




My motivation


- Involved in ground EMS for over 10 years
- Future Fellow in EMS Medicine
- Active Flight Physician
- Assistant Medical Director

***“What you do...
&
What you don’t do...
makes a difference”***



 **ITLS**
International Trauma Life Support

 **Ohio ACEP**
American College of Emergency Physicians
Emergency Medicine • Trauma • Critical Care

University of Cincinnati
Medical Center |  **UC Health.**



Thank You

- Conference planning committee
- UC Dept of Emergency Medicine
- My EMS colleagues both Air & Ground
- My wife & daughter






University of Cincinnati
Medical Center

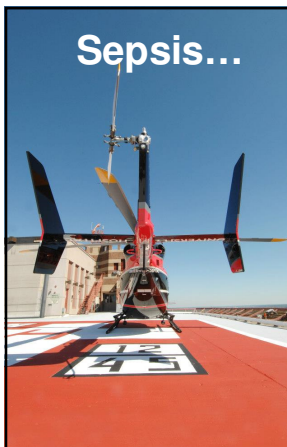


Disclosure



Neither I nor any member of my immediate family have had a financial relationship with any proprietary entity producing health care goods or services.

Sepsis...




Our Objectives


- Acknowledge the problem
- Define the spectrum

- Understand why
- Identify who is at risk

- Review the EMS literature
- What you can do...
- A look around the country



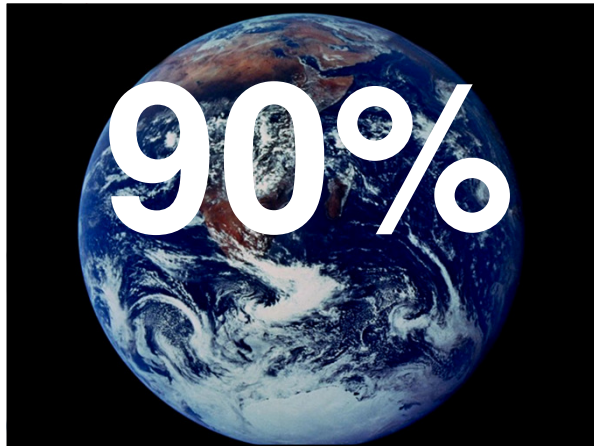
University of Cincinnati
Medical Center











Display Settings: Abstract Send to:

Prehosp Disaster Med. 2013 Apr;28(2):104-6. doi: 10.1017/S1049023X12001744. Epub 2012 Dec 20.

Prehospital Sepsis Project (PSP): knowledge and attitudes of United States advanced out-of-hospital care providers.

Báez AA, Hanudel P, Páez MT, Giraldez EM, Wilcox SR.
Centros de Diagnóstico y Medicina Avanzada y de Conferencias Médicas y Telemedicina (CEDMAT), Santo Domingo, Dominican Republic.

- 15 item survey based on 4 clinical cases.
- 226 EMS providers (82.2% paramedics)
- 70.6% had > 10 years experience in EMS

✓ The 1st & 4th scenario were identical & only 29.53% scored both of the duplicate scenarios correctly

✓ 9.8% responded to all 4 scenarios correctly

✓ Level of training and years of service was irrelevant

ITLS International Trauma Life Support Ohio ACEP American College of Emergency Physicians University of Cincinnati Medical Center iHealth.

UNDERSTANDING

Christopher W. Seymour
Eileen M. Bulger

Anonym

786 EMS

✓ 97% had heard of the term "sepsis"

✓ Overall knowledge of the clinical signs and symptoms and recommended treatment for sepsis was typically > 75%

✓ 76% of respondents believed sepsis is not recognized by EMS "some" or "a lot" of the time

Figure 2. (A) Proportion of emergency medical services (EMS) providers identifying clinical signs and symptoms of sepsis. (B) Proportion of EMS providers identifying recommended treatments for sepsis. All tests of significance (Paramedics vs. EMTs; Paramedics vs. FF-EMTs) are $p < 0.05$, except comparing Paramedics vs. EMTs for altered mental status ($p = 0.37$) and antibiotics ($p = 0.85$). FF-EMTs = firefighter-emergency medical technicians; EMTs = emergency medical technicians.

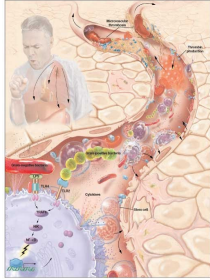
ITLS International Trauma Life Support Ohio ACEP American College of Emergency Physicians University of Cincinnati Medical Center iHealth.



So what is sepsis?

Normal Response to infection

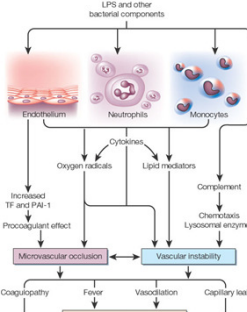
- Serves to localize/control invasion of microorganisms & start repair
- Activation of phagocytic cells & generation of both inflammatory & anti-inflammatory chemicals
- Balance of pro & anti-inflammatory signals facilitates tissue repair.
- When the equilibrium is lost...**



ITLS International Trauma Life Support
Ohio ACEP
University of Cincinnati Medical Center | UC Health.

Sepsis is uncontrolled chaos

- Results when the inflammatory response to infection becomes generalized & extends to normal tissue**
- Tissues remote from the original insult display signs of inflammation
 - Vasodilation
 - Vascular permeability
 - WBC accumulation
- Sepsis is uncontrolled, unregulated, & self-sustaining**



ITLS International Trauma Life Support
Ohio ACEP
University of Cincinnati Medical Center | UC Health.

Homeostasis is lost

- The blood-borne spread & exaggeration of what is normally a very localized & protective inflammatory response
- Consequences of a systemic proinflammatory reaction:**
 - ✓ Endothelial damage
 - ✓ Microvascular dysfunction leading to clots
 - ✓ Impaired tissue oxygenation & organ injury

**THINK
TREAT
STOP!**
sepsis

ITLS International Trauma Life Support
Ohio ACEP American College of Emergency Physicians
Trauma • Critical Care • Emergency

When sepsis goes untreated...

Onset of Multiple Organ Dysfunction Syndrome (MODS)

IAP > 20 mmHg

Brain swelling and ischemia

Increased peak pressure, difficult ventilation and oxygenation: VILI/ARDS

Increased gut ischemia, Impending necrosis

Cardiovascular instability

Vena caval flattening

Anuria/Acute Renal Failure (ARF)

Further worsening of acidosis

The continuum...

SIRS
Temp. >38°C or <36°C, HR >90, RR >20 or PaCO₂ <32, WBCs >12,000 or <4,000 or >10% bands

Sepsis
SIRS + Infection

Severe Sepsis
Sepsis + End Organ Damage

Septic Shock
Severe Sepsis + Hypotension

ITLS International Trauma Life Support
Ohio ACEP American College of Emergency Physicians
Trauma • Critical Care • Emergency
University of Cincinnati Medical Center | **UC Health**

Sepsis is a sliding spectrum

- It is not an isolated event
- Patients are dynamic & always changing

Relationship of Infection, SIRS, Sepsis, Severe Sepsis and Septic Shock

ITLS International Trauma Life Support

Bone et al. Chest 1992; 101:1644

Health.

risk

- Elderly & very young
- Bed confined / immobile
- Dialysis patients
- Nursing home residents
- Recently hospitalized
- Invasive lines
- Unvaccinated
- Immunosuppressed
 - ✓ HIV
 - ✓ Malignancy
 - ✓ Chemo or radiation
 - ✓ Chronic steroids
- Systemic Disease
 - ✓ Diabetes
 - ✓ Liver cirrhosis
 - ✓ Autoimmune diseases
 - ✓ Alcohol dependence

The first step is... clinical suspicion

Suspected Site	Symptoms/Signs
Upper Respiratory Tract	Oral inflammation, exudates, swelling
Lower Respiratory Tract	Productive cough, pleuritic chest pain, consolidative auscultatory findings
Urinary Tract	Fever, urgency, dysuria, hematuria
Wound or burn	Pus, edema, erythema, or discharge
Skin/Soft tissue	Erythema, edema, lymphangitis
Central Nervous system	Stiff neck, AMS, photophobia, vomiting
GI	Abdominal pain, diarrhea, vomiting
Liver	Abdominal pain, ascites, fever, AMS
Peritoneal dialysis	Cloudy PD fluid, abdominal pain, fever
Genital tract	Low abdominal pain, vaginal discharge

ITLS International Trauma Life Support

Ohio ACEP


University of Cincinnati Medical Center

Health.

Most common causes of sepsis

- 1. UTI:** urinary catheters
- 2. Pneumonia:** ETT, trachs, aspiration
- 3. GI:** abscess, perforations, obstructions
- 4. Other Causes:** IVDU endocarditis, grafts, ports


*** Bacterial infections are most common but sepsis is also seen with fungal, virus, & parasite infections



ITLS International Trauma Life Support
Ohio ACEP
University of Cincinnati Medical Center | UCH Health


The rule is... there are **NO RULES**

- Mental status is variable
- Vital signs are variable
- Physiologic Reserve
- Special populations
- Don't be fooled by temporary changes in vitals



ITLS International Trauma Life Support
Ohio ACEP
University of Cincinnati Medical Center | UCH Health

Cryptic Shock



LACTATE - A MARKER FOR SEPSIS AND TRAUMA

- Lactate is a screening test for **CRYPTIC SEPSIS or SHOCK**

Table 1. Causes of Lactic Acidosis

Inadequate oxygen delivery	Disproportionate oxygen demands	Inadequate oxygen utilization
Volume depletion or profound dehydration	Hyperthermia	Systemic inflammatory response syndrome
Significant blood loss	Shivering	Diabetes mellitus
Septic shock	Seizures	Total parenteral nutrition
Profound anemia	Strenuous exercise	Thiamine deficiency
Severe hypoxemia		HIV infection
Prolonged carbon monoxide exposure		Drugs such as metformin, salicylate, antiretroviral agents, isoniazid, propofol, cyanide
Trauma		

*** > 4 mmol/L suggests **SEVERE BADNESS** ***

ITLS International Trauma Life Support
Ohio ACEP
University of Cincinnati Medical Center

LACTATE - A MARKER FOR SEPSIS AND TRAUMA

- Elevation of lactate in severe sepsis = **increased mortality**
- Early clearance of lactate = **improved mortality**

Lactate Level	25d in-hospital mortality	Death within 3d
0-2.4	4.9%	1.5%
2.5-3.9	9.0%	4.5%
>4.0	28.4%	22.4%

Figure 4. Lactate as a predictor of mortality.¹¹ Reprinted with permission from Shapiro et al. Ann Emerg Med. 2005; 45:524-28.

ITLS International Trauma Life Support
Ohio ACEP
University of Cincinnati Medical Center | UCH Health.

CAPNOGRAPHY

CO₂

Time

Adam Thompson, EMT-P, AS

End-tidal carbon dioxide is associated with mortality and lactate in patients with suspected sepsis 2013

Christopher L. Hunter MD, PhD^a, Salvatore Silvestri MD^{a,b,*}, Matthew Dean^b, Jay L. Falk MD^{a,b}, Linda Papa MD, MSc^{a,b}

- Patients with ≥ 2 SIRS criteria & $\text{EtCO}_2 \leq 25\text{mmHg}$ is strongly correlated with lactate levels $> 4\text{mM/L}$ and increased mortality.
- Allows use of existing equipment rather than purchase approved lactate monitors.
- More work is being done on EtCO_2 and lactate...

ITLS International Trauma Life Support
Ohio ACEP
University of Cincinnati Medical Center | ICH Health.

"I'd like to be a paramedic but I don't know anything about the lives he died."

- Anonymous Paramedic

Clinical paper

Opportunities for Emergency Medical Services care of sepsis^{*} 2010

Henry E. Wang^{a,*}, Matthew D. Weaver^b, Nathan I. Shapiro^c, Donald M. Yealy^b

Department of Emergency Medicine, University of Alabama at Birmingham, 619 19th Street South, JTN 260 Birmingham, AL 35249, United States
Department of Emergency Medicine, University of Pittsburgh, Pittsburgh, PA, United States
Department of Emergency Medicine, Beth Israel Deaconess Medical Center, Boston, Massachusetts, United States

- 4,613 ED patients presenting with serious infections

Table 1
Characteristics of Emergency Department patients admitted to the hospital with an infection. Odds ratios and p-values reflect differences between EMS vs. non-EMS patients.

Patient characteristic	EMS (n = 1576) n (%)	Non-EMS (n = 3037) n (%)	Total (n = 4613) n (%)	Odds ratio (95% CI) or p-value
Age—mean (95% CI)	69.4 (68.6–70.3)	55.1 (54.4–55.8)	60.0 (59.4–60.6)	t-Test p < 0.001
Sex				
Male	703 (44.6%)	1533 (50.5%)	2236 (48.5%)	0.8 (0.7–0.9)
Female	873 (55.4%)	1504 (49.5%)	2377 (51.5%)	Referent
Ethnic category				
White	1129 (71.6%)	2239 (73.7%)	3368 (73.0%)	0.9 (0.8–1.0)
Black or African American	236 (15.0%)	317 (10.4%)	553 (12.0%)	1.5 (1.3–1.8)
Asian	39 (2.5%)	87 (2.9%)	126 (2.7%)	0.9 (0.6–1.3)
Hispanic or Latino	63 (4.0%)	156 (5.1%)	219 (4.8%)	0.7 (0.6–0.8)
American Indian or Alaskan	0 (0.0%)	2 (0.0%)	2 (0.0%)	0.0 (0.0–3.7)
Other	30 (1.9%)	66 (2.2%)	96 (2.1%)	0.9 (0.5–1.4)
Unknown	79 (5.0%)	170 (5.6%)	249 (5.4%)	0.9 (0.7–1.2)
Nursing home or rehabilitation facility patient	376 (23.9%)	67 (2.2%)	443 (9.6%)	13.9 (10.6–18.4)
Emergency Department Triage Hemodynamic instability				
Tachycardia (heart rate ≥ 90 beats/min)	927 (58.9%)	1637 (53.9%)	2464 (53.4%)	0.9 (0.8–1.1)
Tachypnea (respiratory rate ≥ 20 breaths/min)	779 (49.4%)	872 (28.7%)	1651 (35.8%)	2.4 (2.1–2.8)
Hypoxia ($\text{SaO}_2 < 90\%$)	160 (10.2%)	109 (3.6%)	269 (5.8%)	3.0 (2.4–3.9)
Hypertension (systolic blood pressure ≥ 90 mm Hg)	139 (8.8%)	118 (3.9%)	247 (5.4%)	2.2 (1.7–2.9)
Serum lactate level—mean (95% CI)	2.37 (2.3–2.5)	1.87 (1.8–1.9)	2.05 (2.0–2.1)	t-Test p < 0.001

ITLS International Trauma Life Support
Ohio ACEP
University of Cincinnati Medical Center | ICH Health.

Clinical paper

Opportunities for Emergency Medical Services care of sepsis[☆]

Henry E. Wang^{a,*}, Matthew D. Weaver^b, Nathan I. Shapiro^c, Donald M. Yealy^b

^aDepartment of Emergency Medicine, University of Alabama at Birmingham, 619 18th Street South, JTN 266 Birmingham, AL 35249, United States
^bDepartment of Emergency Medicine, University of Pittsburgh, Pittsburgh, PA, United States
^cDepartment of Emergency Medicine, Beth Israel Deaconess Medical Center, Boston, Massachusetts, United States

2010

Table 3
 Source of infection, organ dysfunction and outcomes of Emergency Department patients admitted to the hospital with an infection. Odds ratios and p-values reflect differences between EMS vs. non-EMS patients.

Characteristic	EMS (n = 1576) n (%)	Non-EMS (n = 3037) n (%)	Total (n = 4613) n (%)	Odds ratio (95% CI) or p-value
Source of infection				
Pneumonia	414 (26.3%)	405 (13.3%)	819 (17.8%)	2.4 (2.1–2.8)
Urinary tract infection/pyelonephritis	287 (18.2%)	315 (10.4%)	602 (13.1%)	1.9 (1.6–2.3)
Intra-abdominal	66 (4.2%)	247 (8.1%)	313 (6.8%)	0.5 (0.4–0.7)
Skin, soft tissue	179 (11.4%)	799 (26.3%)	978 (21.2%)	0.4 (0.3–0.6)
Unknown or other	630 (40.0%)	1271 (41.9%)	1901 (41.2%)	0.9 (0.8–1.0)
Organ dysfunction				
Altered mental status	287 (18.2%)	132 (4.4%)	419 (9.1%)	4.9 (3.9–6.1)
Respiratory failure	320 (20.3%)	247 (8.1%)	567 (12.3%)	2.9 (2.4–3.5)
Mechanical ventilation	36 (2.3%)	23 (0.8%)	59 (1.3%)	3.1 (1.8–5.4)
Liver failure	6 (0.5%)	18 (0.6%)	26 (0.6%)	0.9 (0.3–2.1)
Renal failure	62 (3.9%)	55 (1.8%)	117 (2.5%)	2.2 (1.5–3.3)
Cardiovascular failure	42 (2.7%)	16 (0.5%)	58 (1.3%)	5.2 (2.8–9.6)
Septicemia	11 (0.7%)	9 (0.3%)	20 (0.4%)	2.4 (0.9–6.5)
Hematopoietic failure	3 (0.2%)	13 (0.4%)	16 (0.4%)	0.4 (0.1–1.6)
Vasopressor use	95 (6.0%)	50 (1.6%)	145 (3.1%)	3.2 (2.3–4.6)
Sepsis severity				
Sepsis	1075 (68.2%)	1820 (59.9%)	2895 (62.8%)	1.4 (1.3–1.6)
Severe Sepsis	604 (38.3%)	419 (13.8%)	1023 (22.2%)	3.9 (3.4–4.5)
Septic Shock	111 (7.0%)	63 (2.1%)	174 (3.8%)	3.6 (2.6–5.0)
Mortality in emergency department sepsis score—median (IQR)	6 (3–10)	3 (0–6)	5 (3–8)	Rank-sum p < .01
Outcomes				
Alive	1450 (92.0%)	2970 (98.8%)	4420 (95.8%)	Referent
Dead	126 (8.0%)	67 (2.2%)	193 (4.2%)	3.9 (2.8–5.3) ^a

^a Unadjusted odds ratios. Odds of death adjusted for age, sex, infection source, number of comorbidities and Mortality in Emergency Department Sepsis Score (MEDS) = 1.8 (95% CI, 1.3–2.6). EMS, Emergency Medical Services.



Severe Sepsis in Pre-Hospital Emergency Care
 Analysis of Incidence, Care, and Outcome

Christopher W. Seymour^{1,2}, Thomas D. Rea^{3,4}, Jeremy M. Kahn^{2,5}, Allan J. Walkey⁶, Donald M. Yealy⁷, and Derek C. Angus^{1,8} **2012**

Retrospective study of 407,176 patients from 2000–2009

STROKE: 2.2 per 100

ACUTE MI: 2.3 per 100

SEPSIS: 3.3 per 100

ITLS International Trauma Life Support
 Ohio ACEP
 University of Cincinnati Medical Center | ICH Health.

Severe Sepsis in Pre-Hospital Emergency Care
Analysis of Incidence, Care, and Outcome

Christopher W. Seymour^{1,2}, Thomas D. Rea^{1,4}, Jeremy M. Kahn^{2,5}, Allan J. Walkey⁶, 2012
Donald M. Yealy⁷, and Derek C. Angus^{1,8}

TABLE 1. PRE-HOSPITAL CHARACTERISTICS OF SEVERE SEPSIS HOSPITALIZATIONS COMPARED WITH THOSE HOSPITALIZED WITH ACUTE MYOCARDIAL INFARCTION OR STROKE

Variable	Hospitalizations with Severe Sepsis (n = 13,249)	Hospitalizations with AMI (n = 9,069)	Hospitalizations with Stroke (n = 8,981)
Age, yr: mean (SD)	71 (16)	71 (14)	75 (14)
Female sex, no. (%)	6,149 (48)	3,861 (44)	4,826 (55)
Level of EMS care, no. (%)			
ALS + BLS	7,114 (54)	6,562 (72)	2,623 (29)
BLS only	6,135 (46)	2,507 (28)	6,358 (71)
EMS arriving, no./day			
Life-threatening	1,822 (19)	1,546 (17)	456 (9)
Urgent	6,999 (53)	6,532 (72)	5,298 (59)
Nonurgent	2,876 (20)	1,378 (18)	2,211 (25)
Pre-hospital time interval, min: mean (SD)			
Responding to scene time	4.7 (3.6)	4.3 (3.3)	4.6 (3.4)
Total scene time	34.8 (18.3)	34.4 (17)	26.9 (14)
Scene-to-hospital time	12.6 (10.3)	12 (9.3)	13.1 (10.2)
Abnormal pre-hospital vital signs, no. (%)			
Systolic blood pressure < 90 mm Hg	2,483 (21)	938 (12)	283 (4)
Respiratory rate > 36 breaths/min	3,790 (30)	481 (9)	132 (2)
Glasgow Coma Scale score < 11	1,099 (14)	381 (4)	1,048 (12)
S _{at} < 90%	1,369 (10)	378 (3)	1,392 (15)
Heart rate > 120 beats/min	2,971 (24)	1,088 (14)	527 (7)
Pre-hospital critical illness risk score, mean (SD) ¹	2.1 (1.4)	1.7 (1.09)	1.49 (0.92)
Pre-hospital interventions, no. (%)			
Supplemental oxygen	9,520 (72)	7,870 (85)	5,868 (66)
Bag valve mask ventilation	1,538 (11.6)	405 (4)	41 (1)
Endotracheal intubation	1,968 (13)	467 (5)	511 (6)
IV fluid resuscitation	8,872 (67)	6,448 (71)	5,947 (67)
Prehospital intubation success ²	6,842 (37)	5,311 (59)	1,438 (16)

Definition of abbreviations: ALS = advanced life support; AMI = acute myocardial infarction; BLS = basic life support; EMS = emergency medical services; S_{at} = arterial oxygen saturation.

¹ Determined by first arriving EMS personnel.

² Calculated as an integer score ranging from 0 to 8, using a previously published risk model (21).

³ Excludes categories with as home with health aid, transfer to acute care hospital, and unknown.

Severe Sepsis in Pre-Hospital Emergency Care
Analysis of Incidence, Care, and Outcome

Christopher W. Seymour^{1,2}, Thomas D. Rea^{1,4}, Jeremy M. Kahn^{2,5}, Allan J. Walkey⁶, 2012
Donald M. Yealy⁷, and Derek C. Angus^{1,8}

TABLE 3. COMPARISON OF OUTCOMES OF EMERGENCY MEDICAL SERVICES ENCOUNTERS HOSPITALIZED WITH SEVERE SEPSIS, ACUTE MYOCARDIAL INFARCTION, AND STROKE

Variable	Hospitalizations with Severe Sepsis (n = 13,249)	Hospitalizations with Acute MI (n = 9,069)	Hospitalizations with Stroke (n = 8,981)
Possible etiologies of sepsis, no. (%) ¹			
Respiratory	6,154 (63)	—	—
Urological	5,043 (38)	—	—
Gastrointestinal	3,508 (29)	—	—
Skin, soft tissue, joint	1,579 (12)	—	—
Central nervous system	75 (1)	—	—
Cardiovascular	105 (1)	—	—
Organ failures, no. (%)			
Renal	7,232 (55)	1,148 (13)	494 (6)
Pulmonary	5,242 (40)	978 (11)	949 (11)
Cardiac	2,279 (17)	663 (7)	85 (1)
Hematologic	1,928 (15)	223 (2)	178 (2)
Neurological	708 (5)	112 (1)	129 (1)
Hepatic	777 (6)	67 (1)	13 (1)
Total organ failures, mean (SD)	1.41 (0.75)	0.33 (0.2)	0.21 (0.49)
Charlson Comorbidity Index, mean (SD)	1.18 (1.7)	2.17 (1.32)	2.34 (1.48)
Admission to intensive care, no. (%)	6,224 (52)	4,460 (50)	2,613 (29)
Hospital length of stay, d: median (IQR)	6 (3–11)	3 (2–5)	3 (2–6)
Discharge disposition, no. (%) ²			
Expired	2,586 (19.6)	932 (10)	1,076 (12)
Home	3,812 (29)	3,957 (44)	2,778 (31)
Skilled nursing facility	3,037 (23)	1,308 (14)	2,527 (28)
Long-term acute care	1,540 (12)	38 (1)	30 (1)

Definition of abbreviations: IQR = interquartile range; MI = myocardial infarction.

¹ Possible etiologies of severe sepsis and the types of organ failures are not mutually exclusive categories.

² Excludes categories with as home with health aid, transfer to acute care hospital, and unknown.

Severe Sepsis in Pre-Hospital Emergency Care
Analysis of Incidence, Care, and Outcome

Christopher W. Seymour^{1,2}, Thomas D. Rea^{1,4}, Jeremy M. Kahn^{2,5}, Allan J. Walkey⁶, 2012
Donald M. Yealy⁷, and Derek C. Angus^{1,8}

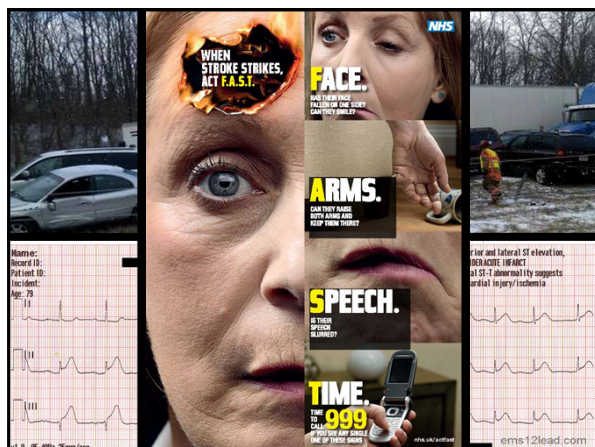
Sepsis versus Acute MI or Stroke

- ✓ More commonly seen, treated, & transported by EMS
- ✓ Worse vital signs
- ✓ Unlikely to receive IV access
- ✓ More organ failure
- ✓ More likely to die
- ✓ Rarely deemed life threatening...

SEPSIS KILLS

ITLS International Trauma Life Support
Ohio ACEP
University of Cincinnati Medical Center | ICH Health.





EARLY GOAL-DIRECTED THERAPY IN THE TREATMENT OF SEVERE SEPSIS AND SEPTIC SHOCK

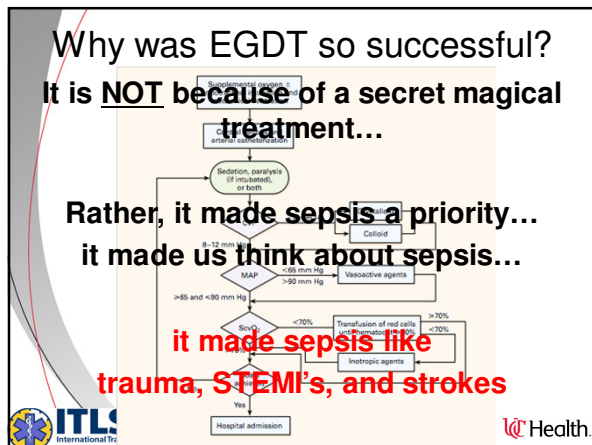
EMANUEL RIVERS, M.D., M.P.H., BRYANT NGUYEN, M.D., SUZANNE HAVSTAD, M.A., JULIE RESSLER, B.S., ALEXANDRIA MUZZIN, B.S., BERNHARD KNORRICH, M.D., EDWARD PETERSON, Ph.D., AND MICHAEL TOMLANOVICH, M.D., FOR THE EARLY GOAL-DIRECTED THERAPY COLLABORATIVE GROUP*

- Landmark study of 263 pts with severe sepsis
- Prioritized the 1st 6 hours of care**
- 16% absolute reduction in-hospital mortality**
- Improved 28 day & 1 year mortality

Sepsis Six

- 1) High flow oxygen
- 2) Fluid resuscitate
- 3) IV antibiotics
- 4) Blood Cultures
- 5) Measure lactate & hemoglobin
- 6) Measure urine output










Surviving Sepsis Campaign




"The resuscitation of a patient in severe sepsis... should begin as soon as the syndrome is recognized and should not be delayed"

 ITLS International Trauma Life Support
 Ohio ACEP
 University of Cincinnati Medical Center |  UC Health


Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012






1. Routine screening of potentially infected seriously ill patients for severe sepsis to allow earlier implementation of therapy (grade 1C).
2. Protocolized, quantitative resuscitation of patients with sepsis-induced tissue hypoperfusion. Goals during first 6 hours of resuscitation:
 - ✓ CVP 8-12mmHg
 - ✓ MAP \geq 65mmHg
 - ✓ Urine output \geq 0.5ml/kg/hr
 - ✓ Central venous or Mixed venous O₂ saturation 70% or 65% respectively

 ITLS International Trauma Life Support
 Ohio ACEP
 University of Cincinnati Medical Center |  UC Health


Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012





3. In patients with elevated lactate levels targeting resuscitation to normalize lactate (grade 2C).
4. Crystalloids as the initial fluid of choice in the resuscitation of severe sepsis and septic shock (grade 1B)


 ITLS International Trauma Life Support
 Ohio ACEP
 University of Cincinnati Medical Center |  UC Health

Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012




5. Initial fluid challenge in patients with sepsis-induced tissue hypoperfusion with suspicion of hypovolemia to achieve a minimum of 30 mL/kg of crystalloids. More rapid administration and greater amounts of fluid may be needed in some patients (grade 1C).
6. Fluid challenge technique be applied where in fluid admin is continued as long as there is hemodynamic improvement.







University of Cincinnati Medical Center | 

Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012




7. Vasopressor therapy initially to target a mean arterial pressure (MAP) of 65 mm Hg (grade 1C).
8. Norepinephrine as the first choice vasopressor (grade 1B).
9. Dopamine as an alternative vasopressor agent to norepinephrine only in highly selected patients (eg, patients with low risk of tachyarrhythmias and absolute or relative bradycardia) (grade 2C).







University of Cincinnati Medical Center | 

Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012




10. Administration of effective IV antibiotics within the first hour of recognition of septic shock (grade 1B) and severe sepsis without septic shock (grade 1C).
11. Specific anatomical diagnosis of infection requiring consideration for emergent source control be sought and diagnosed or excluded as rapidly as possible, and intervention be undertaken for source control within the first 12 hours after the diagnosis is made, if feasible (grade 1C).








University of Cincinnati Medical Center | 

Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012



12. Noninvasive mask ventilation (NIV) may be used in that minority of sepsis-induced ARDS patients in whom the benefits of NIV have been carefully considered and are thought to outweigh the risks (grade 2B)
13. Target a TV of 6ml/kg IBW & a plateau pressure < 30 cm H2O in patients with sepsis induced ARDS (grade 1A)
14. Sepsis patients be maintained with the head of the bed elevated to 30-45° to limit aspiration risk and to prevent the development of ventilator assoc pneumonia (grade 1B).









<http://www.survivingsepsis.org/Pages/default.aspx>

There is so much more information...

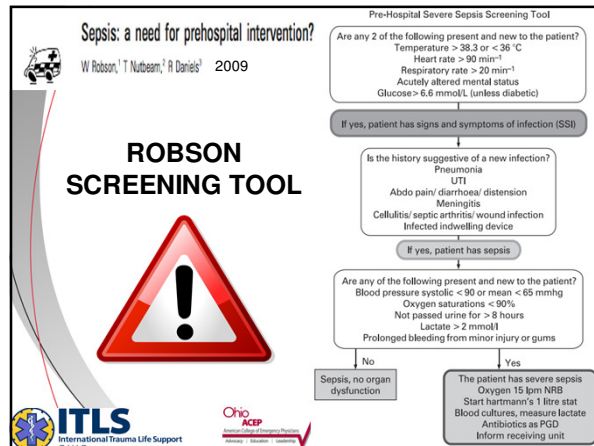





IN TREATING SEPSIS, THE **1**ST HOUR IS CRITICAL

AND THE FIRST **24** CAN BE DECISIVE.

READ MORE
ABOUT THE CLINICAL NEED FOR EARLY DETECTION OF SEPSIS



Original Contribution

The impact of emergency medical services on the ED care of severe sepsis[☆] **2012**

Jonathan R. Studnek PhD^{a,b}, Melanie R. Artho MD^a, Craymon L. Garner Jr^a, Alan E. Jones MD^{a,*}

- 311 patients (51.4% transported by EMS)
- Patients transported by EMS were more critically ill
 - ✓ Shorter time to first antibiotics (111 vs. 146 minutes)
 - ✓ Shorter time from triage to EGDT initiation (119 vs. 160 minutes)
- If EMS provider indicated a written impression of sepsis
 - ✓ Shorter time to antibiotics (70 vs. 122 minutes)
 - ✓ Shorter time to EGDT initiation (69 vs. 131 minutes)
- **Suggests that EMS care impacts both diagnostic & treatment process of patients with severe sepsis**

ITLS International Trauma Life Support

Ohio ACEP

University of Cincinnati Medical Center | UC Health.

Arriving by Emergency Medical Services Improves Time to Treatment Endpoints for Patients With Severe Sepsis or Septic Shock **2011**

Roger A. Band, MD, David F. Gaieski, MD, Julie H. Hytton, Frances S. Shofer, PhD, Munish Goyal, MD, and Zachary F. Meisel, MD, MPH

- 963 severe sepsis patients during a 2 year time period
- **Time to antibiotics:** 116 min for EMS vs. 152 min
- **Median time to initiation of IVF:** 34 min for EMS vs. 68 min
- After adjustment for APACHEII score, age, & initial lactate...
Despite shortened ED treatment times for septic patients who arrive by EMS, an in-hospital mortality benefit could not be demonstrated...

ITLS International Trauma Life Support

Ohio ACEP

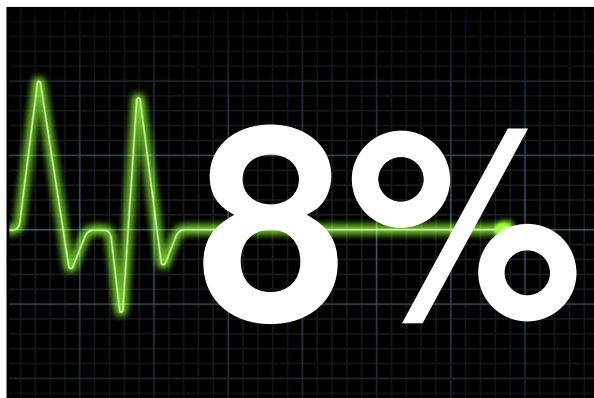
University of Cincinnati Medical Center | UC Health.



MOMENTUM

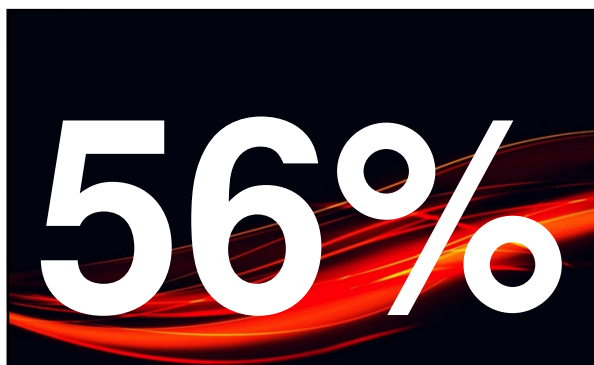
"If a patient is recognized as having sepsis early by EMS personnel, an important trajectory is started that results in decreased time to 2 interventions that are associated with improved survival... aggressive resuscitation, & early antibiotic administration"

ITLS International Trauma Life Support
Ohio ACEP Advanced Critical Emergency Practice
 University of Cincinnati Medical Center | **UC Health**



8%

Kumar A, Roberts D, wood K, et al. Duration of hypotension before initiation of effective antimicrobial therapy is the determinant of survival in human septic shock. Crit Care Med 2006;34:589-96



56%

Brown E, Bleetman A. Ambulance alerting to hospital: the need for clearer guidance. Emerg Med J 2006;23:811-14.



What are departments doing around the country?



Sepsis alert protocol

Centura Health
Prehospital Emergency Services

Centura Health.

- 2 part study in 2009
- 112 patients
- Goal:** Determine EMS feasibility of recognizing sepsis + outcomes
- Utilized POC lactate

ITLS International Trauma Life Support

Ohio ACEP

EARLY DETECTION AND TREATMENT OF PATIENTS WITH SEVERE SEPSIS BY PREHOSPITAL PERSONNEL

Wayne F. Guerra, MD, MBA, Thomas R. Mayfield, MS, NREMT-P, Mary S. Meyers, MS, EMT-P, Anne E. Cloutre, MHS, EMT-P, and John C. Riccio, MD

Table 1. Prehospital Sepsis Alert Protocol Criteria as Stated on Laminated Cards

18 years and older and not pregnant and
At least two systematic inflammatory response syndrome criteria:
Temperature > 38°C (100.4°F) or < 36°C (96.8°F)
Pulse > 90 beats/min
Respiratory rate > 20 breaths/min or mechanically ventilated
and
Suspected or documented infection
and
Hypoperfusion as manifested by one of the following:
Systolic blood pressure < 90 mm Hg
Mean arterial pressure < 65 mm Hg
Lactate level ≥ 4 mmol/L

Table 3. Emergency Medical Services Treatment Protocol for Medical Shock Patients

Administer high-flow oxygen via non-rebreather mask
Establish two large-bore intravenous lines and draw blood samples
Administer 20-cc/kg bolus of crystalloid fluid in 500-cc increments with reassessment of blood pressure and breath sounds after each bolus
Contact base station if systolic blood pressure remains < 90 mm Hg after the 20-cc/kg bolus
Reassess patient regularly and record vital signs, breath sounds, cardiac rhythm, pulse oximetry, venous glucose, and capnography (if available)

ITLS International Trauma Life Support

Ohio ACEP American College of Emergency Physicians

2013

EARLY DETECTION AND TREATMENT OF PATIENTS WITH SEVERE SEPSIS BY PREHOSPITAL PERSONNEL

Wayne F. Guerra, MD, MBA, Thomas R. Mayfield, MS, NREMT-P, Mary S. Meyers, MS, EMT-P, Anne E. Cloutre, MHS, EMT-P, and John C. Riccio, MD

67 of 112 septic patients cared for by "trained providers"

Trained providers identified 32 of these patients (47.8%)

*** 5 pts treated for sepsis by "untrained EMS providers"**

*****30% cryptic septic shock**

Table 4. Patients with Diagnosis of Severe Sepsis: Sepsis Alert Protocol Was Not Initiated by Trained Paramedics Using the Screening Tool

Protocol Not Initiated Due To:	No. of Patients
Prehospital vital signs did not meet criteria	5
Patients had cryptic shock and EMS lactate was not available	8
Patients were identified by an elevated WBC SIRS criteria	13
Severe sepsis not recognized by providers	9
Total	35

EMS = Emergency Medical Services; SIRS = systematic inflammatory response syndrome; WBC = white blood cell count.

ITLS International Trauma Life Support

Ohio ACEP American College of Emergency Physicians

University of Cincinnati Medical Center | **UC Health**

EARLY DETECTION AND TREATMENT OF PATIENTS WITH SEVERE SEPSIS BY PREHOSPITAL PERSONNEL

Wayne F. Guerra, MD, MBA, Thomas R. Mayfield, MS, NREMT-P, Mary S. Meyers, MS, EMT-P, Anne E. Cloutre, MHS, EMT-P, and John C. Riccio, MD

Overall Mortality: 26.7%

Mortality Sepsis Alert Protocol: 13.6% (P= 0.040)

Prehospital Severe Sepsis 1121

Table 5. Unadjusted Mortality of Sepsis Alert Protocol and Non-Sepsis Alert Protocol Patients Transported by Both Trained and Untrained Emergency Medical Technicians and Paramedics (n = 112)

EMS Severe Sepsis Patients	Survivors	Nonsurvivors	Survival: Sepsis Alert Patients,* Odds Ratio	95% Confidence Interval
Alerts† (n = 37)	32	5		
Non-Alerts (n = 75)	50	25	3.19	1.14-8.88

EMS = Emergency Medical Services.
* Fisher's exact test p = 0.040 (Fisher continuity correction, p = 0.045).
† Includes five patients transported by untrained providers.

Table 6. Hospital Interventions: Sepsis Alert Protocol and Non-Sepsis Alert Protocol Patients (n = 112)

Hospital Interventions	Alert (n = 37)	Non-Alert (n = 75)	p Value
Endotracheal intubation, n (%)	3 (8.1)	26 (34.6)	0.003*
Central venous line placement, n (%)	23 (62.1)	51 (68.0)	0.54
Minutes to antibiotics, mean ± SD	72.6 ± 59.3	98.5 ± 89.9	0.07
Hospital length of stay (d), mean ± SD	7.3 ± 6.8	8.4 ± 8.8	0.65

SD = standard deviation.
* Includes five alerts called by untrained providers.

Table 7. Intravenous Fluid Administration: Sepsis Alert Protocol Patients and Non-Sepsis Alert Protocol Patients with Severe Sepsis

Intravenous Fluid Administration	Sepsis Alert Patients (n = 37)	Non-Alert Patients (n = 75)	p Value*
Fluid at 2 h	16.88 ± 12.97	14.97 ± 11.87	0.54
Fluid at 4 h	42.97 ± 33.23	35.17 ± 26.81	0.30
Total fluid (n = 108)	206.4 ± 258.9	263.4 ± 228.2	0.11

Values presented as cc/kg. Includes fluids given by prehospital providers. Values presented as mean ± standard deviation.
* Wilcoxon rank sum.
† Missing values in patient records; 35 missing values at 2 h and 4 h.

ITLS International Trauma Life Support

Ohio ACEP American College of Emergency Physicians

University of Cincinnati Medical Center | **UC Health**

EARLY DETECTION AND TREATMENT OF PATIENTS WITH SEVERE SEPSIS BY PREHOSPITAL PERSONNEL

Wayne F. Guerra, MD, MBA, Thomas R. Mayfield, MS, NREMT-P, Mary S. Meyers, MS, EMT-P, Anne E. Cloutre, MHS, EMT-P, and John C. Riccio, MD

2013

A concern in prehospital sepsis care... the false positives

Table 10. Diagnosis of Patients Not in Severe Sepsis: Sepsis Alert Protocol Initiated by Trained Providers

Diagnosis	No. of Patients
Septic but did not meet criteria for severe sepsis	5
Post-ictal with an infection	1
Pulmonary embolus with infection	1
Ruptured abdominal aortic aneurysm	1
Narcotic withdrawal and infection	1
Tumor lysis syndrome	1
Partial small bowel obstruction	1
Total	11

ITLS International Trauma Life Support
Ohio ACEP
University of Cincinnati Medical Center
Health.

Division of Fire
City of Columbus, Ohio

Standard Operating Procedures

Subject: Sepsis Alert

S.O.P. Number 07-02-23 Vol-CH-Cat.Sub	Approved Fire Chief	Acknowledged Medical Director
---	----------------------------	--------------------------------------

Page: 1 of 2
Reviewed Date: 09/04/2012

Effective Date: 07/01/2012
Revised Date: 09/01/2012

Adult Medical Emergencies **Sepsis Alert**

A. Sepsis is the body's potentially life-threatening response to an infection, which occurs when chemicals released into the bloodstream to fight the infection trigger inflammation throughout the body. This inflammation creates microscopic blood clots that can block nutrients and oxygen from reaching organs, causing them to fail. If sepsis progresses to septic shock, blood pressure drops dramatically and the person may die.

Standard Operating Procedures

Subject: Sepsis Alert

S.O.P. Number 07-02-23 Vol-CH-Cat.Sub	Approved Fire Chief	Acknowledged Medical Director
---	----------------------------	--------------------------------------

Page: 2 of 2
Reviewed Date: 09/04/2012

Effective Date: 07/01/2012
Revised Date: 09/01/2012



Adult Medical Emergencies **Sepsis Alert**

Sepsis Evaluation Criteria	Yes	No
For a patient with suspicion of infection, if "yes" to three or more of the questions below, then pre-hospital screening criteria is met. Declare "Sepsis Alert" and follow appropriate treatment and transportation steps.		
Temperature > 38° C (100.4° F) or < 36° C (96.8° F)?		
Pulse rate > 90?		
Respiratory rate > 20 (or CO ₂ < 30 mm Hg)?		
Systolic blood pressure < 90 mm Hg?		
Lactate level ≥ 4 mmol/L		

Health.

CENTRAL STENO TRAUMA SYSTEM REGIONAL EMS CREATING > (16 YEARS) SEPSIS SCREENING TOOL	
Central Ohio Trauma System	
BMS Agency Name: _____	
Patient Name: _____	
Date/Time: _____	
Serum Lactate Level: _____	
PATIENT HISTORY SUGGESTIVE OF	
• Known or Suspected Infection	<input type="checkbox"/>
• Recent Antibiotic Therapy	<input type="checkbox"/>
• Recent Medical/Surgical Procedure	<input type="checkbox"/>
• Recent Hospitalization	<input type="checkbox"/>
• Indwelling catheter	<input type="checkbox"/>
• History of Cancer	<input type="checkbox"/>
• Patient resident of LTC/rehab facility	<input type="checkbox"/>
<i>If patient history is positive for any of the above, continue to "clinical criteria"</i>	
CLINICAL CRITERIA	
• Systolic BP < 90mmHg	<input type="checkbox"/>
• HR > 90	<input type="checkbox"/>
• RR > 20	<input type="checkbox"/>
• Temperature ≥ 100.4 F or ≤ 96.8 F	<input type="checkbox"/>
• Acute Mental Status Changes	<input type="checkbox"/>
• Lactate Level ≥ 4 mmol/L (if available)	<input type="checkbox"/>
<i>If SBP < 90 or patient meets 2 or more clinical criteria, activate Sepsis Alert</i>	
EMERGENCY DEPARTMENT SEPSIS ALERT	
• Sepsis Alert to ED	<input type="checkbox"/>
• Time Sepsis Alert Activated: _____	<input type="checkbox"/>
APPROVED BY THE PRE-HOSPITAL INTERVENTION TEAM	
• Establish Patient Artery/Intubate if necessary • Administer 100% O ₂ at 15 liters per minute by non re-breather mask (NRB), regardless of SpO ₂ . • Initiate at least one large bore IV of 0.9NS, and preferably two large bore, if time allows, without delaying transport • Administer rapid infusion of normal saline fluid bolus, reassessing blood pressure, pulse and breath sounds with every 500 ml of fluid given to the patient. (If ↑ rates, D/C bolus and maintain IV)	
• Notify Receiving Hospital of Sepsis Alert (if applicable)	
PATIENT MONITORING	
• Vital signs, including temperature and pulse oximetry • Obtain blood sample for lactate (if available) • Apply Cardiac Monitor • Transfer patient flat (if tolerated) • Breath sounds	
Approved by the Pre-Hospital Committee: _____ Approved by the COTS Board: _____	

Orange County EMS System Medical Treatment Protocols



Sepsis

Sepsis is a rapidly progressing, life threatening condition due to systemic infection. Sepsis must be diagnosed early and treated aggressively to prevent progression to shock and death. Sepsis can be identified when the following markers of the Systemic Inflammatory Response Syndrome (SIRS) are present in a patient with suspected infection:

- Temperature > 38°C (100.4°F) OR < 36°C (96.8°F)
- Respiratory Rate > 20 breaths/min
- Heart Rate > 90 beats/min

In addition to physiologic markers of SIRS, severe sepsis may cause hypotension and inadequate organ perfusion, resulting in metabolic acidosis marked by elevated blood lactate levels and decreased TCO2 levels (measured by coagulography)

Sepsis Alert

The purpose of a Sepsis Alert is to provide pre-arrival Emergency Department notification in order to facilitate rapid assessment and treatment of a suspected severe sepsis patient. A Sepsis Alert will be instituted for patients meeting the following 3 criteria:

1. Suspected infection
2. Two or more of the following:
 - Temperature > 38°C (100.4°F) OR < 36°C (96.8°F)
 - Respiratory Rate > 20 breaths/min
 - Heart Rate > 90 beats/min
 - 3. TCO2 ≤ 25 mmHg OR Lactate > 4 mMol


Basic Life Support

- Supplemental 100% Oxygen





Advanced Life Support

- Full ALS Assessment and Treatment
- Notify hospital of incoming Sepsis Alert prior to arrival
- IV 0.9% NaCl as enroute
- Administer 250 ml boluses until systolic BP > 90 mmHg
- Total amount of IVF should not exceed 2000 mL
- Boluses may be given in rapid succession if systolic remains < 90 mmHg
- Syringe BP remains < 90 mmHg after 4 fluid bolus (1000 ml)
- Duration amount of 3-5.00 mmo/hrs treated in metabolic sepsis BP > 90 mm Hg

Take Home Clinical points



- **Manage the airway:** O2 sats > 94%
- **Fluid Resuscitate:** MAP > 65
- **Prevent hypothermia**
- **Trend the vital signs**
- **Check a blood sugar**
- **Transport to the correct ED**
- **Notify the receiving facility**
- **Make your case for sepsis**
- **Advocate for your patient**



Where do we go from here?


- ✓ Continued education
- ✓ Community awareness
- ✓ Improved protocols
- ✓ "Sepsis Centers"
- ✓ Prehospital lactates
- ✓ Further research


University of Cincinnati Medical Center |  Health.


Conclusions

- Sepsis is a **true medical emergency** killing thousands
- For EMS, sepsis is the new STEMI, Stroke, or Trauma
- The first step to making a difference is **clinical suspicion...**
- Early **aggressive resuscitation** saves lives
- Sepsis is tricky... **beware the patient who looks well**
- Remember the risk factors for sepsis
- **Advocate** for your patient in the ED
- Future fight against sepsis will absolutely extend into EMS

"What you do... & what you don't do... makes a difference"


 **ITLS**
International Trauma Life Support


 **Ohio ACEP**
American College of Emergency Physicians
Emergency • Trauma • Critical Care


University of Cincinnati Medical Center |  Health.

References

- Booker E. Sepsis, Severe Sepsis, and Septic shock: Current Evidence for Emergency Department Management. *Emergency Medicine Practice* 2011;13:5
- Blomkalns AL. Lactate- A marker for trauma and sepsis. www.emcreg.org
- Dellinger RP et al. Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2013;41:580-637
- Guerra WF, Mayfield TR, Meyers MS, Cloutre AE, Riccio JC. Early Detection and treatment of patients with severe sepsis by prehospital personnel. *J Emerg Med* 2013;44:1116-1125
- Herlitz J, Bang A, Wireklind-Sundstrom B, et al. Suspicion and treatment of severe sepsis. An overview of the prehospital chain of care. *Journal of Trauma, Resuscitation and Emergency Medicine* 2012;20:42-50
- Robson W, Nutbeam T, Daniels R. Sepsis: a need for prehospital intervention? *Emerg Med J* 2009;26:535-538
- Rubulotta FM, Ramsay G, Parker MM, et al. An international survey: public awareness and perception of sepsis. *Crit Care Med* 2009;37:167-70.
- Seymour CW, Band RA, Cooke CR, et al. Out-of-hospital characteristics and care of patients with severe sepsis: a cohort study. *J Crit Care* 2010;25:553-62.
- Seymour CW, Carlbom D, Engelberg RA, et al. Understanding of Sepsis Among Emergency Medical Services: A Survey Study. *J Emerg Med* 2012;42:666-67

 **ITLS**
International Trauma Life Support

 **Ohio ACEP**
American College of Emergency Physicians
Emergency • Trauma • Critical Care

University of Cincinnati Medical Center |  Health.

References

- Seymour CW, Rea TD, Kahn JM, Walkey AJ, Yealy DM, Angus DC. Severe Sepsis in Pre-Hospital Emergency Care: analysis of incidence, care, and outcome. *Am J Respir Crit Care Med* 2012;186:1264-1271.
- Seymour CW, Cooke CR, Mikkelsen ME, et al. Out-of-hospital fluid in severe sepsis: effect on early resuscitation in the emergency department. *Prehosp Emerg Care* 2010;14:145-152.
- Singh N, Weingart SD. Current Guidelines For The Management of Severe Sepsis and septic Shock. *EMPractice* 2013;5.
- Studnek JR, Artho MR, Garner CL, Jones AE. The impact of emergency medical services on the ED care of severe sepsis. *AJ Emerg Med* 2012;30:51-56.
- Wang HE, Weaver MD, Shapiro NI, Yealy DM. Opportunities for Emergency Medical Services care of sepsis. *Resuscitation* 2010;81:193-7.



University of Cincinnati
Medical Center



Questions



ryan.gerecht@uc.edu