Sepsis Mortality Reduction Challenges, Successes & Outcomes of a Quality Improvement Project

Beacon Northern California Council
Patient First Safety Luncheon & Education Program
Marci Hoze, RN, BSN, MPA
March 19, 2013
Program Objects

• Describe a strategy to reduce sepsis mortality through early identification and goal directed therapy optimizing the electronic health record.
  • Implementing a sepsis screening process
  • Implementing standardized severe sepsis treatment (EGDT)
• Identify challenges to varied data sources and reporting methods
  • Developing a means for abstracting and reporting data
• Recognize the need for a quality improvement infrastructure to advance and sustain quality improvement projects
  • Managing organizational change.
University of California Davis

- 619 Bed Acute Care Hospital
- Serves 33 Counties, 65,000 sq mile area
- Level 1 Trauma Center
- Burn Center
- Children’s Hospital
- Medical & Nursing School
- 12,000 Faculty & Staff
- 61,037 ER Visits
- 888,632 Office Visits
- 31,450 Admissions
Sepsis

- Internationally, sepsis affects more than 18 million persons per year
- Nationally, sepsis kills more than 215,000 annually (averaging 500 deaths per day)
- Leading cause of death in the Intensive Care Unit
- Tenth leading cause of death in the United States
- Annual total costs of over $16.7 billion
UC Davis and Sepsis

- On average we have approximately 40-80 cases of severe sepsis and septic shock every month.
- 1 in 3-4 patients die (Observed mortality 25-33%) (2009 baseline from University Healthsystem Consortium database)
- Observed to expected mortality ratio greater than 1.18 and UHC sepsis ranking of 35/120 (2011 - 2nd Quarter)
UC Davis Goals

• Reduce Sepsis Mortality by 15%
  • Identify Patients Early
  • Evidence Based Timely Early Goal Directed Therapy (EGDT)
    • Screen Severe Sepsis and Septic Shock Patients with a Lactate Acid
    • Blood cultures prior to antibiotic administration
    • Antibiotics within 60 minutes
    • IV Fluid bolus of 20mg/kg within 3 hours
    • Vasopressors for refractory hypotension
    • Goal directed fluids to correct SVO2 or MAP

• Leverage EMR

• Engage Frontline Nursing Staff
Advantages

• Executive Leadership/Support
• Gordon & Betty Moore Foundation Grant
• DSRIP
• Formation of Multidisciplinary Collaborative
• Highly Developed Electronic Heath Record
Sepsis Improvement Collaborative (original group)

- Cathy Adamson
- Timothy Albertson
- Tony Berger
- Hugh Black
- Kimmie Bleichner-Jones
- Godwin Castrence
- Nikki Chahon
- Melinda Cherko
- Cinda Christensen
- Christine Cocanour
- Linda Cooke
- Tina DiPierro
- Amy Doroy
- Lisa Eckers
- Jeff Green
- Jim Hill
- Marci Hoze
- Marsha Hunkins-Flores
- Hershan Johl
- Jihye Kim
- Marsha Koopman
- Joleen Lonigan
- Felicidad Loomis
- Jack MacMillan
- Maile Mauer
- Karen Mondino
- Linda Moore
- Joanne Natale
- Marsha Nelson
- Hien Nguyen
- Joyce Nochez
- Edward Panacek
- Tricia Parker
- Ho Phan
- Jared Quinton
- Victoria Ritter
- Christian Sandrock
- Trish Sudbury
- Stefanie Stewart
- Jacqueline Stocking
- Emily Torres
- ABG / Main Lab
  - Christopher Polage
  - Darrell O-Sullivan
- OB / Trauma / Burn
  - Finta / Towner
  - Scherer / Palmieri
Challenges

• Deciding on a sepsis screening tool – SIRS BPA
• Negotiating bundle measures
• Orchestrating organizational change
  • Increasing use of lactates in differential
  • Reducing time from blood culture order to draw
  • Reducing time to antibiotics
  • Hardwiring rate, amount, and timing of fluids
• Data abstraction
  • Determining mortality – Coding vs Clinical
  • Defining “time of presentation”
  • Determining bundle compliance
Diagram Present/Future State
Electronic breadcrumbs

We have purposely created “electronic breadcrumbs” in the process of patient care that can act as reporting signals for us to trace potential sepsis patients

We have placed these processes of care into policy
ER vs. Acute Care / Intensive Care

Emergency Room – if no – 4 hour lock out

Acute and Intensive Care – if no – 12 hour lock out
Finding the Severe Sepsis Patient

**Paper Process**
Bedside nurse screens all patients for severe sepsis and makes determination of who should be evaluated for severe sepsis.

**UC Davis Process**
- EHR screens all patients for severe sepsis with SIRS criteria
- Bedside nurse determines if SIRS due to infection or "at risk" for severe sepsis
- Lactic acid screen sent for all "at risk" patients
- Positive screening test activates severe sepsis evaluation / management
Concept to Reality

- Implemented new health system policy allowing nurses to send off screening lactic acid and follow up lab for abnormal lactates
- Implemented new health system lactic acid to be done in the ABG lab – rapid turn around time of 10 minutes
Tools

- Best Practice Alert
- Standardized Protocol
- Screening Orders
- Treatment Orders
- Reassessment Views
- Reassessment Orders
- Professional Exchange Report
Go-Live and Training

Stop severe sepsis in 60 minutes... Be Prepared. Be Involved.

We are committed to stopping sepsis in 60 minutes. Are you?

Sepsis kills more than 250,000 people per year in the United States. Learn the steps we can all take to reduce the number of deaths due to sepsis.

Visit http://sepsis.ucdavis.edu for more information.

Together, we can make a difference... we can save lives.
SIRS BPA in the Emergency Department

Updated May 25, 2012

SIRS BPA
Single Trigger: SBP ≤ 90
Two or More to Trigger: HR > 90, RR ≥ 20, Temp < 36 or > 38, WBC < 4K or > 12K or > 10% Bands

- No New or Progressive s/s of Infection (RN’s Clinical Judgment)
- Signs or Symptoms of Infection?
  - Yes: Open SIRS Screening Order Set: Possible s/s of infection Present
  - No: Let turn of BP for 4 hours

- Lactic Acid ≥ 4
  - within 5 minutes
  - Reassess Patient & Notify MD
  - within 20 minutes
  - Severe Sepsis Order Set
  - within 1 hour
  - Draw Labs and blood cultures x 2
  - Give Antibiotics and IV Fluid
  - Reassess Patient per ED Policy*

- Lactic Acid 2.4-4.9 (Notify MD)
  - at 4 hours
  - Draw Second Lactic Acid

- Lactic Acid < 2 (Continue with Plan of Care)
  - within 10 minutes
  - Draw V&G with Lactic Acid and CBC

Helpful Hints:

- Mortality increases 7.9% for every hour antibiotics are not given
- Clock stops ticking when ONE of these are identified:
  - Lactic Acid ≥ 4 result comes back
  - BPA fires when SBP ≤ 90
  - Severe Sepsis Order Set initiated
- Encourage MD to utilize severe sepsis order set to expedite care
- RRT PA is automatically paged for Lactic Acid ≥ 4 for assistance with septic patients
- During day shift call clinical pharmacist for antibiotics, call “code blue Marmalade” after hour

*Policy & Procedures:
XI-17 - Severe Sepsis Early Recognition & Management (http://internet.ucdmc.ucdavis.edu/policies/patient_care_standards/infectious_diseases/06-17.html)
A HEALTHIER WORLD THROUGH BOLD INNOVATION
## ADULT SEPSIS ANTIBIOTIC COMPATIBILITY - Y-SITE

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<th>Drug name</th>
<th>Amikacin</th>
<th>Ampicillin</th>
<th>Azithromycin</th>
<th>Aztreonam</th>
<th>Cefepime</th>
<th>Ceftriaxone</th>
<th>Clindamycin</th>
<th>Gentamicin</th>
<th>Meropenem</th>
<th>Metronidazole</th>
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<td>C</td>
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</table>

I = incompatible  
C = compatible  
? = no information, avoid mixing  
inappropriate combination
Alert Stats

Average day (10-6-12)

Census: 358 adult patients (61 admissions)
# Alerts Fired - 610 (includes ED patients)
# Patients with suspected severe sepsis - 23
# Patients identified - 3
SIC Dashboard

http://intranet.ucdmc.ucdavis.edu/pcs/sepsis/dashboard
UC Davis Measuring “EGDT Compliance”
Measures 2, 5, & 6

Severe Sepsis Cohort
- SBP <= 90 OR Lactate >= 4

Orderset “600”
- Credit IV fluids, Vasopressors, Fluid Resuscitation

20mL/kg in 6 hours AND started in < 1 hour
- No
  - Fail Compliance for Fluids

- Yes

MAP < 65 at 3-6 hours after start time?
- No
  - Credit Vasopressors Fluid Resuscitation

- Yes

Vasopressor Admin? Within start time to 6hr
- No
  - Fail Vasopressors

- Yes

W/in 6 hours:
1) MAP >= 65
2) Lactate <= 2
3) SvO2 >= 70%
- No
  - Fail Fluid Resuscitation

- Yes

Credit Fluid Resuscitation

Credit Fluids
Sepsis Improvement Collaborative

A HEALTHIER WORLD THROUGH BOLD INNOVATION

**SIC Mortality Rate by Calendar Year**

Severe Sepsis (995.92) and Septic Shock (785.52)

- **2009**
- **2010**
- **2011**
- **2012**

![Graph showing mortality rate changes with SIC Forms and Initiative Go-Live markers.](image)

- **Observation (months)**
  - 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41

- **Mortality Rate**
  - 0.0% to 70.0%

- **Average Mortality Rate**: $\overline{X}=26.7\%$

*Source Data from HIM*
## Sepsis Improvement Collaborative

### A Healthier World Through Bold Innovation

<table>
<thead>
<tr>
<th>Year</th>
<th>SIC Population</th>
<th>Numerator</th>
<th>Denominator</th>
<th>UCDMC SIC Mortality Rate</th>
<th>Rate of Patient Population Increase (From Baseline)</th>
<th>Expected Deaths</th>
<th>O/E Ratio</th>
<th>Potential Lives Saved</th>
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<tbody>
<tr>
<td>2009*</td>
<td>SIC Population</td>
<td>179</td>
<td>492</td>
<td>36.4%</td>
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<tr>
<td>2010</td>
<td>SIC Population</td>
<td>194</td>
<td>640</td>
<td>30.3%</td>
<td>30.1%</td>
<td>233</td>
<td>0.83</td>
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<td>176</td>
<td>632</td>
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<td>28.5%</td>
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<td>0.77</td>
<td>54</td>
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<tr>
<td>2012**</td>
<td>SIC Population</td>
<td>180</td>
<td>658</td>
<td>27.4%</td>
<td>33.7%</td>
<td>239</td>
<td>0.75</td>
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<tr>
<td>TOTAL</td>
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<td></td>
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<td>463</td>
<td>0.80</td>
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* Baseline

** CY 2012 YTD (Jan-12 to Nov-12)

## SIC Population Breakout

<table>
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<tr>
<th>Year</th>
<th>Patient Population</th>
<th>Numerator</th>
<th>Denominator</th>
<th>UCDMC SIC Mortality Rate</th>
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</thead>
<tbody>
<tr>
<td>2009*</td>
<td>Septic Shock</td>
<td>112</td>
<td>257</td>
<td>43.6%</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
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<td>67</td>
<td>235</td>
<td>28.5%</td>
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<tr>
<td>2010</td>
<td>Septic Shock</td>
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<td>310</td>
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<td>20.6%</td>
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<tr>
<td>2011</td>
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</tr>
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* Baseline

** CY 2012 YTD (Jan-12 to Nov-12)
UC Davis Average Length of Stay

![Graph showing average length of stay (ALOS) for Adult ICU vs. Sepsis Population from CY2009 to CY2011. The graph indicates a decrease in ALOS over the years.]
### SIC Mortality Rate by CY

(CY 2012 YTD Jan-12 to Nov-12)

<table>
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Electronic Health Records and Sepsis

Novel Characteristics of the UC Davis SIC Program
- Eliminates paper screening process
- Focus on "at risk" patients instead of confirmed cases
- Embeds "Electronic Breadcrumbs"
  - Establishes a real-time registry of patients
  - Automated process of compliance metrics
- Establishes an on-going process of QI using real-time data for identification of opportunities for education
  - Point of care / bedside
  - Classroom / simulation

Improves quality of care as measured by evidenced process measures
Reduces mortality by 25% over 2009 baseline - 54 lives saved in 2011
Lessons Learned

• Anticipated hospital areas where the SIRS alert may be problematic
  • Reports highlight units and services where SIRS is very common / expected
  • Allowed for lock out times to be determined clinically
• Training is key to ensuring alerts are being evaluated appropriately
  • Mandatory 15 minute eLearning for nursing
  • Follow-up in-service on each unit
• Institutional Support is key to buy-in
• If workflow is dependent on timely entry of vital signs, track how timely vitals are entered.
Lessons Learned - EGDT

- Physician education is key
- Because of constant turnover in physician housestaff, nurses also must be educated
- Rapid response team is critical to maintaining consistency in process
- Bundle should be done prior to transfer of patient to another unit
- Antibiotic stewardship process was significantly altered for improved compliance
- Overall bundle compliance improved when using an orderset
Lessons Learned – Data & Sustainability

- Measurement must be part of the initial design for any quality improvement project.
- Capture clinical recognition time.
- Subsequent changes must also be reviewed to ensure that outcomes can be captured.
- Project plans must account for time to develop and validate reports.
- Ongoing process improvement requires institutional infrastructure to maintain and track ongoing quality projects.
Data Source
Why do we care?

• Clinical Legitimacy
• Process Improvement
• Public Opinion
• Reimbursement
SIC Population: Clinical vs. Coding*
FY 2012 (July 2011 to June 2012)
*Coding = Severe Sepsis (995.92) and Septic Shock (785.52)

Clinical  
n = 613

Coding  
n = 670

433  
180  
490
SIC Population: Clinical vs. Coding*
FY 2012 (July 2011 to June 2012)
*Coding = Severe Sepsis (995.92) and Septic Shock (785.52)

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<tr>
<td>Q4</td>
<td>192</td>
<td>150</td>
<td>57</td>
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</table>

*December-February 2nd wave of concentrated unit based education, monthly nursing education classes, imbedded order-sets, increased champion role
Analysis – Coded vs. Clinical

– Clinical
  • Patient identified/tx early – did not progress
  • Overtreating
    – BPA too sensitive
    – BPA lacks enough specificity

– Coded
  • Documentation
    – Multiple care-givers over long hospitalization
    – False positive: “R/O Sepsis”
    – False negative: “Urosepsis”
Quality Improvement Data Challenges

Coded Data

- Infrastructure supports “coded data”
  - Coded data is retrospective
  - Coded data is generated upon discharge
    - 2 to 4 weeks post care provided
  - Coded data is generated from what is documented
    - False positive: “R/O Sepsis”
    - False negative: “Urosepsis”
Quality Improvement Data Challenges

Clinical Data

- **Need for clinical data**
  - Effects “real-time” decision making at the point of care
    - Heightens clinician suspicion
    - Influences patient outcomes
  - Supports behavioral change
    - What can I do in this moment?
    - Allows for just in time coaching/education
  - Supports culture change

- **Requires infrastructure development**
Coding Data/Clinical Data

- Robust Health Information Management (HIM)
  - Member of multidisciplinary team
  - Physician/Staff collaboration

- Fully integrated EPIC Electronic Health Record
  - Emergency Department, Inpatient (ACU/ICU), Outpatient procedural areas
  - Best Practice Alerts (BPA’s), Order-sets, Registries
Implications of Using Different Cohorts

- **Is compliance different?**
  - Need to manually validate both populations
  - Which population should we focus on for compliance improvement projects

- **Does education need to be different?**
  - Who do we educate
  - What should we educate
  - Urgency
Opportunities for Improvement

- Focus on clinical data
- Improve coding
  - Severe Sepsis
  - Septic Shock
- Improve clinical cohort accuracy
- Improve bundle compliance
  - Population clinically relevant
  - Data distribution
  - Just in time coaching/education
Using Data for Quality Improvement

- MD Team
- RN Team
- Crit Care
- EMR
- Pharm Team
- SIC (and unit/service representatives)

Mortality Data
Performance Data

External Reporting

Internal Reporting
- Unit Dashboards
- Service Dash
- Provider Dash

Data Collected (and validated)
General outcomes and Primary processes identified

Identify processes in need for improvement – “A3”
(Additional Data collected)
RCA with front line staff

Audit / Feedback / Education / Training (both one on one and group – class and unit)
Ongoing Evaluations and Improvement

Sepsis Improvement Collaborative Quality Improvement Projects

- Over 50 ongoing A3’s
- Highlights
  - Evaluation of the cost effectiveness of the program
  - Comparison of coding data set vs. clinical data set
  - Development of a physician audit / feedback mechanism
  - Vital sign entry within 10 minutes of taken time
  - Analysis of IV pump availability on the floor
  - Development of a "Code Sepsis" response to include pharmacy and critical care consult team
# UC Davis – Process Improvement

## SIC Quality Initiative Directory

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<th>Priority</th>
<th>Category</th>
<th>QI Name</th>
<th>QI Objective</th>
<th>QI Lead(s)</th>
<th>Start</th>
<th>End</th>
<th>Comments</th>
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<tr>
<td>2 - High</td>
<td>Mortality</td>
<td>SIC Mortality</td>
<td>Reduce SIC mortality by at least 15% from the 2009 baseline of 36%</td>
<td>Hien Nguyen, MD Marci Hoze, RN</td>
<td>01/01/12</td>
<td>12/31/12</td>
<td>Data source department = HIM</td>
</tr>
<tr>
<td>2 - High</td>
<td>Process</td>
<td>SIC Bundle Compliance</td>
<td>Improve SIC bundle compliance (85% individual and 65% total)</td>
<td>Hien Nguyen, MD Marci Hoze, RN</td>
<td>01/01/12</td>
<td>12/31/12</td>
<td>Data source department = IT</td>
</tr>
<tr>
<td>2 - High</td>
<td>Cost</td>
<td>Reduce ICU ALOS</td>
<td>Reduce SIC related ICU ALOS</td>
<td>Jared Quinton</td>
<td>07/13/11</td>
<td>12/31/12</td>
<td>Data source department = FINANCE</td>
</tr>
<tr>
<td>3 - Medium</td>
<td>Process</td>
<td>Antibiotic Administration in the ED</td>
<td>Validate SIC process data with documented clinical practice</td>
<td>Tiffany Pou, PharmD Tricia Parker, PharmD Ginde Christensen, PharmD</td>
<td>04/02/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 - Medium</td>
<td>Process</td>
<td>Chart Review</td>
<td>Validate SIC process data with documented clinical practice</td>
<td>Jamie Meyers, RN</td>
<td>04/02/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 - Medium</td>
<td>Process</td>
<td>SIC QI Website</td>
<td>Build and maintain SIC QI website to provide communication and infrastructure</td>
<td>Jared Quinton</td>
<td>07/13/11</td>
<td>12/31/12</td>
<td>Update/refresh planned for 4/11/2012</td>
</tr>
<tr>
<td>5 - Complete</td>
<td>Process</td>
<td>Modification of SIRS BPA Acknowledgement Options</td>
<td>Physician and nursing input dictated a change to be made for clarity of BPA options</td>
<td>Marci Hoze, RN</td>
<td>03/26/12</td>
<td>04/03/12</td>
<td>Update on SIC website and posted to First Tuesday</td>
</tr>
<tr>
<td>6 - Proposed</td>
<td>EMR</td>
<td>Validate clinical data vs. coding data</td>
<td>Analyze data accuracy &amp; propose process improvements</td>
<td>Hershan Jothi, MD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Quality Improvement Infrastructure

• Sustainability
  • Issue Identification
  • Information Clearinghouse
  • Data Capture
  • Data Validation
  • Report Creation
  • Analysis
  • Action Planning
  • Create Output
  • Front Line Education
  • Analyze Success of Action on Issue Identified
Overall Lessons Learned

• Plan, plan, plan

• Clinical input, clinical informatics, and reporting at every stage

• Training / Education must occupy a central role in the project plan

• Institutional and clinical support is necessary for success

• Institutional infrastructure necessary for maintenance and ongoing process improvement

• Quality improvement and clinical informatics must align with institutional priorities
Input & Feedback

- Contact Information:
  
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  Nurse Manager  
  Co-Lead Sepsis Mortality Improvement  
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