

Sepsis and care bundles

August 12, 2015

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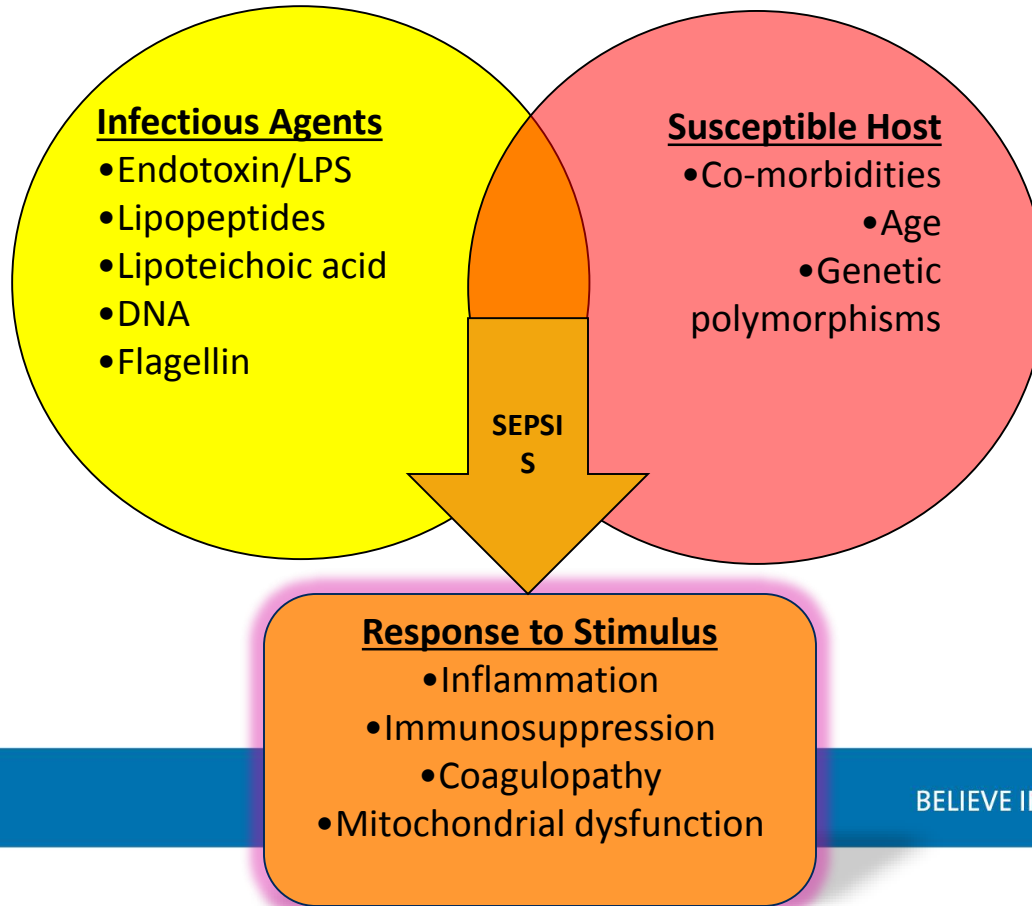
Vice President, Quality and Patient Safety

OhioHealth Riverside Methodist Hospital

Objectives

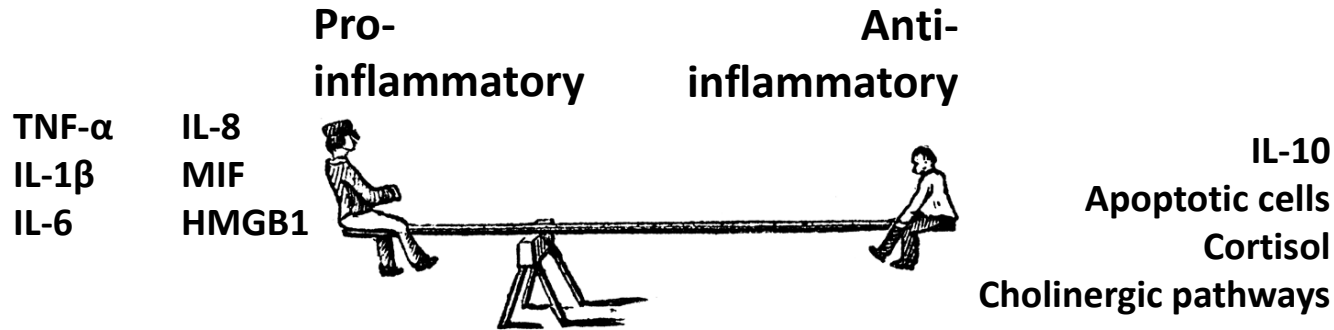
- To briefly describe the pathogenesis of sepsis
- To understand the evidence supporting the elements of the “bundles”
- To consider how to begin improvement work
- To appreciate alternative approaches/bundles to improve outcomes

The Pathogenesis of Sepsis

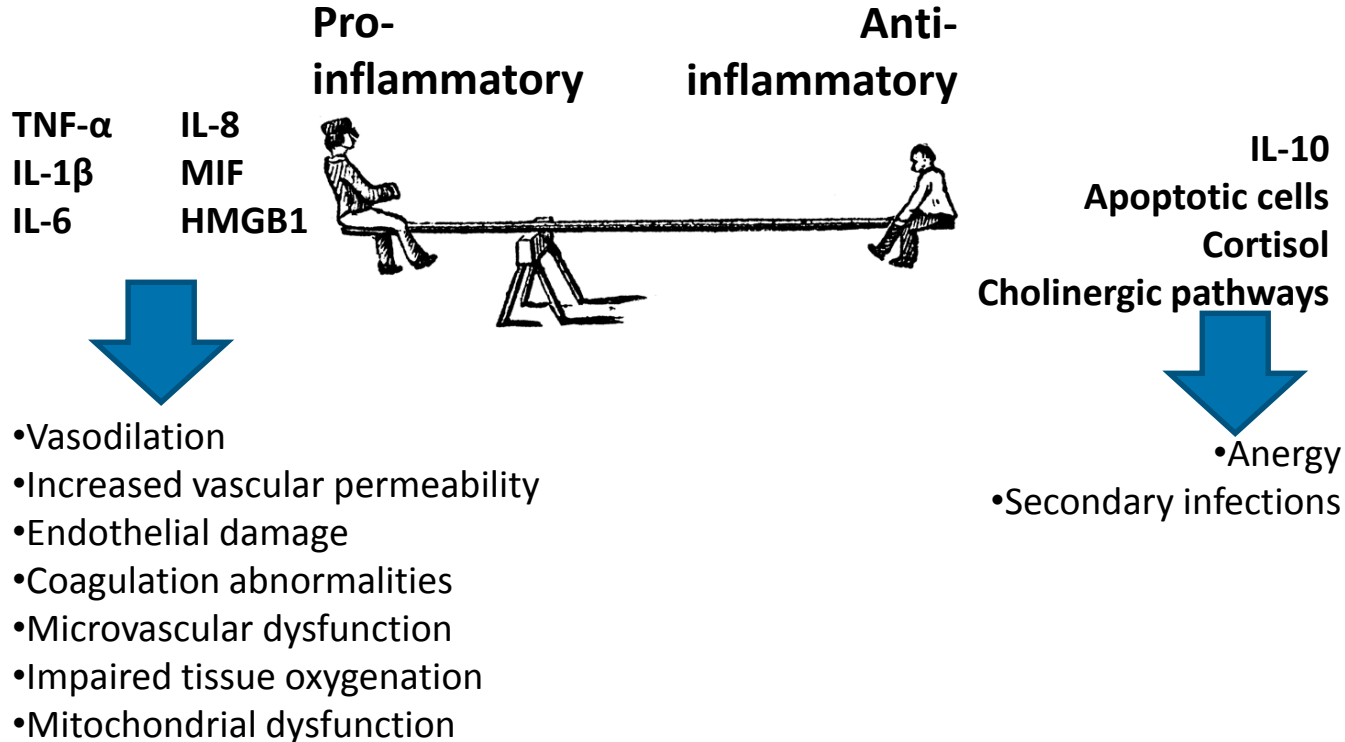


Sepsis = malignant disseminated inflammation

- Malignant = uncontrolled, unregulated, self-sustaining
- Disseminated= widespread changes which are usually cell-to-cell interactions
- Inflammatory = exaggerations of normal inflammatory response



Sepsis = malignant disseminated inflammation



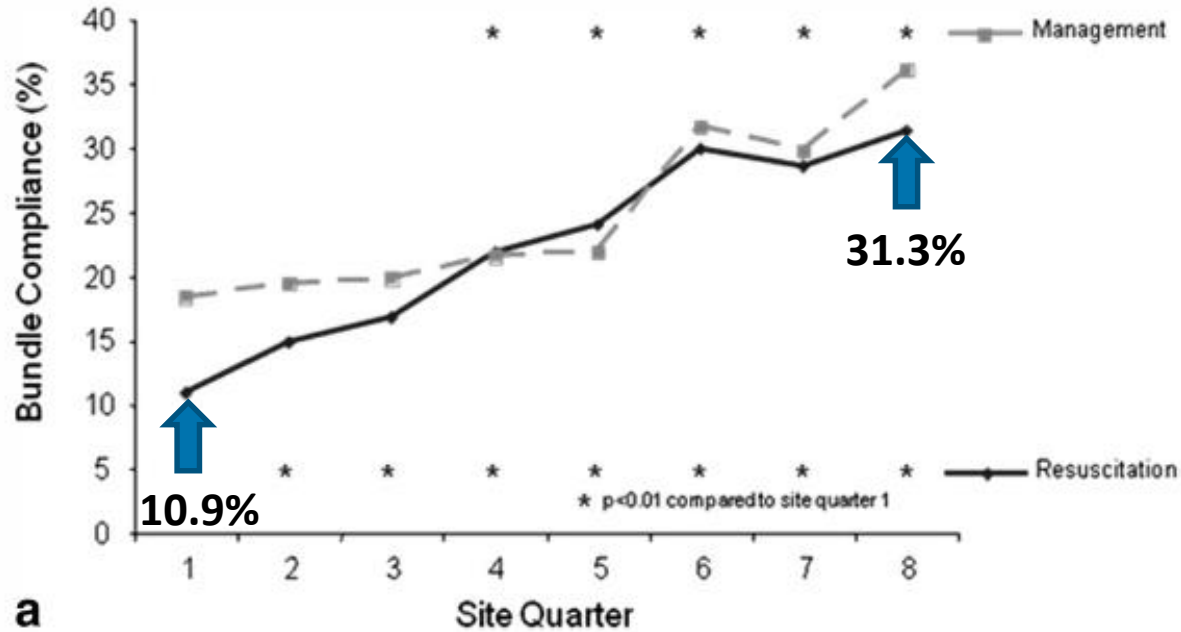
The Surviving Sepsis Campaign bundle

TO BE COMPLETED WITHIN 3 HOURS:

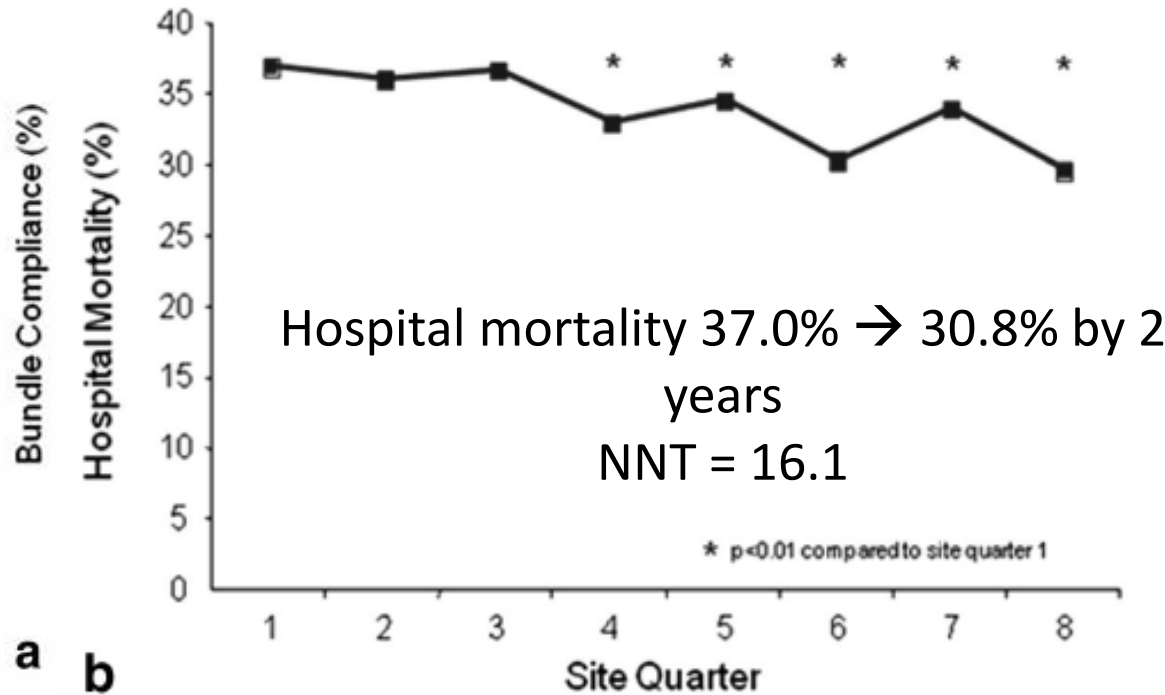
1. Measure lactate level
2. Obtain blood cultures prior to administration of antibiotics
3. Administer broad-spectrum antibiotics
4. Administer 30ml/kg crystalloid for hypotension or lactate ≥ 4 mmol/L

“Time of presentation” is defined as the time of triage in the emergency department or, if presenting from another care venue, from the earliest chart annotation consistent with all elements of severe sepsis or septic shock ascertained through chart review

SSC Results



SSC Results



The Surviving Sepsis Campaign: Results of an international guideline-based performance improvement program targeting severe sepsis *Crit Care Med* 2010; 38: 367-74

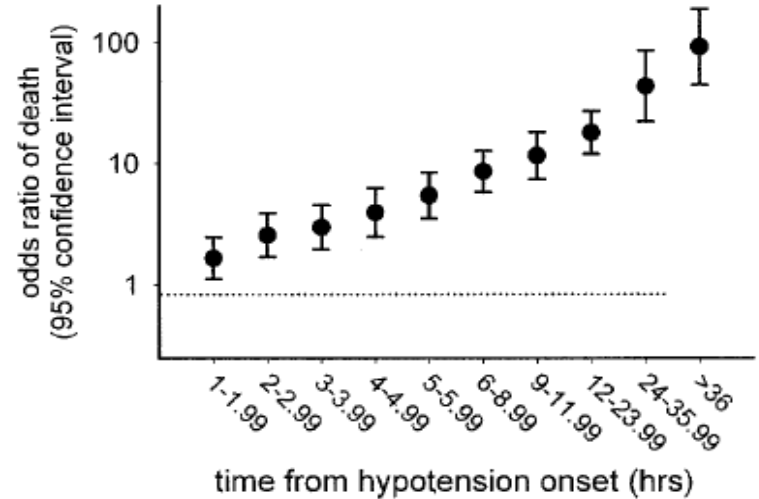
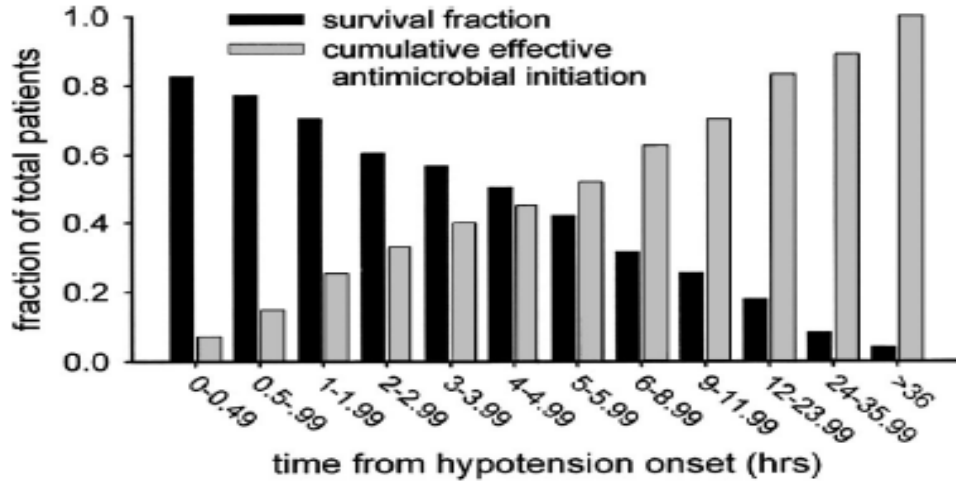
Table 5. Risk-Adjusted impact of bundle targets on hospital mortality^a

Bundle Target	Population	n	Unadjusted		Risk-Adjusted		
			OR	p	OR	95% CI	p
Measure lactate	All ^a	15,022	0.86	<.0001	0.97	0.90, 1.05	.48
Obtain blood cultures before antibiotics	All ^a	15,022	0.70	<.0001	0.76	0.70, 0.83	<.0001
Commence broad-spectrum antibiotics	All ^a	15,022	0.78	<.0001	0.86	0.79, 0.93	<.0001
Achieve tight glucose control	All ^a	15,022	0.65	<.0001	0.67	0.62, 0.71	<.0001
Administer drotrecogin alfa	Multiorgan failure ^b	8733	0.90	.26	0.84	0.69, 1.02	.07
Administer drotrecogin alfa	Shock despite fluids ^c	7854	0.91	.30	0.81	0.68, 0.96	.02
Administer low-dose steroids	Shock despite fluids ^c	7854	1.06	.18	1.06	0.96, 1.17	.24
Demonstrate CVP ≥8 mm Hg	Shock despite fluids ^c	7854	1.08	.10	1.00	0.89, 1.12	.98
Demonstrate ScvO ₂ ≥70%	Shock despite fluids ^c	7854	0.94	.24	0.98	0.86, 1.10	.69
Achieve low plateau pressure control	Mechanical ventilation ^d	7860	0.67	<.0001	0.70	0.62, 0.78	<.0001

	2004	2008-10	“Relative waste reduction”
<i>Eligible for later bundle elements*</i>			
Fluid resuscitation	75%	71%	5%
Vasopressors	63%	35%	44%
CVP and ScvO2 monitoring	64%	29%	55%
Inotropes and RBC transfusions	59%	13%	78%
Glucocorticoids	63%	21%	67%
Lung protective ventilation	43%	14%	67%

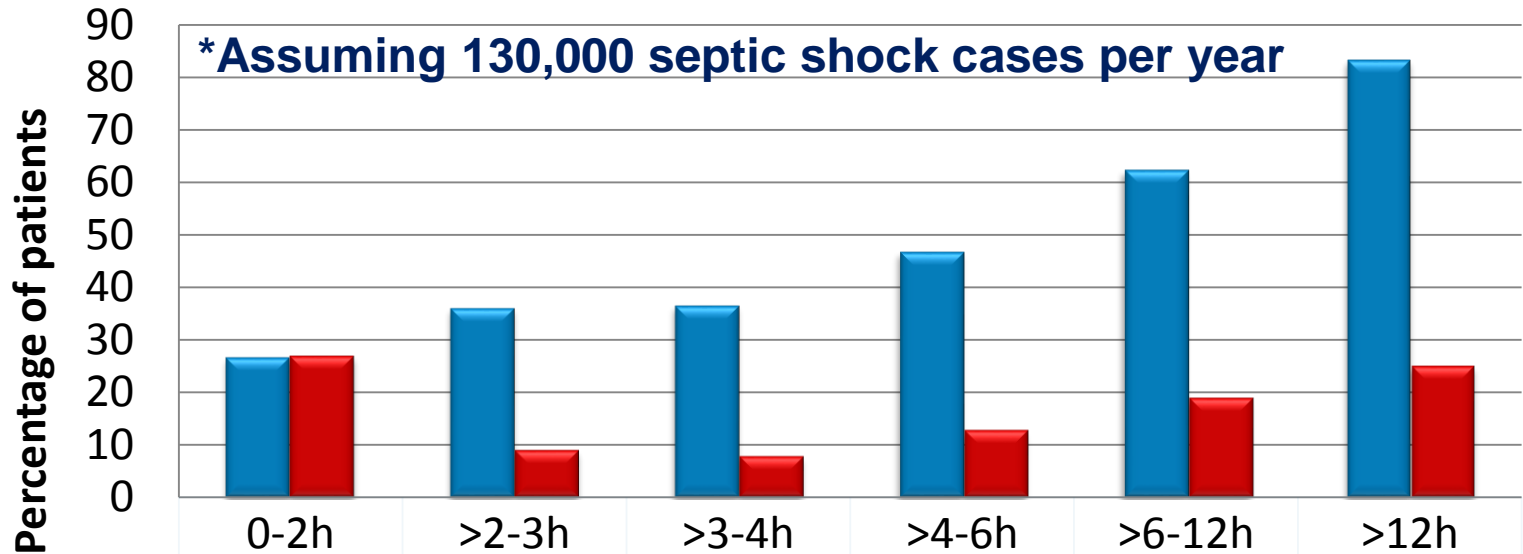
*By diagnosing severe sepsis and providing atbx, blood cultures and lactate measurement at very high rates

Antibiotics – No time to waste



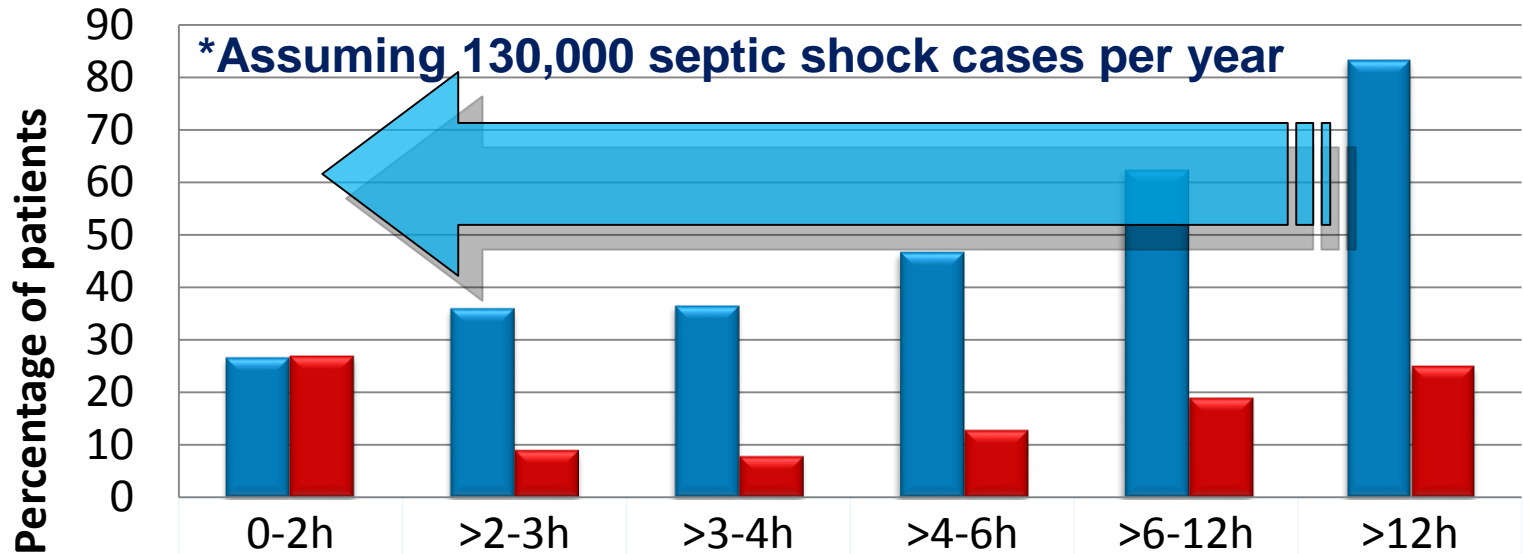
- Every hour in delay of appropriate atbx = 7.6% lower survival
- Median time to appropriate atbx = 6h

Shock to Effective Antibiotic Time and Mortality in Septic Shock*



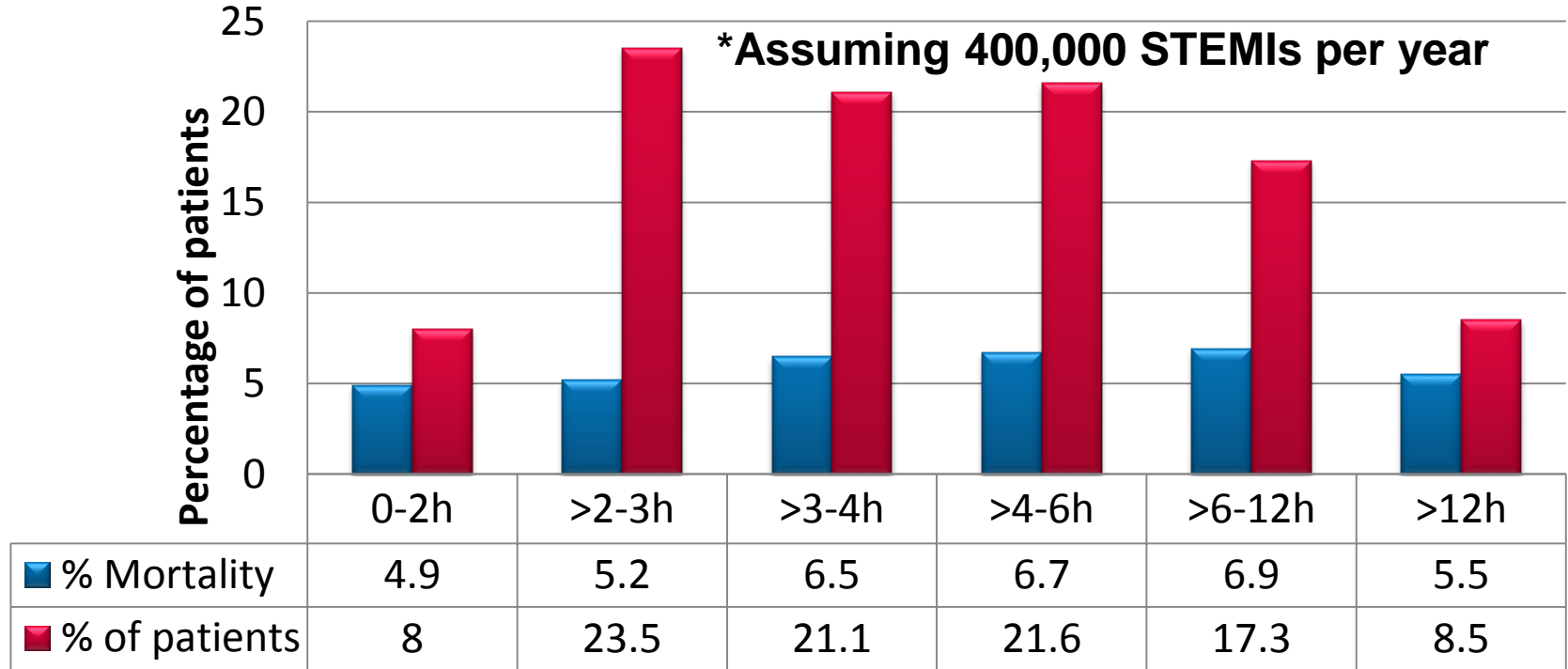
■ %Mortality	26.7	36.1	36.6	46.8	62.3	83.1
■ % of patients	26.8	9.0	7.8	12.8	18.8	24.9

Shock to Effective Antibiotic Time and Mortality in Septic Shock*

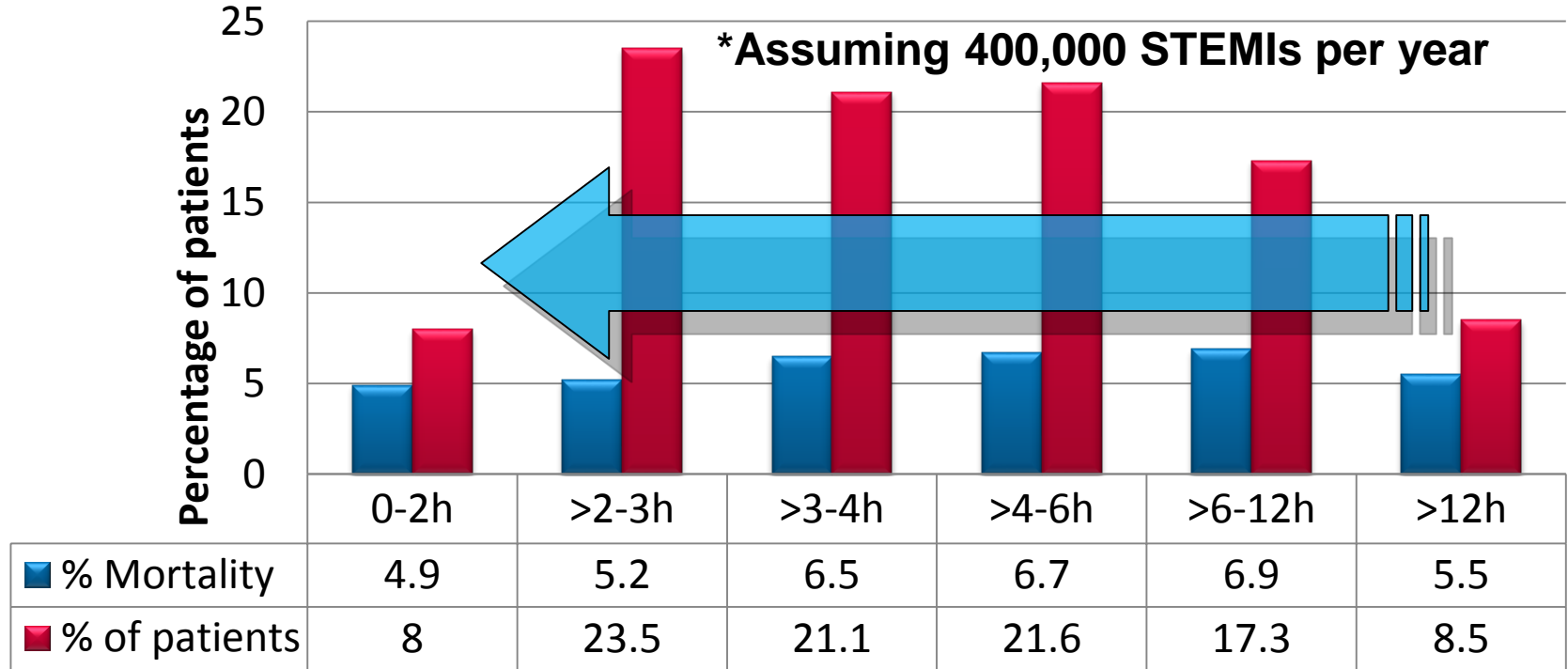


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Door to Balloon Time and Mortality in STEMI*



Door to Balloon Time and Mortality in STEMI*



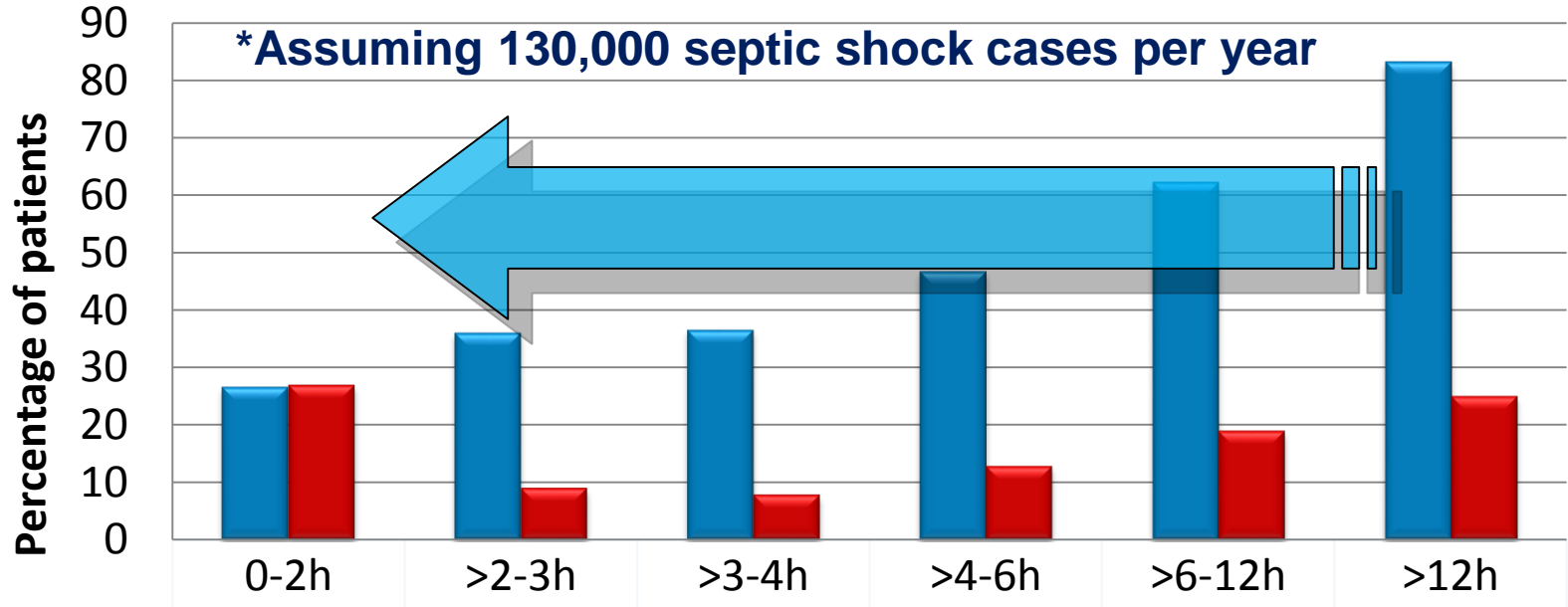
Door to Balloon Time and Mortality in STEMI*

25

By getting door-to-balloon times of <2h for ALL STEMI patients, we would save **4775 lives per year.** (13 people a day)

■ % Mortality	4.9	5.2	6.5	6.7	6.9	5.5
■ % of patients	8	23.5	21.1	21.6	17.3	8.5

Shock to Effective Antibiotic Time and Mortality in Septic Shock*



■ %Mortality	26.7	36.1	36.6	46.8	62.3	83.1
■ % of patients	26.8	9.0	7.8	12.8	18.8	24.9

Shock to Effective Antibiotic Time and Mortality in Septic Shock

By getting shock-to-antibiotic times of <2h for ALL septic shock patients, we would save

32,360 lives per year.

(89 people a day)

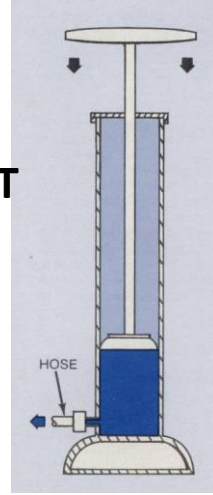
(3.7 people an hour)

(3.5 times the effect of STEMI intervention)

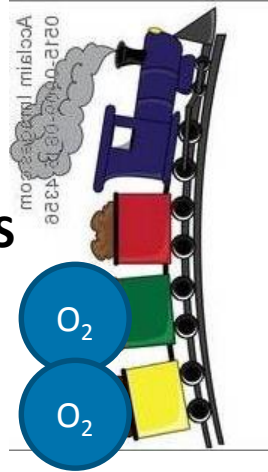
Addressing circulation in sepsis

- Why is circulation affected in sepsis?
 - Dehydration
 - Loss of vascular tone
 - Loss of endothelial integrity
 - Shunting
 - Occlusion
 - Decreased cardiac output
- How is circulation addressed in sepsis?
 - Replete intravascular volume
 - Vasopressors

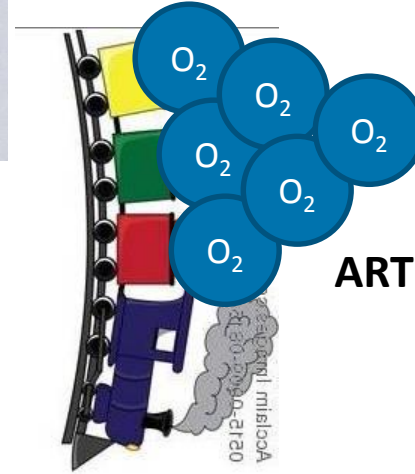
HEART



VEINS



ARTERIES

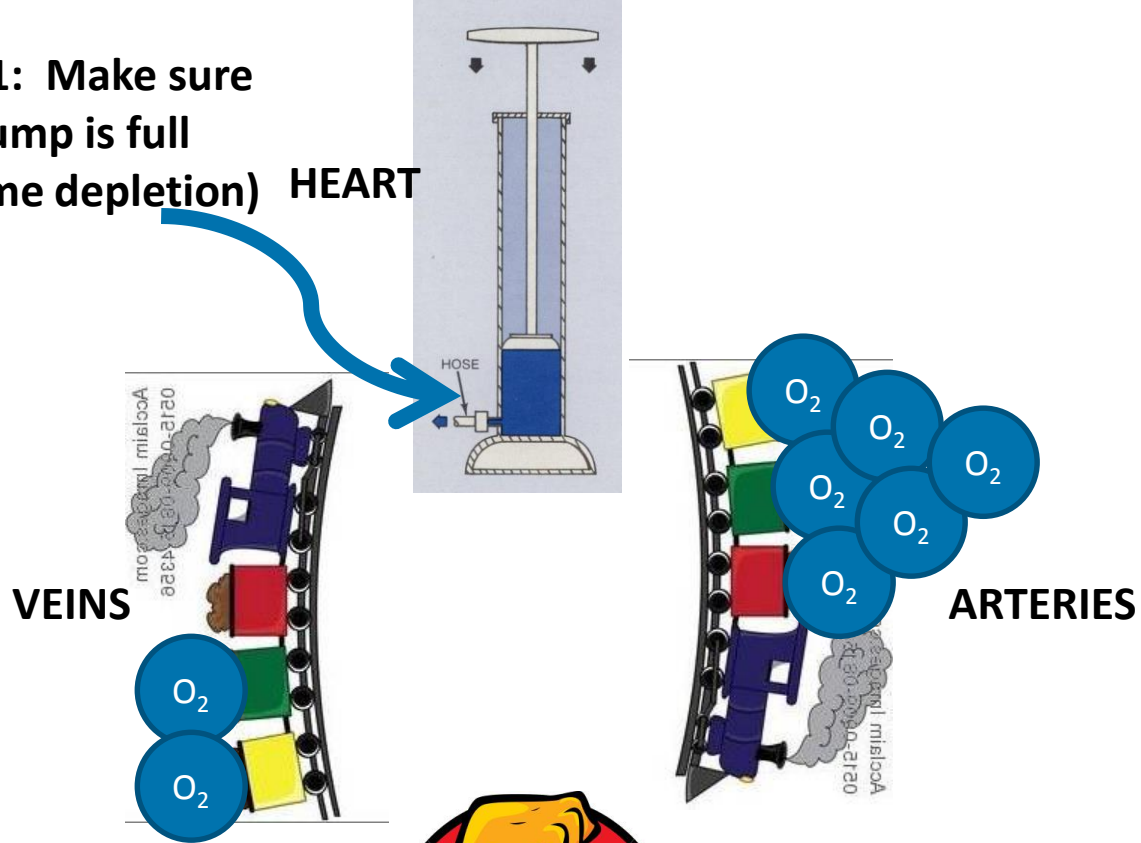


ORGANS



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**STEP 1: Make sure
the pump is full
(volume depletion) HEART**



ORGANS

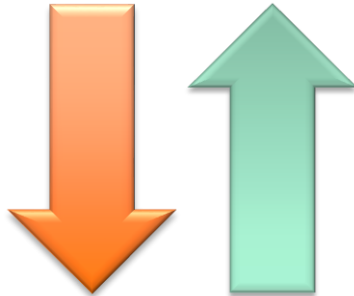


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Volume Resuscitation

Assess for Volume Depletion

- History
- Exam - Organ perfusion – skin, brain, kidneys
- Measure intravascular pressures – arterial, central venous



See what happens

- Blood pressure
- Central venous pressure
- Urine output
- Heart rate

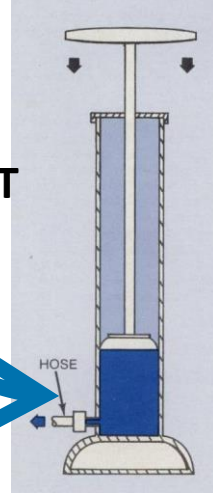
Administer a “Fluid Challenge”

- 1000mL crystalloid OR 500mL colloid
- Intravenous over 30 minutes

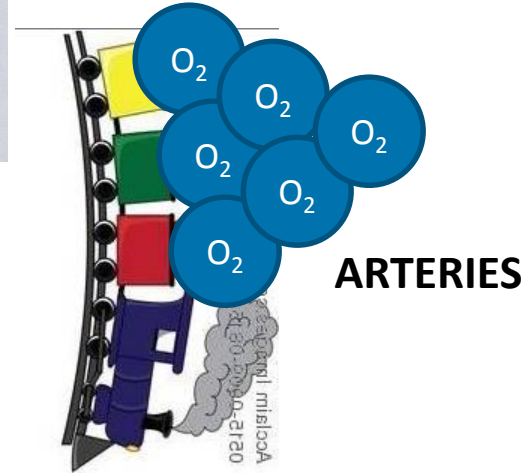
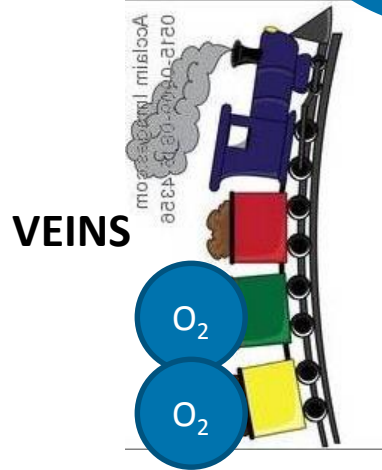
Intravenous fluids in recent studies of septic shock

	Hour 0 to 6		Hour 6 to 72	
	EGDT	Usual care	EGDT	Usual care
ProCESS	2805 ml	2279 ml	4458 ml	4354 ml
PROMISE	1750 ml	1500 ml	3403 ml	3694 ml
ARISE	1547 ml	1374 ml	3520 ml	3608 ml

**STEP 1: Make sure
the pump is full
(volume depletion) HEART**



**STEP 2: Make the
train is on a fast
track (vascular tone)**



ORGANS



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A Comparison of Dopamine and Norepinephrine in the Treatment of Septic Shock

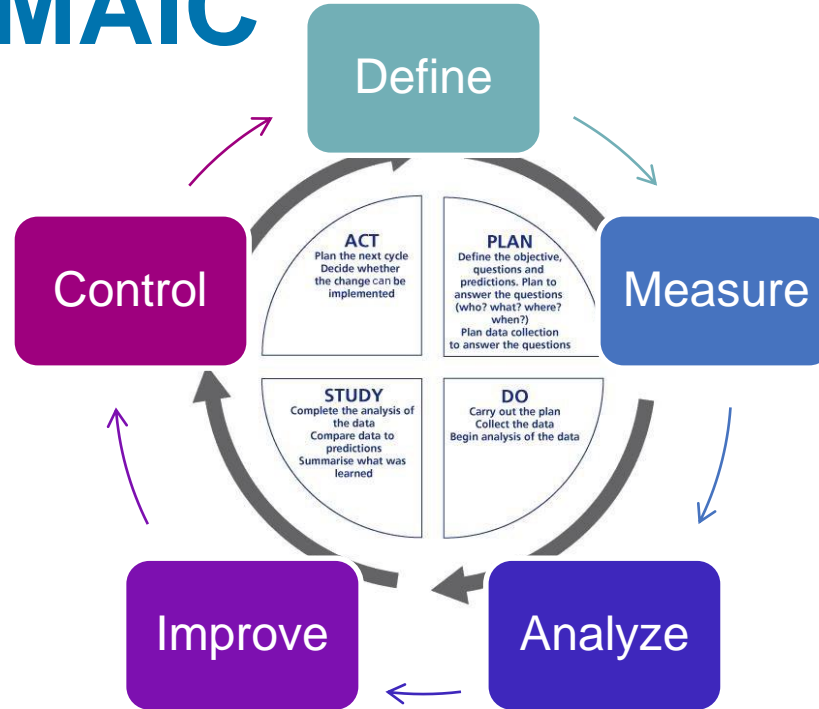
	Dopamine	Norepinephrine	OR (95% CI)
ICU mortality	50.2%	<u>45.9%</u>	1.19 (0.98 – 1.44)
Hospital mortality	59.4%	<u>56.6%</u>	1.12 (0.92 – 1.37)
6mon mortality	63.8%	<u>62.9%</u>	1.06 (0.86 – 1.31)
12mon mortality	65.9%	<u>63.0%</u>	1.15 (0.91 – 1.46)
			P value
Vasopressor-free days	12.6	<u>14.2</u>	0.007
RRT-free days	12.8	<u>14.0</u>	0.07
ICU-free days	8.1	<u>8.5</u>	0.43
Arrhythmias	24.1%	<u>12.4%</u>	<0.0001
Skin ischemia	6.5%	<u>4.1%</u>	0.09
Arterial occlusion	2.7%	<u>2.4%</u>	0.12

Some comments about lactate

- Marker of anaerobic metabolism
- Elevated level associated with death in multiple studies
 - $>4\text{mmol/L}$ most common threshold (if in mg/dl , divide by 9 to convert)
 - Improvement associated with better outcomes
- Can be venous, don't have to remove tourniquet
- On ice if measuring $>30\text{min}$ after drawn
 - (increases 0.3 mmol/L vs when on ice)
- Normal bicarb doesn't exclude high lactate
- Low levels doesn't mean you shouldn't worry

How do you get started?

PDSA/DMAIC



Which of these is sepsis?

1. Confusion, cough, nausea
2. Fever, shortness of breath, chest pain
3. Abdominal pain, lightheadedness, diarrhea
4. Rash, leg swelling, anorexia
5. Tachycardia, chills, sweating

Can we identify these patients?

Seymour *et al.* *JAMA* 2010; 304(7):747-54.

- 166,908 non-trauma, non-cardiac arrest patient encounters by King County EMS (except Seattle), 2002-6
 - Over 66,000 encounters excluded for no vital signs documented in field
- Critical illness occurred in 5%
 - **Severe sepsis (61%)**
 - Need for mechanical ventilation (48%)
 - Death during hospitalization (35%)

Can we identify these patients?

Seymour *et al.* JAMA 2010; 304(7):747-54.

Points	Age	RR	SBP	HR	SaO2	GCS
0	<45	12-23	>90	<120	≥88	15
1	≥45	<12, 24-35	≤90	≥120	<88	8-14
2		≥36				<8

All vital signs are initial out-of-hospital measurements documented by first-arriving emergency medical services responder.

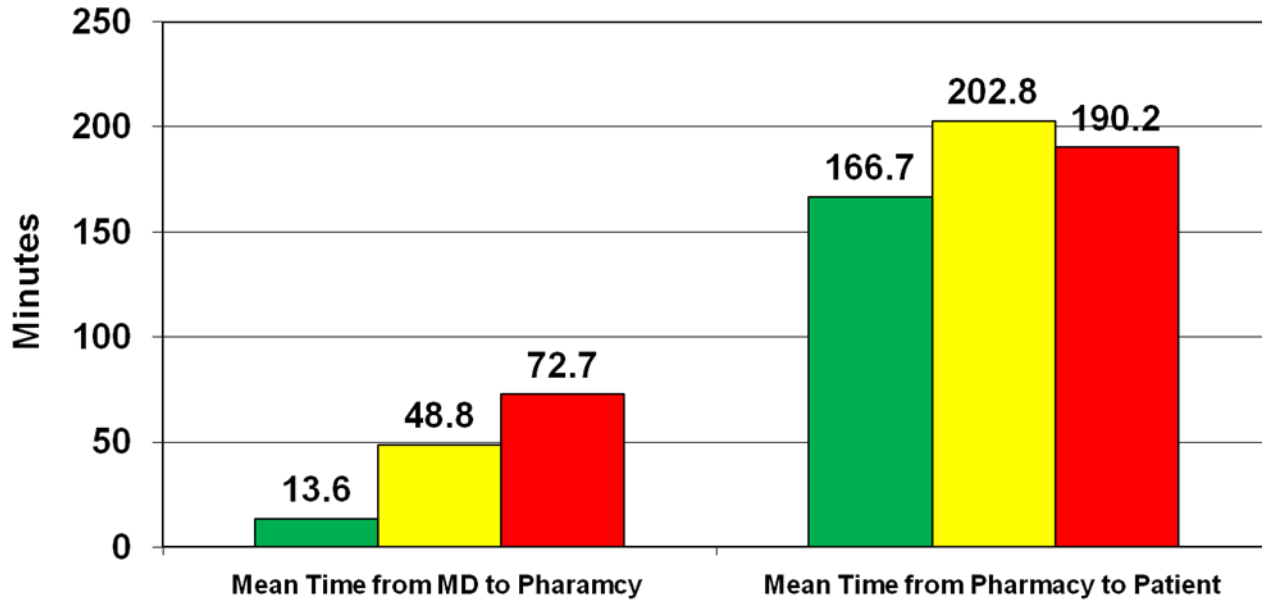
If you used a cut-point of ≥ 4 to trigger triage to a regional referral center for critical care services,

- 3.2% of those going to nonreferral center would be transported and 36% of these would develop critical illness
- 4.4% of those with a score < 4 would develop critical illness

A focus on antibiotics: Not all orders are created equal

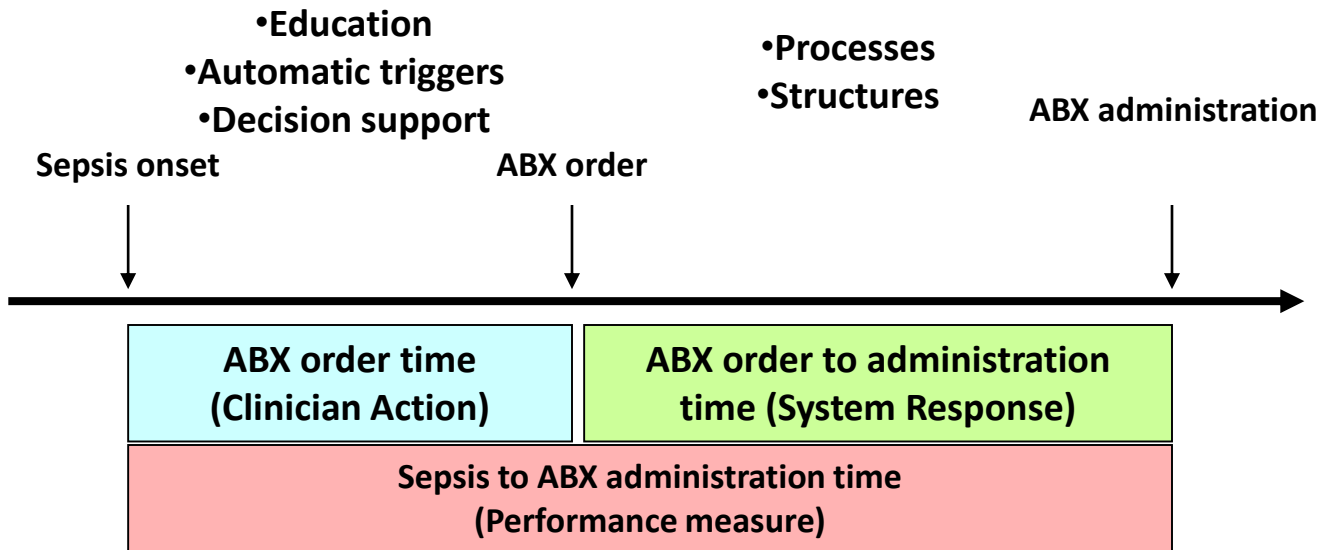
- ROUTINE – will be scheduled for next *usual* scheduled administration time.
 - QD = 9am
- NOW– will be prepared in usual queue then delivered with next scheduled delivery and administered when it arrives
- STAT – prints on different printer, different color paper, prepped immediately, immediately delivered to unit

Order Priority Comparisons



■ STAT ■ Now/Routine ■ Routine

Affecting the emergency response to sepsis: Antibiotics



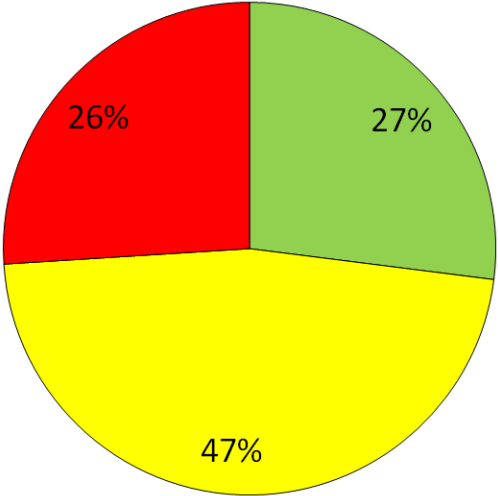
Affecting the emergency response to sepsis: Antibiotics

Is there any situation in which you are giving antibiotics for an infection in which you want the initial dose delayed?

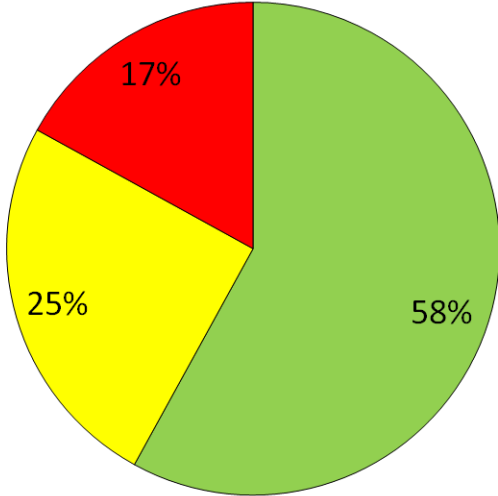
Maybe we should focus on time from order to administration?

Order Priority

Pre-intervention

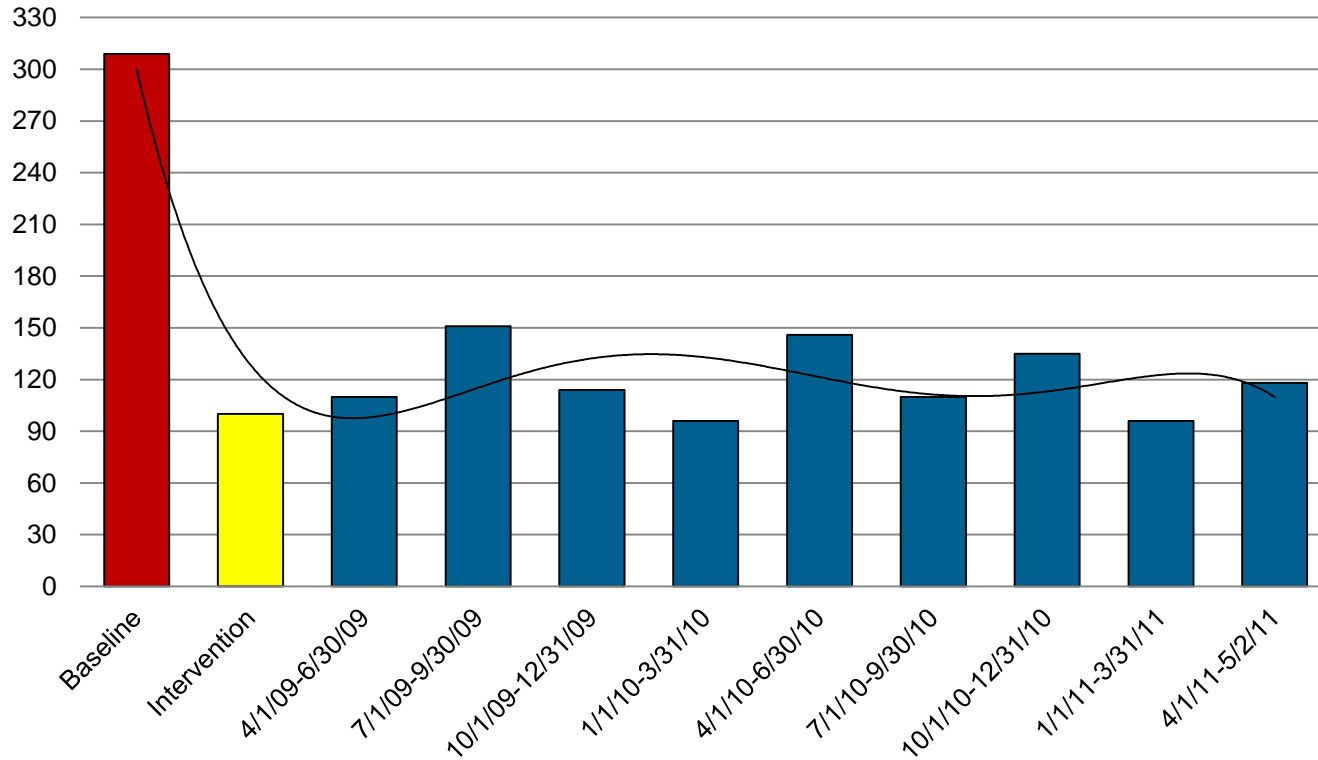


Post intervention



 STAT  NOW  ROUTINE

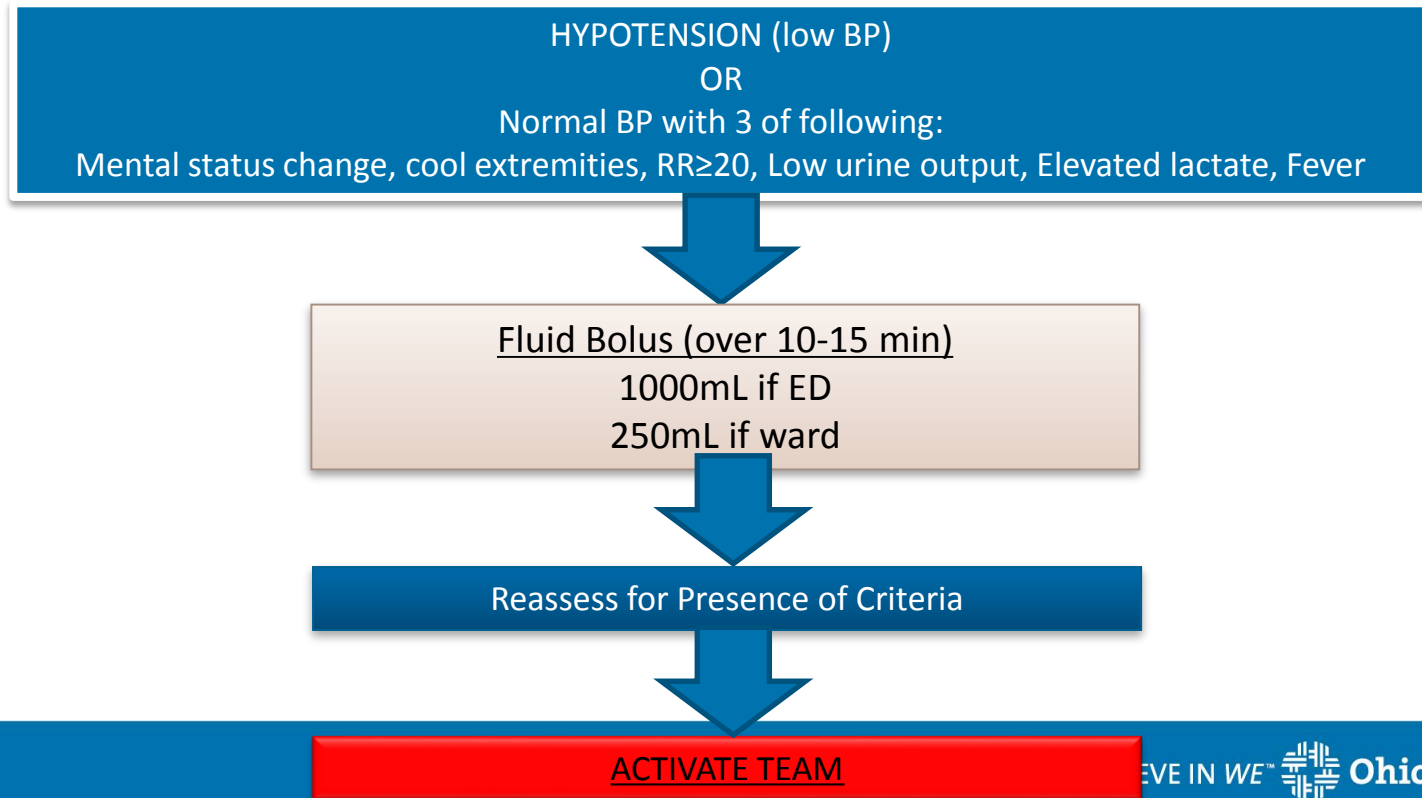
Median time to antibiotics (min) in septic shock



Is the SSC the only approach?

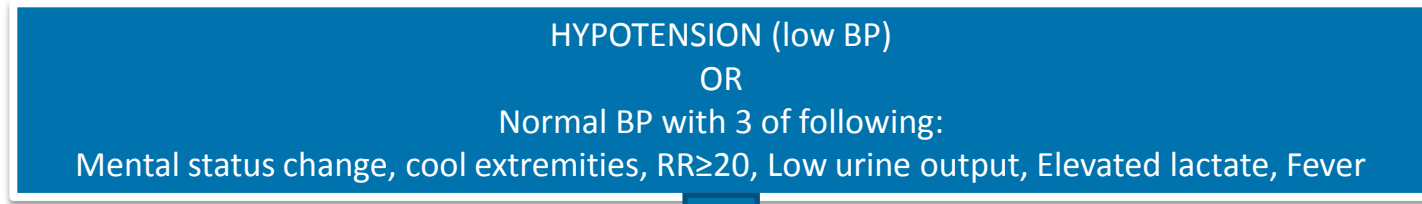
Effect of a rapid response system for patients in shock on time to treatment and mortality during 5 years

Sebat *et al* CHEST 2007; 35: 2568-2575



Effect of a rapid response system for patients in shock on time to treatment and mortality during 5 years

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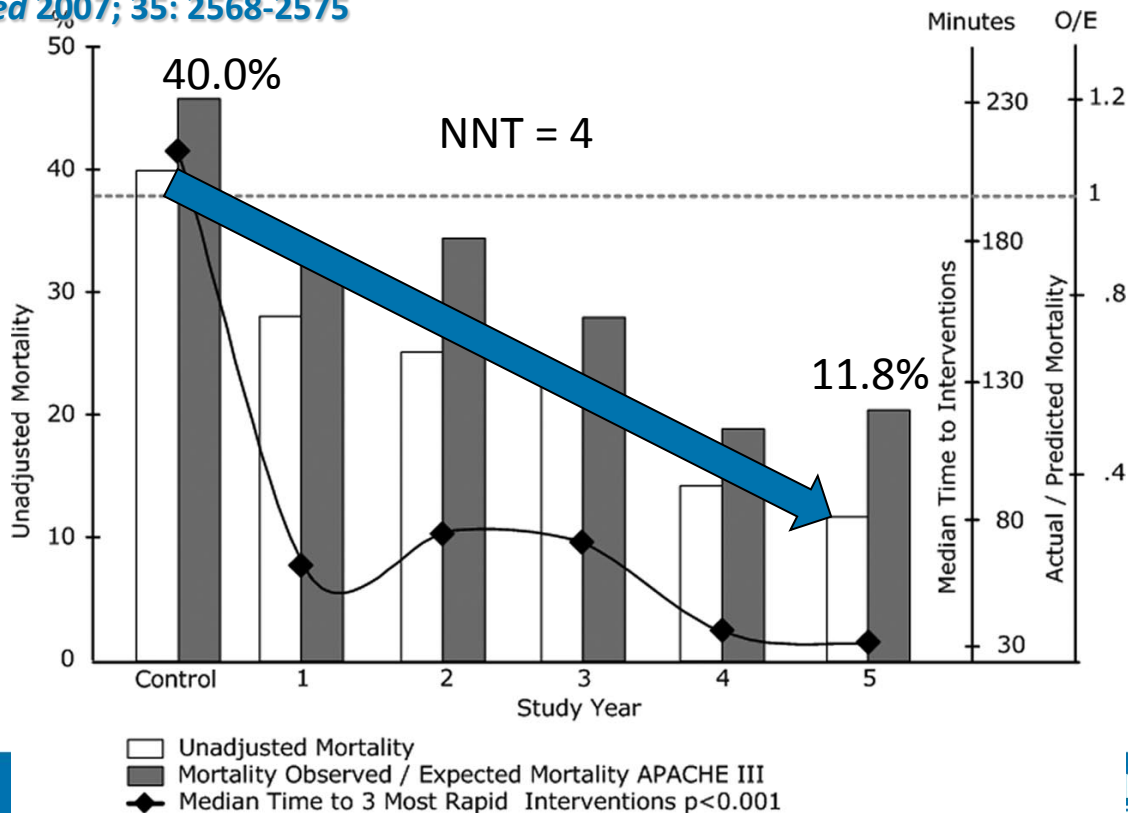


43% of patients with septic shock
(46% “hypovolemic”)

ACTIVATE TEAM

Effect of a rapid response system for patients in shock on time to treatment and mortality during 5 years

Sebat et al *Crit Care Med* 2007; 35: 2568-2575



Effect of a rapid response system for patients in shock on time to treatment and mortality during 5 years

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Minutes O/E

Among septic shock patients, mortality decreased from 50% to 10%

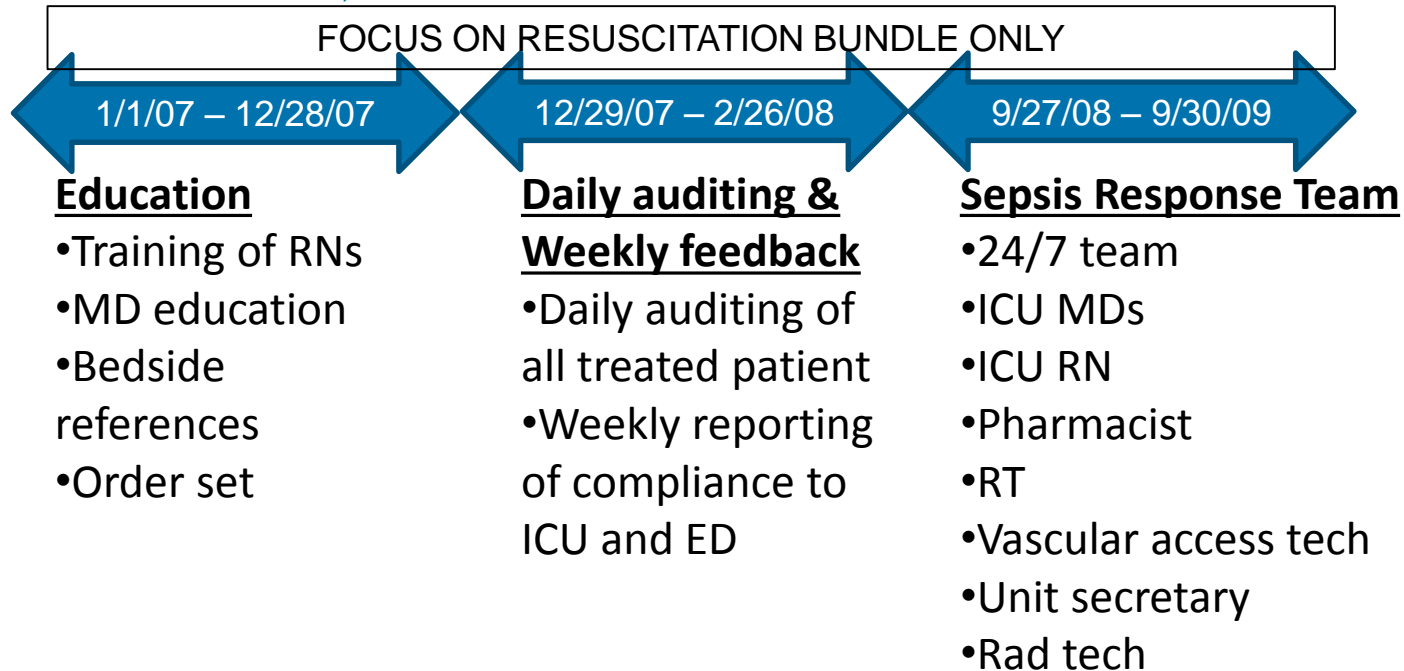
NNT = 2.5

Or 80% of prior deaths were due to lack of the shock team!

- Unadjusted Mortality
- Mortality Observed / Expected Mortality APACHE III
- ◆ Median Time to 3 Most Rapid Interventions $p < 0.001$

Septic shock: A multidisciplinary response team and weekly feedback to clinicians to improve the process of care and mortality

Schramm et al. *Crit Care Med* 2011; 39: 252-8



Septic shock: A multidisciplinary response team and weekly feedback to clinicians to improve the process of care and mortality

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Bundle Element	Education	Feedback	Response team*	p
Lactate**	75.4%	91.2%	97.0%	<0.001
Blood cultures	87.7%	93.0%	97.7%	<0.001
Antibiotics (1h)**	77.2%	83.8%	91.0%	<0.001
IV Fluids	57.1%	64.1%	76.2%	<0.001
Vasopressors	93.0%	94.0%	89.1%	0.046
RBCs	82.5%	86.3%	85.6%	0.40
Dobutamine	35.8%	55.6%	61.6%	<0.001
All 7 elements**	12.7%	37.7%	53.7%	<0.001

*Response team only called in 43% of eligible patients

**Compliance associated with mortality ($p < 0.05$)

Septic shock: A multidisciplinary response team and weekly feedback to clinicians to improve the process of care and mortality

Schramm et al. *Crit Care Med* 2011; 39: 252-8

Bundle Element	Education	Feedback	Response team*	p
Mortality	30.3%	28.7%	22.0%	0.029

After risk-adjustment, compared to education period
odds of dying were:

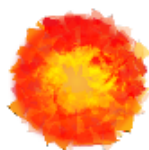
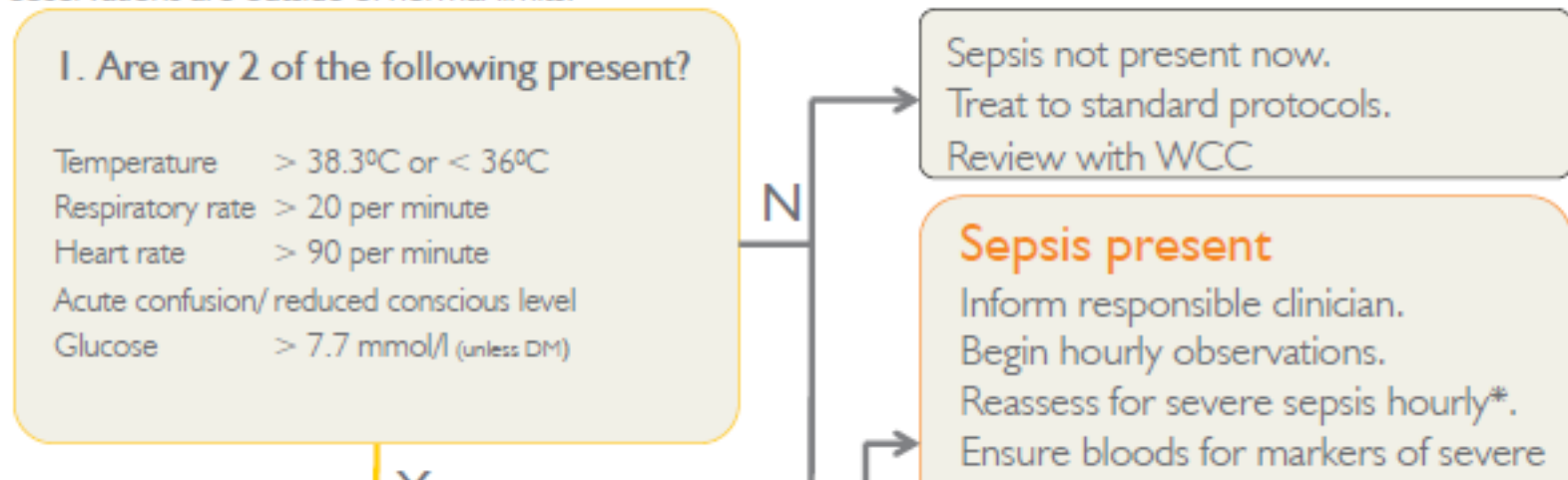
Feedback – 1% higher (p=0.95)

Response team – 35% lower (p=0.023)

Or 27% of patients dying were because of lack of
Response Team (versus education approach)

Emergency Department Sepsis Screening and Action Tool

Sepsis is a time critical condition. Screening, early intervention and immediate treatment saves lives. This tool should be applied to all adult patients who are not pregnant who have a suspected infection or their clinical observations are outside of normal limits.



THE UK
SEPSIS
TRUST

Respiratory rate > 20 per minute
Heart rate > 90 per minute
Acute confusion/ reduced conscious level
Glucose > 7.7 mmol/l (unless DM)

Y

2. Could this be an infection?

For example:
Pneumonia
Urinary Tract Infection
Abdominal pain or distension
Meningitis
Cellulitis/ septic arthritis/ infected wound

Y

3. Is any red flag present?

Systolic B.P < 90 mmHg or MAP < 65 mmHg
Lactate > 2 mmol/l
Heart rate > 130 per minute
Respiratory rate > 25 per minute
Oxygen saturations < 91%
Responds only to voice or pain/ unresponsive
Purpuric rash

N

N

N

Y

Sepsis present

Inform responsible clinician.
Begin hourly observations.
Reassess for severe sepsis hourly*.
Ensure bloods for markers of severe sepsis are sent*.
Monitor urine output
Consider life threatening sepsis mimics e.g. Asthma.

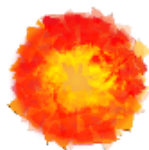
Red Flag Sepsis

This is a time critical condition, immediate action is required. Assume severe sepsis present.

Sepsis Six

- 1 High-flow oxygen.
 - 2 Blood cultures and consider source control.
 - 3 Intravenous antibiotics.
 - 4 Intravenous fluid resuscitation.
 - 5 Check haemoglobin and serial lactates.
 - 6 Hourly urine output measurement.
- Record the time each of these actions is completed. All actions should be completed as soon as possible but always within 60 minutes.

Communication:



THE UK
SEPSIS
TRUST

The Sepsis Six – to be delivered within 1 hour

3 Investigations

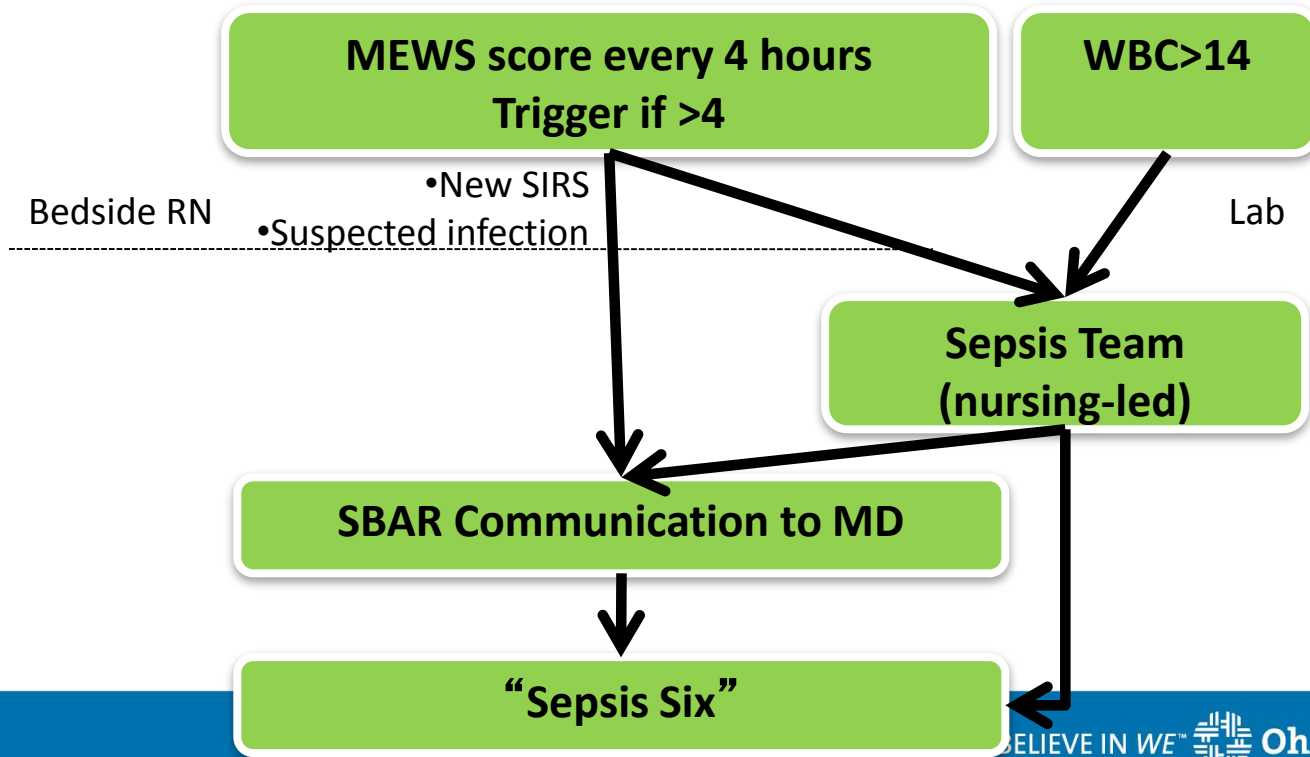
- Blood cultures
- Measure lactate
- Measure urine output

3 Treatments

- High-flow oxygen
- IV antibiotics
- Fluid challenge

...and Identify Severe Sepsis and Septic Shock

Systematically Raising Suspicion and Simplifying Intervention



Do you want a Sepsis 6 Nurse?

N=567	% patients	Sepsis 6 Achieved (1h)	Resuscitation Bundle Achieved (SSC – 6h)	Mortality
Sepsis 6 Nurse	25.4%	82.6%	72.9%	25.5%
No Sepsis 6 Nurse	74.6%	23.9%	23.4%	38.4%
			NNT	7.8

So, presuming 567 patients per year

One could conclude a 24/7 program could save 73 lives a year – that's one person saved ever 5 days AT THAT HOSPITAL

Or one-third of patients dying, die because of lack of a Sepsis 6 Nurse!

Summary

- This won't be easy
- There is no cookbook for improving care
- Resuscitation bundle elements (in some form) are associated with better outcomes
- You need to understand your problems before developing solutions
- We are partners with you in this journey

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MEDCENTRAL MANSFIELD HOSPITAL + MEDCENTRAL SHELBY HOSPITAL + WESTERVILLE MEDICAL CAMPUS

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