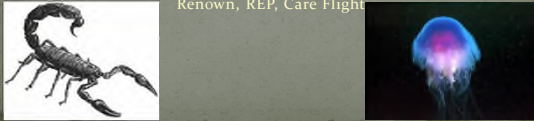


The stealthy sting of death: Sepsis

Jeremy Gonda MD
Emergency Medicine & Critical Care
Renown, REP, Care Flight



This slide features a dark green background with a white border. The title 'The stealthy sting of death: Sepsis' is written in a white serif font. Below the title, the presenter's name 'Jeremy Gonda MD' and his affiliations 'Emergency Medicine & Critical Care' and 'Renown, REP, Care Flight' are listed. At the bottom, there are two small images: a black scorpion on the left and a glowing purple jellyfish on the right.

Disclosures

- No financial disclosures
- I am NOT a scorpiontologist or jelly fishologist...

Stealthy sting of sepsis



This slide has a dark green background with a white border. The title 'Stealthy sting of sepsis' is at the top. Below it is a collage of six images: a map of Uruguay, a tropical beach, a person's hands, a close-up of a skin lesion, a jar of ointment, and a bottle of Benadryl.

Domino effect



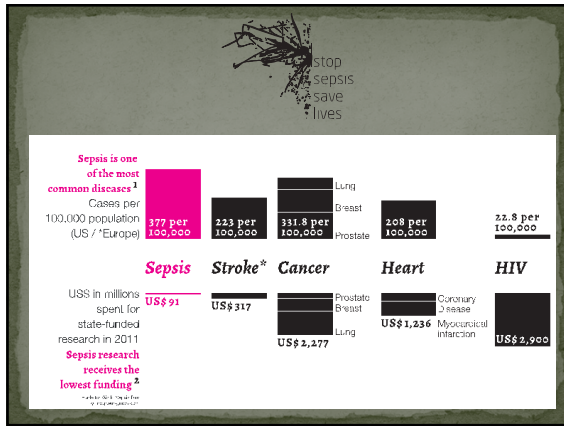
- Initial insult (may be minor)
- Inflammatory cascade
- Organ dysfunction
- Failure
- Death

Objectives

- Define sepsis and describe what is happening to the patient
- Review early recognition and triage of sepsis in the field and in the Emergency Department.
- Review the management of sepsis and common pitfalls to avoid.
- To discuss the most recent research and controversies in sepsis management and where the future is taking us.


Epidemiology

- 570,000 patients/yr arrive to ED with Sepsis
 - Mean ED LOS 5 hrs
 - Increasing prevalence each year 1.5%
 - Estimated 1 million/yr by 2020
- Cost of Sepsis: \$50,000/patient
 - \$17 billion/yr in the United States
- Mortality 20-50%
 - Leading cause of death in noncoronary ICUs
 - 10th leading cause of death overall in the US

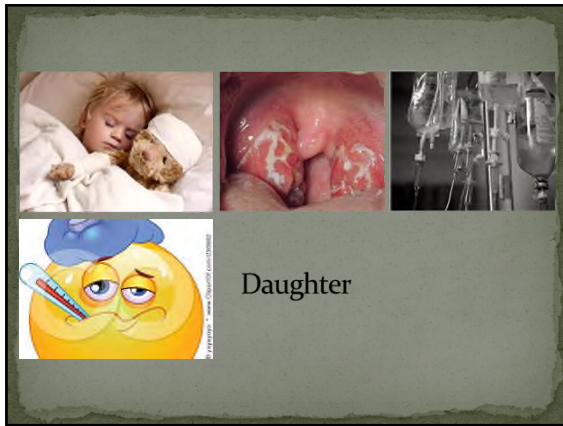


“The world sepsis declaration”

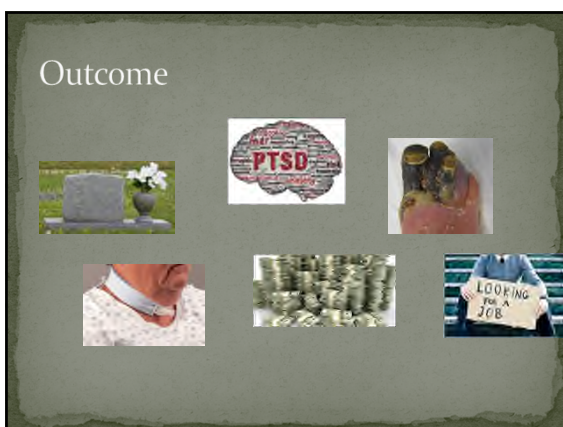
- Sepsis is one of the most common, least-recognized illnesses in both the developed and developing world. Globally, 20 to 30 million patients are estimated to be afflicted every year, with over 6 million cases of neonatal and early childhood sepsis and over 100,000 cases of maternal sepsis.
- Worldwide, a person dies from sepsis every few seconds.

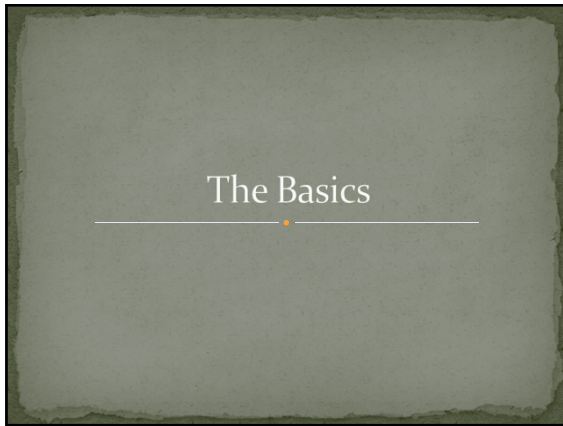


Grandma



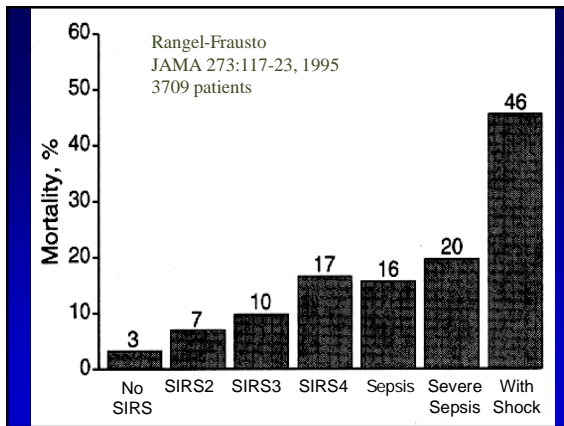










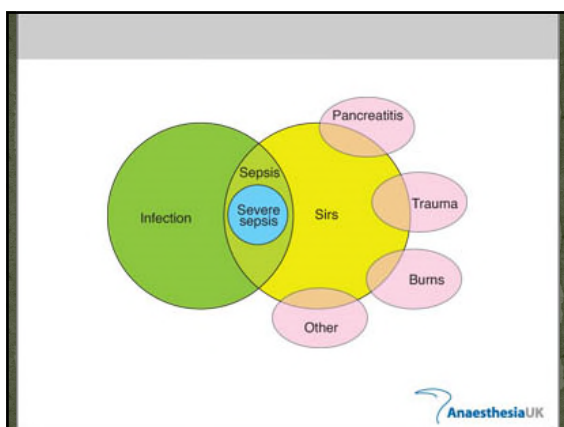


SIRS

- Temp: $> 38^{\circ}\text{C}$ (100.4°F) or $< 36^{\circ}\text{C}$ (96.8°F)
- HR: > 90
- RR: > 20 or $\text{pCO}_2 < 32$
- WBC: $> 12\text{k}$ or $< 4\text{k}$ or $> 10\%$ bands

Need 2 or more to qualify for "SIRS"
Sensitive, NOT specific

Roger Bone *et al*, Chest 101: 1644, 1992



Case # 1

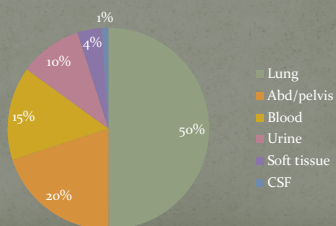
- Called to scene of 18 yo M found down in park...
- No bystanders, found by bench with drug paraphernalia next to him and unconscious
- Vital signs: HR 130, RR 25, temp 100.8F, skin – hot to the touch

Case # 2

- 43 yo F BIB EMS for LUQ abdominal pain radiating to back, nausea/vomiting and significant alcohol abuse history but last drink 2 days ago.
- Vital signs: Temp 98F, HR 140, RR 28, BP 110/80, confused and tremulous
- Labs: WBC 25,000, lipase 9000

Sepsis = SIRS + Infection

Confirmed or presumed source of infection (bacterial, viral, or fungal)



History

- Collect as much information as can in field to relay to receiving hospital.
- Ask specifically about localizing symptoms or risk factors
- Risk factors:
 - elderly, young, immunosuppressed, indwelling lines/foley catheters, recent surgeries/hospitalizations, prior sepsis

Physical exam findings:

- Neuro – AMS
 - CV – tachycardia, hypotension, capillary refill
 - Resp – tachypnea, hypoxic
 - GI – N/V, pain
- Renal – reported low UOP, skin turgor/mucous membranes
 - Skin – color, "knee test", petechiae
 - Overall gestalt

Case #3

- Called to evaluate a young, previously healthy 20 yo F with AMS, fever x 1 day.
 - Too confused to give any history
 - Hypotensive, tachycardic, temp 104F
- Roommate available for questioning
 - What questions might you ask?
 - What things might you look for on physical exam or around the patient?

Case #4

- 86 yo M in nursing home with AMS, syncope, and hypothermia
- Important physical exam findings that might give clue to infectious source?

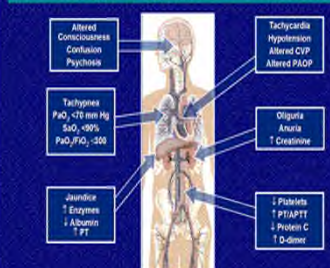
Severe Sepsis = Sepsis + Organ dysfunction

- Organ dysfunction:
 - Altered mental status
 - Acidosis
 - Lactate
 - Cardiovascular
 - Respiratory
 - Renal, GI, Hematology, Skin, etc.

Assessment of organ dysfunction

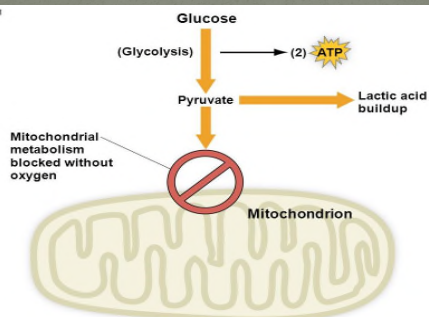
- Physical exam
- Labs:
 - CBC
 - CMP
 - Coags
 - Cardiac enzymes
 - Cultures (blood, UA/urine, sputum)
 - LACTATE!
- Imaging:
 - EKG
 - CXR

Identifying Acute Organ Dysfunction as a Marker of Severe Sepsis



LACTATE > 2.0

Figure 3.31



Septic Shock = Severe sepsis + refractory hypotension

- Refractory hypotension + LA 4+
- MAP < 65 after adequate fluid resuscitation (20-30mL/kg)
- Requiring vasopressor support

What is Shock?

VO₂:DO₂

SHOCK = cellular hypoperfusion

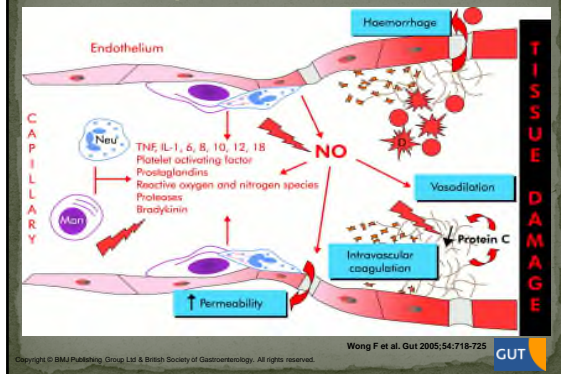
Oxygen delivery (DO₂) can NOT keep up with demand/consumption (VO₂)



Traditional types of shock

- Cardiogenic – pump failure
 - Infarction, valvular abnormality
- Obstructive
 - PE, tamponade
- Distributive
 - **Septic**, neurogenic
- Hypovolemic
 - Dehydration, hemorrhagic
- Cytotoxic
 - CO, cyanide

Sepsis - Vasodistributive



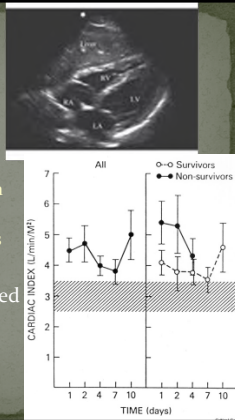
Sepsis - Hypovolemia



- Increased capillary membrane permeability
- Increased insensible losses
- Decreased oral intake

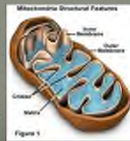
Sepsis - Cardiogenic

- Dynamic process
 - "Warm shock, cold shock"
 - Depressed myocardial function
 - Toxin mediated
 - Dilated left and right ventricles
- Survivors were those who showed decreased myocardial dysfunction

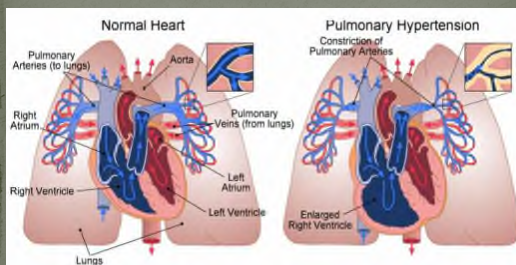


Cytotoxic shock

- Mitochondrial dysfunction
 - inhibition of the electron transport chain enzymes
 - hormonal influences that decrease mitochondrial activity
 - Down-regulation of mitochondrial protein expression



Obstructive shock



Mortality reaches 40%!





Early Recognition and
Assessment of Sepsis and Shock

The transition to serious illness occurs during the critical "golden hours," when definitive recognition and treatment provide maximal benefit in terms of outcome

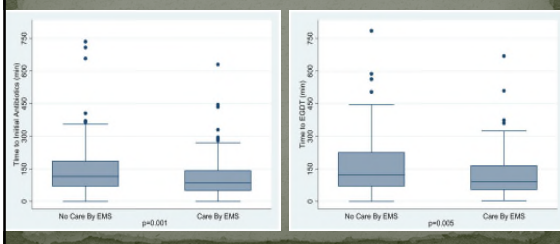
Rivers et al. N Engl J Med; 2001

We must recognize and act before it takes its victim...

- Out of hospital education and sign recognition with early treatment
- Triage protocols in EDs
 - Using Sensitive criteria (not specific) for larger safety net
- Team approach
 - EMS → ED with MD (ED → ICU), RN, lab, pharmacy, RT, administration, etc.

EMS role in sepsis

- Studock JR, et al. The impact of emergency medical services on the ED care of severe sepsis. *Am J Emerg Med.* 2012 Jan;30(1):51-6.



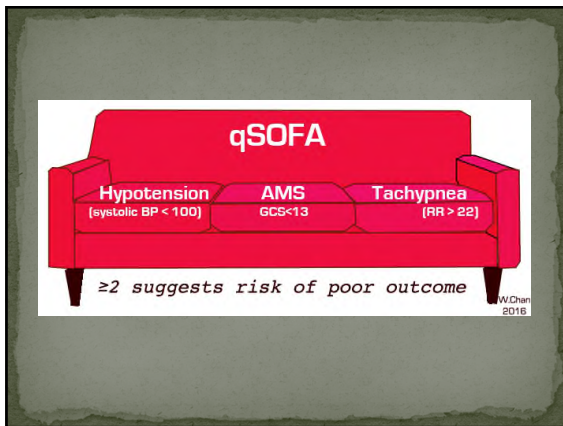
Screening tools

Robson

1. Temperature > 38.3 degrees C (100.9 degrees F) or < 36.0 degrees C (96.8 degrees F);
2. Heart rate > 90 Beats per minute;
3. Respiratory rate > 20 Breaths per minute;
4. Acutely altered mental status; or
5. Serum glucose < 120 mg/dL or 6.6 mmol/L.

BAS 90-30-90

1. Systolic blood pressure < 90;
2. Respiratory rate > 30 breaths per minute; or
3. Oxygen saturation < 90%.




- ### Adjuncts in pre-hospital
- ETCO₂
 - Inversely proportional to lactic acid levels
 - EKG changes of ischemia
 - Point of Care
 - Lactic acid
 - Procalcitonin
 - Sending facility work-up
 - WBC, creatinine, troponin, EKG, CXR, UA, etc.

Alert


- "Sepsis pre-alert"
- Use the word "sepsis" or "septic shock" in report

Management of Sepsis

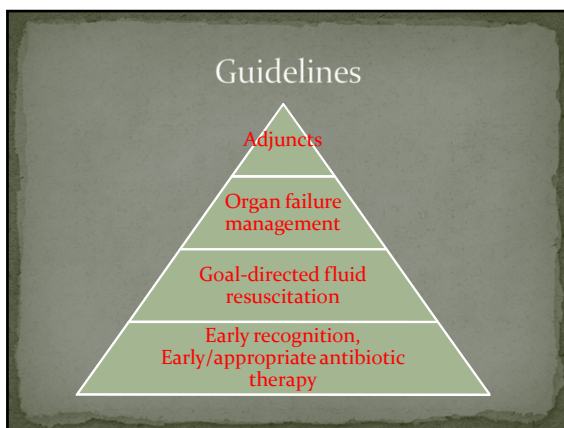
& Pitfalls to avoid



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"Careful, I added some pollyfish to get that authentic ocean feel."



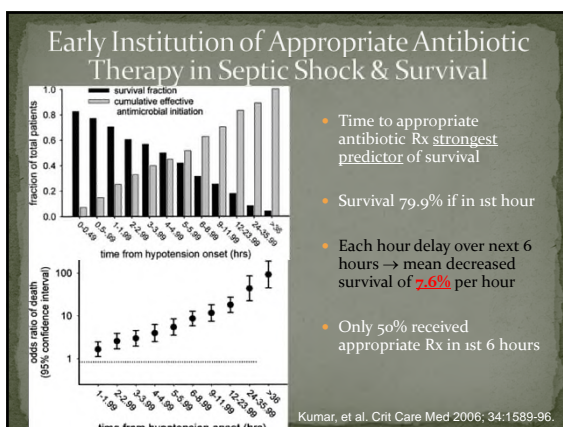
Antibiotics

Surviving Sepsis Campaign

Antibiotic therapy

- Blood cultures before antibiotic therapy (1C)
- Imaging studies performed promptly to confirm a potential source of infection (UG)
- Administration of broad-spectrum antimicrobials therapy within 1 hr of recognition of septic shock and severe sepsis (1B)
- Reassessment of antimicrobial therapy daily for de-escalation, when appropriate (1B)





Appropriate Antibiotic choice

- Start BROAD and narrow therapy later
 - Attempt to get cultures prior to initiating antibiotics if won't cause delay
- If concern for healthcare associated exposure or immunocompromise:
 - Treatment should cover for pseudomonas and MRSA
 - Vancomycin + Piperacillin/tazobactam +/- fluoroquinolone (combination therapy)
- Otherwise, appropriate to most likely infectious etiology



Source Control



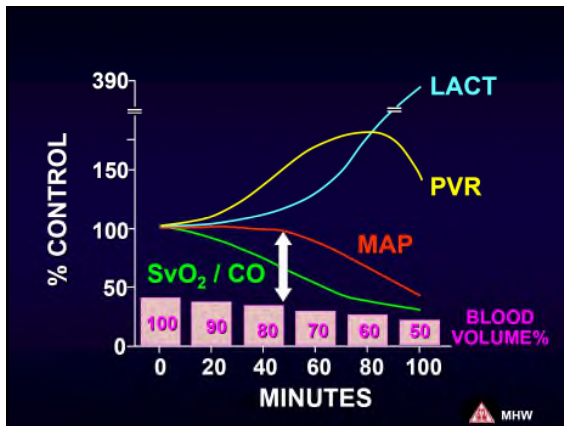
Early Goal Directed Therapy

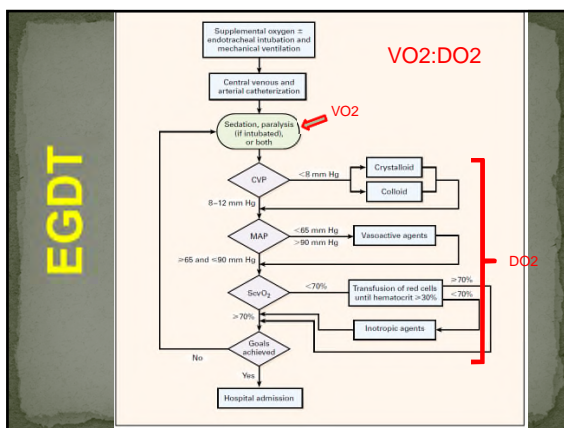
The New England Journal of Medicine

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

EMANUEL RIVERS, M.D., M.P.H., GWYNETH NGUYEN, M.D., SUZANNE HARTUNG, M.A., JULIE ROSSLER, B.S., ALEXANDRA MULLIN, B.S., BERNHARD KNORRICH, M.D., EDWARD PETERSON, Ph.D., AND MICHAEL TOMLANDOVICH, M.D., FOR THE EARLY GOAL-DIRECTED THERAPY COLLABORATIVE GROUP*

Nov 2001, NEJM





EMS pre-hospital sepsis therapy

- Early recognition
- ABCs
 - Intubate or start on NIV if breathing inadequate or not protecting airway
 - use higher PEEP and vent settings given likely level of acidosis and hypoxemia
 - Large bore IV or IO access (just as would in trauma) with volume resuscitation (30mL/kg bolus)
 - Draw blood sample/cultures
 - Blood pressure support with vasopressors
 - Check and monitor glucose
 - Control body temperature
 - Fever vs hypothermia
 - Antibiotics if available

Surviving Sepsis Campaign

Vasoactive agents

- NE (levophed) as the first-choice vasopressor to maintain MAP \geq 65 mm Hg (1B)
- Epinephrine when an additional agent is needed to maintain adequate blood pressure (2B)
- Vasopressin (0.03 U/min) can be added to norepinephrine to either raise mean arterial pressure to target or to decrease norepinephrine dose but should not be used as the initial vasopressor (UG)
- Dopamine is not recommended except in highly selected circumstances (2C)
- Dobutamine infusion administered or added to vasopressor in the presence of a) myocardial dysfunction as suggested by elevated cardiac filling pressures and low cardiac output, or b) ongoing signs of hypoperfusion despite achieving adequate intravascular volume and adequate mean arterial pressure (1C)

Case #6



ROCK BOTTOM

you'll know it when you get there

Case (cont)

- History:
 - "Aagh.....blubde, duh saney."
- Physical exam:
 - Temp 94F, HR 133, RR 32, O₂ sat 86%, BP 65/32
 - Other pertinent things to look for?
- Management:
 - Steps?

Case (cont) - Hospital follow-up

- Diagnosis:
 - Aspiration PNA, septic shock, strep pneumonia bacteremia, acute renal failure, ARDS, pancreatitis, acute ETOH intoxication
- Pertinent ED labs:
 - lactate 12, Hgb 8, platelets 65k, WBC 32k, creatinine 2.3, CO2 10, troponin 1.8, ScVO2 60%, ETOH 0.48, lipase 2000, ABG 7.18/34/55.





Adjuncts to care



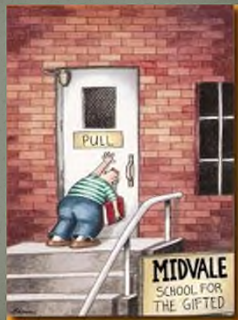
Future changes

- What is the correct volume of fluid?
- Metabolic resuscitation
 - Marik protocol
- Genetic testing and prevention
 - Immunostimulation
 - Flu/PNA vaccinations
 - Public awareness

Summary

- Early recognition and triage of patients with sepsis is key
- Early antibiotics and EGDT decreases mortality
- Future involves genetic, micro, hemodynamic monitoring devices, bedside echo, education, policy...

Questions?



References

- Deane, O, et al. Clinical review: Myocardial depression in sepsis and septic shock. *Crit Care*. 2002; 6(6): 500–508.
- Ceccechia, M. Mitochondrial dysfunction during sepsis. *Intens Care Med*. 2010 Sep;10(3):214–23.
- Rhee, J, et al. The impact of emergency medical services on the ED care of severe sepsis. *Ann Emerg Med*. 2012 Jan;30(1):51–6.
- Evans, AE, et al, for the Emergency Medicine Shock Research Network (EMShockNet) Investigators. Lactate Clearance vs Central Venous Oxygen Saturation as Goals of Early Sepsis Therapy: A Randomized Clinical Trial. *JAMA*. 2016 February 14; 315(8): 729–739.
