Severe Sepsis: Early Recognition and Management Saves Lives

Kathleen Vollman, Sepsis Solutions International LLC / Advanced Nursing LLC

A Webber Training Teleclass

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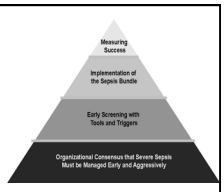

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Hosted by Nicole Kenny
Virox Technologies Inc

Overview

- Why Sepsis? Why Now?
- Defining the continuum
- Brief overview of pathophysiologic derangements
- Process for development of a hospital wide sepsis program: The Power of the Pyramid
  - Organizational support
  - Early Recognition Screening/triggers
  - Implementation/protocols
  - Measurement
- Worldwide Sepsis Program Outcomes

Overview

- Significance of the Problem
- Sepsis Recognition & Management= Patient Safety & Advocacy
- Brief overview of Pathophysiologic derangements
- Prevention
- Early Recognition & Resuscitation
- Case Studies
- Outcome studies

Severe Sepsis: A Significant Healthcare Challenge

- Sixth most common reason for hospitalization
- Most costly reason for hospitalization in 2009**
  - 15.4 billion in aggregate hospital cost
- 1 out of 23 patients in hospital had septicemia**
- Major cause of morbidity and mortality worldwide
  - Leading cause of death in noncoronary ICU (US)[1]
  - 10th leading cause of death overall (US)[2]*
  - In the US, **more than 700 patients die of severe sepsis daily** (1.6 million new cases per year)

* Based on data for septicemia
†Reflects hospital-wide cases of severe sepsis as defined by infection in the presence of organ dysfunction

1 Sands KE, et al. *JAMA* 1997;278:234-40.
2 National Vital Statistics Reports. 2005.
3 Angus DC, et al. *Crit Care Med* 2001;29:1303-10.

**AHRQ Healthcare cost & Utilization Project October 2011

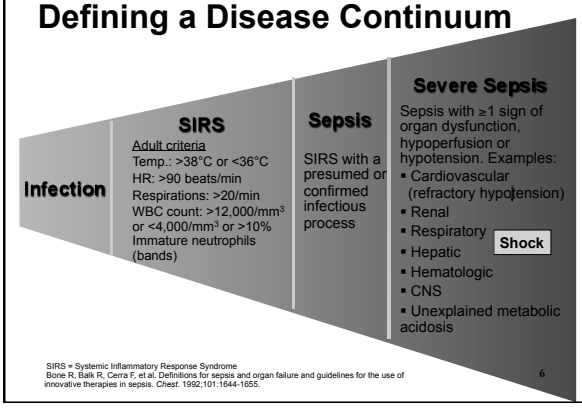
How Does Severe Sepsis Compare to Your Current Care Priorities?

Quality Projects	US Incidence	# of Deaths	Mortality Rate
AMI[1]	895,000	171,000	19%
Stroke[1]	700,000	157,800	23%
Pneumonia[2]	1,300,000	61,800	4.8%
Severe Sepsis[3]	751,000	215,000	29%

Why do you think that severe sepsis has not received the same focus as these other common disease states?

1. American Heart Association. Heart Disease and Stroke Statistics 2006 Update. 2. National Center for Health Statistics. Available at: www.cdc.gov/nchs/fastats/pneumonia.htm. Accessed February 4, 2005. 3. Angus DC, et al. *Crit Care Med* 2001;29(7):1303-1310.

Sepsis: Defining a Disease Continuum



SIRS = Systemic Inflammatory Response Syndrome
Bone R, Balk R, Cerra F, et al. Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. *Chest*. 1992;101:1644-1655.

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4-Tier Process for Severe Sepsis Program Implementation

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Organization Support

- Executive management supports a program for targeting Severe Sepsis
- Aligned with hospital's current year goals
- Resources aligned with program
- Minimum .5 FTE for project management, data collection & teachable moments
- 2 to 3+ year program
- Existing culture that supports change
- Established team
- **Collect baseline data—essential step**

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The Team Is KEY! Can Be Major Barrier If Not Functioning Well

- **Must** have nurse and physician champions from ED and ICU (need at least one physician at all meetings)
- **Must** be linked in the organization's quality or operational structure
- **Must** meet at least 2 times per month
- Team members **must** be well educated
- **MUST** have bedside nurses on team—provide reality check and best knowledge of barriers

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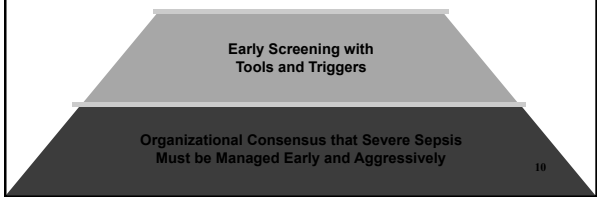
Second Tier: Implementation of Early Screening Tools and Triggers



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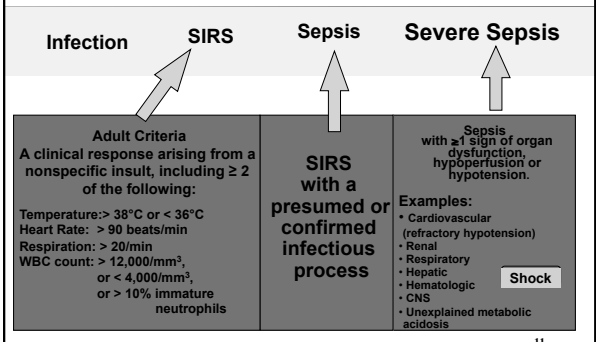
Severe Sepsis: Defining a Disease Continuum



SIRS = Systemic Inflammatory Response Syndrome
Bone et al. *Chest*.1992;101:1644-1654.

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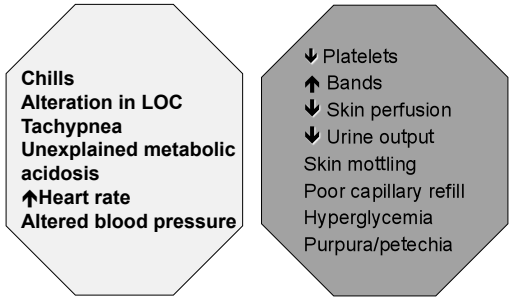
Signs & Symptoms of Sepsis



Levy M, et al. *Crit Care Med* 2003;31:1250-6.

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Severe Sepsis: Defining a Disease Continuum

Infection or Trauma → SIRS → Sepsis → Severe Sepsis

Sepsis with ≥1 sign of organ dysfunction, hypoperfusion or hypotension

Examples:

- Cardiovascular (refractory hypotension)
- Renal
- Respiratory
- Hepatic
- Hematologic
- CNS
- Unexplained metabolic acidosis

Shock

SIRS = Systemic Inflammatory Response Syndrome
Bone et al. *Chest*.1992;101:1644-1654.

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Severe Sepsis: Defining a Disease Continuum

Infection → **SIRS** → **Sepsis** → **Severe Sepsis**

Adult Criteria
A clinical response arising from a nonspecific insult, including ≥ 2 of the following:

Temperature:> 38°C or < 36°C
Heart Rate: > 90 beats/min
Respiration: > 20/min
WBC count: > 12,000/mm^3, or < 4,000/mm^3, or > 10% immature neutrophils

SIRS with a presumed or confirmed infectious process

Sepsis with ≥1 sign of organ dysfunction, hypoperfusion or hypotension.

Examples:

- Cardiovascular (refractory hypotension)
- Renal
- Respiratory
- Hepatic
- Hematologic
- CNS
- Unexplained metabolic acidosis

Shock

SIRS = Systemic Inflammatory Response Syndrome
Bone et al. *Chest*.1992;101:1644-1654.

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Why Do You Need to Have a Screening Process?

- TIME IS TISSUE!!
  - The speed and appropriateness of therapy administered in the initial hours after severe sepsis develops are likely to influence outcomes.[1]
- To screen effectively, it must be part of the nurses' daily routines— i.e., part of admission and shift assessment
- Must define a process for what to do with the results of the screen

If you don't screen you will miss patients that may have benefited from the interventions.

1. Dellinger RP, Levy MM, Carlet JM, et al. Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock: 2008. *Crit Care Med*. 2008;36:296-327.

Make Screening for Severe Sepsis Process-Dependent

- Weave into fabric of current practice
- Assess for on a shift basis
- Identify strategies for initiation of therapy response once patient is identified

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Incorporate Screening and Early Identification Throughout the Hospital

- Emergency Department
- ICUs
- Patient Care Units
- Rapid Response Team

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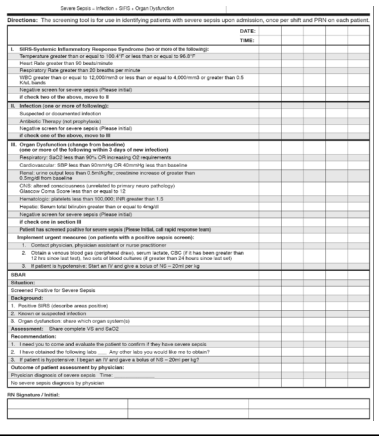
SEVERE SEPSIS SCREENING TOOL



Severe Sepsis – Infection – SIRS – Organ Dysfunction

Directions: The screening tool is for use in identifying patients with severe sepsis upon admission, once per shift and PRN on each patient.

DATE:
TIME:

I. SIRS-Systemic Inflammatory Response Syndrome (two or more of the following):
- Temperature greater than or equal to 100.4°F or less than or equal to 96.8°F
- Heart Rate greater than 90 beats/minute
- Respiratory Rate greater than 20 breaths per minute
- WBC greater than or equal to 12,000/mm3 or less than or equal to 4,000/mm3 or greater than 0.5 K/uL bands
- Negative screen for severe sepsis (Please initial)

If check two of the above, move to II

II. Infection (one or more of following):
- Suspected or documented infection
- Antibiotic Therapy (not prophylaxis)
- Negative screen for severe sepsis (Please initial)

If check one of the above, move to III

III. Organ Dysfunction (change from baseline) (one or more of the following within 3 days of new infection)
- Respiratory: SaO2 less than 90% OR increasing O@ requirements
- Cardiovascular: SBP less than 90mmHg OR 40mmHg less than baseline
- Renal: urine output less than 0.5ml/kg/hr, creatinine increase of greater than 0.5mg/dl from baseline
- CNS: altered consciousness (unrelated to primary neuro pathology) Glascow Coma Score less than or equal to 12
- Hematologic: platelets less than 100,000, INR greater than 1.5
- Hepatic: Serum total bilirubin greater than or equal to 4mg/dl
- Negative screen for severe sepsis (Please initial)

If check one in section III

Patient has screened positive for severe sepsis (Please Initial, call rapid response team)

Implement urgent measures: (on patients with a positive sepsis screen):
1. Contact physician, physician assistant or nurse practitioner
2. Obtain a venous blood gas (arterial draw), serum lactate, CBC (if it has been greater than 12 hrs since last test), two sets of blood cultures (if greater than 24 hours since last set)
3. If patient is hypotensive: Start an IV and give a bolus of NS – 20ml per kg

SBAR

Situation:
Screened Positive for Severe Sepsis

Background:
1. Positive SIRS (describe areas positive)
2. Known or suspected infection
3. Organ dysfunction: share which organ system(s)

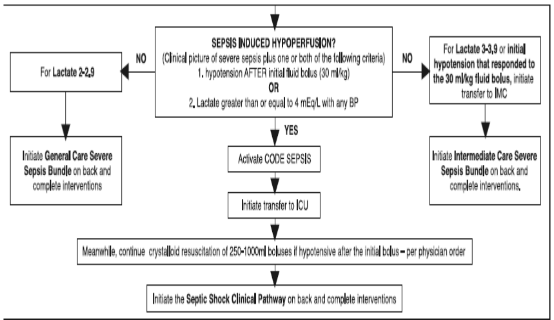
Assessment: Share complete VS and SaO2

Recommendation:
1. I need you to come and evaluate the patient to confirm if they have severe sepsis
2. I have obtained the following labs …. Any other labs you would like me to obtain?
3. If patient is hypotensive: I began an IV and gave a bolus of NS – 20ml per kg?

Outcome of patient assessment by physician:
Physician diagnosis of severe sepsis: Time: _____
No severe sepsis diagnosis by physician

RN Signature / Initial:

Direction Post Screening



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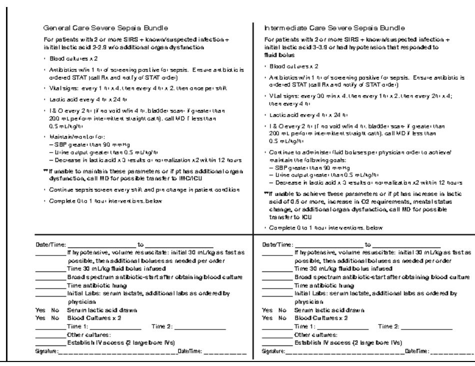
Sepsis Severity Screen		2300 - 0700	0700 - 1500	1500 - 2300
	Results/Interventions: **Sepsis** (Infection+ SIRS): If criteria for step I & II are met, the patient has screened positive for **Sepsis**. Initiate the following: – Increase screening frequency to Q4h. – Notify physician for further orders. (suggest serum lactate Q6H x 4) **Severe Sepsis** (Acute Organ Failure): If criteria for steps I – III are met, the patient has screened positive for **Severe Sepsis**. Initiate/ document the following: ☐ Sepsis Alert / RRT called @__________ ☐ PMA/eICU Intensivist notified @__________ ☐ Attending/Dr.______ notified @ __________ RN Signature(s): ____________________ ____________________	**Step I: Infection** Presence/suspicion of infection or on antibiotics (not prophylaxis) ☐ Neg., stop screen, time:______ ☐ Positive, continue below. **Step II: SIRS** *(Two or more of the following)* ☐ Temp greater than 38(100.4) or less than 36 (96.8) ☐ Heart rate greater than 90 ☐ Resp. rate greater than 20 ☐ WBC greater than 12,000, less then 4,000 or greater than 10% neutrophils **Step III: Acute Organ Failure** *(One or more of the following)* ☐ SBP less than 90 or MAP less than 65 ☐ SBP decrease more than 40mmHG from baseline. ☐ Increased oxygen requirement to maintain SpO2 greater than 90% ☐ Lactate greater than 2mmol/L ☐ Platelets less then 100,000 ☐ Urine output less than 0.5ml/kg/hr or creatinine greater than 2 ☐ Acute mental status change from baseline/altered GCS **Results:** Time:________________ ☐ Sepsis ☐ Severe Sepsis ☐ Neg Time:________________ ☐ Sepsis ☐ Severe Sepsis ☐ Neg	**Step I: Infection** Presence/suspicion of infection or on antibiotics (not prophylaxis) ☐ Neg., stop screen, time:______ ☐ Positive, continue below. **Step II: SIRS** *(Two or more of the following)* ☐ Temp greater than 38(100.4) or less than 36 (96.8) ☐ Heart rate greater than 90 ☐ Resp. rate greater than 20 ☐ WBC greater than 12,000, less then 4,000 or greater than 10% neutrophils **Step III: Acute Organ Failure** *(One or more of the following)* ☐ SBP less than 90 or MAP less than 65 ☐ SBP decrease more than 40mmHG from baseline. ☐ Increased oxygen requirement to maintain SpO2 greater than 90% ☐ Lactate greater than 2mmol/L ☐ Platelets less then 100,000 ☐ Urine output less than 0.5ml/kg/hr or creatinine greater than 2 ☐ Acute mental status change from baseline/altered GCS **Results:** Time:________________ ☐ Sepsis ☐ Severe Sepsis ☐ Neg Time:________________ ☐ Sepsis ☐ Severe Sepsis ☐ Neg	**Step I: Infection** Presence/suspicion of infection or on antibiotics (not prophylaxis) ☐ Neg., stop screen, time:______ ☐ Positive, continue below. **Step II: SIRS** *(Two or more of the following)* ☐ Temp greater than 38(100.4) or less than 36 (96.8) ☐ Heart rate greater than 90 ☐ Resp. rate greater than 20 ☐ WBC greater than 12,000, less then 4,000 or greater than 10% neutrophils **Step III: Acute Organ Failure** *(One or more of the following)* ☐ SBP less than 90 or MAP less than 65 ☐ SBP decrease more than 40mmHG from baseline. ☐ Increased oxygen requirement to maintain SpO2 greater than 90% ☐ Lactate greater than 2mmol/L ☐ Platelets less then 100,000 ☐ Urine output less than 0.5ml/kg/hr or creatinine greater than 2 ☐ Acute mental status change from baseline/altered GCS **Results:** Time:________________ ☐ Sepsis ☐ Severe Sepsis ☐ Neg Time:________________ ☐ Sepsis ☐ Severe Sepsis ☐ Neg

What To Do Based on Where the Deposition of the Patient



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Screening: Barriers/Strategies

- **Barriers**
  - Time for nurses to do it (perception vs. reality)
  - Screening is not sensitive only for severe sepsis
  - Positive screen is not a diagnosis of severe sepsis
- **Strategies**
  - Must assign responsibility and enforce accountability
  - Perform audits to measure compliance and identify problems
  - Round on unit and ask nurses how it is going and discuss issues

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Screening: Barriers/Strategies

- Lesson learned:
  - Bedside nurse must do daily screening.
  - Education/Simulation/Education
    - Every 6 months
    - Build into orientation
    - Must be part of your documentation structure
    - Practice-Practice-Practice

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Clinical Scenario I: Early identification and intervention

- **88 year old**, 51.6kg,white, female admit from ED; resided in ECF
- **History**: CAD, COPD, dementia, Alzheimer disease, depression, SVT
- **Chief Complaint:** rib pain, chest congestion and SOB
- Awake, alert and oriented, slight combative (history of combative behavior)

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Clinical Scenario I: Early Identification and Intervention

- **Initial VS:**
  - Temp: 101.6 F
  - RR: 31
  - HR: 109, atrial fib with occasional SVT
  - B/P: 79/51
  - 2L of O2, O2 sat of 96%
- Does this patient screen positive for severe sepsis?

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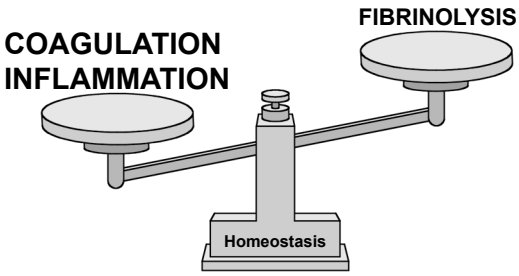
Homeostasis Is Unbalanced in Severe Sepsis



Carvalho AC, Freeman NJ. *J Crit Illness* 1994;9:51-75.
Kidokoro A, et al. *Shock* 1996;5:223-8.
Vervloet MG, et al. *Semin Thromb Hemost* 1998;24:33-44.

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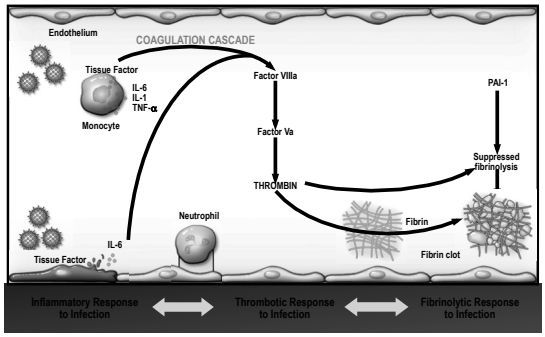
Inflammation, Coagulation and Impaired Fibrinolysis In Severe Sepsis



Adapted from Bernard GR, et al. *N Engl J Med.* 2001;344:699-709.

OXYGEN SUPPLY/DEMAND DYNAMICS

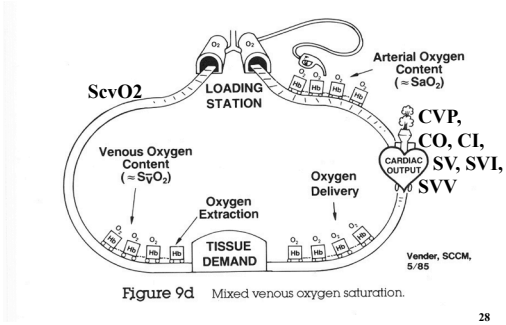


Figure 9d Mixed venous oxygen saturation.

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Cornerstones of Multidisciplinary Management of Severe Sepsis/MODS

- Prevention
- Screening and Early Identification
- Early Intervention: Source control, Blood cultures and broad spectrum antibiotics
- Resuscitation Bundle
- Management Bundle

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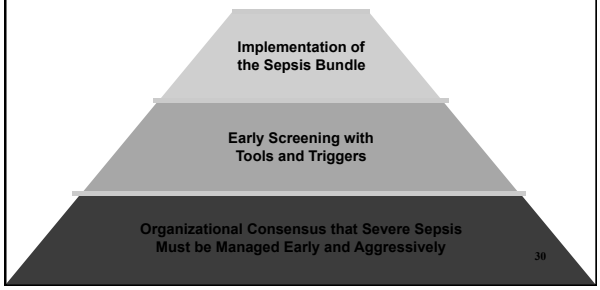
Third Tier: Implementation of Evidence-Based Sepsis Bundles



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SURVIVING SEPSIS CAMPAIGN BUNDLES

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 30 mL/kg crystalloid for hypotension or lactate ≥4mmol/L

TO BE COMPLETED WITHIN 6 HOURS:
5) Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a mean arterial pressure (MAP) ≥ 65 mm Hg
6) In the event of persistent arterial hypotension despite volume resuscitation (septic shock) or initial lactate ≥4 mmol/L (36 mg/dL):
   - Measure central venous pressure (CVP)*
   - Measure central venous oxygen saturation ($ScvO_2$)*
7) Remeasure lactate if initial lactate was elevated*

*Targets for quantitative resuscitation included in the guidelines are CVP of ≥8 mm Hg, $ScvO_2$ of ≥70%, and normalization of lactate.

CRITICAL CARE MEDICINE

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Initial Sepsis Resuscitation Bundle

- Measure serum lactate
- Obtain blood cultures prior to administration of antibiotics (1C)
- Minimize time to administration of broad spectrum antibiotics (within 1 hr with shock;(1B) within 3 hrs without shock (1C))
- In the event of hypotension and/or lactate ≥4, deliver **30ml/kg** of crystalloid (1B) (3hrs)

New: if lactate 2.1-3.9: target resuscitation to normalize the lactate (2C)

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Adapted from the revised guidelines: SCCM presentation Houston Feb 2012

No Management Bundle/Guidelines for Care of the Severe Sepsis/Septic Shock Patient

- Source control (1C) As rapid as possible <12hrs drain
- Continue to recommend the use of lung protective strategies for pts with ALI/ARDS (no change)
- Recommend—No steroids if can get MAP > 65 with fluids and vasopressors; if unable, then adminster 200mg/day (2C)
- Start insulin gtt if get (2) consecutive BG > 180; target glucose < 180
- Also added nutritional recommendations to guidelines

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Adapted from the revised guidelines: SCCM presentation Houston Feb 2012

Septic Shock Bundle

- Continue the challenge (1C)
  - CVP > 8 (suggest dynamic parameters of fluid responsiveness)
- MAP > 65 (1C)
  - Levophed first line (1B) (epi second choice 2B)
  - Dopamine removed
- ScVO2 > 70 (2C)
  - Use dobutamine with evidence of cardiac dysfunction (1C)

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Adapted from the revised guidelines: SCCM presentation Houston Feb 2012

HEALTH SYSTEM
A Member of Trinity Health

Room # _____ ICU admission Date: _____ Time: _____

Please complete the following:
- **ED Triage: Date:** _____ **Time:** _____
- **Septic Shock* diagnosis (Time Zero): Date:** _____ **Time:** _____
- Patient transferred from (unit or hospital): _____
- Patient was identified as having severe sepsis or septic shock: ☐ ED ☐ Floor ☐ ICU Admission ☐ During ICU Stay
- Decision to move to comfort care in first 24 hours after diagnosis: Yes No
- ICU discharge: Date: _____ Time: _____
- Discharge status: Alive Expired **Attending physician at time of diagnosis: ED** _____ **ICU** _____

*Septic Shock (Time Zero) defined as: SBP less than 90mmHg or 40mmHg decrease from baseline after 20ml/kg fluid bolus, or requires vasopressors or initial lactate is greater than or equal to 4mmolA.

**Vasopressor unresponsive defined as: Requiring more than one vasopressors after fluid resuscitation completed.

Sepsis Daily Goals	Date_____ to _____ 0-1 Hours	Date_____ to _____ 1-6 Hours	Date_____ to _____ 6-24 Hours	Date_____ to _____ 24-72 Hours
1. Goal directed therapy to achieve increased O2 delivery: CVP 8-12mmHg on vent 12-15mmHg MAP greater than 65mmHg ScvO2 greater than or equal to 70%	☐ Initial Labs: serum lactate, additional labs as ordered by physician Yes No Serum lactate drawn within 6 hours? Yes No Blood Cultures X 2 Time 1: _____ Time 2: _____ ☐ Other Cultures: ☐ Establish IV access ☐ Volume resuscitate: initial 20ml/kg over 30 minutes then additional boluses as needed per order	Refer to Severe Sepsis Resuscitation Algorithm Yes No Was initial lactate greater than 4mmol/L?	Yes No Is patient on vasopressor at greater than 6 hours	☐ Confirm Infectious Source ☐ Re-assess need for broad spectrum antibiotics based on culture reports.
2. Blood Glucose 110-150 mg/dl		Yes No Was patient hypotensive after initial fluid bolus?	Yes No Eligibility for Activated Protein C was assessed (Xigris) – (see Infonet under Pharmacy-Drug Information or speak to pharmacist)	Yes No Was the organism that was identified sensitive to the initial antibiotic?
3. Urine output greater than 0.5 ml/kg/hour		Yes No Did patient require vasopressor(s)?		
4. In patients with acute lung injury or ARDS:		Yes No CVP placed If no, why? _____	Yes No Was patient eligible for Activated Protein C?	☐ Discontinue arcomycin if appropriate
Yes No Patient on mechanical ventilator		_____ Time CVP placed (record first CVP reading prior to x-ray confirmation)	Yes No If Xigris administered, Start Time: _____	☐ D/C or taper steroids if vasopressors off
_____ PaO2 / FiO2 ratio	Yes No Did patient receive greater than 1.5 Liter bolus in first hour?	Record the **FIRST TIME** the following is achieved:	Yes No Considered Hydrocortisone if vasopressor unresponsive**	☐ Re-evaluate need for invasive lines and tubes
Yes No Is tidal volume 6ml / kg of ideal body weight in first 24 hours?	☐ Broad Spectrum Antibiotic-start after obtain blood culture (see Infonet under Pharmacy Guide to Antimicrobial Therapy)	_____ CVP 8-12 mmHg on vent 12-15 mmHg	Yes No If hydrocortisone administered, provide 50mg every 6 hours Start Time: _____	☐ Nutrition Therapy
Yes No Are the static or plateau inspiratory pressures less than 30cmH2O in first 24 hours?	Yes No Was a new antibiotic initiated for this episode of septic shock?	_____ MAP greater than or equal to 65 mmHg	Yes No Consider Vasopressin for refractory septic shock	
	_____ Time antibiotic hung	_____ $ScvO_2$ greater than 70% : mixed venous greater than or equal to 65%		
	☐ Source Control	_____ Optimized stroke volume (optional)		
		Yes No Assess for risk factors for abdominal compartment syndrome		
Nurse				
Nurse				
Physician				
Signature, Date & Time				

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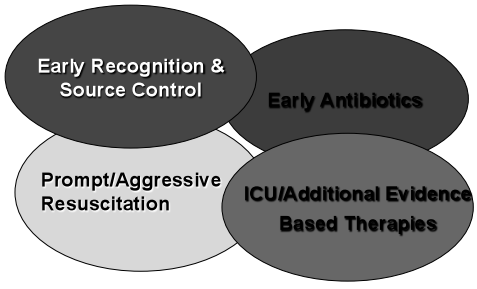
EARLY MANAGEMENT



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SSC Guidelines Antibiotics

- **We recommend that intravenous antibiotic therapy be started as early as possible and within the first hour of recognition of septic shock (1B) and severe sepsis without septic shock (1C)**

Remark: Although the weight of evidence supports prompt administration of antibiotics following the recognition of severe sepsis or septic shock, the feasibility with which clinicians may achieve this ideal state has not been scientifically validated

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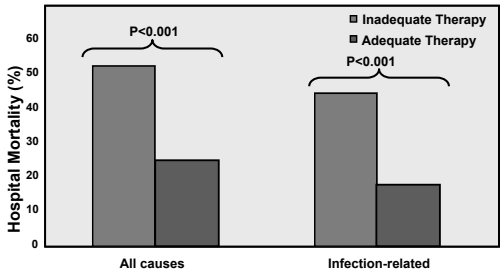
Mortality as a Function of Adequacy of Empiric Antimicrobial Therapy



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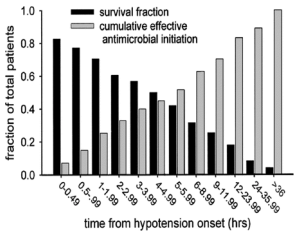
Kollef MH, et al. *Chest* 1999;115:462-74.

Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock



CCM 2006 Vol. 34 No.6

*2,154 septic shock patients

*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%)

Initiation of Inappropriate Antimicrobial Therapy Results in a Fivefold Reduction of Survival in Human Septic Shock

- Objective: determine the impact of the initiation of inappropriate antimicrobial therapy on survival to hospital discharge of patients with septic shock
- Retrospective review of 5,715 patients from 22 different hospitals in Canada, US and Saudi Arabia
- Data collected from 1996-2005

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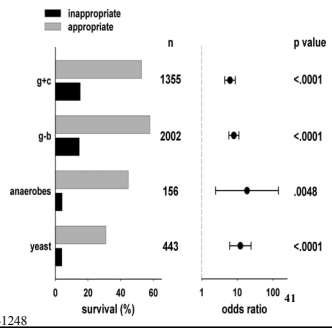
Kumar A. et al. Chest, 2009; 136; 1237-1248

Initiation of Inappropriate Antimicrobial Therapy Result in a 5-Fold Reduction of Survival in Human Septic Shock

- 5,715 patients in septic shock in three countries
- 55% of cases were from community acquired infection
- Decrease in survival with inappropriate initial antibiotics was fivefold



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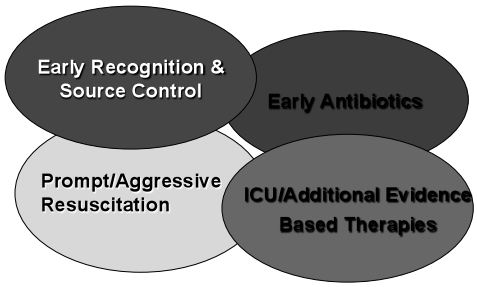
Kumar A. et al. Chest, 2009; 136; 1237-1248

EARLY MANAGEMENT



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Initial Resuscitation (1C)

- Protocolized resuscitation should begin as soon as sepsis induced tissue hypoperfusion is recognized

or

- Elevated Serum lactate identifies tissue hypoperfusion in patients at risk who are not hypotensive

30ml/kg of NS.

- Initial fluid challenges be started at ≥ 1000 mL or 300-500 mL of colloid over 30 minutes (1C)

Dellinger, et. al. Crit Care Med 2008, 36:296-327.
Rivers et. al. N Engl J Med. 2001;345;19:1368-1377

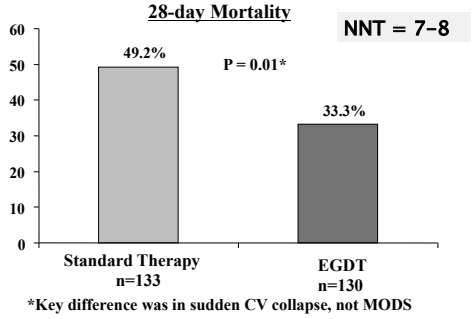
Early Goal Directed Therapy

Methodology: 263 severe sepsis patients

- Early Goal-Directed Therapy (EGDT)
  - Continuous ScvO2 monitoring & tx with fluids, blood, inotropes &/or vasoactives to maintain:
    - ScvO2 ≥70%, SaO2 ≥ 93%, Hct ≥ 30%, CI/VO2
    - CVP ≥ 8-12
    - MAP ≥ 65
    - UO ≥ .5ml/kg/hr
- Standard Therapy
  - CVP ≥ 8-12
  - MAP ≥ 65
  - UO ≥ .5ml/kg/hr

Rivers et. al. N Engl J Med. 2001;345;19:1368-1377
44

Early Goal-Directed Therapy Results



*Key difference was in sudden CV collapse, not MODS

Rivers et. al. N Engl J Med. 2001;345;19:1368-1377.

Evidence of Early Goal Directed Therapy

- First 6 hours of EGDT:
  - 1500cc more fluid
  - 64% received blood products vs. 18.5%
  - 13.7% received inotropes vs. 0.8%
  - No difference in vasopressor use or mechanical ventilation

Rivers et. al. N Engl J Med. 2001;345;19:1368-1377.
46

SSC Guidelines Resuscitation

Should be protocolized, quantitative resuscitation of patients with sepsis induced hypoperfusion (defined as hypotension persisting after initial fluid challenge or blood lactate ≥ 4mmol/L)

Recommend
Insertion central venous catheter

Recommended Goals
- **Central venous pressure: 8-12 mmHg**
  - **Higher with altered ventricular compliance or increased intrathoracic pressure**
- **ScvO2 saturation ≥ 70% (1C)**

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SSC Guidelines Fluid Therapy

1. **We recommend crystalloids be used in the initial fluid resuscitation of severe sepsis (1B)**
2. **We suggest the use of albumin in the fluid resuscitation of severe sepsis and septic shock when patients require substantial amounts of crystalloids. (2C)**
3. **We recommend against the use of hydroxyethyl starches (HES) for fluid resuscitation of severe sepsis and septic shock patients (1B)**

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SSC Guidelines

- Fluid challenge technique be applied wherein fluid administration is continued as long as there is hemodynamic improvement either based on dynamic (eg, change in pulse pressure, stroke volume variation) or static (eg, arterial pressure, heart rate) variables (UG).

Dellinger RP, et al. Crit Care Med. 2013;41580-637 49

Optimize Cardiac Performance

Fluid Bolus to define place on curve:
- **Record CI and SV**
- **Give 250-500 NS bolus over 15minutes**
- **Record CI and SV**
- **If see greater than a 10% increase in SV or CI—pt is on steep portion of curve and will still respond to fluid**

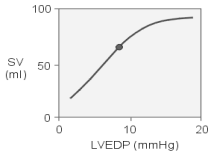

Figure 1. Frank-Starling mechanism. Increasing venous return to the left ventricle increases left ventricular end-diastolic pressure (LVEDP) and volume, thereby increasing ventricular preload. This results in an increase in stroke volume (SV). The "normal" operating point is at a LVEDP of ~8 mmHg and a SV of ~70 ml/beat.

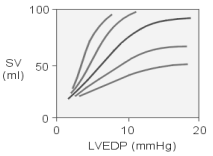

Figure 2. Family of Frank-Starling curves. Changes in afterload and inotropy shift the Frank-Starling curve up or down.

Serum Lactate is Associated with Mortality in Severe Sepsis Independent of Organ Failure and Shock

Objective:
- Test whether the association between initial serum lactate level and mortality in patients presenting to the ED with severe sepsis is independent of organ dysfunction and shock

Design:
- Retrospective, single center cohort study
- Academic teaching hospital

Patients:
- 830 adults admitted with severe sepsis in the ED
- Stratified lactate into 3 groups: low (<2), intermediate (2-3.9) and high (> or equal to 4)

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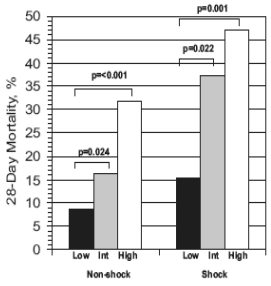
Mikkelsen, Mark et al CCM 2009 Vol 37 No 5

Serum Lactate is Associated with Mortality in Severe Sepsis Independent of Organ Failure and Shock

Results:

• Intermediate and high serum lactate significantly associated with mortality regardless of the presence of shock or other organ dysfunction

•A single serum lactate seems to risk-stratify patients independent of organ dysfunction or hemodynamic instability



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Mikkelsen, Mark et al CCM 2009 Vol 37 No 5

SSC Guidelines

Resuscitation-Lactate Clearance

Should be protocolized, quantitative resuscitation of patients with sepsis induced hypoperfusion (defined as hypotension persisting after initial fluid challenge or blood lactate ≥ 4mmol/L)

In patients with elevated lactate levels as a marker of tissue hypoperfusion, we suggest targeting resuscitation to normalize lactate as rapidly as possible (2C)

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Multicenter Study of Central Venous Oxygen Saturation as a Predictor of Mortality in Patients With Sepsis

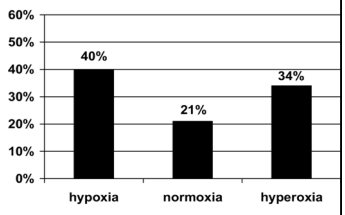
- Objective:
  - Primary: an abnormal (both low and high) ScvO2 is associated with increased mortality in emergency department (ED) patients with septic shock.
  - Secondary : determine whether the initial ScvO2 or the maximum ScvO2achieved was associated with mortality.
- 619 patients from 4 hospitals; prospectively collected data

54
Pope; et al j.annemergmed.2009

Central Venous Oxygen Saturation(ScvO2) as a Predictor of Mortality in Patients With Sepsis

Maximum ScvO2 in 6 hours relates to mortality

Considering the maximum ScvO2 achieved in the ED, the presence of both hypoxia and hyperoxia was associated with a higher mortality rate compared with that of the normoxia group



Pope; et al j.annemergmed.2009

55

Clinical Investigations

The effect of a quantitative resuscitation strategy on mortality in patients with sepsis: A meta-analysis

Alan E. Jones, MD; Michael D. Brown, MD, MSc; Stephen Trzeciak, MD, MPH; Nathan I. Shapiro, MD, MPH; John S. Garrett, MD; Alan C. Heffner, MD; Jeffrey A. Kline, MD; on behalf of the EMSHOCKNET investigators

- This meta-analysis evaluates the treatment effect of using a quantitative resuscitation strategy in the treatment of patients with sepsis.
- Using pooled data from nine studies that randomized a total of 1001 subjects, we found the magnitude of the decrease in mortality (OR 0.50 with the upper limit 95% CI 0.69) was profound when the resuscitation strategy was implemented early.

CCM, October 2008

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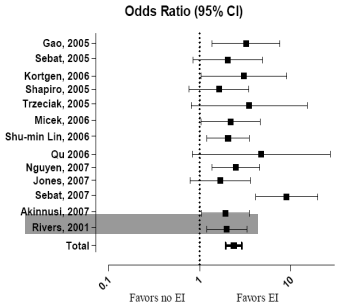
Peer Review Publications



Before	1104	After	1175

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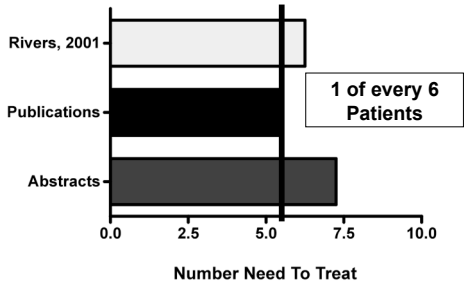
Abstracts and Publications



4125 Before	3328 After

58

Vasopressors

- Vasopressor therapy initially to target a mean arterial pressure (MAP) of 65 mm Hg (grade 1C).
- Norepinephrine as the first choice vasopressor (grade 1B).
- Epinephrine (added to and potentially substituted for norepinephrine) (grade 2B).
- Vasopressin 0.03 units/minute can be added to norepinephrine (NE) with intent of either raising MAP or decreasing NE dosage (UG).
- Low dose vasopressin is not recommended as the single initial vasopressor (UG).
- Dopamine as an alternative vasopressor agent to norepinephrine only in highly selected patients (grade 2C).

Dellinger RP, et al. *Crit Care Med.* 2013;41580-637

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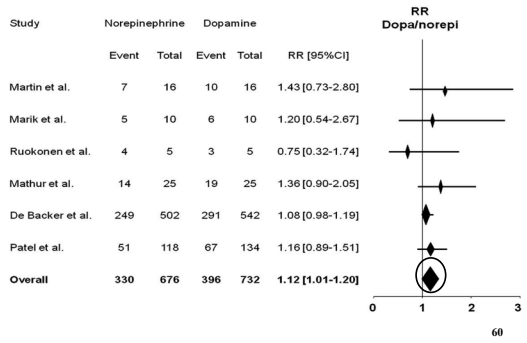
Recommendation Norepinephrine vs. Dopamine



60

De Backer D, et al. Crit Care Med. 2012;40:725-730

Clinical Scenario II: Early identification and Intervention

- **88 year old**, 51.6kg,white, female admit from ED; resided in ECF
- **History**: CAD, COPD, dementia, Alzheimer disease, depression, SVT
- **Chief Complaint:** rib pain, chest congestion and SOB
- Awake, alert and oriented, slight combative (history of combative behavior)

The Rest of the Story

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Clinical Scenario II : Early Identification and Intervention-ER

- **Labs:**
  - WBC: 11.5
  - Hgb: 15.8
  - Hct: 47.4
  - BUN: 28 Creatinine:1.6
  - Glucose:158
  - BNP:78 (moderate CHF); troponin:0.03
  - Lactic acid: 4.6
  - U/A: positive for bacteria
  - ScvO2: 49.1%
  - Blood cultures X 2 drawn

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Clinical Scenario II : Early Identification and Intervention-ER

- **CXR:** RLL consolidation
- **Additional Interventions:**
  - Broad spectrum antibiotics given within 3 hours of presentation
  - Lactic acid >4mmol/L so CVP inserted
  - Fluid resuscitation continued
  - Foley inserted
- Received total of **3 Liters of NS** during 3 hour ED stay
- **ED diagnosis:** Septic Shock, Pneumonia , UTI, CHF
- **Transferred to MICU**

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Clinical Scenario II : Early Identification and Intervention--MICU

- **Additional Interventions: Day 1**
  - Continued fluid resuscitation—7 L
  - Low dose vasopressor-weaned off by hour 6
  - No need for low dose steroids
  - Remained on 2 L nasal canula
  - Not eligible for Xigris (renal failure resolved and vasopressor weaned off within 6 hours after ICU admission)
- **Labs:**
  - ScvO2: 72.8 (after resuscitation)
  - Lactic acid: 4 hours after ICU admission: 6.7
    12 hours after ICU admission: 3.0

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Clinical Scenario II : Early Identification and Intervention

- **Day 2:**
  - CVP 18
  - Lasix to assist with fluid mobilization
  - Lactic acid: 3.0
- **Day 3:**
  - Lactic acid: 1.2
  - O2 sat 93% on room air
  - Central line discontinued
- Transferred to intermediate care on Day 3
- Discharged from hospital on day 7

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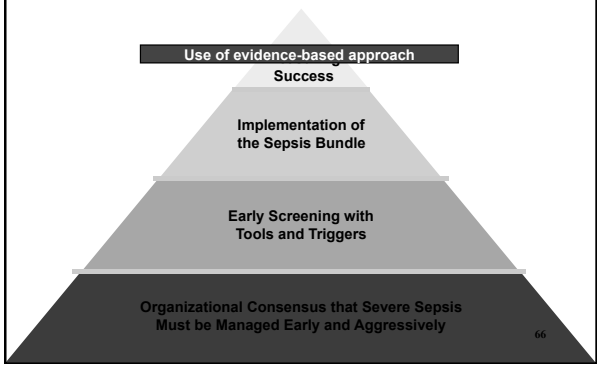
Fourth Tier: Measuring Process & Outcome Changes



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Data Collection

- Patient Log
  - Define how will find all patients that receive the bundles
  - Real time data collection is optimal—then used as checklist to ensure patient receives all appropriate interventions
- Outcome
  - Mortality (ICU and Hosp)
  - Hosp LOS
  - Cost per case (total and direct)
- Process
  - SSC database
  - Data elements that measure implementation of resuscitation and management bundle

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Finding the Patients: Prospective Patient Log

Unit	Pt #	Point of Entry	Date of Septic Shock Dx	Time of Septic Shock Dx	Data Obtained	Data Complete	Comments / Follow-up

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Sustaining and Improving: Strategies

- **Independent checks**
  - Checklists, pathway
  - Multidisciplinary rounds
  - Part of handoffs
- **Real time feedback and on-going education**
  - Unit rounds
  - Unit champions
  - Staff meetings
  - Orientation---RN and residents
  - Quarterly with current staff

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Sustaining and Improving: Strategies

- Creating sense of urgency
  - 'Code Sepsis' or 'Sepsis Alert'
  - Staffing ratio for initial 6 hours of ICU or ED care
  - Clock on the door
  - Electronic alerts

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Impact of Implementing the Sepsis Bundles

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A Prospective Multi-Center Collaborative Study Before and After Implementation of an Early Sepsis Initiative

The Multi-Center Severe Sepsis & Septic Shock Collaborative Group

Presented by Emanuel Rivers at the World Federation of Critical care Medicine, Florence Italy 08/09

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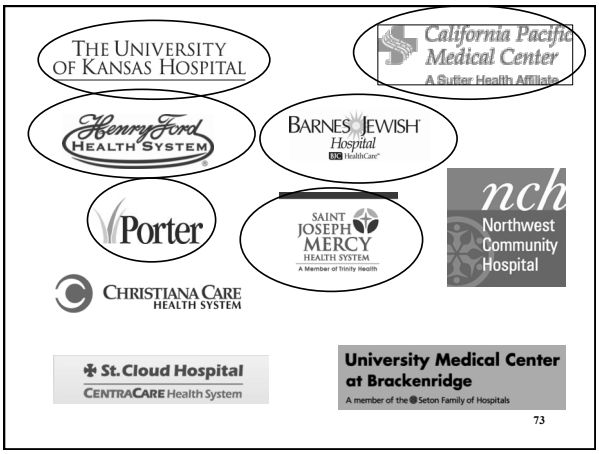
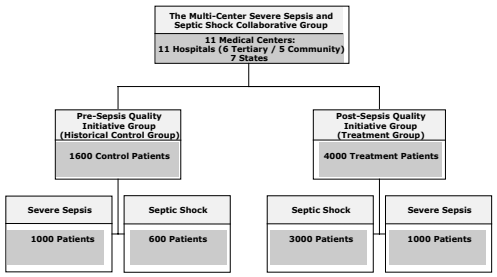


Multi-center Severe Sepsis & Septic Shock Collaborative



In this intention-to-treat evaluation, all patients including DNR were examined.

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Presented by Emanuel Rivers at the World Federation of Critical care Medicine, Florence Italy 08/09

Results

- There were 5467 total patients enrolled, 1446 pre- and 4021 post-implementation.
- The post-implementation group had higher baseline APACHE II scores with a 8.45% higher predicted mortality.
- In-hospital mortality was 39.12% before implementation and 28.97% after implementation (*P* < 0.001) for an absolute risk reduction of 10.15% and a relative risk reduction of 26.0%.
- Post-implementation secondary outcomes included improved organ dysfunction and lactate clearance; less vasopressor use and mechanical ventilation; shorter hospital length of stay (5 days)

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Surviving Sepsis Campaign Implementation Results

Now close to 30,000 patients

Presented at SCCM, 2012

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Surviving Sepsis Campaign Results (28,150 patients)

Entry Point	Subjects	Mortality (hosp)
ED	54.3%	27.0
ICU	33.2%	40.5
Ward	12.5%	44.3

Presented at SCCM 2012

Surviving Sepsis Campaign
In campaign for 36 months

- Mortality: 42.5% to 31.9% RRR: 25% p<0.001
- Compliance at sites
  - Lactate: 73.5%
  - Blood cultures: 83.4%
  - Antibiotics: 72.3%
  - Fluids: 75.7%
  - CVP: 29.9%
  - ScvO2: 22.3%
  - All Elements: 19.6%

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Presented at SCCM Congress Jan. 2013

Surviving Sepsis Campaign
In campaign for 36 months

Characteristic	Low compliance	High Compliance (all elements-29.2%)	P value
Count	6,439 (34.3%)	12, 306 (65.7%)	
Hospital Mortality	31.3	26.8	<0.001
Origin%			0.385
ED	64.4	65.4	
Ward	25.8	25.2	
ICU	9.8	9.4	
Hospital mortality if origin is ED,%	27.3	23.2	0.001
Hospital mortality if origin is Ward, %	38.2	33.1	0.058
Hospital mortality if origin is ICU, %	38.7	34.7	0.008

Surviving Sepsis Campaign

Bundle Element	Mortality Odds Ratio	95% CI	P value
Lactate	0.90	0.84-0.96	0.002
Blood Cultures	0.88	0.83-0.94	<0.001
Antibiotics	0.89	0.84-0.94	<0.001
Fluid Administration	0.68	0.63-0.74	<0.001
CVP	0.94	0.86-1.01	0.103
ScvO2	0.89	0.81-0.97	0.007

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WHAT WE DO AND HOW WELL WE DO IT MAKES A SIGNIFICANT DIFFERENCE IN MORTALITY!

81

Keys to Success

- Team in place with key stakeholders overseeing implementation
- Project coordinator with lead clinical staff on each unit
- Sepsis resource/coordinator rounds frequently on units
- Strong physician leadership on team
- Reminders to staff through use of bedside sepsis tools/ checklist
- Empowerment of nursing staff to prevent errors
- Administrative support to help manage barriers
- Review data monthly to identify opportunities for improvement
- Support from state-wide collaborative/surviving sepsis campaign

EDUCATION, DATA, PROCESS, EDUCATION, COMPLIANCE

Seize the Opportunity

The Power of The Pyramid Can Make a Difference in Your Hospital's Severe Sepsis Outcomes

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25 July IMPROVING HAND HYGIENE BEHAVIOUR: THE EFFECTS OF SOCIAL INFLUENCE AND LEADERSHIP
Dr. Anita Huis, Radboud University, The Netherlands

07 August *(FREE ... WHO Teleclass – North America)*
DECONTAMINATION OF HIGH-TOUCH ENVIRONMENTAL SURFACES IN HEALTHCARE: A CRITICAL LOOK AT CURRENT PRACTICES AND NEWER APPROACHES
Speaker: Prof. Syed A. Sattar, Centre for Research on Environmental Microbiology, University of Ottawa

22 August THE INFECTIOUS DISEASE FOLLOUT FOLLOWING NATURAL DISASTERS – THE HURRICANE SANDY STORY
Dr. Michael Tapper, Lenox Hill Hospital, New York

29 August *(FREE South Pacific Teleclass – Broadcast live from the IPCNC conference in New Zealand)*
FROM LITTLE THINGS BIG THINGS GROW: THE IMPORTANCE OF LEADERSHIP SKILLS IN INFECTION PREVENTION

www.webbertraining.com/schedulep1.php

Severe Sepsis: Early Recognition and Management Saves Lives
Kathleen Vollman, Sepsis Solutions International LLC / Advanced Nursing LLC
A Webber Training Teleclass

Hosted by Nicole Kenny, Virox Technologies Inc
www.webbertraining.com