



Middle East Critical Care Assembly



# Evidence Based Management of Severe Sepsis Case



**MOUHAMAD GHYATH JAMIL, MD, FCCP  
CCM, PULMONARY & SLEEP MEDICINE  
DIRECTOR SLEEP MEDICINE UNIT  
DIRECTOR HOME MECHANICAL  
VENTILATION  
DIRECTOR TELE-ICU  
KING FAISAL SPECIALIST HOSPITAL &  
RESEARCH CENTER**

**[MECRITICALCARE.NET](http://MECRITICALCARE.NET)**

pH, Arterial	pCO2, Arterial	pO2, Arterial	HCO3, Arterial	Total CO2, Arterial	O2 SatC, Arterial	Total Hemoglobin	Na, Arterial
7.37	L 3.8 k Pascal	L 8.7 k Pascal	L 16.2 mmol/L	L 17 mmol/L	91	142 g/L	L 133 mmol/L
K, Arterial	Cl, Arterial	Ca++, Arterial	Anion Gap, Arterial	Mode, Arterial	Flow Rate, Arterial	Hematocrit, Arterial	Base Excess
H 6.1 mmol/L	98 mmol/L	L 1.01 mmol/L	H 24.7 %	nrm	15.00 L/min	42.00 %	L -7.5 mmol/L
O2 Content, Arterial							
L 179 mL/L							
Reduced Hemoglobin	Methemoglobin	Oxyhemoglobin	Carboxyhemoglobin				
H 8.8 %	.3 %	L 90 %	1.4 %				
WBC	RBC	Hemoglobin	Hematocrit	MCV	MCH	MCHC	RDW
H 16.60 10^9/L	L 4.11 10^12	140 g/L	0.404 %	H 98.3 fL	H 34.1 pg	347 g/L	13.2 %
Platelet	MPV	Polymorph	Polymorph Ab	Lymphocyte	Lymphocyte	Monocyte	Monocyte Ab
201 10^9/L	8.3 fL	H 81 %	H 13.45 10^9/L	L 8 %	L 1.33 10^9/L	9 %	H 1.49 10^9/L
Basophil	Basophil Ab	Metamyelocyte	Metamyelocyte	Platelet Estimat	Macrocytosis	Polychromasia	Target Cells
1 %	H .17 10^9/L	1 %	.17 10^9/L	Normal	Slight	Slight	Slight
Urea	Creatinine	e-GFR	K	Na	Cl	CO2	Ca, Total
H 18.6 mmol/L	* H 261 umol/L	* 21 mL/min/1.73m	* C 6.1 mmol/L	L 134 mmol/L	98 mmol/L	L 18 mmol/L	2.24 mmol/L
PO4	Glucose, f	Mg	Albumin	Bilirubin, Tot	Lactic Acid		
H 2.17 mmol/L	21.7 mmol/L	L 0.60 mmol/L	37 g/L	17 umol/L	H 6.4 mmol/L		
CK	Troponin	Pro-Brain Natriu	ALT	Alkaline Phc			
H 613 U/L	* 0.03 ug/L	* 11346 pg/mL	H 702 U/L	47 U/L			
Chest X-ray Supir							
* Chest X-ray Sup							

PMH

HPI

Labs

CXR

46,  
DM,  
HTN,  
CAD, PTCA,  
Dyslipidemia

Progressive  
respiratory distress  
with fever (38.1)  
and hypotension

WBC 16,000  
Creat 3.2  
K 6.1,  
LA 6.4,  
HCO3 18,  
PO2 60 on 15L/m



# Infection

# SIRS

# Sepsis

# Severe Sepsis

# Septic Shock

Microorganism invading sterile tissue

- A clinical response arising from a nonspecific insult, with  $\geq 2$  of the following:
  - T  $>38^{\circ}\text{C}$  or  $<36^{\circ}\text{C}$
  - HR  $>90$  beats/min
  - RR  $>20$ /min
  - WBC  $>12,000/\text{mm}^3$  or  $<4,000/\text{mm}^3$  or  $>10\%$  bands

SIRS with a presumed or confirmed infectious process

- Sepsis with organ failure
- ❑ Vascular collapse
  - ❑ Renal
  - ❑ Hemostasis
  - ❑ Lung
  - ❑ LA

Refractory hypotension

46, DM, HTN, CAD, PTCA, Dyslipidemia

Progressive respiratory distress with fever (38.1) and hypotension

WBC 16,000  
Creat 3.2  
K 6.1,  
LA 6.4,  
HCO<sub>3</sub> 18,  
PO<sub>2</sub> 60 on 15L/m



# Identifying Acute Organ Dysfunction

**Altered  
Consciousness  
Confusion  
Psychosis**

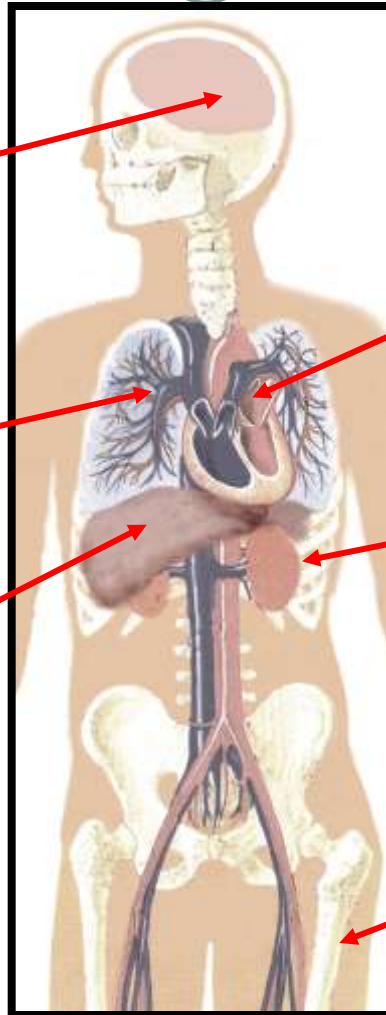
**Tachypnea  
PaO<sub>2</sub> <70 mm Hg  
SaO<sub>2</sub> <90%  
PaO<sub>2</sub>/FiO<sub>2</sub> ≤300**

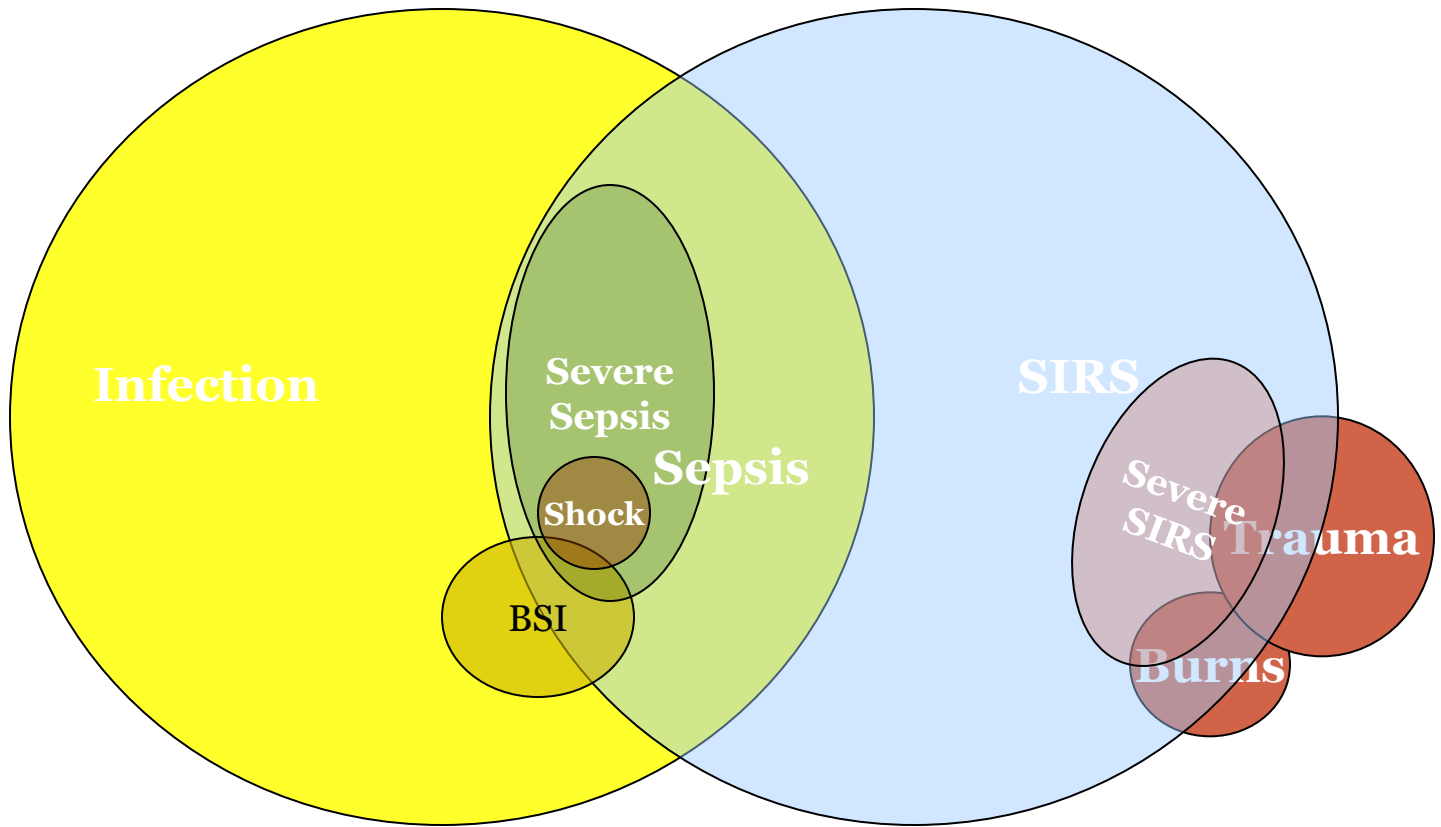
**Jaundice  
↑ Enzymes  
↓ Albumin  
↑ PT**

**Tachycardia  
Hypotension  
↑ CVP  
↑ PAOP**

**Oliguria  
Anuria  
↑ Creatinine**

**↓ Platelets  
↑ PT/APTT  
↓ Protein C  
↑ D-dimer**





46,  
DM,  
HTN,  
CAD, PTCA,  
Dyslipidemia

Progressive  
respiratory distress  
with fever (38.1)  
and hypotension

WBC 16,000  
Creat 3.2  
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HCO<sub>3</sub> 18,  
PO<sub>2</sub> 60 on 15L/m



# Does the patient have SIRS? ✓

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- ✓  $T > 38^{\circ}\text{C}$  or  $< 36^{\circ}\text{C}$
- ✓  $\text{HR} > 90$  beats/min
- ✓  $\text{RR} > 20/\text{min}$
- ✓  $\text{WBC} > 12,000/\text{mm}^3$  or  $< 4,000/\text{mm}^3$

**SIRS = 2 out of 4 of SIRS criteria**

46,  
DM,  
HTN,  
CAD, PTCA,  
Dyslipidemia

Progressive  
respiratory distress  
(RR:41/min) with  
fever (38.1), HR  
92/min and  
hypotension

WBC 16,000  
Creat 3.2  
K 6.1,  
LA 6.4,  
HCO<sub>3</sub> 18,  
PO<sub>2</sub> 60 on 15L/m



# Does the patient have Sepsis?



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- ✓ Suspected or confirmed infection
- ✓ SIRS

**Sepsis= SIRS due to infection**

46,  
DM,  
HTN,  
CAD, PTCA,  
Dyslipidemia

Progressive  
respiratory distress  
(RR:41/min) with  
fever (38.1) , HR  
92/min and  
hypotension

WBC 16,000  
Creat 3.2  
K 6.1,  
LA 6.4,  
HCO<sub>3</sub> 18,  
PO<sub>2</sub> 60 on 15L/m



5/2

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# Does the patient have Severe Sepsis? ✓

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- ✓ **Cardiovascular dysfunction:** systolic BP  $\leq 90$  mm Hg or mean arterial pressure  $\leq 70$  mm Hg (for at least 1 hour despite fluid resuscitation) or require vasopressor support?
- ✓ **Respiratory dysfunction:** PaO<sub>2</sub>/FiO<sub>2</sub> ratio of  $\leq 250$ , PEEP  $> 7.5$  or require mechanical ventilation?
- ✓ **Renal dysfunction:** low urine output (eg  $< 0.5$  mL/kg/hr for 1 hour despite adequate fluid resuscitation), increased creatinine ( $> 50\%$  increase from baseline) or require acute dialysis?
- **Hematologic dysfunction:** low platelet count ( $< 100,000/\text{mm}^3$ ) or PT/PTT  $>$  upper limit of normal?
- ✓ **Lactic acidosis:** 1.5 X normal value

Severe Sepsis = Sepsis + At Least One Organ Dysfunction

46,  
DM,  
HTN,  
CAD, PTCA,  
Dyslipidemia

Progressive  
respiratory distress  
(RR: 41/min) with  
fever (38.1), HR  
92/min and  
hypotension

WBC 16,000  
Creat 3.2  
K 6.1,  
LA 6.4,  
HCO<sub>3</sub> 18,  
PO<sub>2</sub> 60 on 15L/m  
Plats: 201



# Surviving Sepsis Campaign

- Launched in Fall 2002 as a collaborative effort of European Society of Intensive Care Medicine, the International Sepsis Forum, and the Society of Critical Care Medicine
- Goal: reduce sepsis mortality by 25% in the next 5 years
- Guidelines revealed at SCCM in Feb 2004
  - *Critical Care Medicine* March 2004 32(3):858-87.
  - Website: [survivingsepsis . org](http://survivingsepsis.org)



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Progressive  
respiratory  
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WBC 16,000  
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LA 6.4,  
HCO<sub>3</sub> 18,  
PO<sub>2</sub> 60 on 15L/m



Severe sepsis  
Vascular collapse  
Lactic acidosis  
ALI  
Kidney failure

# THE SEVERE SEPSIS BUNDLES: SSC/IHI

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## 6 Hour Bundle

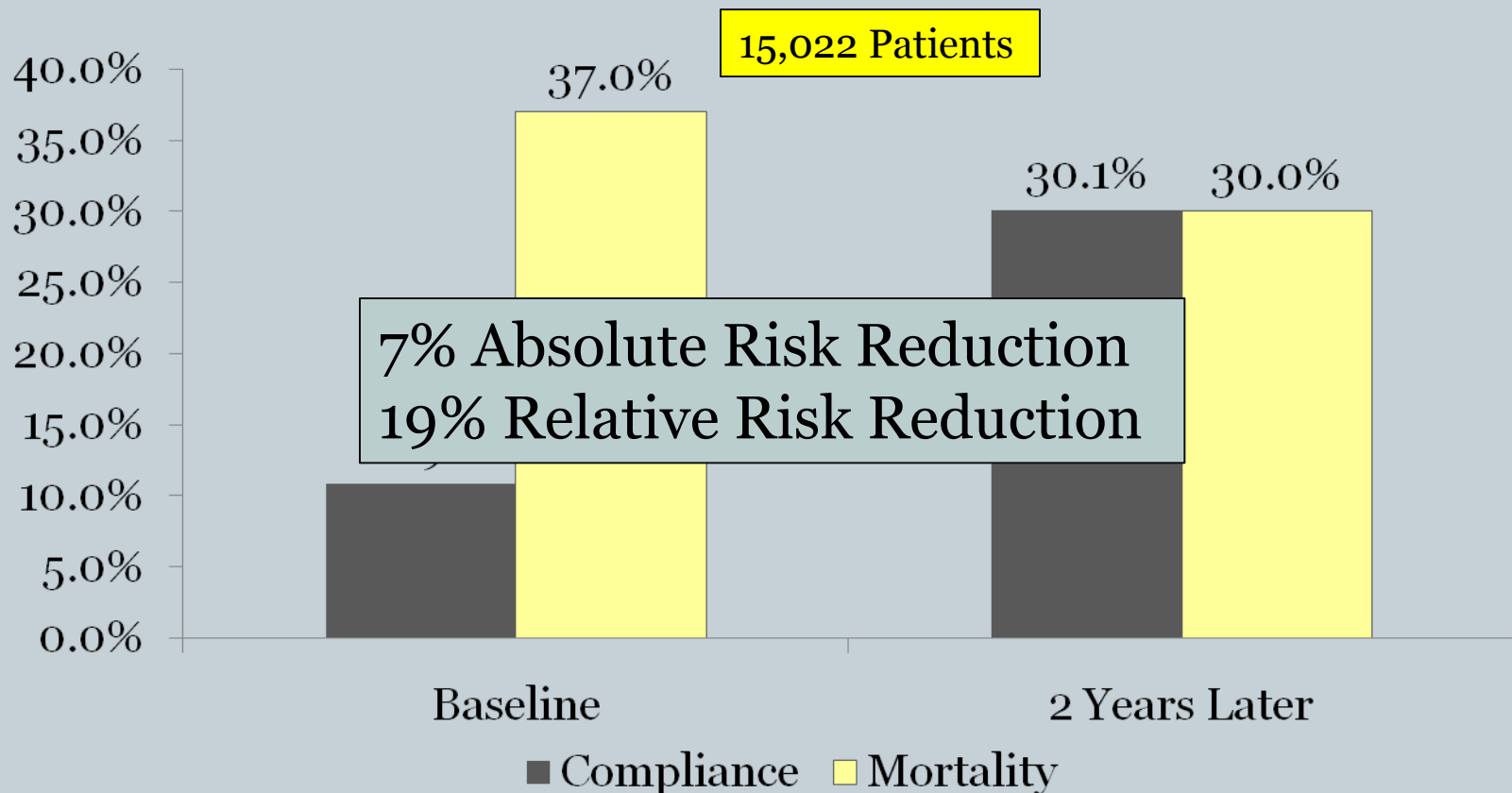
- ✓ Measure serum lactate
- ✓ Blood Cultures prior to antibiotics
- ✓ Broad spectrum antibiotics within 1 hr of presentation
- ✓ Initial fluid resuscitation with 20-40 mL/kg crystalloid (or equivalent colloid) if hypotensive (SBP < 90 mmHg or MAP < 70) or lactate > 4 mmol/L
- ✓ Vasopressors
- ✓ If septic shock or lactate > 4 mmol/L:
  - ✓ CVP and ScvO<sub>2</sub> or SvO<sub>2</sub> measured
  - ✓ CVP maintained 8-12 mm Hg
- ✓ Inotropes (and/or PRBCs if Hct ≤ 30%) delivered for ScvO<sub>2</sub> < 70% or SvO<sub>2</sub> < 65% if CVP ≥ 8 mmHg

## 24 Hour Bundle

- ✓ Glucose control maintained < 150 mg/dL
- ✓ Drotrecogin alfa (activated) administered in accordance with hospital guidelines
- ✓ Steroids given for septic shock requiring continued use of vasopressors for ≥ 6 hours
- ✓ Lung protective strategy with plateau pressures ≤ 30 cm H<sub>2</sub>O for mechanically ventilated patients

# SCCM 2009: Sepsis Management "Bundles" Boost Guideline Implementation, Reduce Mortality

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# Therapy Across the Sepsis Continuum

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Infection

SIRS

Sepsis

Severe Sepsis

Septic Shock

- 
- CVP  $\geq$  8-12 mm Hg
  - MAP  $\geq$  65 mm Hg
  - Urine Output  $\geq$  0.5 ml/kg/hr
  - ScvO<sub>2</sub>  $\geq$  70%
  - SaO<sub>2</sub>  $\geq$  93%
  - Hct  $\geq$  30%

\* **Early Goal Directed Therapy**

**Early Goal-Directed Therapy (EGDT):** involves adjustments of cardiac preload, afterload, and contractility to balance O<sub>2</sub> delivery with O<sub>2</sub> demand: Fluids, Blood, and Inotropes

# Goal #1: Maintain CVP 8-12 cm H<sub>2</sub>O



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## □ Monitoring:

- Central line placement and CVP monitoring

## □ Interventions:

- Initial bolus 20-40 ml/kg NaCl
- 500 mL 0.9% NaCl bolus every 15 minutes to maintain a CVP goal
- Colloids (Albumin) if CVP <4
- Transfuse 1 unit of PRBC's if Hg <10

**CVP** 8-12  
cm H<sub>2</sub>O

**MAP** >  
65  
mm Hg

**Urine  
Output**  
>0.5  
mL/kg/hr

**ScvO<sub>2</sub>** ≥  
70%

**SaO<sub>2</sub>** ≥  
93%

**Hct** ≥  
30%

# Goal #2: Maintain MAP >65 mm Hg!



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## Monitoring

- Non-invasive blood pressure monitoring every 3-5 minutes
- Continuous invasive blood pressure monitoring: arterial line

## Interventions

- Volume:
  - Crystalloids: NS
  - Colloids: Albumin 5%
- Vasoactive agents
  - Norepinephrine or dopamine
  - Phenylephrine or vasopressin

**CVP** 8-12  
cm H<sub>2</sub>O

**MAP** >  
65  
mm Hg

**Urine  
Output**  
>0.5  
mL/kg/hr

**ScvO<sub>2</sub>** ≥  
70%

**SaO<sub>2</sub>** ≥  
93%

**Hct** ≥  
30%

# Goal #3: Maintain Urine Output $>0.5$ mL/kg/hr



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## Monitoring

- Foley catheter

## Interventions:

- Volume (guided per CVP)
  - Crystalloids: NS
  - Colloids: Albumin 5%
- Vasoactive agents (Guided per MAP):
  - Dopamine
  - Norepinephrine

**CVP** 8-12  
cm H<sub>2</sub>O

**MAP** >  
65  
mm Hg

**Urine  
Output**  
>0.5  
mL/kg/hr

**ScvO<sub>2</sub>** ≥  
70%

**SaO<sub>2</sub>** ≥  
93%

**Hct** ≥  
30%

# Goal #4: Maintain ScvO<sub>2</sub> ≥70%



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## Monitoring

- Central line or Swan Ganz catheter
- Obtain central venous specimen

## Interventions

- More fluids
- Transfuse 1 PRBC's if Hg level <10 mg/dL
- Start Dobutamine 2.5-20 mcg/kg/min IV infusion
- Intubation and ventilation

**CVP** 8-12  
cm H<sub>2</sub>O

**MAP** >  
65  
mm Hg

**Urine  
Output**  
>0.5  
mL/kg/hr

**ScvO<sub>2</sub>** ≥  
70%

**SaO<sub>2</sub>** ≥  
93%

**Hct** ≥  
30%

# Goal #5: Maintain SaO<sub>2</sub> ≥ 93%



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## Monitoring

- Pulse oxymetry

## Interventions:

- Inspired oxygen
- CPAP and non-invasive ventilation
- Intubation

**CVP** 8-12  
cm H<sub>2</sub>O

**MAP** >  
65  
mm Hg

**Urine  
Output**  
>0.5  
mL/kg/hr

**ScvO<sub>2</sub>** ≥  
70%

**SaO<sub>2</sub>** ≥  
93%

**Hct** ≥  
30%

# Goal #6: HCT Maintain $\geq 30\%$



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## Monitoring

- Hematocrit

## Interventions

- PRBC transfusion

**CVP** 8-12  
cm H<sub>2</sub>O

**MAP** >  
65  
mm Hg

**Urine  
Output**  
>0.5  
mL/kg/hr

**ScvO<sub>2</sub>**  $\geq$   
70%

**SaO<sub>2</sub>**  $\geq$   
93%

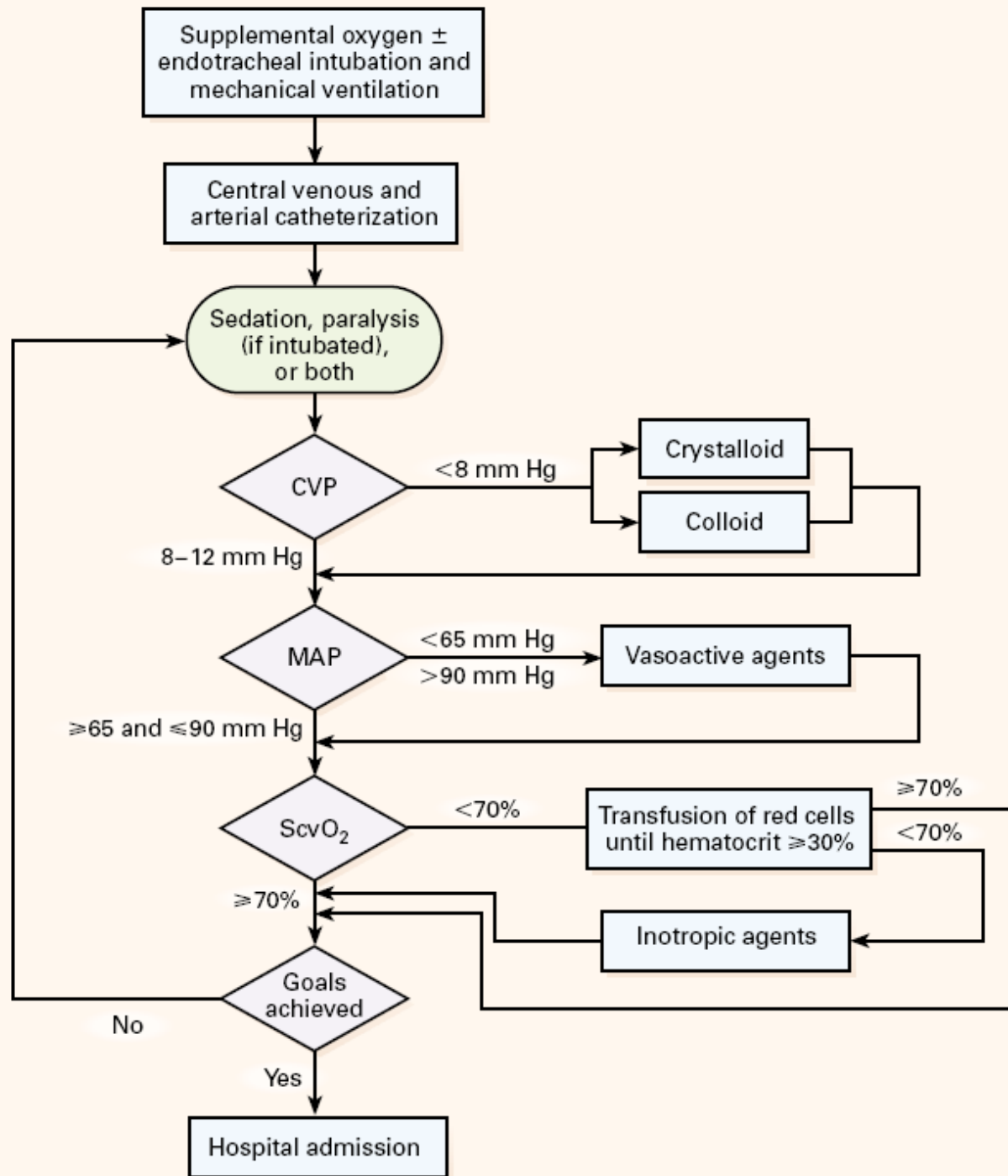
**Hct**  $\geq$   
30%

The New England Journal of Medicine

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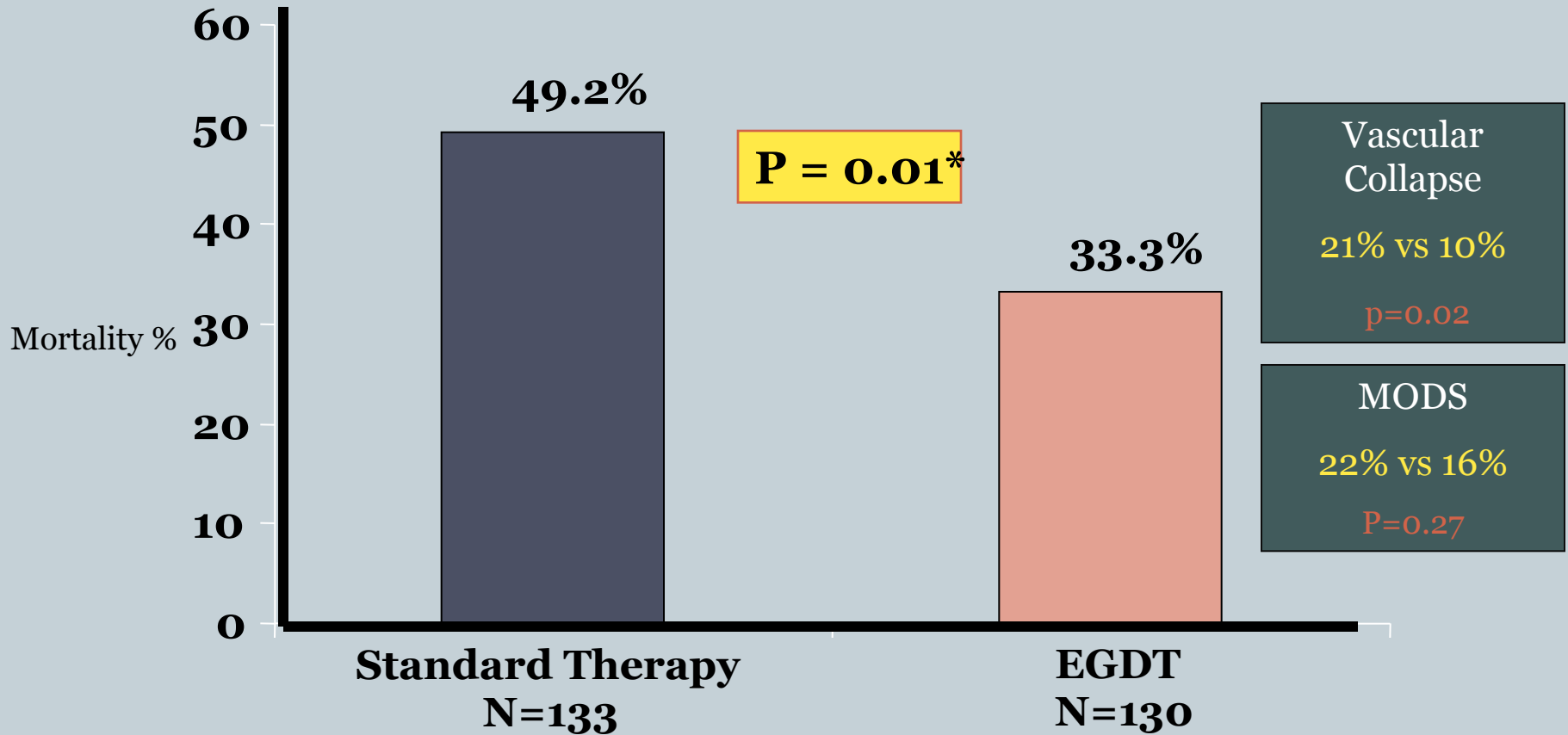
**EARLY GOAL-DIRECTED THERAPY IN THE TREATMENT OF SEVERE SEPSIS  
AND SEPTIC SHOCK**

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



# Early Goal-Directed Therapy Results: 28 Day Mortality

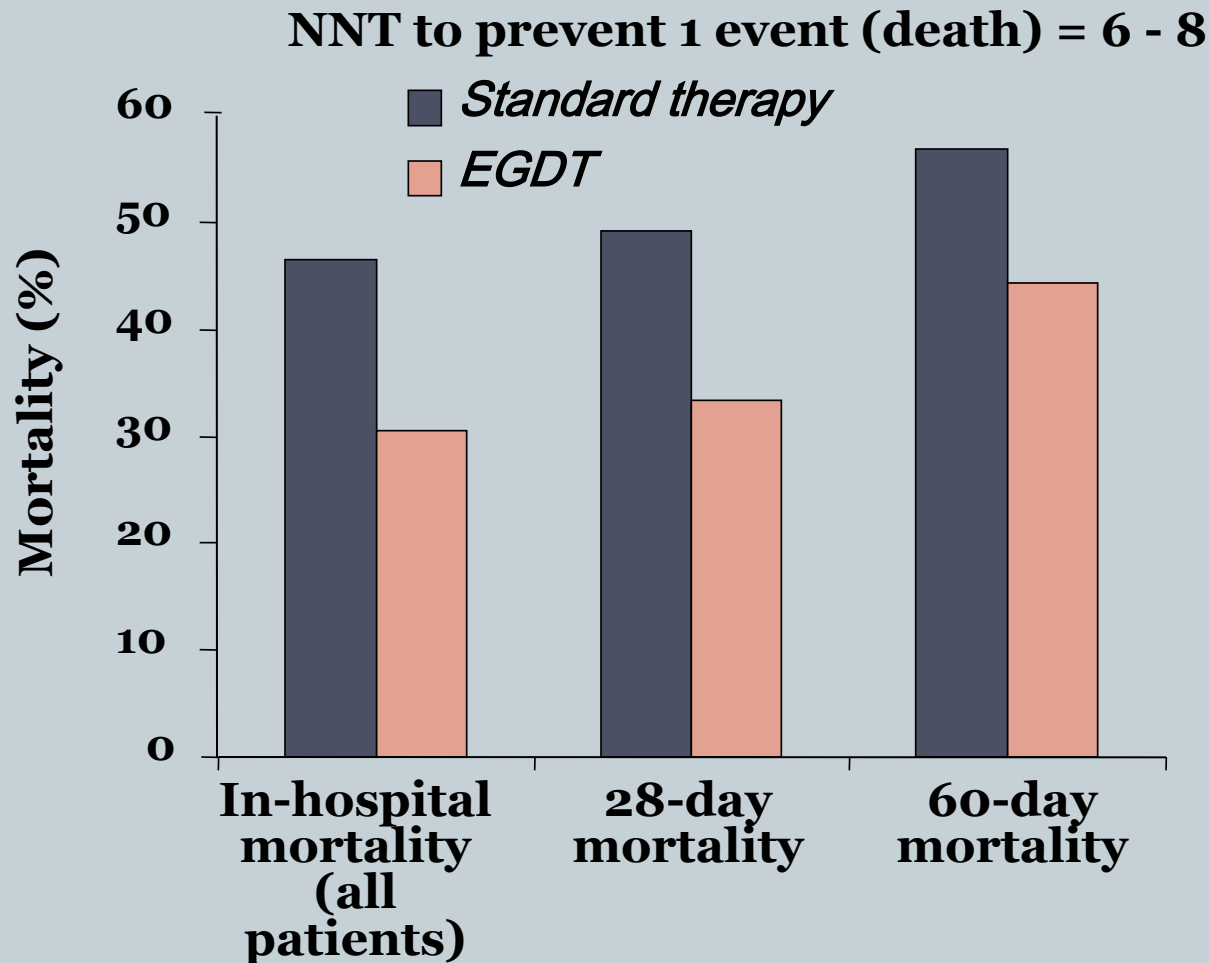
21



\*Key difference was in sudden CV collapse, not MODS

# The Importance of Early Goal-Directed Therapy for Sepsis-induced Hypoperfusion

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# Sepsis Bundles



Serum Lactate Measured

Blood Culture Obtained Prior to Antibiotic Administration

Broad-Spectrum Antibiotics Administered within 1 Hour of ED Admission

Fluid Resuscitation for Hypotension or Lactate  $>4\text{mmol/L}$

Vasopressors for Ongoing Hypotension

Maintain Adequate Central Venous Pressure

Maintain Adequate Central Venous Oxygen Saturation

Administer Low Dose Steroid Therapy for Septic Shock

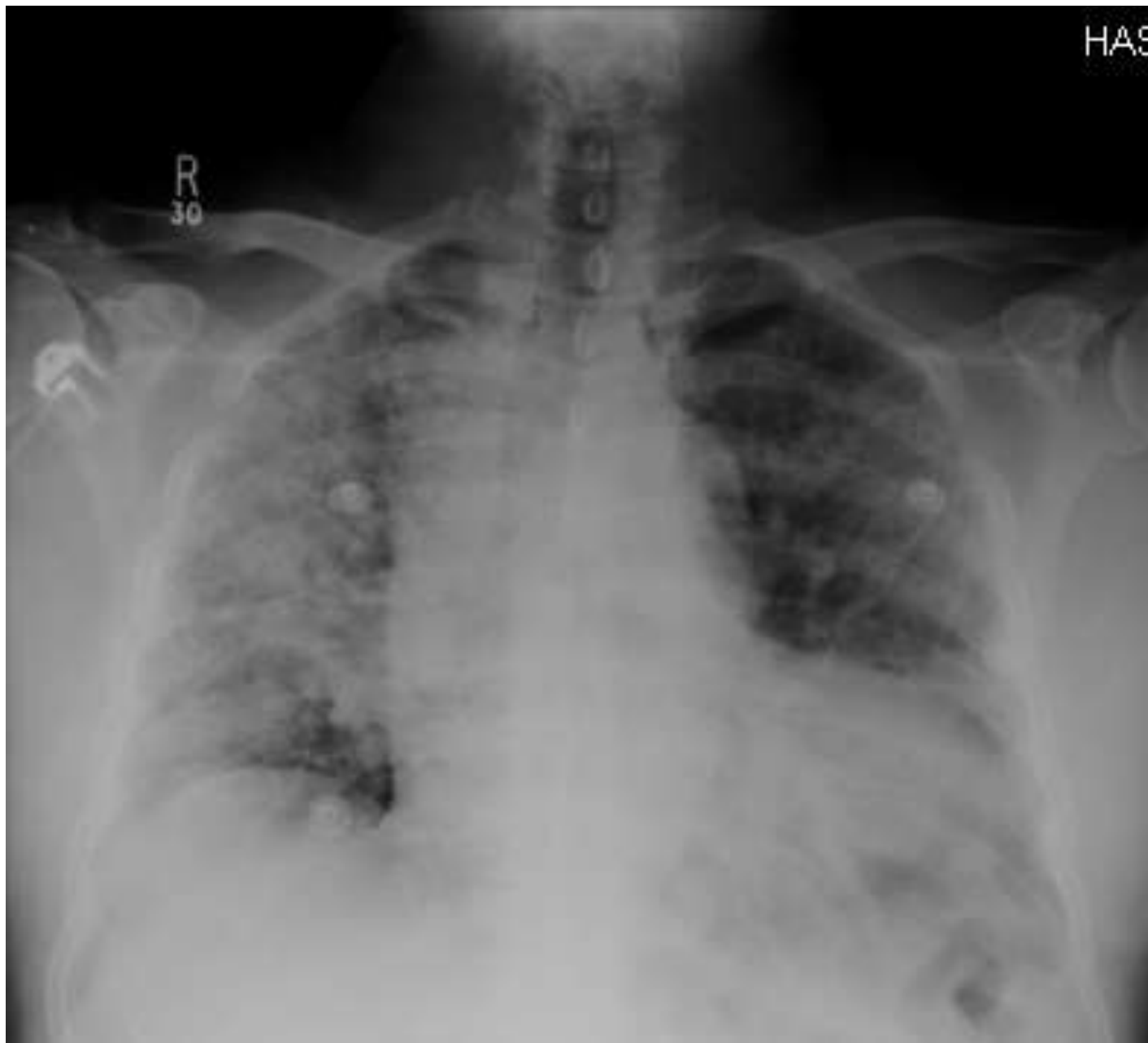
Maintain Adequate Glycemic Control

Administer Recombinant Human Activated Protein C (rhAPC)

Prevent Excessive Inspiratory Plateau Pressures

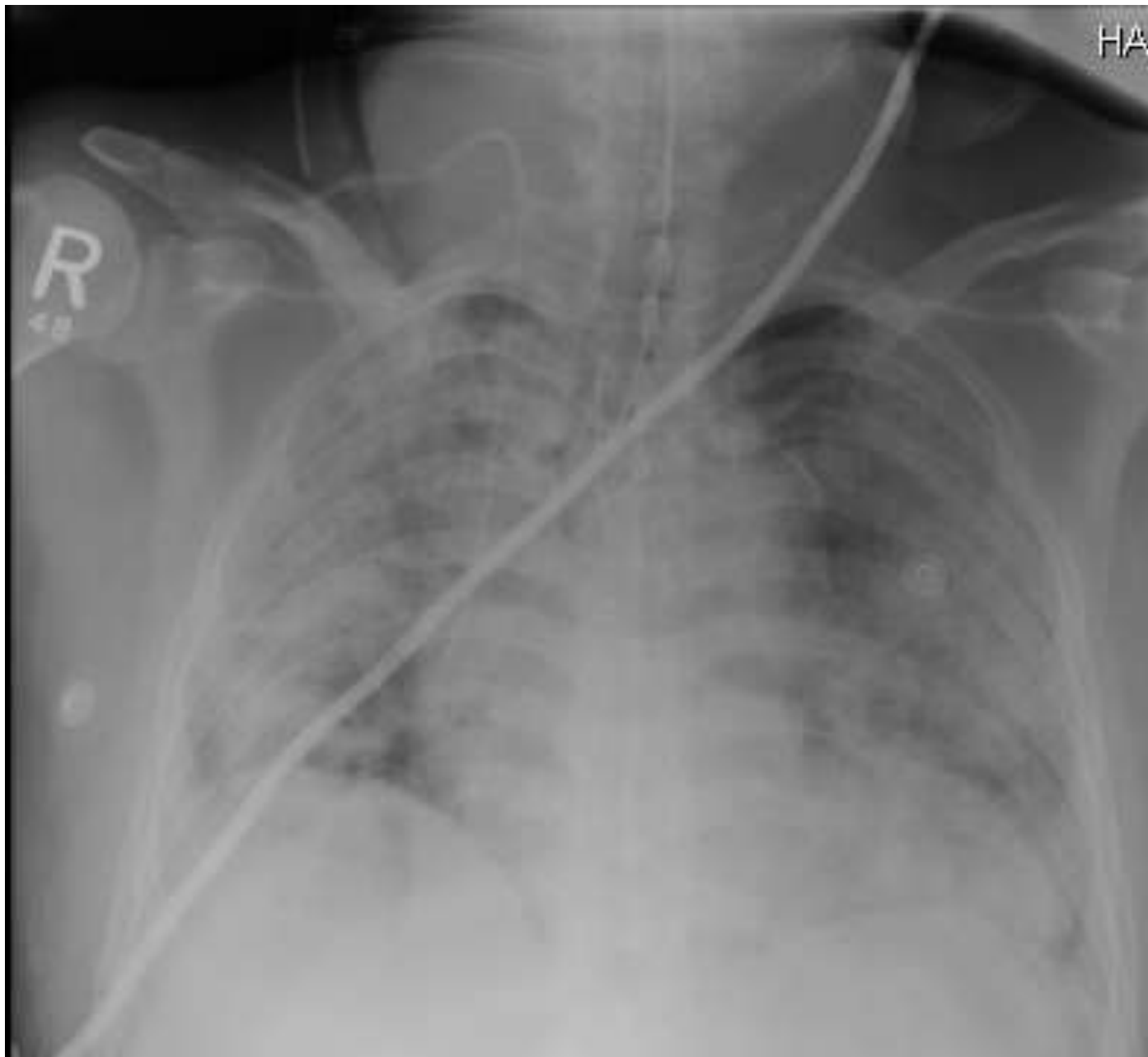
Resuscitation Bundle

Management Bundle



HAS

R  
30



# SUMMARY: SEPSIS GUIDELINES 2008

## Strong Recommendation (1): Recommended

A

DVT Prophylaxis

H<sub>2</sub> Blocker PUD Prophylaxis

No Renal Dose Dopamine

No High Dose Steroids

B

Antibiotics within 1 hr for Septic Shock

Glycemic Control

Crystalloid = Colloid

PPI PUD Prophylaxis

Low VT for ALI

HOB >45

Limited Transfusion

No Antithrombin II

No Erythropoietin

Intermittent = Continuous sedation

Weaning Protocol/SBT

Avoid NMB

C

EGDT and Protocolized Resuscitation

Fluid Challenge

BC prior to Abx

Source Control

Dopamine or Norepinephrine

Limit P plateau <30 cm H<sub>2</sub>O

PEEP

De-escalation Antibiotic Therapy

Conservative Fluid in ALI with no Shock

D

Antibiotics within 1 hr in No septic Shock Patients

7-10 day Antibiotic Duration

Consider Limiting Support

# SUMMARY: SEPSIS GUIDELINES 2008

## Weak Recommendation (2): Suggested

A



B

APC in high risk and non-surgical

equivalency of continuous veno-veno hemofiltration or intermittent hemodialysis

NIV for ALI/ARDS mild/moderate hypoxemia

C

PRBCs or Dobutamine

APC for high risk and surgical

Low dose steroids for septic shock

ACTH test not to be done

B/S < 150

Prone Position in ARDS

D

Wean Steroids

# Early Goal Directed Therapy

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- ⊙ Obtain blood cultures and lactic acid level
- ⊙ Start antibiotics within one hour
- ⊙ Target a central venous pressure target to  $\geq 8$  mmHg
- ⊙ Target a mean arterial blood pressure target of  $\geq 65$  mmHg
- ⊙ Target a central venous O<sub>2</sub> saturation of  $\geq 70\%$
- ⊙ Target your urine output to  $>0.5$  mL/Kg/Hour

# Thank You

