

# Sepsis in the Pre-hospital Setting

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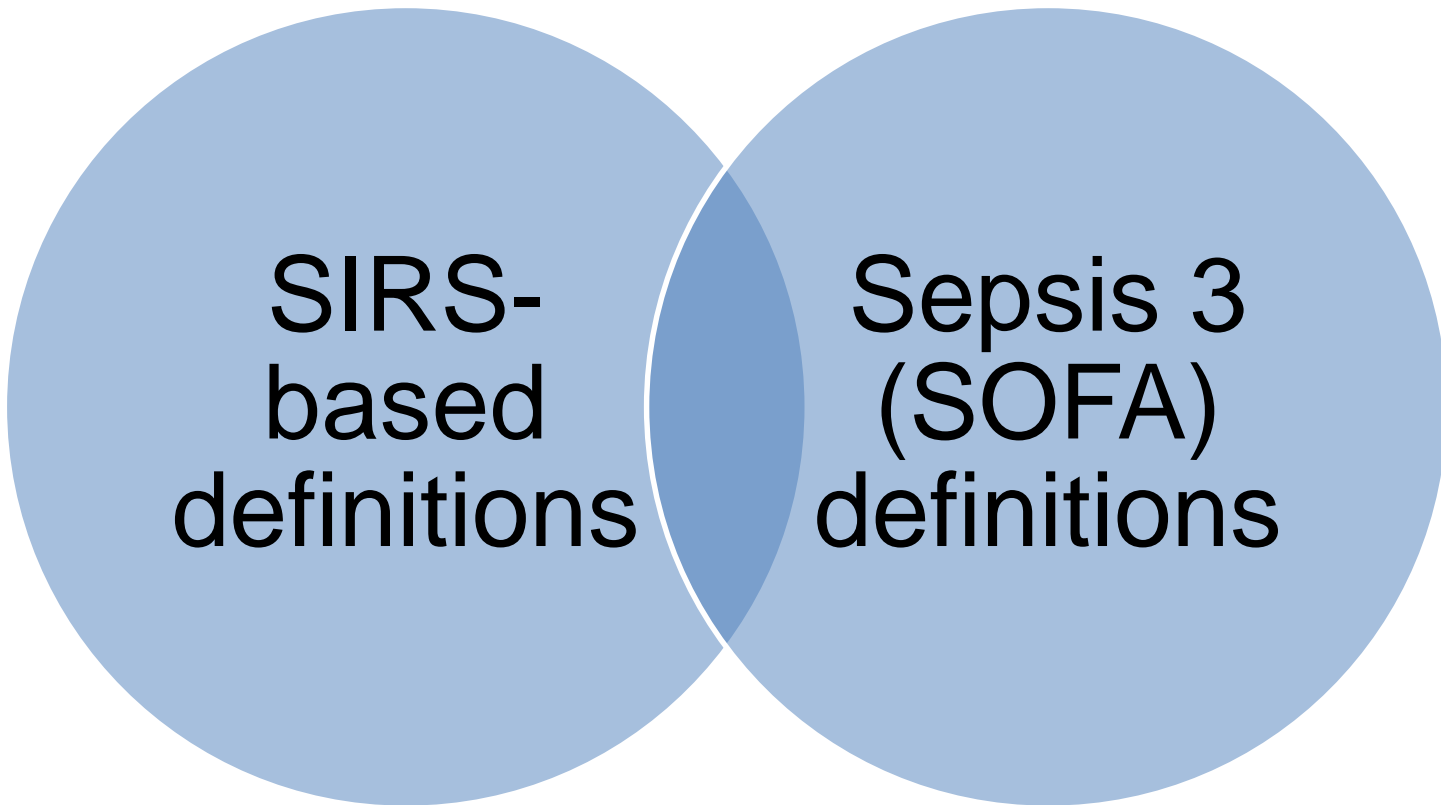
# Outline

*Sepsis definitions and epidemiology*

Diagnostic tools

Integrating with hospital care

# What is *sepsis*?



*life-threatening organ dysfunction caused by a dysregulated host response to infection*

	ESTABLISHED DEFINITIONS <i>(used by CMS)</i>	SEPSIS-3 DEFINITIONS
<b>SEPSIS</b>	Presumed/known infection + $\geq 2$ systemic inflammatory response syndrome criteria	$\geq 2$ SOFA criteria (present or increased)  Includes: hypotension + normal lactate (shock)
<b>SEVERE SEPSIS</b>	Sepsis + end organ dysfunction, lactate $> 4$ mmol/L	Not a category
<b>SEPTIC SHOCK</b>	Sepsis + refractory hypotension ( $\pm$ lactate)	Vasopressors and lactate $> 2$ mmol/L

Why does lactate greater  $> 4$  mmol/L mean?

System	Score				
	0	1	2	3	4
<b>Respiration</b>					
PaO <sub>2</sub> /FIO <sub>2</sub> , mmHg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
<b>Coagulation</b>					
Platelets, ×10 <sup>3</sup> μL <sup>-1</sup>	≥150	<150	<100	<50	<20
<b>Liver</b>					
Bilirubin, mg dL <sup>-1</sup> (μmol L <sup>-1</sup> )	<1.2 (20)	1.2–1.9 (20–32)	2.0–5.9 (33–101)	6.0–11.9 (102–204)	>12.0 (204)
<b>Cardiovascular</b>					
MAP ≥ 70 mmHg	MAP < 70 mmHg	Dopamine < 5 or dobutamine (any dose) <sup>a</sup>	Dopamine 5.1–15 or epinephrine ≤ 0.1 or norepinephrine ≤ 0.1 <sup>a</sup>	Dopamine > 15 or epinephrine > 0.1 or norepinephrine > 0.1 <sup>a</sup>	
<b>Central Nervous System (CNS)</b>					
Glasgow Coma Scale score <sup>b</sup>	15	13–14	10–12	6–9	<6
<b>Renal</b>					
Creatinine, mg dL <sup>-1</sup> (μmol L <sup>-1</sup> )	<1.2 (110)	1.2–1.9 (110–170)	2.0–3.4 (171–299)	3.5–4.9 (300–440)	>5.0 (440)
Urine output, mL per day				<500	<200

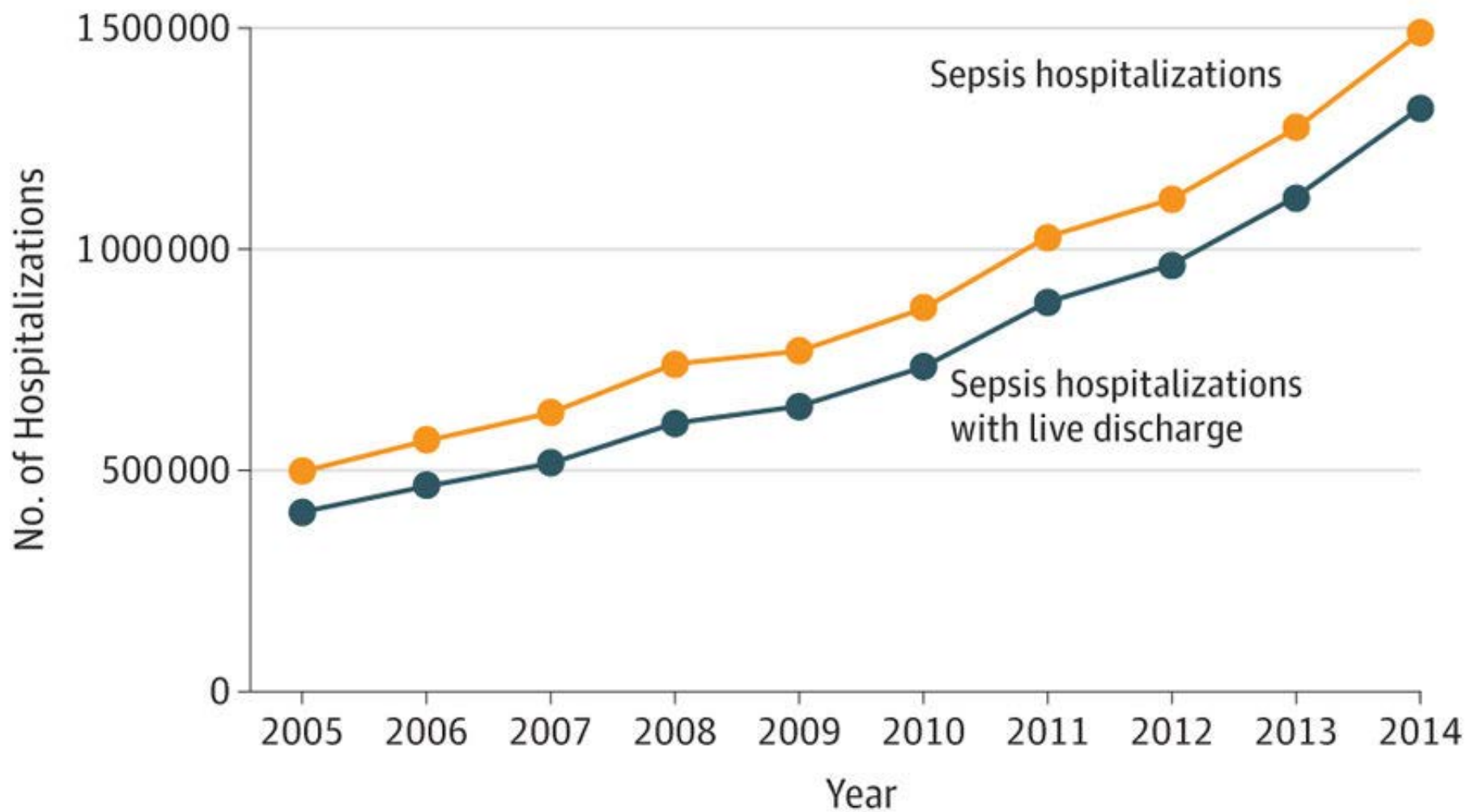
FIO<sub>2</sub>: fraction of inspired oxygen; MAP: mean arterial pressure; PaO<sub>2</sub>: partial pressure of oxygen.

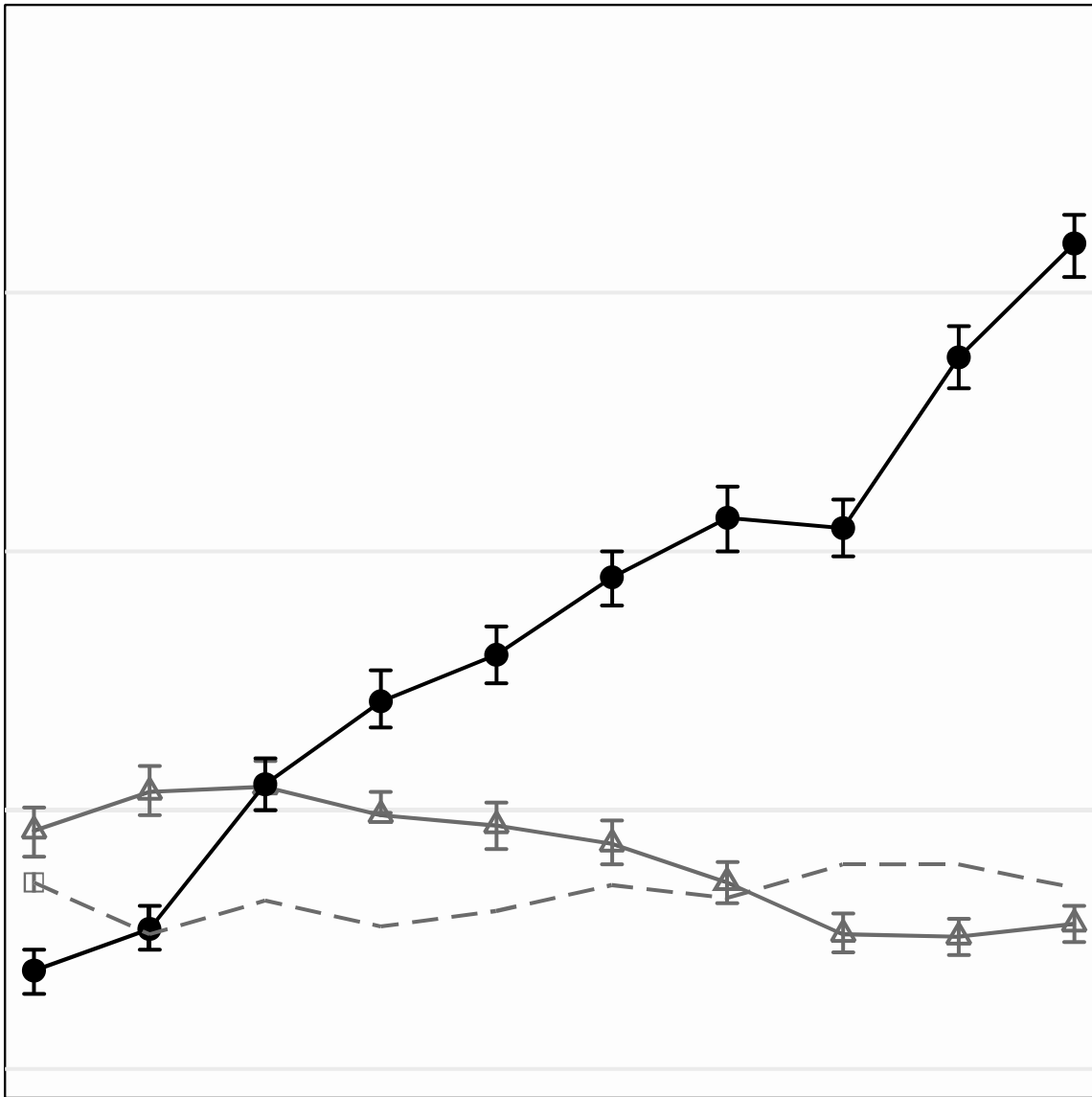
<sup>a</sup>Catecholamine doses are given as μg kg<sup>-1</sup> min<sup>-1</sup> for at least 1 h.

<sup>b</sup>Glasgow Coma Scale scores range from 3 to 15; higher score indicates better neurological function.

<b>BLS</b>	<b>ALS</b>
<ul style="list-style-type: none"><li><input type="checkbox"/> O<sub>2</sub> Saturation prn</li><li><input type="checkbox"/> O<sub>2</sub> and/or ventilate prn</li><li><input type="checkbox"/> NPO, anticipate vomiting</li><li><input type="checkbox"/> Remove any transdermal patch</li><li><input type="checkbox"/> Obtain baseline temperature</li></ul>	<ul style="list-style-type: none"><li><input type="checkbox"/> Monitor EKG</li><li><input type="checkbox"/> IV/IO <u>SO</u></li><li><input type="checkbox"/> Capnography <u>SO</u> prn</li></ul> <div data-bbox="879 464 1781 839" style="border: 2px solid red; padding: 5px;"><p><b><u>Suspected Sepsis:</u></b> If history <b>suggestive of infection</b> and two or more of the following are present, suspect sepsis and report:</p><ol style="list-style-type: none"><li>1. Temperature <math>\geq 100.4</math> or <math>&lt; 96.8</math></li><li>2. HR <math>\geq 90</math></li><li>3. RR <math>\geq 20</math></li></ol></div> <p><b><u>Administer:</u></b></p> <ul style="list-style-type: none"><li><input type="checkbox"/> 500 ml fluid bolus regardless of blood pressure or lung sounds IV/IO <u>SO</u></li><li><input type="checkbox"/> 500 ml fluid bolus if BP <math>&lt; 90</math> regardless of lung sounds <u>SO</u> x1 after initial fluid bolus</li></ul> <p><b>If BP refractory to fluid boluses:</b> Dopamine 400 mg/250 ml @ 10-40 mcg/kg/min IV/IO drip. Titrate BP <math>\geq 90</math> <i>BHPO</i>.</p>

**Note:** The initial treatment of sepsis involves maximizing perfusion with intravenous fluid boluses, not vasopressors.







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*Diagnostic tools*

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# WHY DOES LACTATE RISE IN SEPSIS?

TRADITIONAL THINKING



MARIK & BELLOMO

GLOBAL HYPOPERFUSION



HYPOXIC METABOLISM



INCREASED PYRUVATE



INCREASED LACTATE

ADRENALINE



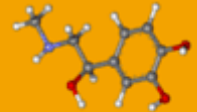
HYPERMETABOLIC STATE

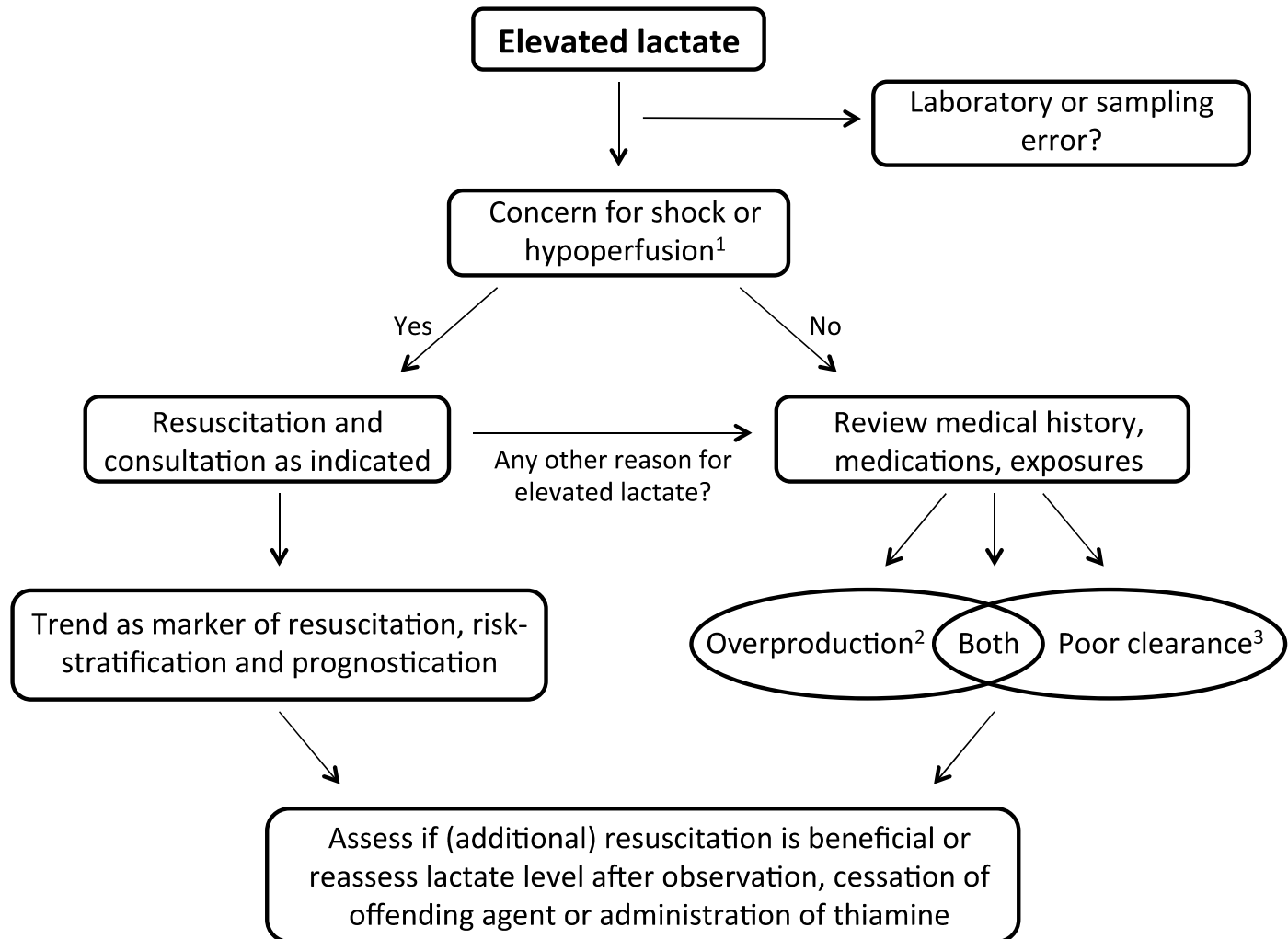


INCREASED PYRUVATE



INCREASED LACTATE





1: Cardiac arrest, any shock state, limb or mesenteric ischemia, compartment syndrome, trauma, burn or inhalational injury, cyanide toxicity

2: Beta agonists, sepsis, seizure, exertion, malignancy, alcohol, diabetic ketoacidosis

3: Liver injury, renal failure, thiamine deficiency



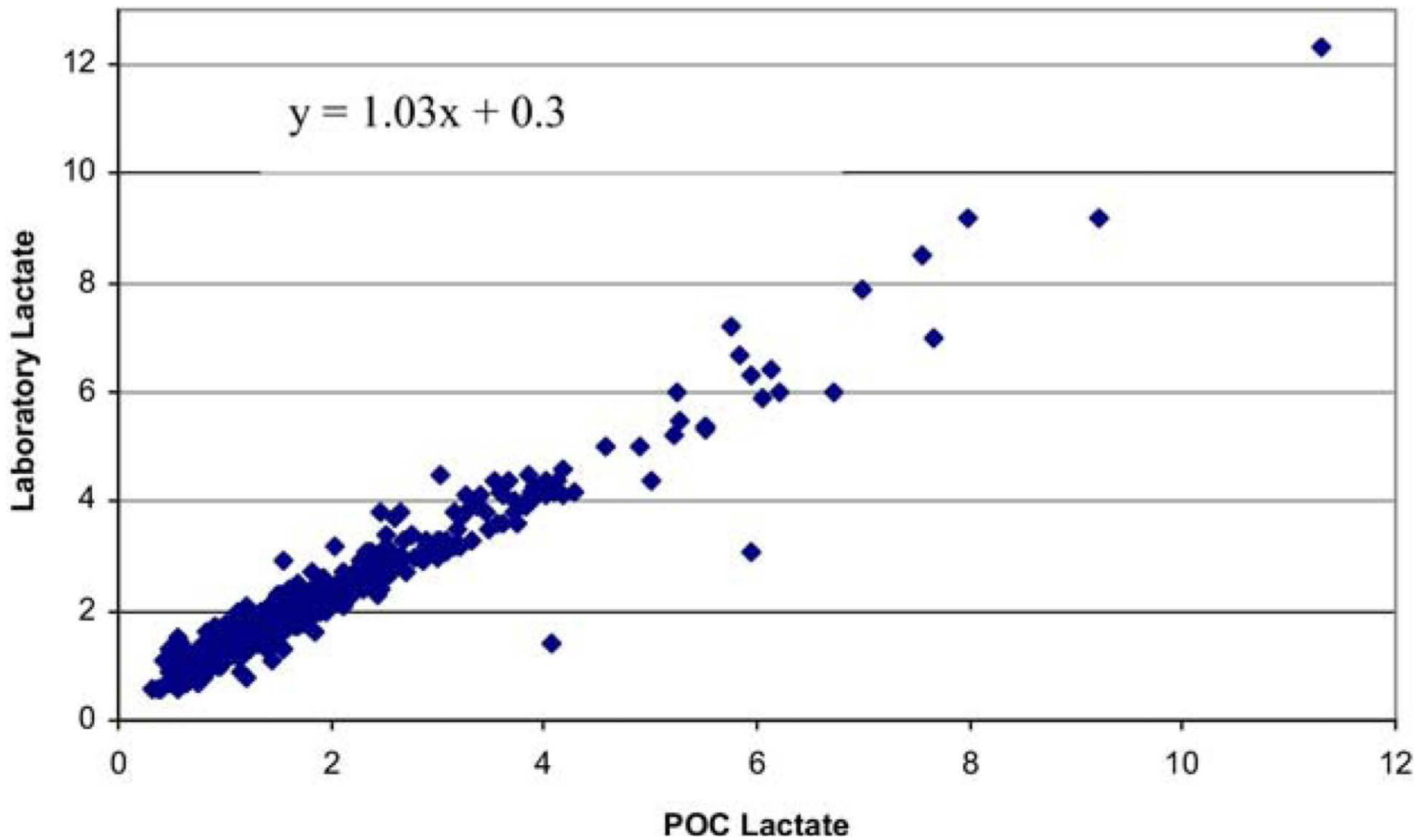
Lactate Pro 2

14.1  
mmol/L  
14:26

arkray



arkray



# EtCO<sub>2</sub> instead of lactate?

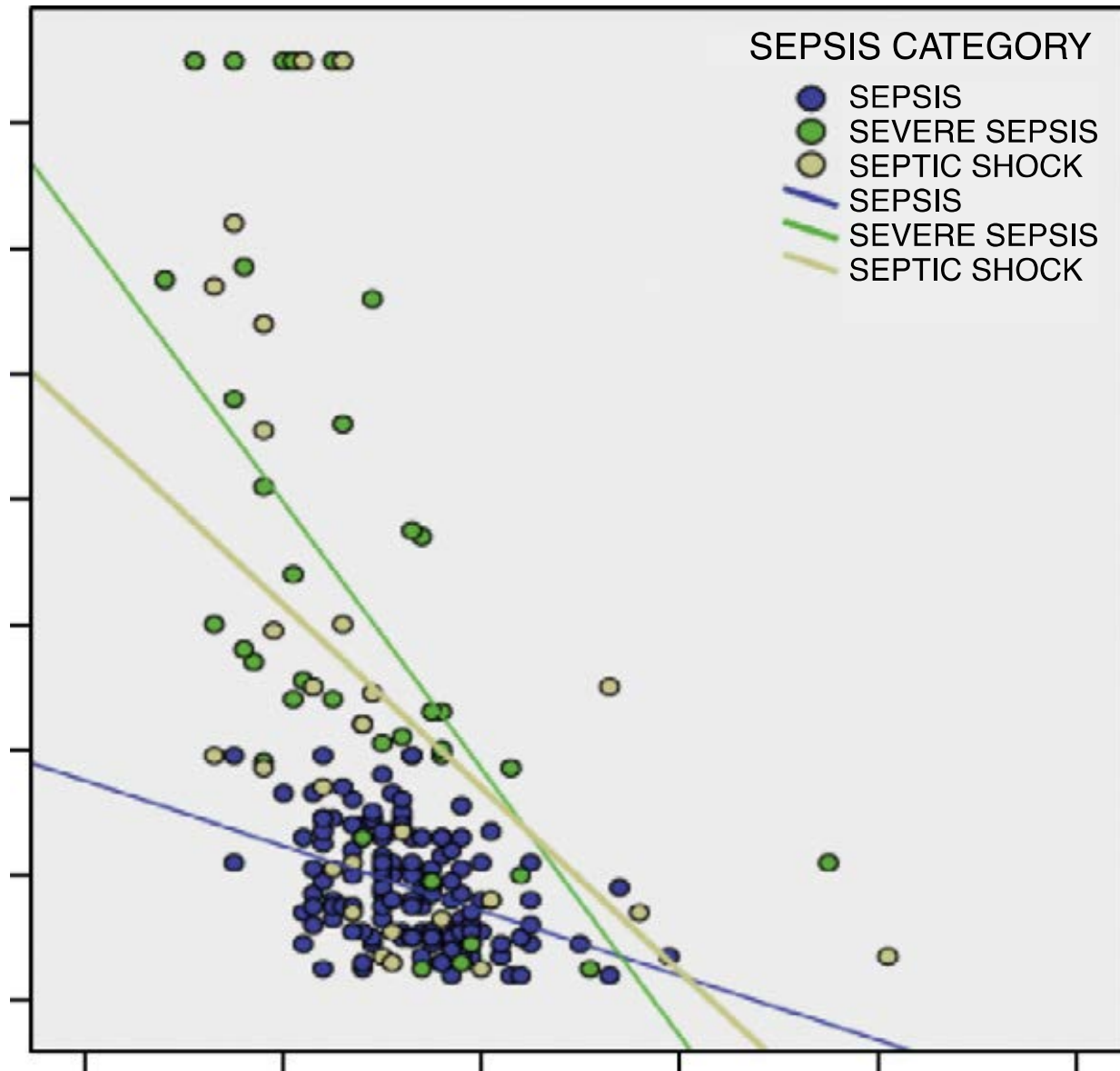
Easier to use than POC  
lactate

Less invasive

Continuous monitoring

But does it correlate?





# Risk assessment in sepsis



**Table 3 Day-1 body temperature and 28-day mortality**

Range of body temperature (°C)	28-day mortality	Unadjusted odds ratio	95% CI	P-value
≤35.5	40.4%	3.096	1.611, 5.947	0.001
35.6 to 36.5	34.4%	2.032	1.009, 4.088	0.047
36.6 to 37.5	20.5%	1.000	(reference)	
37.6 to 8.5	18.1%	0.853	0.461, 1.577	0.621
38.6 to 39.5	15.8%	0.726	0.377, 1.395	0.404
≥39.6	17.2%	0.803	0.363, 1.778	0.693




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# Sepsis 1973 Harrison's Internal Medicine, 6<sup>th</sup> Edition

- Early volume resuscitation (8-12 L)
- Measure CVP
- Hourly urine output
- Early appropriate antibiotics (ampicillin, kanamycin)
- Vasoactive drugs (phenoxybenzamine, isoproterenol)
- Consider corticosteroids
- Transfuse



# 2016 SEP-1 Measure

## Severe Sepsis/Septic Shock : SEP-1

### To be completed within 3 hours:

- Serum Lactate
- Blood cultures before initial antibiotic administration
- Administration of broad-spectrum antibiotics
- Administration of 30 mL/kg crystalloid for hypotension or lactate  $\geq 4$  mmol/L

### To be completed within 6 hours:

- Repeat lactate for elevated initial lactate (Lactate $>2$ )
- For hypotension that does not respond to initial fluid administration, administration of vasopressors to maintain MAP  $>65$ mmHg
- Repeat volume status and tissue perfusion reassessment if hypotension persists after fluid admin

**BLS**

**ALS**

- O<sub>2</sub> Saturation prn
- O<sub>2</sub> and/or ventilate prn
- NPO, anticipate vomiting
- Remove any transdermal patch
- Obtain baseline temperature

- Monitor EKG
- IV/IO SO
- Capnography SO prn

**Suspected Sepsis:**

If history **suggestive of infection** and two or more of the following are present, suspect sepsis and report:

1. Temperature  $\geq 100.4$  or  $< 96.8$
2. HR  $\geq 90$
3. RR  $\geq 20$

**Administer:**

- 500 ml fluid bolus regardless of blood pressure or lung sounds IV/IO SO
- 500 ml fluid bolus if BP  $< 90$  regardless of lung sounds SO x1 after initial fluid bolus

**If BP refractory to fluid boluses:**

Dopamine 400 mg/250 ml @ 10-40 mcg/kg/min IV/IO drip. Titrate BP  $\geq 90$  BHPO.

**Note:** The initial treatment of sepsis involves maximizing perfusion with intravenous fluid boluses, not vasopressors.

EMS transports to King County acute care hospitals  
N = 45,394

Excluded

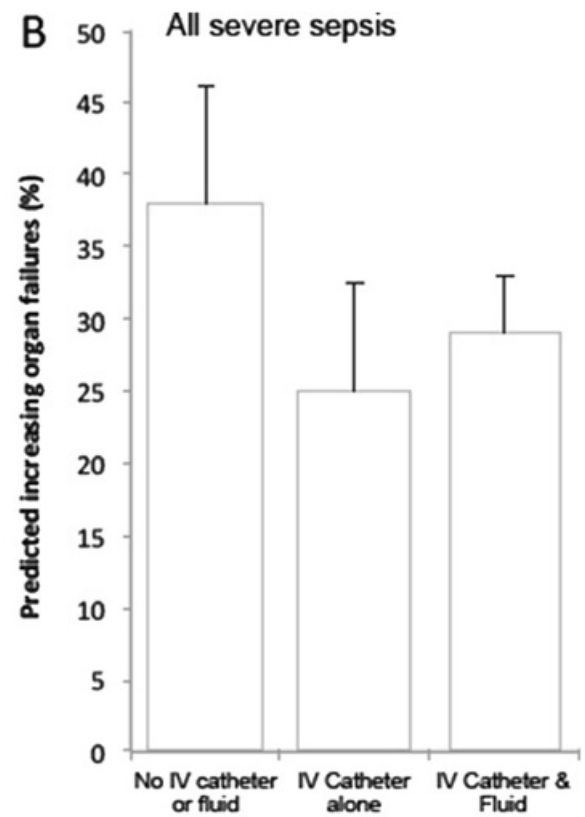
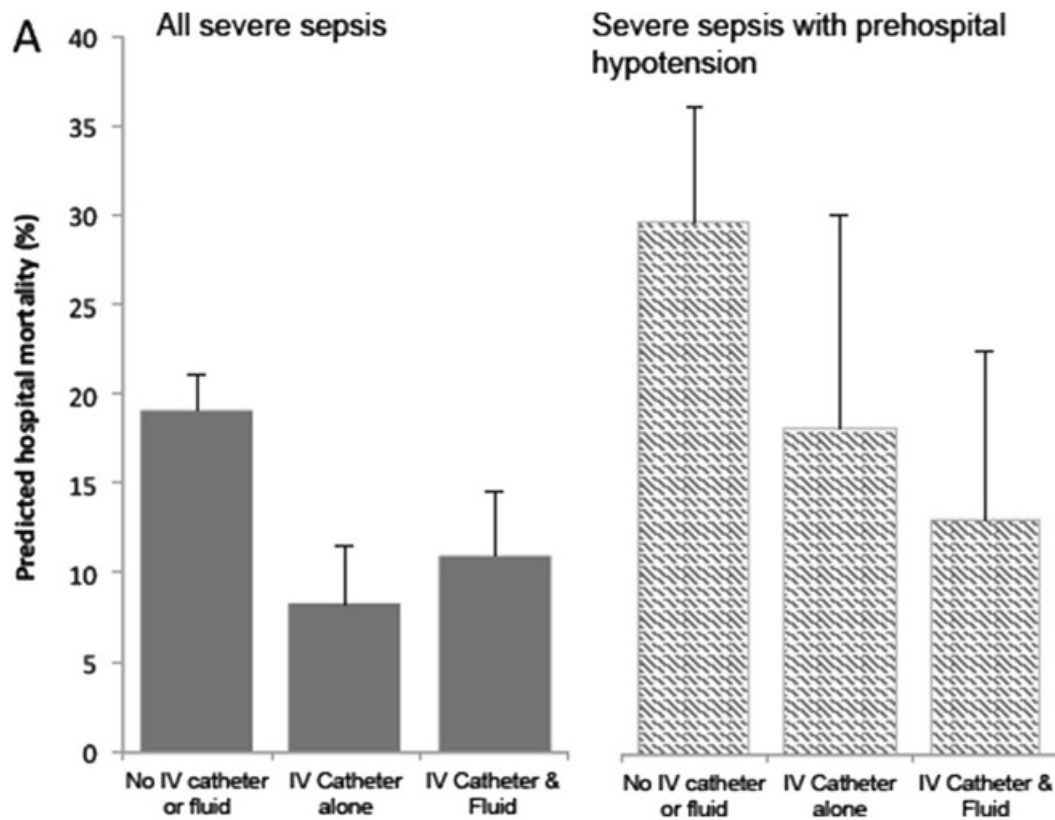
Trauma transport	N = 8,990	20%
Age < 18 years	N = 2,143	5%
Cardiac arrest	N = 67	<1%
No severe sepsis on admission	N = 32,844	72%

Eligible, EMS transports with severe sepsis on admission  
N = 1,350

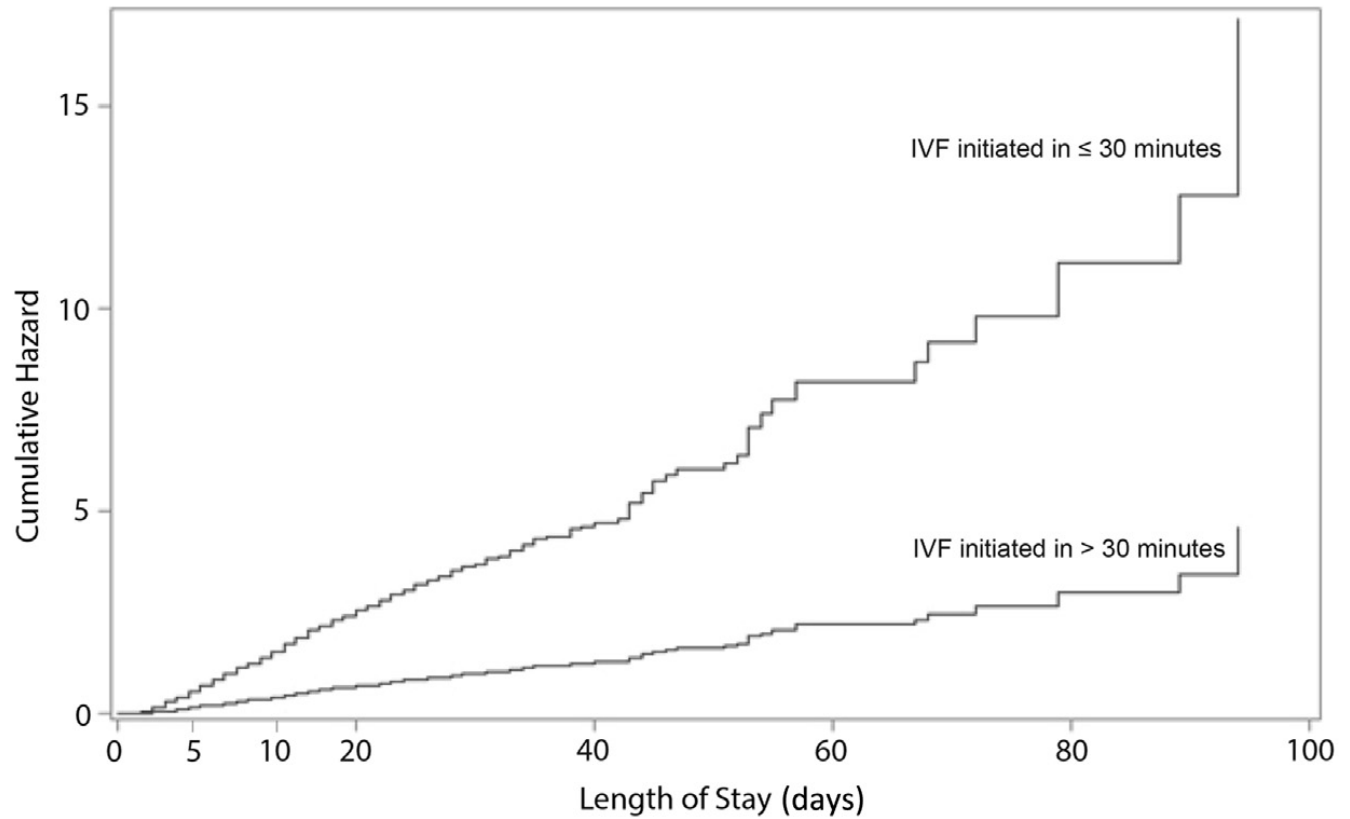
No prehospital catheter, no prehospital fluid  
N = 948 (70%)

Prehospital catheter alone  
N = 90 (7%)

Prehospital catheter, prehospital fluid  
N = 312 (23%)







**Number of subjects at risk**

	0	5	10	20	40	60	80	100
IVF Initiated in ≤ 30 min	1194 (100%)	812 (68.0%)	395 (33.1%)	92 (7.7%)	17 (1.4%)	5 (0.4%)	2 (<0.1%)	
IVF initiated in > 30 minutes	673 (100%)	493 (73.3%)	253 (37.6%)	84 (12.5%)	23 (3.4%)	8 (1.2%)	5 (<0.1%)	





Improved diagnostics  
and initiation of  
therapy?

Education of EMS  
providers

Incorporation of  
etCO<sub>2</sub> or POC  
lactate

Emphasis on  
identification and  
fluids when needed

Sepsis alerts to  
hospitals?

Questions?

Thank you!

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