

SEPSIS

Lisa Jarnagin, MD

Pulmonary & Critical Care PGY6

GOALS AND OBJECTIVES

- Define sepsis and septic shock
- Define SIRS criteria and understand its limitations
- Describe SOFA score and qSOFA score
- Describe management of sepsis
- Understand the Surviving Sepsis Campaign
- Choose a vasopressor in septic shock

WHAT IS SEPSIS?

- A. Fever, hypotension, and elevated lactic acid due to bacteremia
- B. Life-threatening organ dysfunction due to dysregulated host response to infection
- C. Infection causing fever $> 38^{\circ}\text{C}$, HR > 90 , RR > 20 , and either leukocytosis > 12 , or leukopenia $< 4\text{k}$
- D. An infection causing tissue injury

WHAT IS SEPSIS?

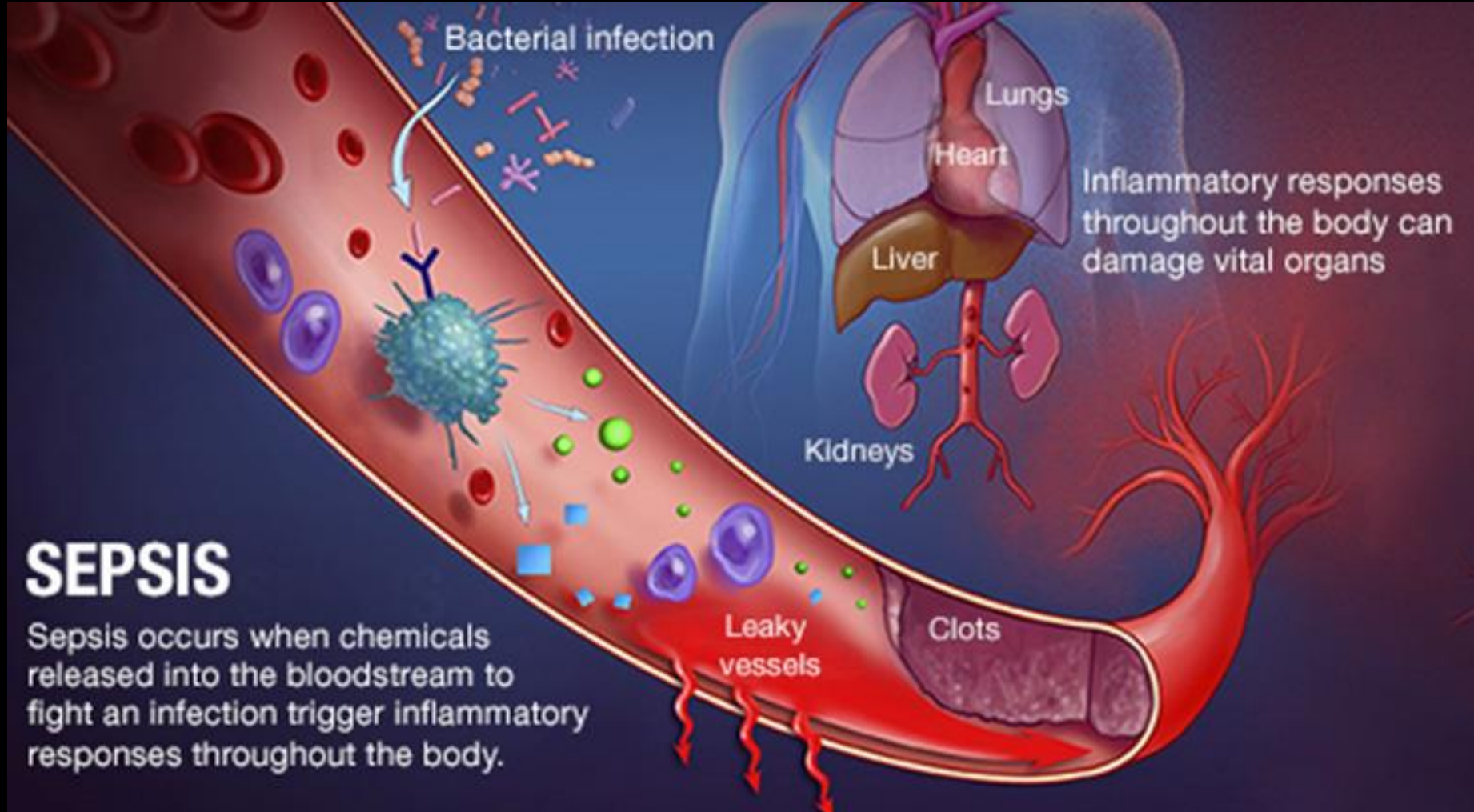
- A. Fever, hypotension, and elevated lactic acid due to bacteremia
- B. Life-threatening organ dysfunction due to dysregulated host response to infection**
- C. Infection causing fever $> 38^{\circ}\text{C}$, HR > 90 , RR > 20 , and either leukocytosis > 12 , or leukopenia $< 4\text{k}$
- D. An infection causing tissue injury

SEPSIS

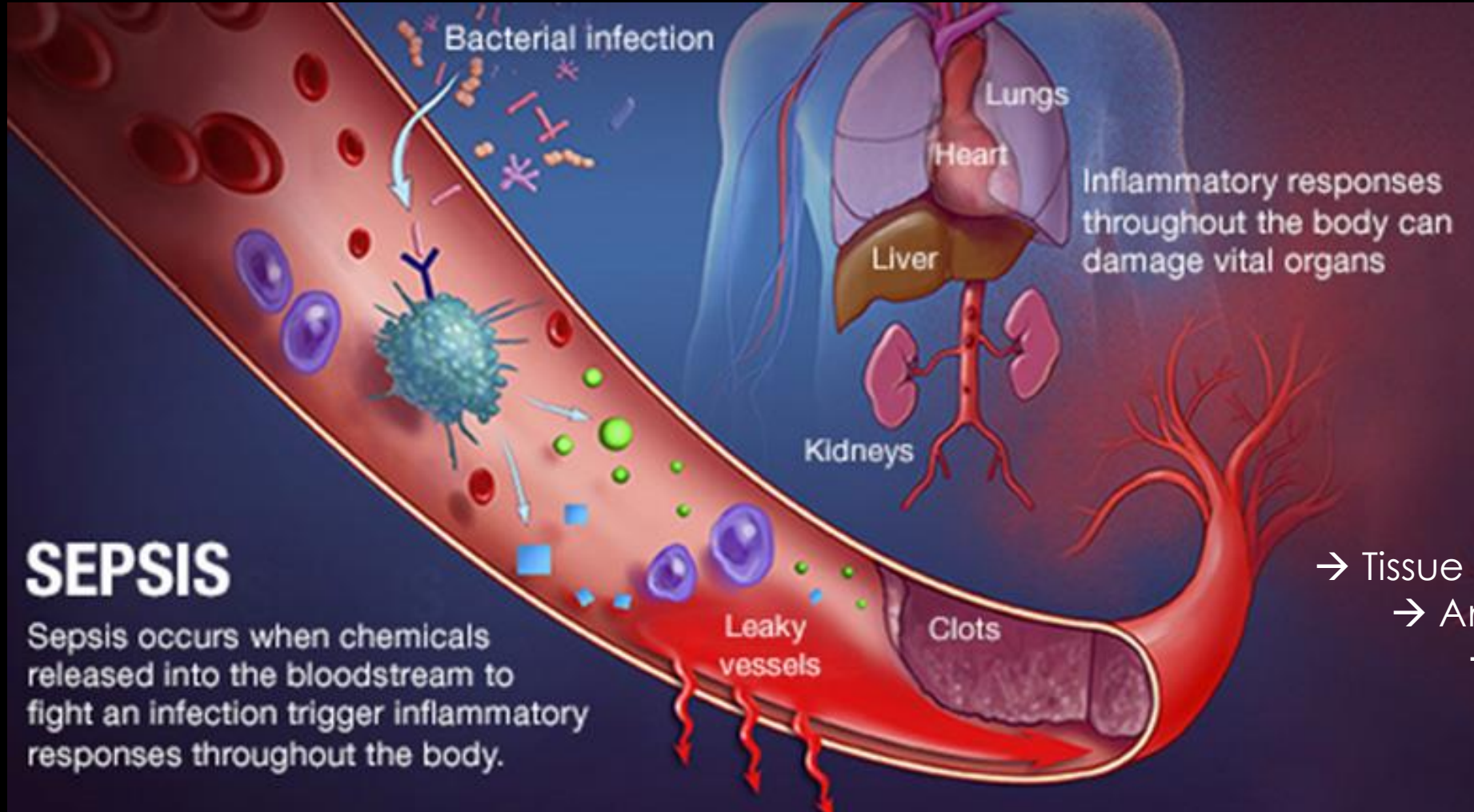
Life threatening

- Mortality rates 28.3% in the US
- Annual incidence 300/100,000 people

DYSREGULATED IMMUNE RESPONSE



ORGAN DYSFUNCTION



- Tissue hypoperfusion
- Anaerobic glycolysis
- Lactic acidosis



SEPSIS

Life threatening

- Mortality rates 28.3% in the US
- Annual incidence 300/100,000 people

Organ dysfunction

- Tissue hypoperfusion
- Lactic acidosis

Dysregulated immune response

- Leaky capillaries
- Vessel dilatation
- Microvascular thrombosis

Infection

SYSTEMIC INFLAMMATORY RESPONSE SYNDROME (SIRS)

- Temperature $> 38^{\circ}\text{C}$
 - HR > 90 bpm
 - RR > 20 or $\text{PaCO}_2 < 32$ mmHg
 - WBC $> 12\text{K}$ or $< 4\text{K}$
- *OLD* sepsis definition: two of four SIRS criteria

WHICH PATIENT MEETS SIRS CRITERIA?

- A. A 35M found down with methamphetamine outside on 117F day. Febrile 38C, HR 120, RR12, WBC 8.
- B. An 89M with known EF 15% presents with orthopnea, pedal edema, elevated JVD. T 37. HR 120, RR 28. WBC 10.
- C. A 64F on chemotherapy presents with altered mental status. T 37. HR 120. RR 18. WBC 5.
- D. Both A & B

WHICH PATIENT MEETS SIRS CRITERIA?

- A. A 35M found down with methamphetamine outside on 117F day. Febrile 38C, HR 120, RR12, WBC 8.
- B. An 89M with known EF 15% presents with orthopnea, pedal edema, elevated JVD. T 37. HR 120, RR 28. WBC 10.
- C. A 64F on chemotherapy presents with altered mental status. T 37. HR 120. RR 18. WBC 5.
- D. Both A & B**

WHICH PATIENT IS MOST LIKELY TO HAVE SEPSIS?

- A. A 35M found down with methamphetamine outside on 117F day. Febrile 38C, HR 120, RR12, WBC 8.
- B. An 89M with known EF 15% presents with orthopnea, pedal edema, elevated JVD. T 37. HR 120, RR 28. WBC 10.
- C. A 64F on chemotherapy presents with altered mental status. T 37. HR 120. RR 18. WBC 5.
- D. Both A & B

WHICH PATIENT IS MOST LIKELY TO HAVE SEPSIS?

- A. A 35M found down with methamphetamine outside on 117F day. Febrile 38C, HR 120, RR12, WBC 8.
- B. An 89M with known EF 15% presents with orthopnea, pedal edema, elevated JVD. T 37. HR 120, RR 28. WBC 10.
- C. A 64F on chemotherapy presents with altered mental status. T 37. HR 120. RR 18. WBC 5.**
- D. Both A & B

WHICH PATIENT IS MOST LIKELY TO HAVE SEPSIS?

- A. A 35M found down with methamphetamine outside on 117F day. Febrile 38C, HR 120, RR12, WBC 8.
- B. An 89M with known EF 15% presents with orthopnea, pedal edema, elevated JVD. T 37. HR 120, RR 28. WBC 10.
- C. A 64F on chemotherapy presents with altered mental status. T 37. HR 120. RR 18. WBC 5.**
- D. Both A & B

Life-threatening organ dysfunction due to dysregulated host response to infection

SEPSIS

- Organ dysfunction
- Dysregulated immune response

SIRS

- *Adaptive* response to inflammation
- Not always due to infection
- 1/8 patients with sepsis will not meet SIRS criteria



HOW DO YOU IDENTIFY SEPSIS?

HOW DO YOU IDENTIFY SEPSIS?

Sequential [Sepsis-related] Organ Failure Assessment



- Organ dysfunction identified as an acute change ≥ 2 points
- SOFA score $\geq 2 \rightarrow$ 10% increase mortality

SOFA

Diagnosis > Management

PaO₂

Norm: 75 - 100

mm Hg ⇌

FiO₂

See [Evidence](#) for estimating FiO₂ from flow/delivery rates

On mechanical ventilation
Including [CPAP](#)

Platelets, ×10³/μL

Glasgow Coma Scale

If on sedatives, estimate assumed GCS off sedatives

Bilirubin, mg/dL (μmol/L)

15

13-14

10-12

Mean arterial pressure OR administration of vasoactive agents required

Listed doses are in units of mcg/kg/min

Creatinine, mg/dL (μmol/L) (or urine output)

No hypotension

MAP <70 mmHg

DOPamine ≤5 or DOBUTamine (any dose)

DOPamine >5, EPINEPHrine ≤0.1, or norEPINEPHrine ≤0.1

DOPamine >15, EPINEPHrine >0.1, or norEPINEPHrine >0.1

<1.2 (<110)

1.2–1.9 (110–170)

2.0–3.4 (171–299)

3.5–4.9 (300–440) or UOP <500 mL/day

≥5.0 (>440) or UOP <200 mL/day

SOFA vs NEWS Score

Chart 1: The NEWS scoring system

| Physiological parameter | Score | | | | | | |
|--------------------------------|-------|--------|-----------|---------------------|-----------------|-----------------|---------------|
| | 3 | 2 | 1 | 0 | 1 | 2 | 3 |
| Respiration rate (per minute) | ≤8 | | 9–11 | 12–20 | | 21–24 | ≥25 |
| SpO ₂ Scale 1 (%) | ≤91 | 92–93 | 94–95 | ≥96 | | | |
| SpO ₂ Scale 2 (%) | ≤83 | 84–85 | 86–87 | 88–92 ≥93 on air | 93–94 on oxygen | 95–96 on oxygen | ≥97 on oxygen |
| Air or oxygen? | | Oxygen | | Air | | | |
| Systolic blood pressure (mmHg) | ≤90 | 91–100 | 101–110 | 111–219 | | | ≥220 |
| Pulse (per minute) | ≤40 | | 41–50 | 51–90 | 91–110 | 111–130 | ≥131 |
| Consciousness | | | | Alert | | | CVPU |
| Temperature (°C) | ≤35.0 | | 35.1–36.0 | 36.1–38.0 | 38.1–39.0 | ≥39.1 | |

QUICK SOFA (QSOFA)



- A score ≥ 2 suggests increase risk of poor patient outcomes

1. Respiratory rate ≥ 22
2. Altered mental status
3. Systolic BP ≤ 90 mmHg

Management > diagnosis

WHAT ARE YOUR INITIAL STEPS IN MANAGEMENT OF SEPSIS?

A 76F presents with fever, chills, and dysuria. Vitals 38.6C, HR 132, BP 91/52, RR24. Leukocytosis to 18, UA positive for nitrites, WBC, and bacteria.

- A. Order lactic acid and blood cultures
- B. Order lactic acid, blood cultures, and 1L IVF
- C. Order lactic acid, blood cultures, 30cc/kg IVF, and blood
- D. Order lactic acid, blood cultures, 30cc/kg IVF, and antibiotics

WHAT ARE YOUR INITIAL STEPS IN MANAGEMENT OF SEPSIS?

A 76F presents with fever, chills, and dysuria. Vitals 38.6C, HR 132, BP 91/52, RR24. Leukocytosis to 18, UA positive for nitrites, WBC, and bacteria.

- A. Order lactic acid and blood cultures
- B. Order lactic acid, blood cultures, and 1L IVF
- C. Order lactic acid, blood cultures, 30cc/kg IVF, and blood
- D. Order lactic acid, blood cultures, 30cc/kg IVF, and antibiotics**

SEPSIS MANAGEMENT

Investigations

- Lactic acid – organ dysfunction
- Panculture – source identification
- Imaging – source identification

Treatment

- 30cc/kg IVF
- Antibiotics

Surviving Sepsis
Campaign®

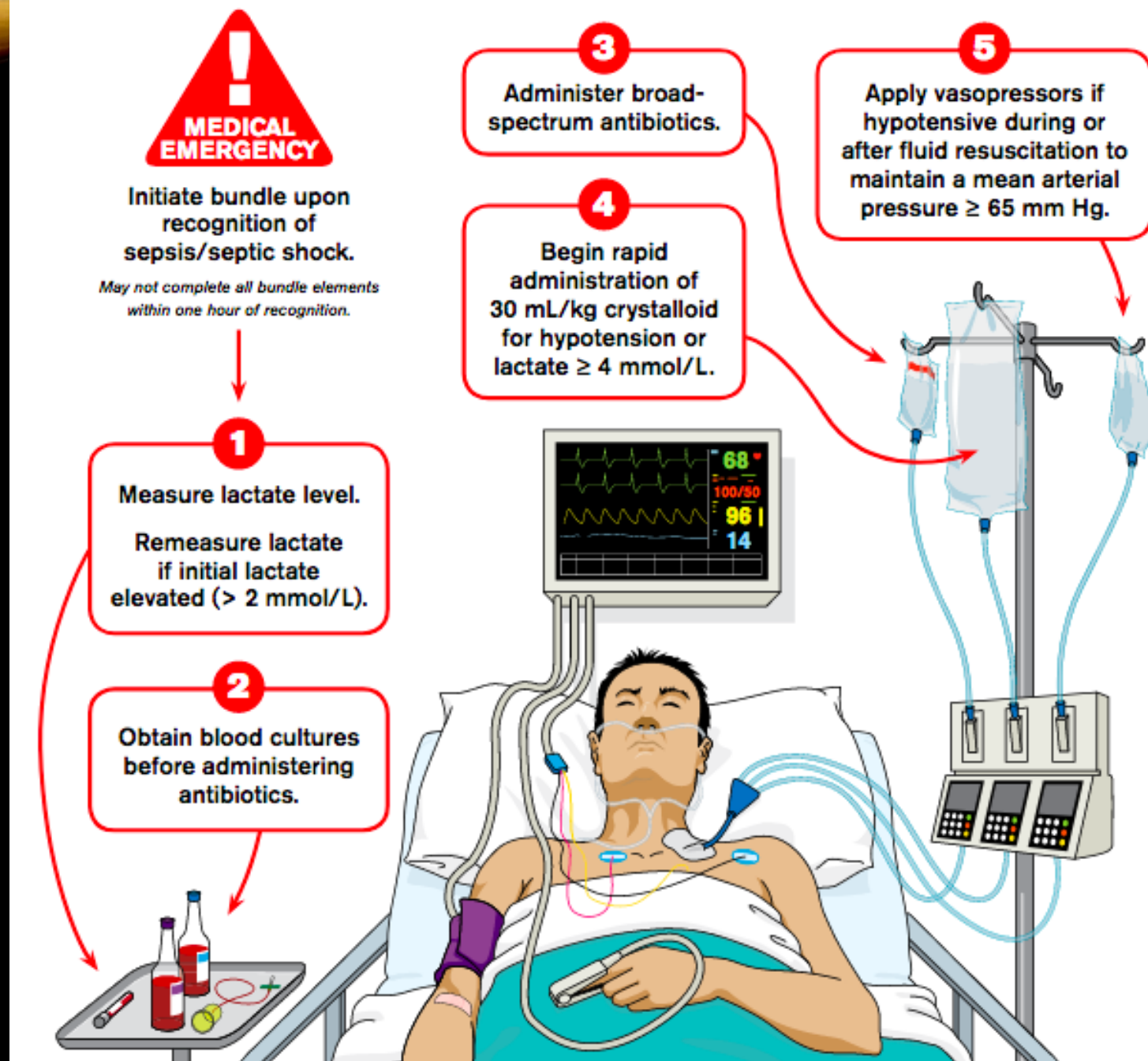
Surviving Sepsis Campaign

Hour-1 Bundle

Initial Resuscitation for Sepsis and Septic Shock

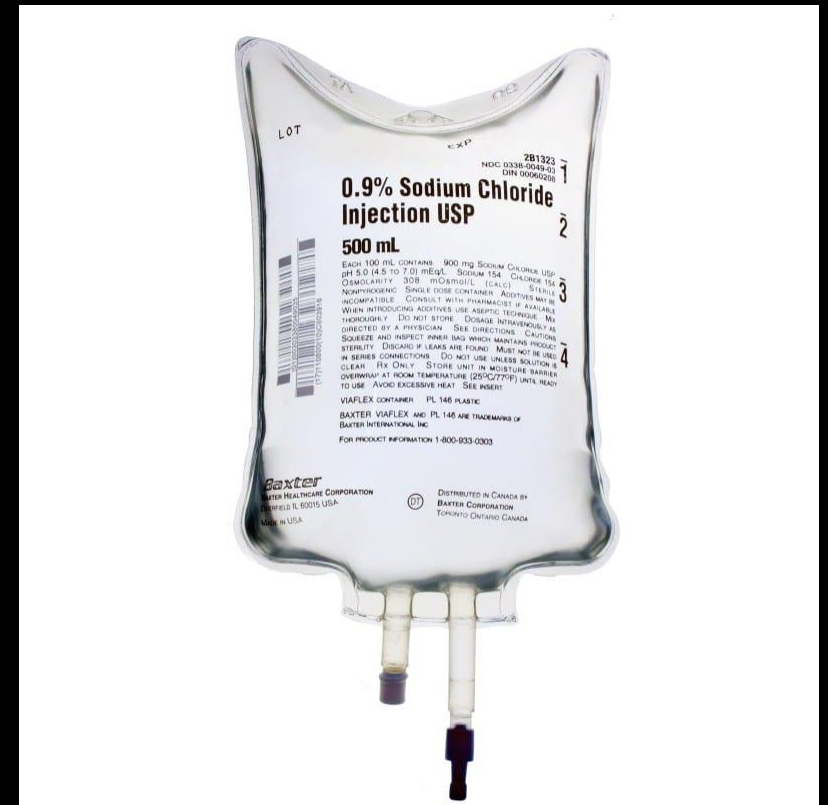
Hour-1 Bundle

Initial Resuscitation for Sepsis and Septic Shock



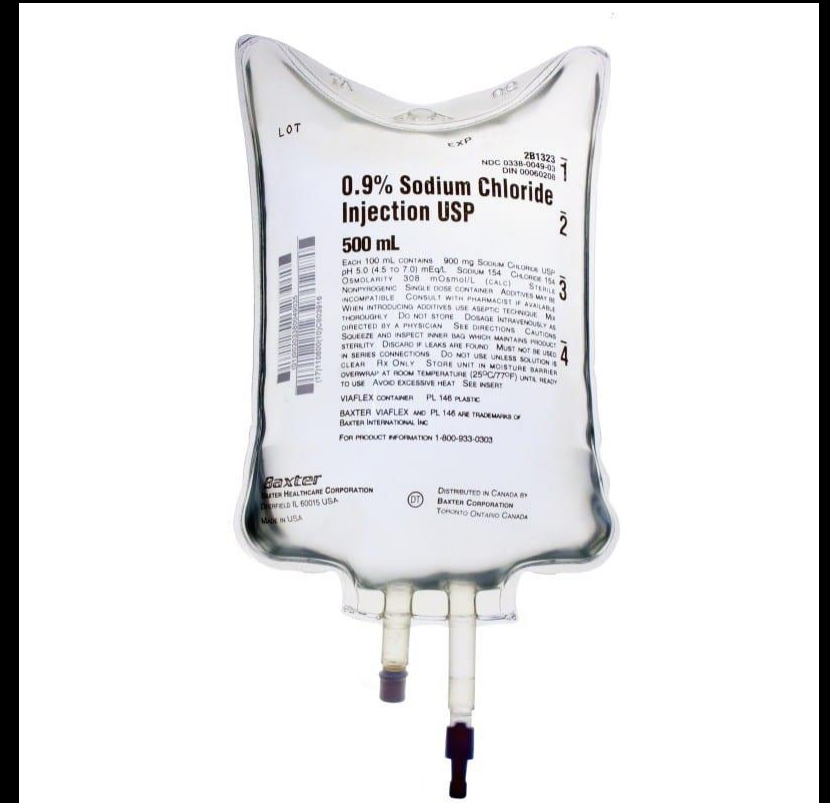
CHOICE OF FLUID RESUSCITATION

1. Safe (risk profile)



CHOICE OF FLUID RESUSCITATION

1. Safe (risk profile)



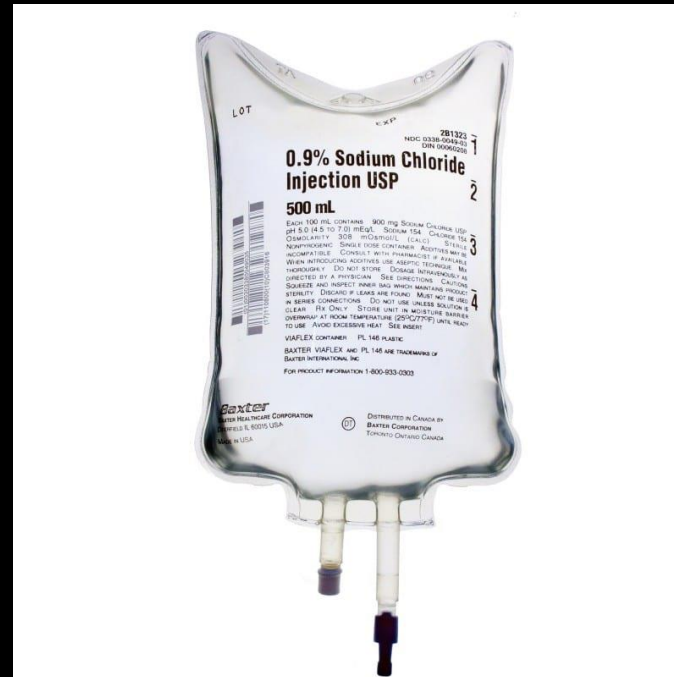
CHOICE OF FLUID RESUSCITATION

1. Safe (risk profile)
2. Effective



CHOICE OF FLUID RESUSCITATION

1. Safe (risk profile)
2. Effective
3. Inexpensive



ORIGINAL ARTICLE

Balanced Crystalloids versus Saline in Critically Ill Adults

Matthew W. Semler, M.D., Wesley H. Self, M.D., M.P.H., Jonathan P. Wanderer, M.D., Jesse M. Ehrenfeld, M.D., M.P.H., Li Wang, M.S., Daniel W. Byrne, M.S., Joanna L. Stollings, Pharm.D., Avinash B. Kumar, M.D., Christopher G. Hughes, M.D., Antonio Hernandez, M.D., Oscar D. Guillamondegui, M.D., M.P.H., Addison K. May, M.D., et al., for the SMART Investigators and the Pragmatic Critical Care Research Group*



SEPTIC SHOCK

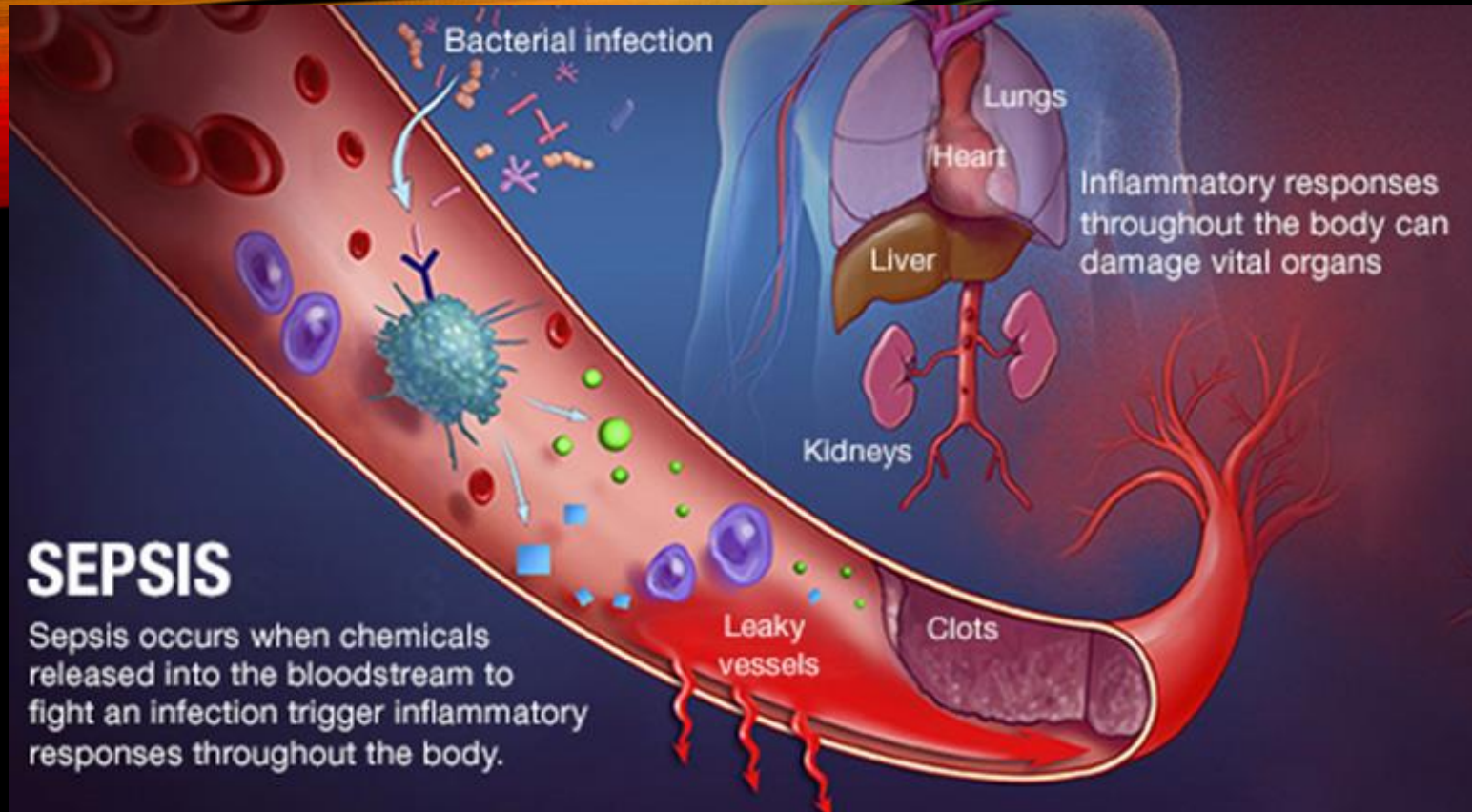
- Clinical subset of sepsis
 - Underlying circulatory and metabolic abnormalities
- Increased mortality 40%
- Persistent hypotension requiring pressor for MAP > 65 mmHg despite adequate IVF

A 76F presents with fever, chills, and dysuria. Vitals 38.6C, HR 132, MAP 60, RR24. Leukocytosis to 18, UA positive for nitrites, WBC, and bacteria. Lactic acid is 3.2. Urine and blood cultures are ordered, and patient is started on broad spectrum antibiotics. Despite 30cc/kg of lactated ringers, MAP remains 60. What is the next best step?

- A. Give additional 20cc/kg of lactated ringers
- B. Order 2 units pRBC and albumin
- C. Start norepinephrine for MAP > 65 mmHg
- D. Start dobutamine for MAP > 65 mmHg

A 76F presents with fever, chills, and dysuria. Vitals 38.6C, HR 132, MAP 60, RR24. Leukocytosis to 18, UA positive for nitrites, WBC, and bacteria. Lactic acid is 3.2. Urine and blood cultures are ordered, and patient is started on broad spectrum antibiotics. Despite 30cc/kg of lactated ringers, MAP remains 60. What is the next best step?

- A. Give additional 20cc/kg of lactated ringers
- B. Order 2 units pRBC and albumin
- C. Start norepinephrine for MAP > 65 mmHg**
- D. Start dobutamine for MAP > 65 mmHg



IVF

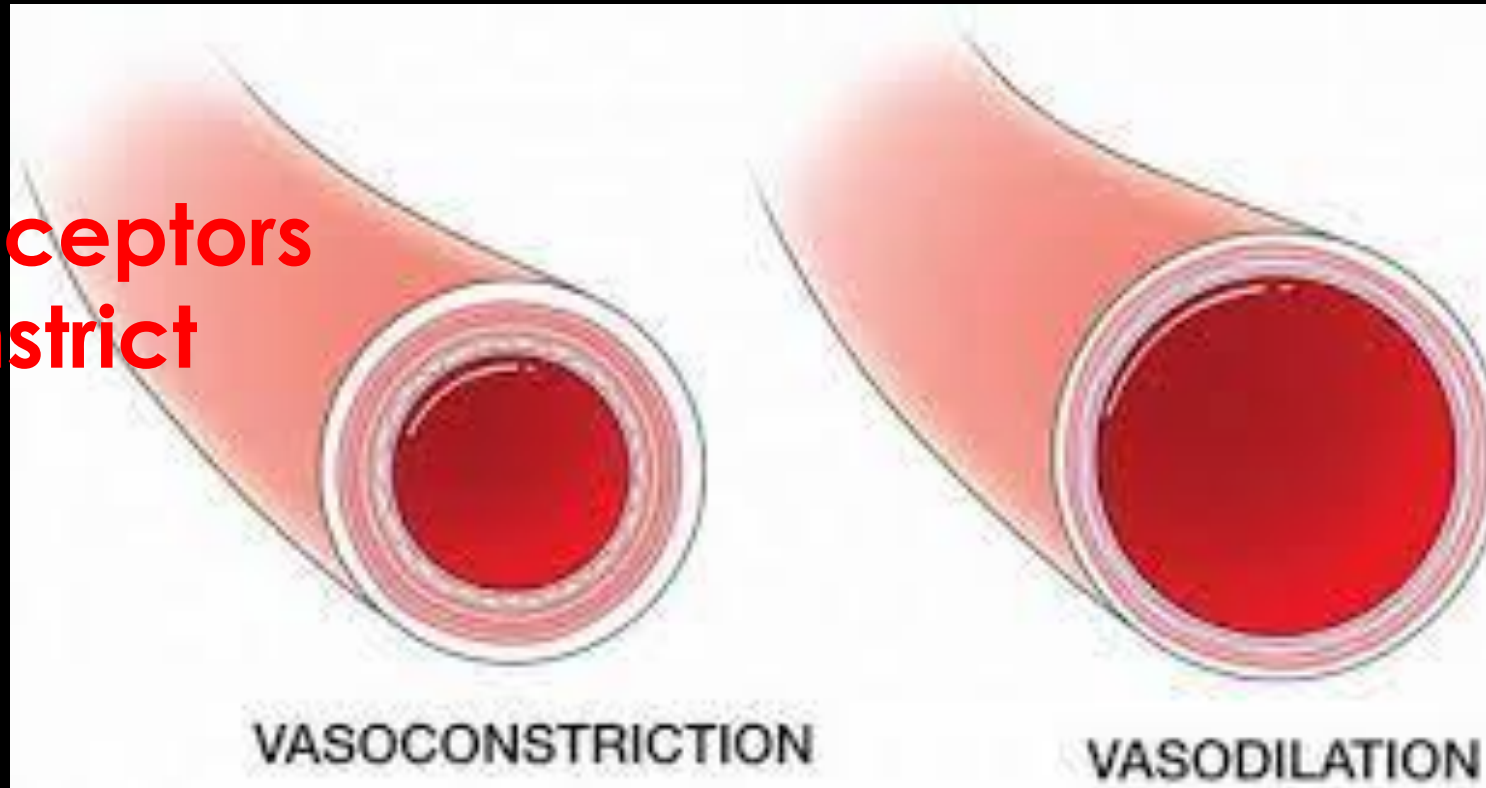


Vasopressors



- Leaky capillaries
- Vessel dilatation
- Microvascular thrombosis

**Alpha receptors
vasoconstrict**



VASOPRESSOR IN SEPTIC SHOCK

- Two mechanisms of action
 - Alpha adrenergic agonist
 - Beta-adrenergic agonist



FIRST LINE
PRESSOR

REFERENCES

- Singer et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016; 315(8):8-01-810.
<https://jamanetwork.com/journals/jama/fullarticle/2492881>
- Gyawall et al. Sepsis: The evolution in definition, pathophysiology, and management. SAGE Open Medicine. 2019. Volume 7:1-13.
- <https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2>
- <https://www.sccm.org/getattachment/SurvivingSepsisCampaign/Guidelines/Adult-Patients/Surviving-Sepsis-Campaign-Hour-1-Bundle.pdf?lang=en-US>