

# There's Nothing Normal About Normal Saline...Sepsis, Including the NS vs. LR Debate

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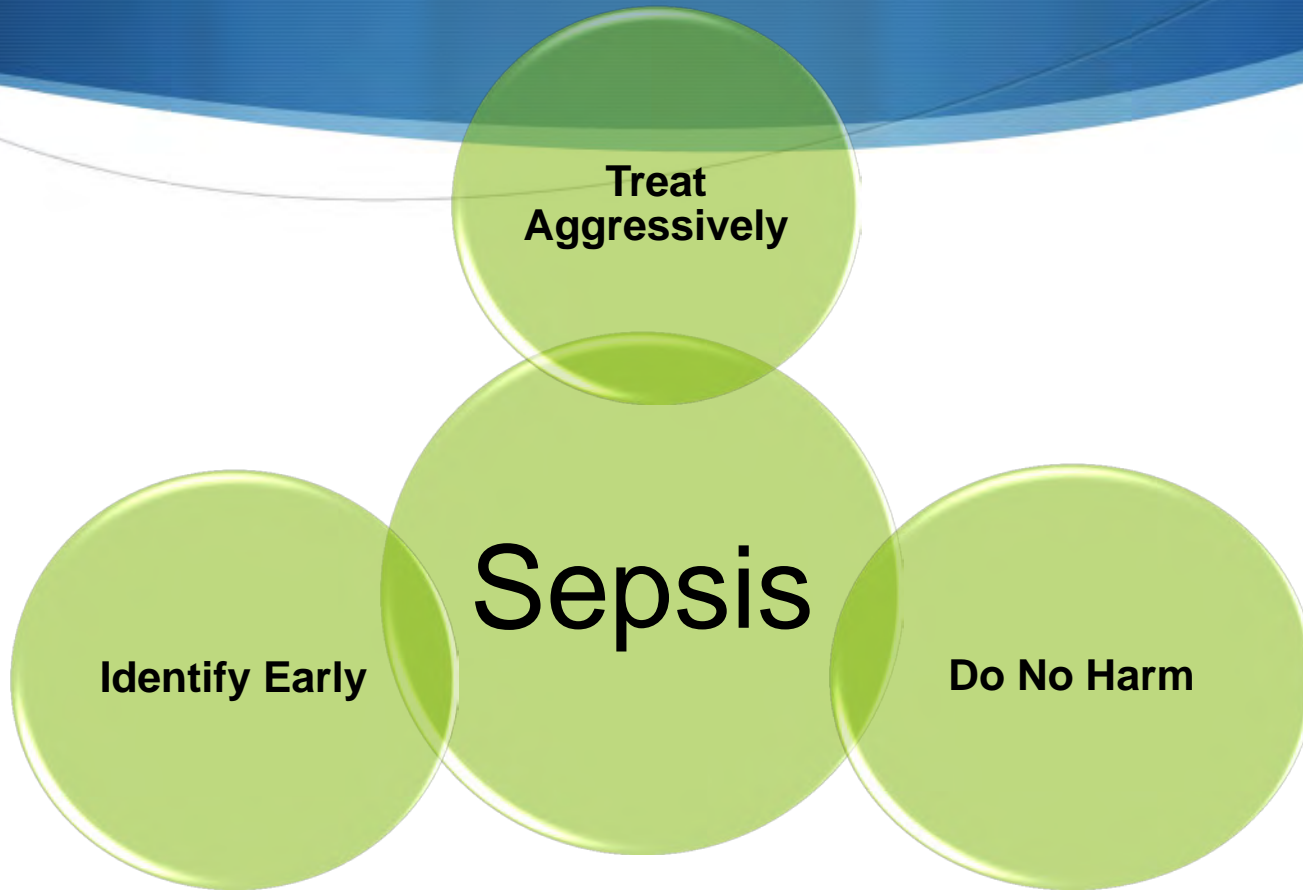


# Disclosures

- ◆ No relevant financial interests to disclose

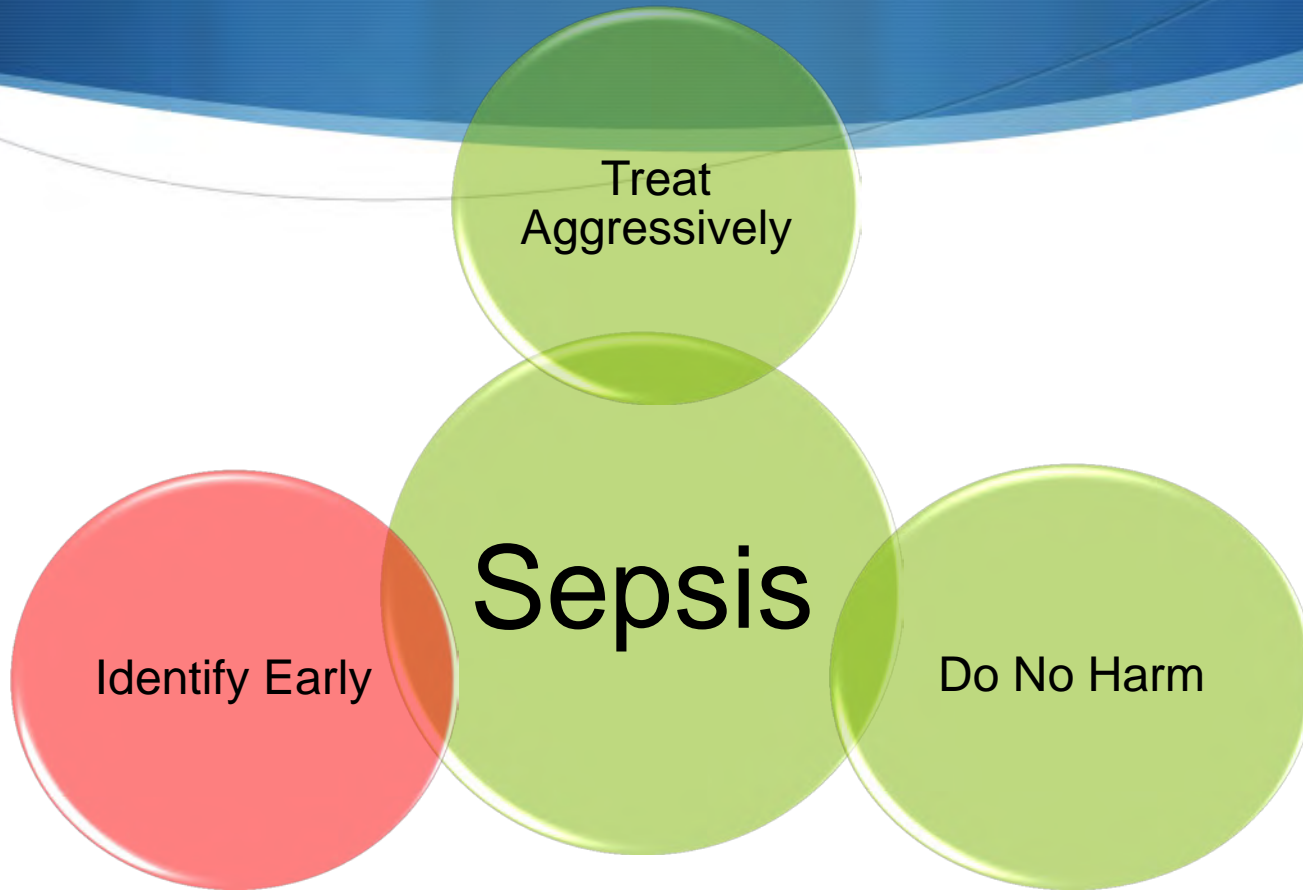


# Goals



**Modern Advanced Sepsis Care**

# Goals

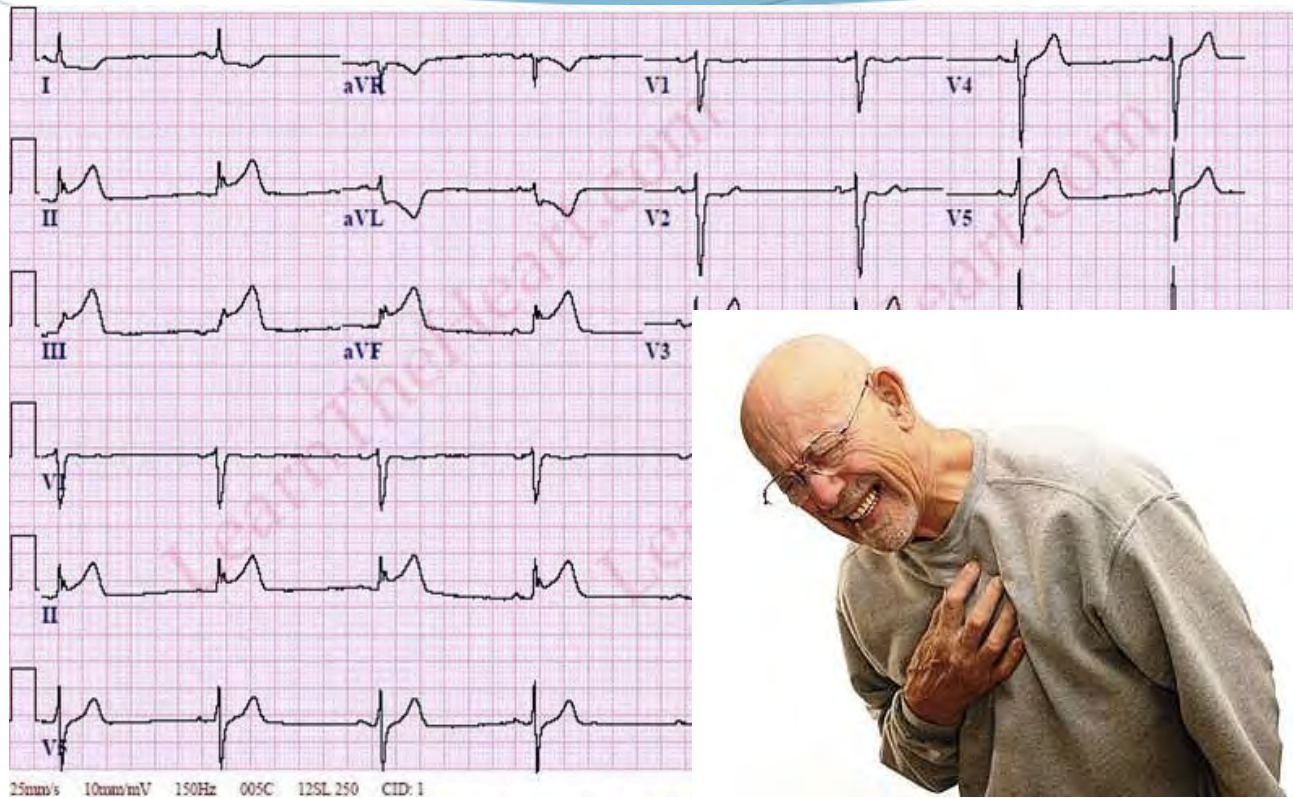


**Modern Advanced Sepsis Care**

# Trauma Golden Hour



# Time Is Muscle



# Time is Brain

**Stroke – there's treatment if you act FAST.**



**F** *Face*  
Face look uneven?



**A** *Arm*  
One arm hanging down?



**S** *Speech*  
Slurred speech?



**T** *Time*  
Call 911 NOW!

**SEPSIS  
KILLS**



# Case #1



# Case #2

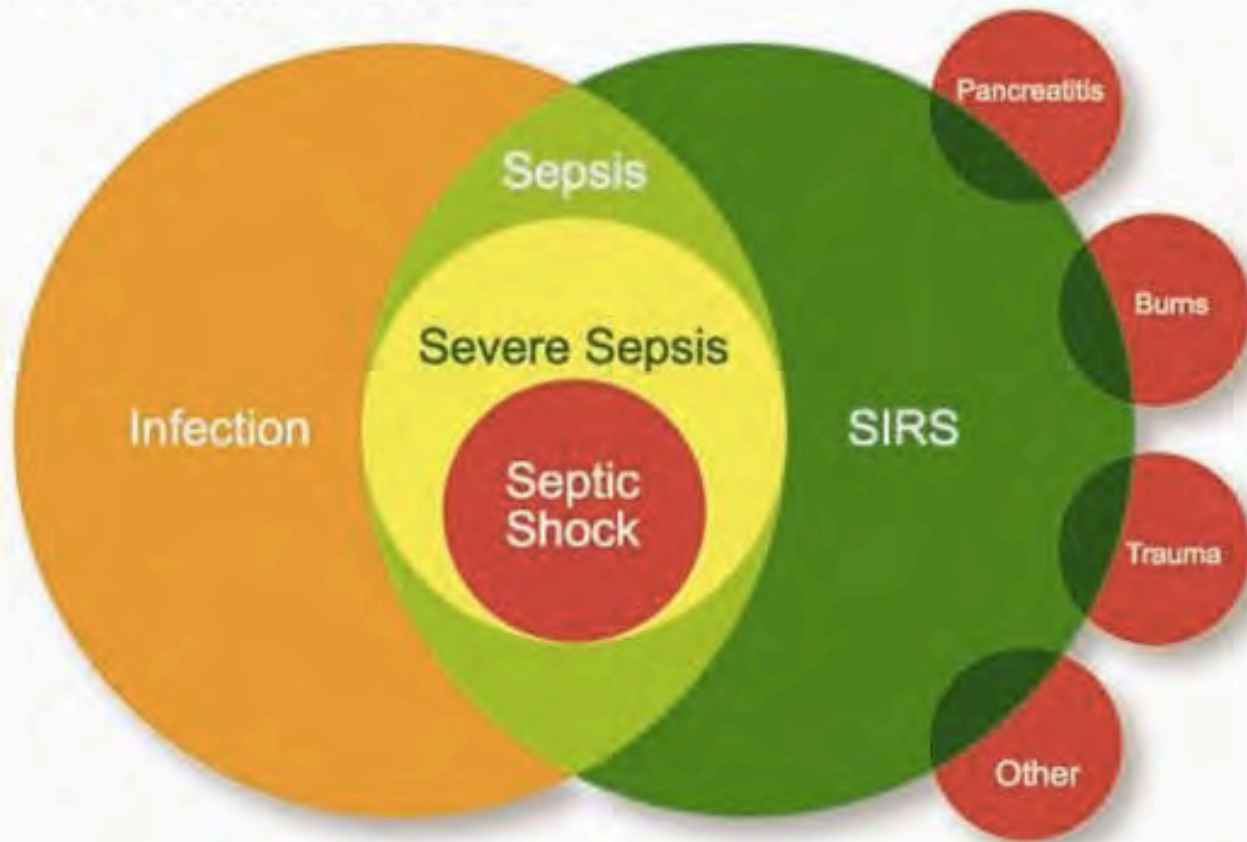


# Sepsis...

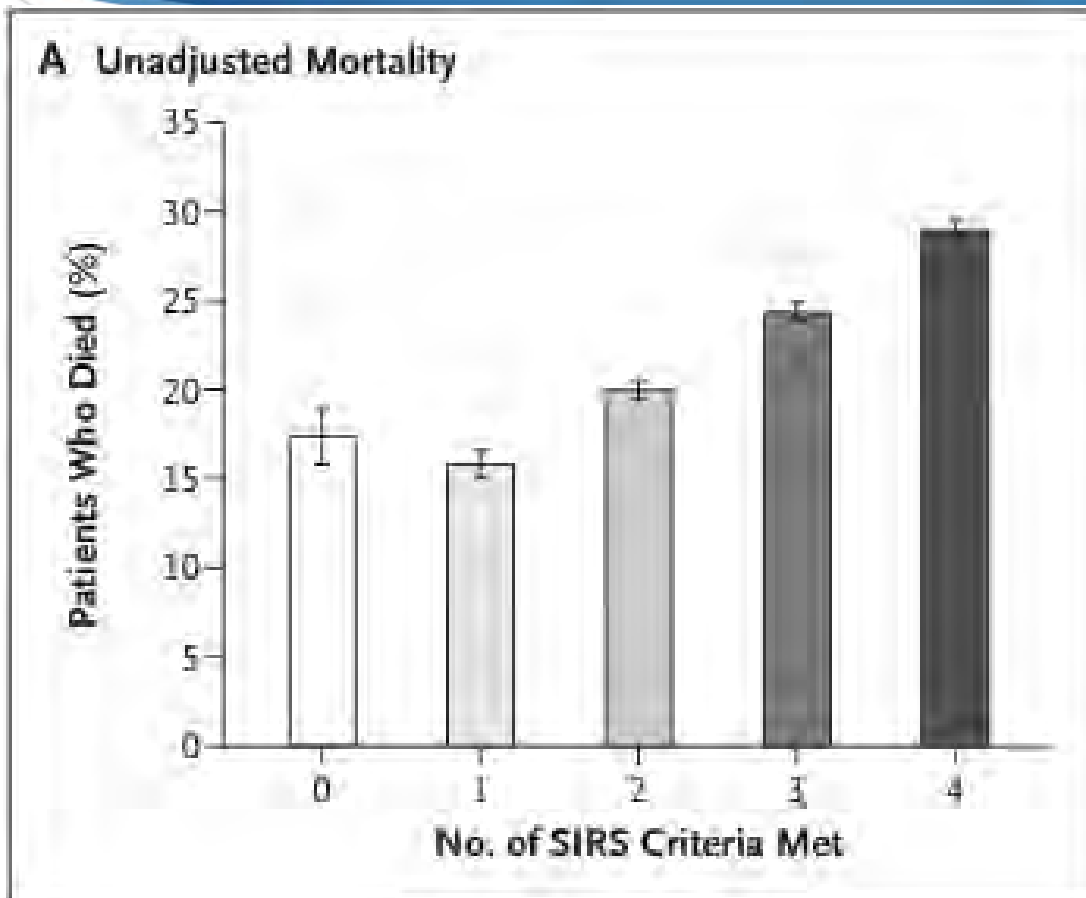


**Time Is Life**

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



# SIRS Criteria Not Perfect



Missed 1 out of 8 patients!



- ◆ Abnormal vitals signs
  - ◆ Shock index & physical exam
- ◆ Elderly & very young
- ◆ Immunosuppressed
  - ◆ Post-transplant, steroids, HIV, chemotherapy
- ◆ Chronic illness
  - ◆ DM, cirrhosis, ESRD (dialysis)
- ◆ Recently hospitalized / Invasive lines
- ◆ YOUR GUT INSTINCT!



# Screening Tools

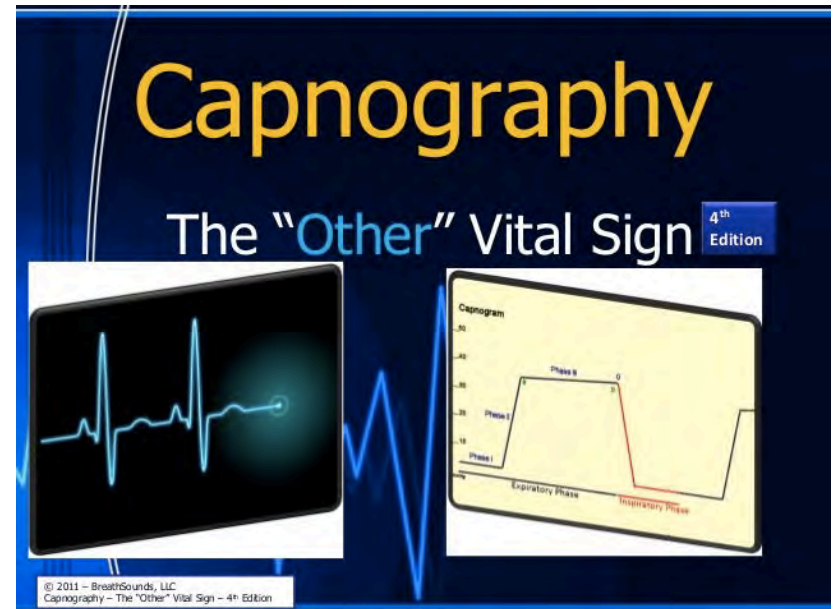
- ◆ Robson Screening Tool
- ◆ PRESEP score
- ◆ BAS 90-30-90
- ◆ Etc.





# Screening Tools

- Pre-hospital lactate measurement
- ETCO<sub>2</sub> as a surrogate marker for lactate



## 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. Clouatre, MHS, EMT-P, and John C. Riccio, MD

J Emerg. Med 2013

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	3.19	1.14-8.88
Non-Alerts (n = 75)	50	25		

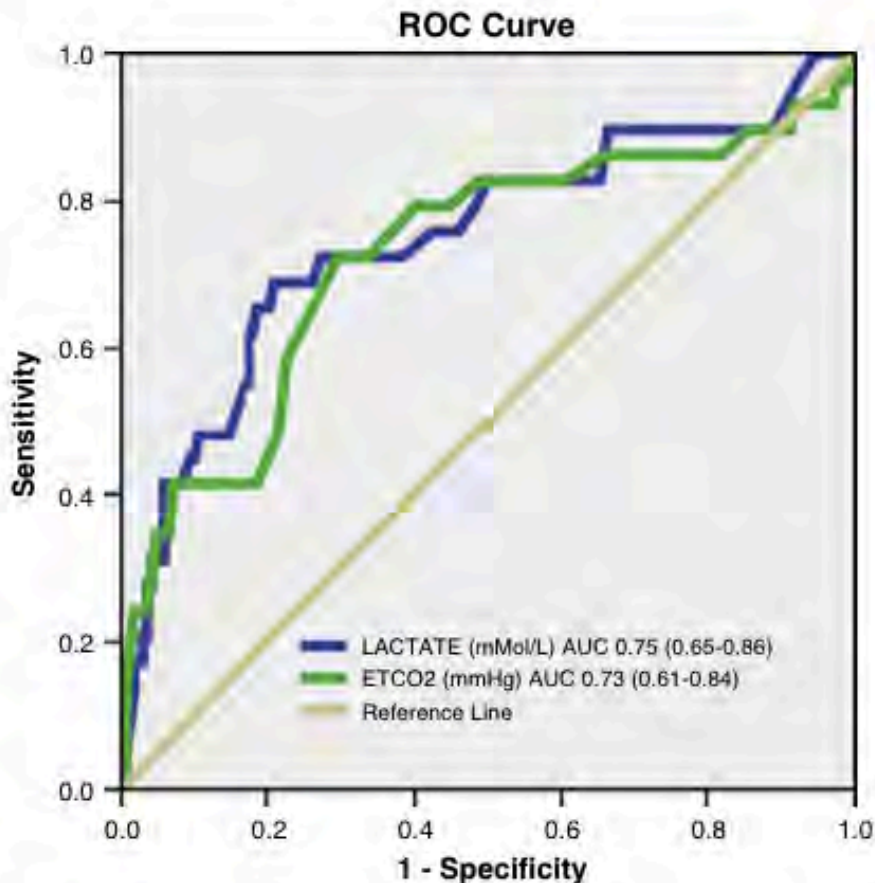
**Overall sepsis mortality – 26.7%**

**Sepsis alert mortality – 13.6%**

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

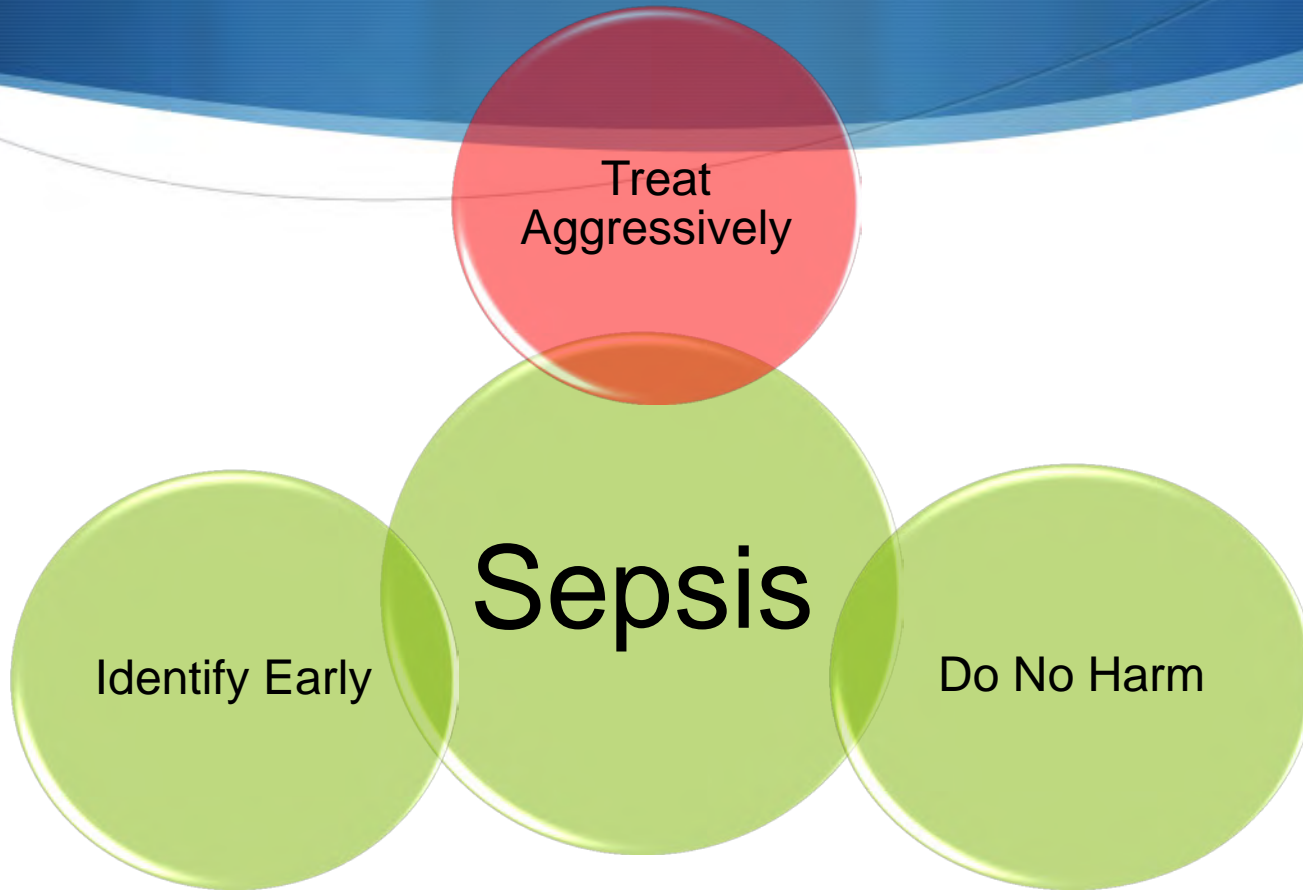
Christopher L. Hunter MD, PhD<sup>a</sup>, Salvatore Silvestri MD<sup>a,b,\*</sup>, Matthew Dean<sup>b</sup>, Jay L. Falk MD<sup>a,b</sup>, Linda Papa MD, MSc<sup>a,b</sup>

Am J. Emerg. Med 2012



**Fig. 2** Receiver operating characteristic curves for predicting mortality in all patients.

# Critical Actions



Treat  
Aggressively

Sepsis

Identify Early

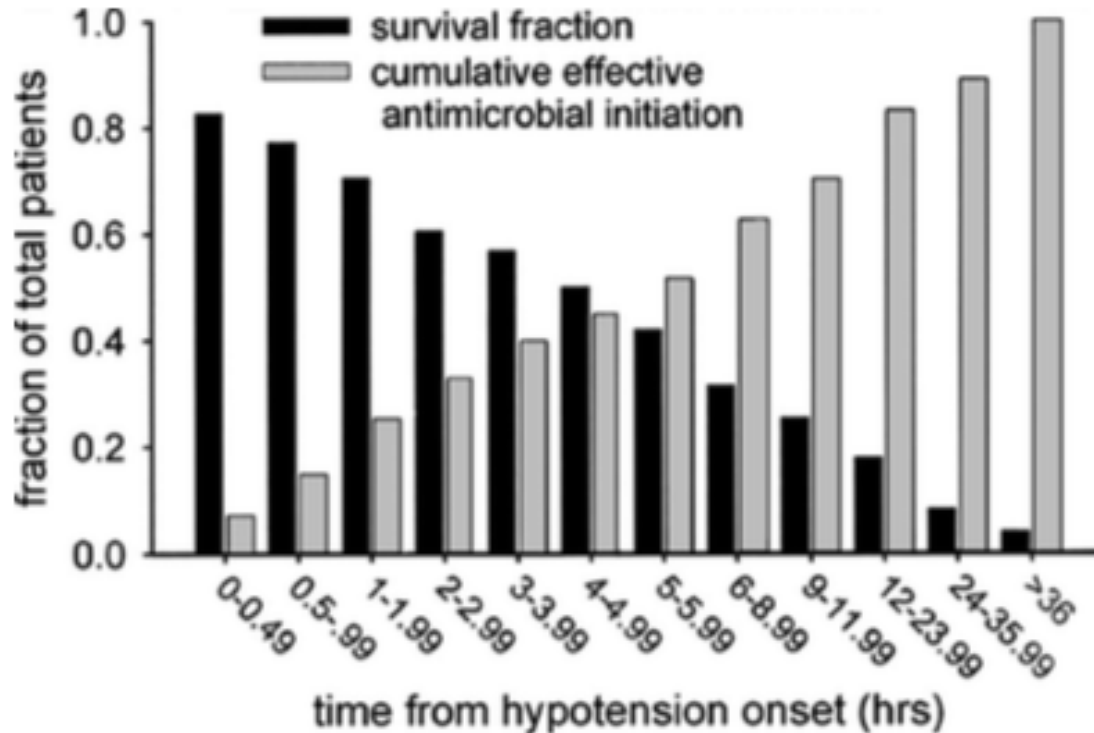
Do No Harm

# Aggressive Treatment

## 💧 Resuscitation

- 💧 Broad spectrum antibiotics...quickly
  - 💧 Pre-hospital???....Stay tuned
- 💧 Source control
  - 💧 If applicable

# To Be Early Is To Be On Time

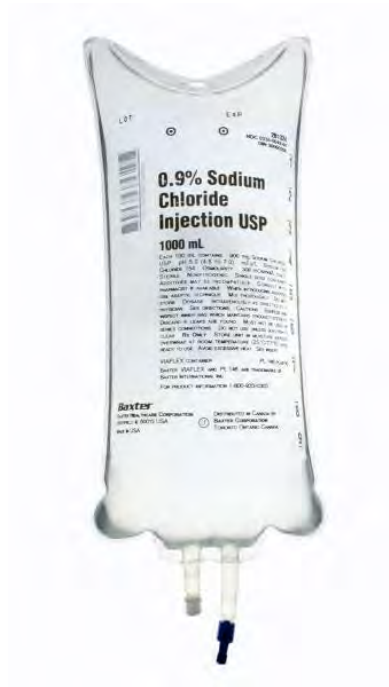
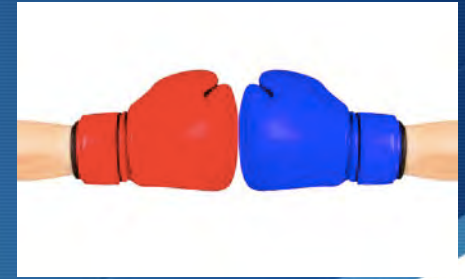


# FLUIDS!!!!



Early

# The Dilemma



Normal Saline

vs.



Lactated Ringer's



# The Problem

**Table 2.** Composition of Trial Fluids<sup>a</sup>

	0.9% Saline	Hartmann
Sodium	150	129
Potassium	0	5
Chloride	150	109
Calcium	0	2
Magnesium	0	0
Lactate	0	29
Acetate	0	0
Gluconate	0	0
Octanoate	0	0

<sup>a</sup>All concentrations in mmol/L.

# The Data

**Association Between a Chloride-Liberal  
vs Chloride-Restrictive Intravenous Fluid  
Administration Strategy and Kidney Injury  
in Critically Ill Adults**

JAMA 2012

# The Data

**Table 3.** Incidence of Acute Kidney Injury Stratified by Risk, Injury, Failure, Loss, and End-Stage (RIFLE) Serum Creatinine Criteria

RIFLE class	No. (%) [95% CI] of Patients <sup>a</sup>		P Value
	Control Period (n = 760)	Intervention Period (n = 773)	
Risk	71 (9.0) [7.2-11.0]	57 (7.4) [5.5-9.0]	.16
Injury	48 (6.3) [4.5-8.1]	23 (3.0) [1.8-4.2]	.002
Failure	57 (7.5) [5.6-9.0]	42 (5.4) [3.8-7.1]	.10
Injury and failure	105 (14) [11-16]	65 (8.4) [6.4-10.0]	<.001

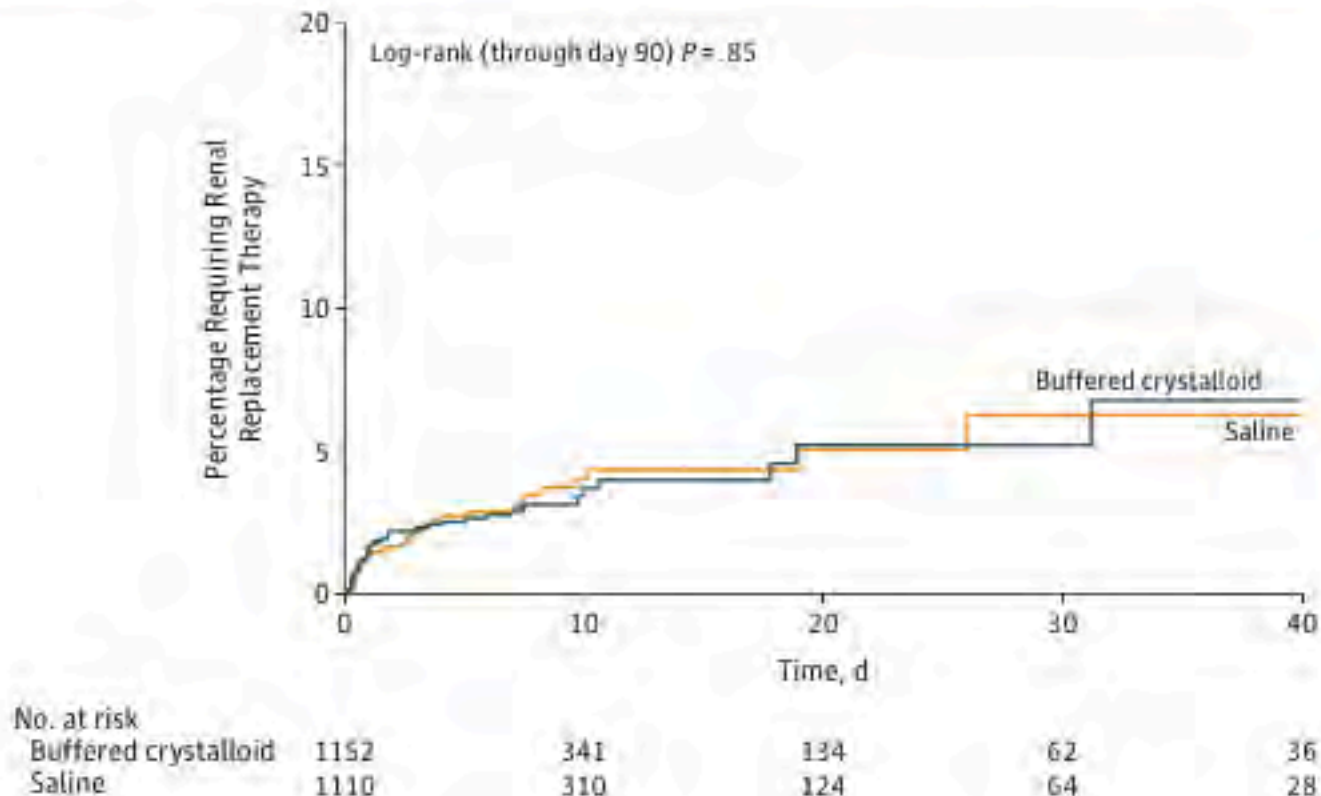
<sup>a</sup> The control period was from February 18 through August 17, 2008, and the intervention period was from February 18 through August 17, 2009.

# Effect of a Buffered Crystalloid Solution vs Saline on Acute Kidney Injury Among Patients in the Intensive Care Unit

## The SPLIT Randomized Clinical Trial

JAMA 2015

Figure 2. Cumulative Incidence of Patients Requiring Renal Replacement Therapy Until Day 90 After Enrollment in the SPLIT Trial



# My Thoughts? (Pre-Hospital Setting)





**Surviving  
Sepsis**

**Campaign**

## **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  $\geq 4$ mmol/L

MAP < 65-70  
(despite fluid  
boluses)

Start weight based  
**Norepinephrine** & titrate up  
\*PIV okay temporarily\*

MAP < 65-70

Reassess volume status

Vasopressin +  
IV steroids  
+/- Dobutamine

# SSG Updates 04/2015

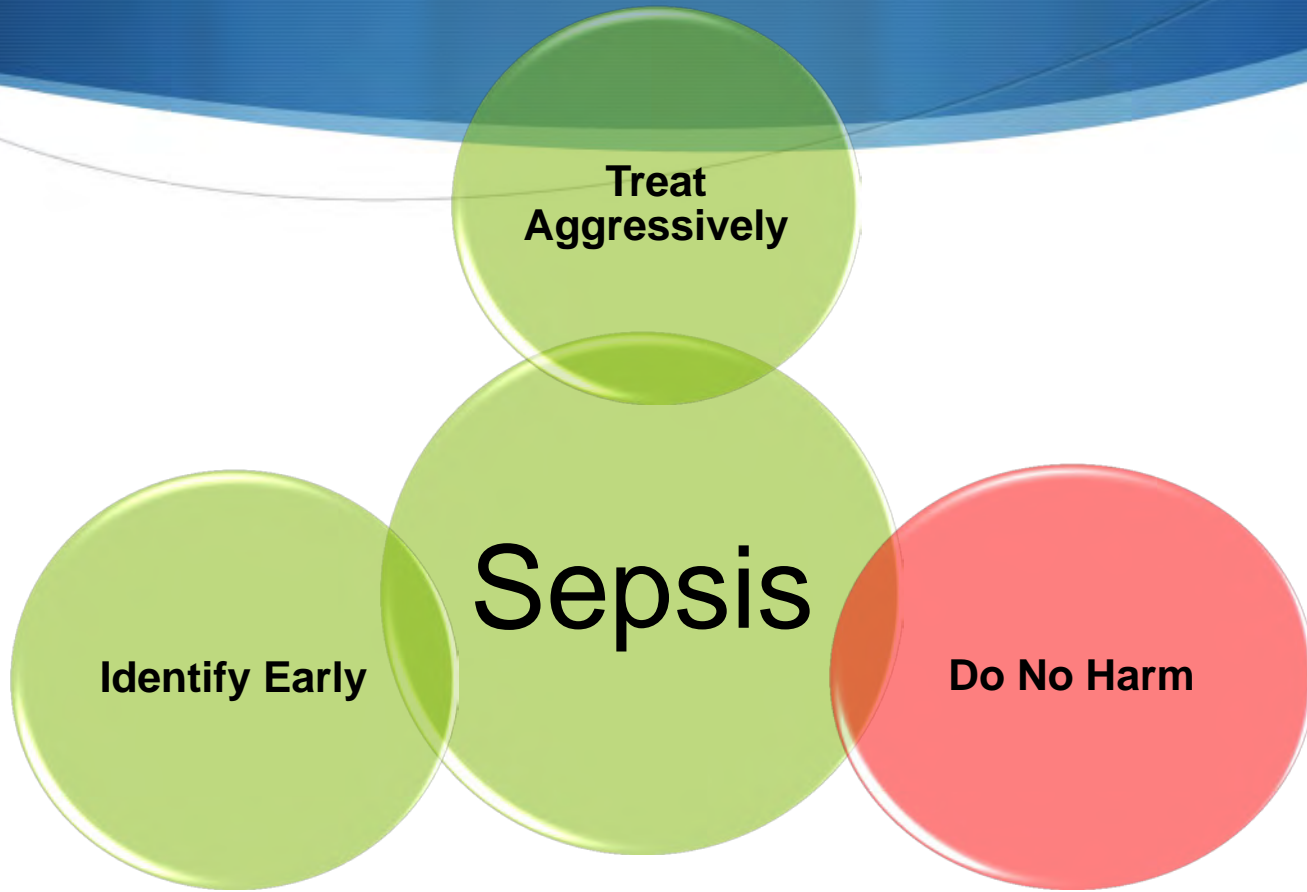
TO BE COMPLETED WITHIN 6 HOURS OF TIME OF PRESENTATION:

5. Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a mean arterial pressure (MAP)  $\geq 65$  mmHg
6. In the event of persistent hypotension after initial fluid administration (MAP < 65 mm Hg) or if initial lactate was  $\geq 4$  mmol/L, re-assess volume status and tissue perfusion and document findings according to Table 1.
7. Re-measure lactate if initial lactate elevated.

CVP and ScVO<sub>2</sub> *optional*



# Goals



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# When **Less** Is More

- 💧 **Less** tidal volume
  - 💧 Protect the lungs
- 💧 **Less** blood
- 💧 **Less** heavy sedation/paralysis

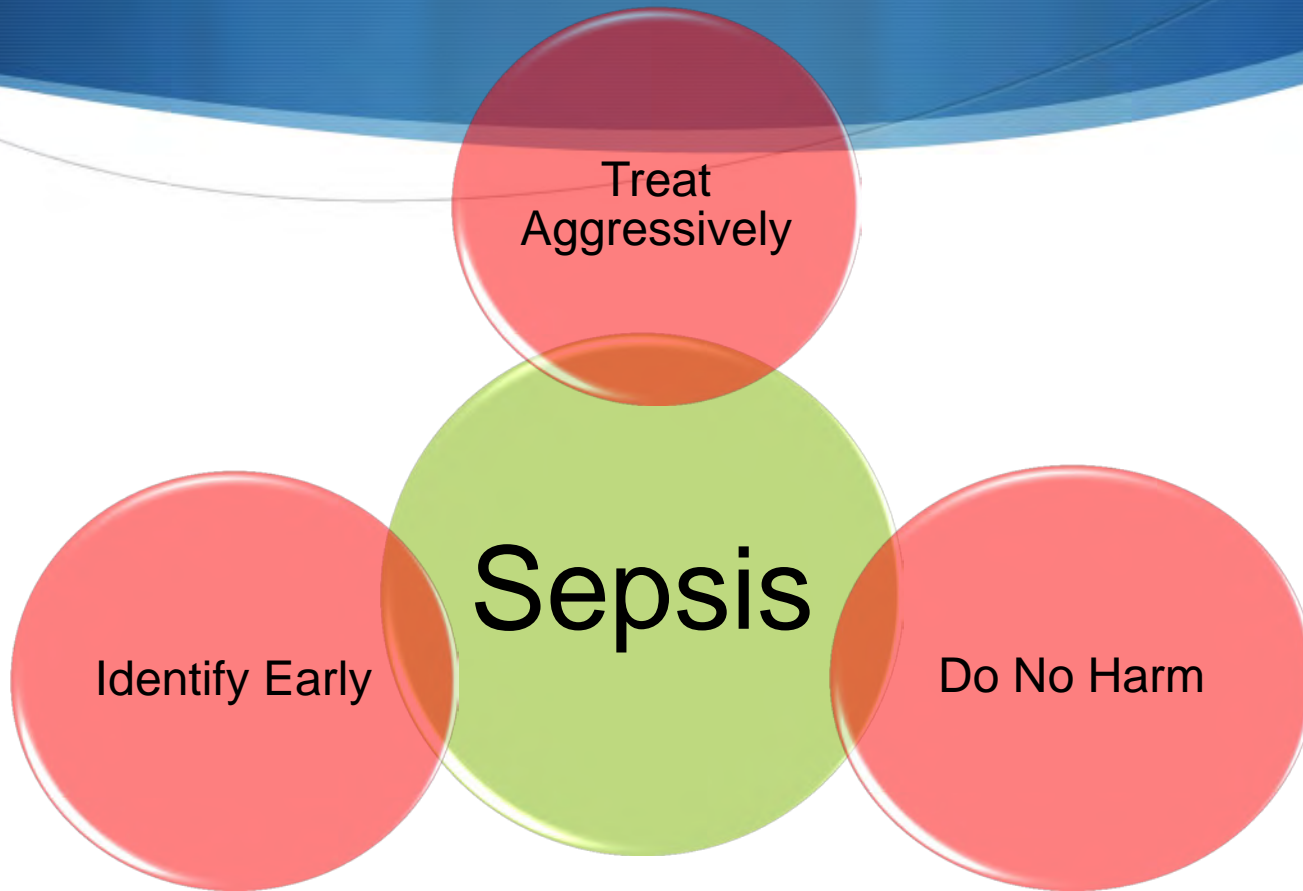
- 💧 **Less** immobility
- 💧 **Less** delirium and sleepless nights
- 💧 **Less** NPO / TPN

MONTH DAY YEAR PM HOUR MIN  
OCT 26 1985 : 09 : 00  
DESTINATION TIME

MONTH DAY YEAR PM HOUR MIN  
OCT 28 2005 : 00 : 28  
PRESENT TIME

MONTH DAY YEAR PM HOUR MIN  
NOV 12 1999 : 00 : 38

# Sepsis in 2045



**“Future” Advanced Sepsis Care**