-Sept 2012 (N=24 month)

- % Lactate Drawn
- % of BC drawn before Abx
- % ABX given w/in 3 hrs of ED Adm or 1hr non-ED ICU Adm
- % 20cc/kg IV NS followed by pressors, if needed
- % of CVP>8 and ScvO2 >70 or SvO2 65% w/in 6 hrs
- % Mortality
6 hour Bundle Compliance with Mortality thru April 2011, Oct-Dec 2011, Jan-Sept 2012 (N=24 month)
What is the ABF Index?

ABX compliance% + IVF compliance% = max. of 200%

What if ≥ 160?, What if >140?, What if <140?
All Septic Shock Patients

ABF Index vs. Mortality
All Patients with Septic Shock
ABX Compliance % + IVF Compliance % (n=24/month)
ABF Index vs. Mortality
ED Patients with Septic Shock
ABX Compliance % + IVF Compliance % (n=10/month)

% Mortality / ED Recognition

% Mortality
ED MD Recognition
ABF Index

- % Mortality
- ED MD Recognition
- ABF Index
# ABF Index vs Mortality Septic Shock in ED

<table>
<thead>
<tr>
<th>ED ABF Index</th>
<th>ED Septic Shock Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥160 (n=70)</td>
<td>7%</td>
</tr>
<tr>
<td>&gt;140 (n=180)</td>
<td>12%</td>
</tr>
<tr>
<td>≤140 (n=100)</td>
<td>26%</td>
</tr>
</tbody>
</table>
ED Patients

United ED does 16%

Mortality Rate
ED Patients with Septic Shock
United Hospital

Mortality Rate

Mortality Rate

Mortality Rate


UCL 62%

CL 16%
## United ED/IP 1st Qtr. 2016

<table>
<thead>
<tr>
<th>Sepsis Order set</th>
<th>Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactate w/in 180 min</td>
<td>97.1%</td>
</tr>
<tr>
<td>2 BC’s before ABX</td>
<td>79.7%</td>
</tr>
<tr>
<td>IVF w/in 180 min</td>
<td>60.9%</td>
</tr>
<tr>
<td>ABX w/in 180 min</td>
<td>97.1%</td>
</tr>
<tr>
<td>Remeasure lactate if elevated</td>
<td>87%</td>
</tr>
<tr>
<td>Vasopressors w/in 180 min</td>
<td>64.5%</td>
</tr>
<tr>
<td>Fluid Reassessment</td>
<td>32.6%</td>
</tr>
<tr>
<td>7 Part Bundle compliance</td>
<td>21.7%</td>
</tr>
</tbody>
</table>
Allina Sepsis Program Milestones - 11 hospitals

• Interdisciplinary teams at each hospital, supported by Sepsis Coordinator and Leadership Team

• Defining and implementing best practice sepsis care together
  – Order sets: More than 12 (2014); to 4 (2014); and now 1
  – Faster lactate: iSTAT (point of care) in large EDs (2015)

• Standard measurement system—Sepsis Dashboard (EPIC)

• Education & leadership development
  – Nurses, physicians, care team
  – Sepsis Grand Rounds
  – Sepsis Summit
Severe Sepsis / Septic Shock Recognition/ Documentation
Order Set Use
(ABX ordered from OS)

ABX ordered off Sepsis OS

<table>
<thead>
<tr>
<th>Visits</th>
<th>Lactate 180 min</th>
<th>2 BC Before</th>
<th>Abx 180 min</th>
<th>Fluids 180 min</th>
<th>Re-measure Lactate if Abnormal</th>
<th>Vasopressor 180 min</th>
<th>Fluid Reassessment</th>
<th>7-Part OC Bundle</th>
<th>Avg IP LOS</th>
<th>Mortality Rate *</th>
<th>Avg Total Variable Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used</td>
<td>2,021</td>
<td>99.5%</td>
<td>91.1%</td>
<td>94.2%</td>
<td>30.0%</td>
<td>73.6%</td>
<td>31.8%</td>
<td>9.6%</td>
<td>13.9%</td>
<td>5.78</td>
<td>7.5%</td>
</tr>
<tr>
<td>Not Used</td>
<td>4,299</td>
<td>84.5%</td>
<td>73.4%</td>
<td>82.1%</td>
<td>15.3%</td>
<td>61.3%</td>
<td>24.9%</td>
<td>9.7%</td>
<td>6.1%</td>
<td>7.68</td>
<td>9.2%</td>
</tr>
</tbody>
</table>

Avg: 22.5% (Used / Total Eligible Visits: 2,825 / 12,532)

Discharge Year
### Severe Sepsis / Septic Shock Patient Mortality Rate

<table>
<thead>
<tr>
<th>Discharge Year</th>
<th>Mortality Rate</th>
<th>Expired in Hospital</th>
<th>Visits</th>
<th>Lives Saved from Previous Year</th>
<th>Mortality rate reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>14.7%</td>
<td>378</td>
<td>2578</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>10.9%</td>
<td>400</td>
<td>3655</td>
<td>136</td>
<td>3.7%</td>
</tr>
<tr>
<td>2015</td>
<td>8.5%</td>
<td>433</td>
<td>5088</td>
<td>124</td>
<td>2.4%</td>
</tr>
</tbody>
</table>
It all boils down to:

• Recognize and act on the *possibility* of sepsis
• Look for organ dysfunctions and count them
• Organ dysfunction trumps SIRS (if<2 present) and qSOFA
• Use a sepsis order set. Makes it easier to do the right thing.
• Hurry, you don’t have much time to give ABX and IVF.