Sepsis and Septic Shock Recognition and Management

Jawad Nazir, MD, FACP
Medical Director, Infection Prevention and Control
Avera Health and Avera McKennan Hospital
Clinical Associate Professor of Medicine
Sanford School of Medicine, Univ of South Dakota

Why care about sepsis?

- Greater than 230,000 US patients are affected by septic shock each year.
- Sepsis is the leading cause of death in non-coronary care intensive care units, with a mortality rate between 30% and 50%
- Financial impact
  - From 2007 to 2009, over 2,047,038 patients were admitted with a sepsis-related illness
  - 6th most common principal reason for hospitalization in US

Why care about sepsis?

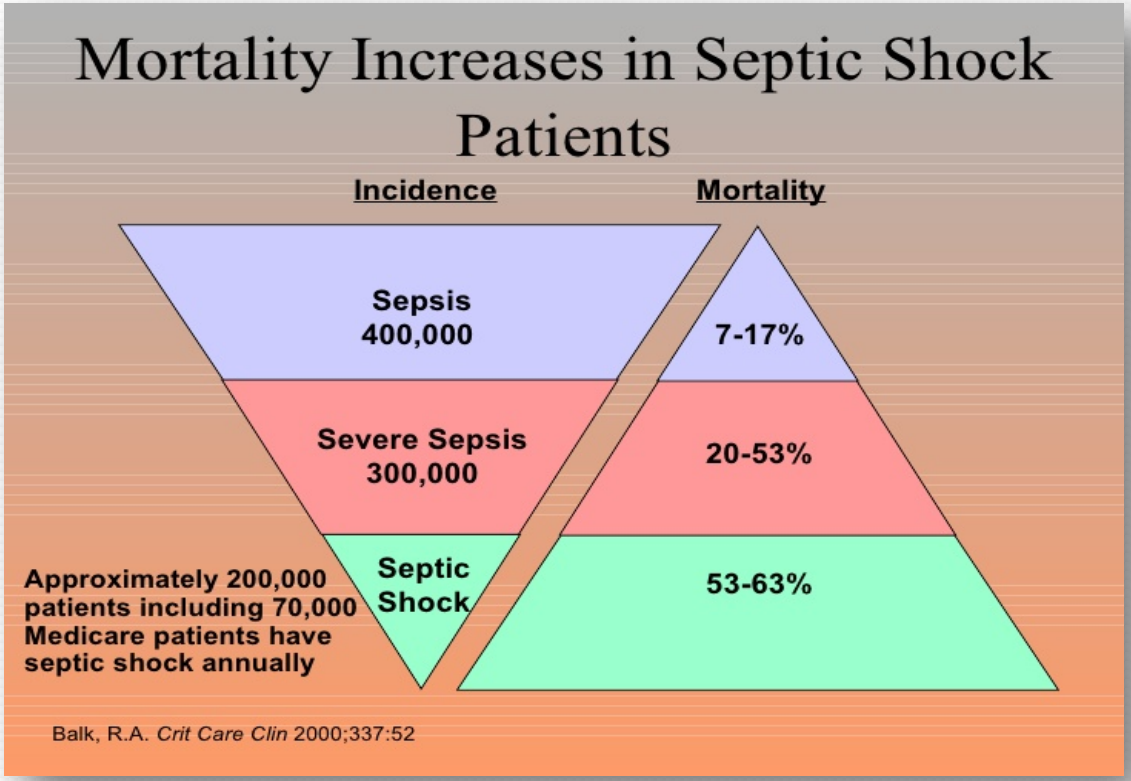
- **Patients hospitalized were**
  - ***More severely ill*** **than patients hospitalized for other diagnosis**
  - ***Stayed longer*** **than other inpatients (LOS 75 % greater)**
  - ***More likely to die*** **during hospitalization (8 times more)**
  - ***Rising inpatient costs*** **($14.6 billion in 2008) with increasing mortality**

- **Aging population with chronic illnesses, greater use of invasive devices, immunosuppressive drugs, chemotherapy, transplantation and increasing antibiotic resistance**

NCHS Data Brief. No 62, June 2011

Comparing Sepsis

- US Mortality rates for Severe Sepsis exceed Acute Myocardial Infarction and common cancers (Lung, Colon and Breast Cancer)



Hall, M.J, et al. NCHS data brief, 62. Hyattsville, MD: National Center for Health Statistics.

History of sepsis definitions

- **<u>Bacteremia</u>**
  - The presence of viable bacteria in the blood

- **<u>Systemic Inflammatory Response Syndrome</u> (SIRS)**
  - 2 or more of the following
    - Fever or hypothermia (T >100.4 or < 96.8)
    - Tachycardia (HR > 90)
    - Tachypnea (RR > 20 or $PaCO_2$ < 32)
    - Leukocytosis, leukopenia or left shift (WBC > 12,000, < 4,000 or > 10% bands)

History of sepsis definitions

TABLE 2. Severe Sepsis

Severe sepsis definition = sepsis-induced tissue hypoperfusion or organ dysfunction (any of the following thought to be due to the infection)
Sepsis-induced hypotension
Lactate above upper limits laboratory normal
Urine output < 0.5 mL/kg/hr for more than 2 hrs despite adequate fluid resuscitation
Acute lung injury with Pao_2/Fio_2 < 250 in the absence of pneumonia as infection source
Acute lung injury with Pao_2/Fio_2 < 200 in the presence of pneumonia as infection source
Creatinine > 2.0 mg/dL (176.8 μmol/L)
Bilirubin > 2 mg/dL (34.2 μmol/L)
Platelet count < 100,000 μL
Coagulopathy (international normalized ratio > 1.5)

Adapted from Levy MM, Fink MP, Marshall JC, et al: 2001 SCCM/ESICM/ACCP/ATS/SIS International Sepsis Definitions Conference. *Crit Care Med* 2003; 31: 1250–1256.

Severe sepsis definition changes

1991

Sepsis induced hypotension, persisting despite adequate fluid resuscitation, along with the presence of hypoperfusion abnormalities or organ dysfunction

2001

State of acute circulatory failure characterized by persistent arterial hypotension unexplained by other causes

2016

Subset of sepsis in which underlying circulatory, cellular and metabolic abnormalities are associated with a greater risk of mortality than sepsis alone

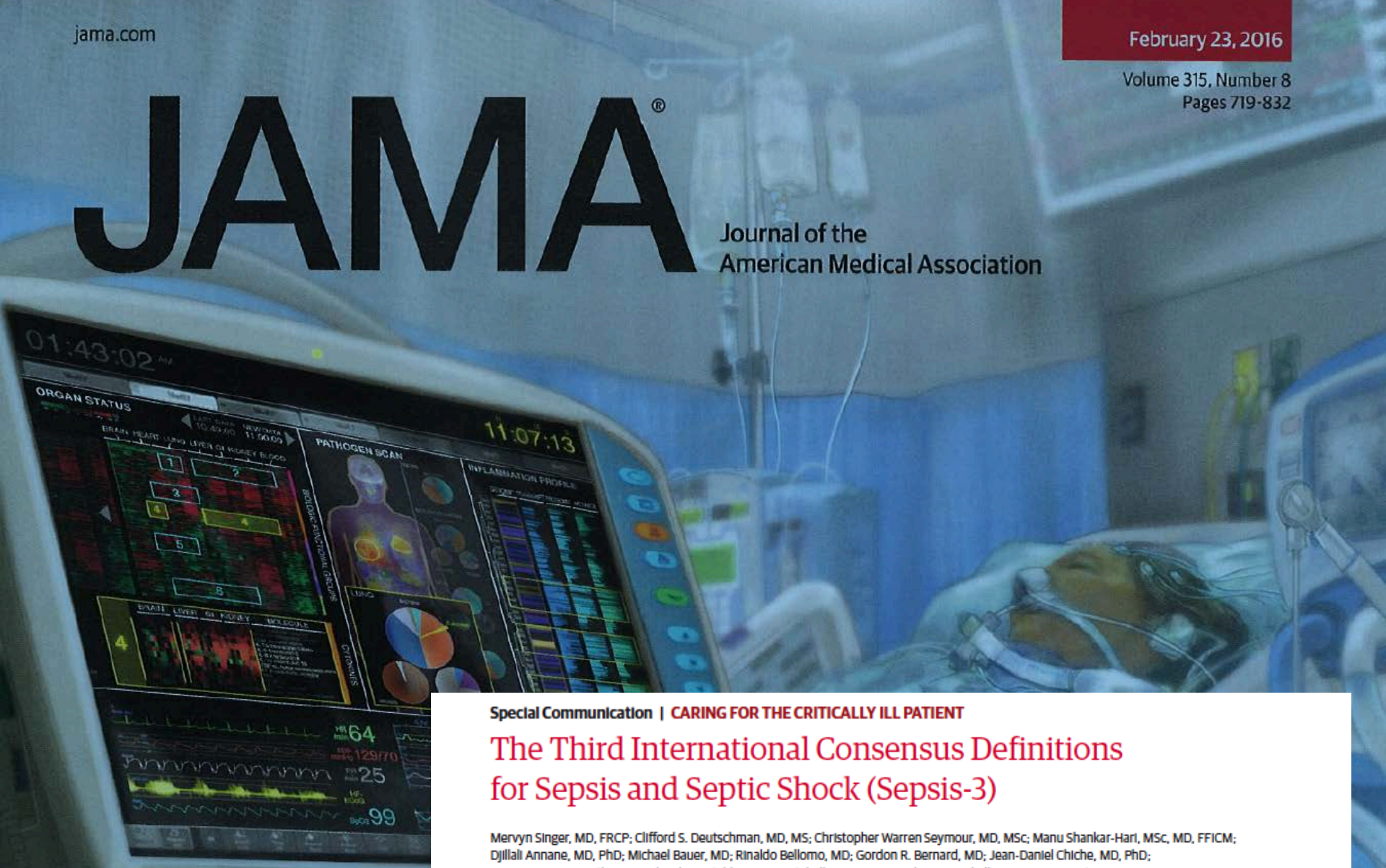
jama.com

February 23, 2016

Volume 315, Number 8
Pages 719-832

JAMA®

Journal of the American Medical Association



Special Communication | CARING FOR THE CRITICALLY ILL PATIENT

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)

Mervyn Singer, MD, FRCP; Clifford S. Deutschman, MD, MS; Christopher Warren Seymour, MD, MSc; Manu Shankar-Hari, MSc, MD, FFICM; Djillali Annane, MD, PhD; Michael Bauer, MD; Rinaldo Bellomo, MD; Gordon R. Bernard, MD; Jean-Daniel Chiche, MD, PhD; Craig M. Coopersmith, MD; Richard S. Hotchkiss, MD; Mitchell M. Levy, MD; John C. Marshall, MD; Greg S. Martin, MD, MSc; Steven M. Opal, MD; Gordon D. Rubenfeld, MD, MS; Tom van der Poll, MD, PhD; Jean-Louis Vincent, MD, PhD; Derek C. Angus, MD, MPH

Evolving Issues in Critical Care and Sepsis

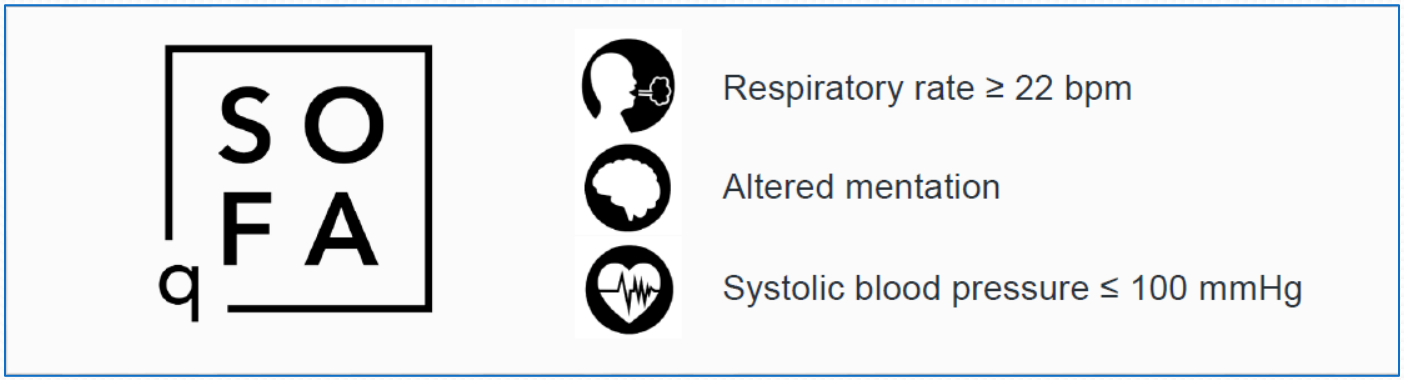
Key definition changes

- **Sepsis**
  - Life-threatening organ dysfunction due to a dysregulated host response to infection
  - Lay-term definition
    - "Sepsis is a life-threatening condition that arises when the body's response to an infection injures it's own tissues and organs"
- **Septic shock**
  - A subset of sepsis in which particularly profound circulatory, cellular, and metabolic abnormalities substantially increase mortality

Singer, m. et al. (2016). The third international consensus definitions for sepsis and septic shock (sepsis-3). *The Journal of the American Medical Association, 315*(8), 801-810. doi: 10.1001/jama.2016.0287

qSOFA (Quick SOFA) criteria

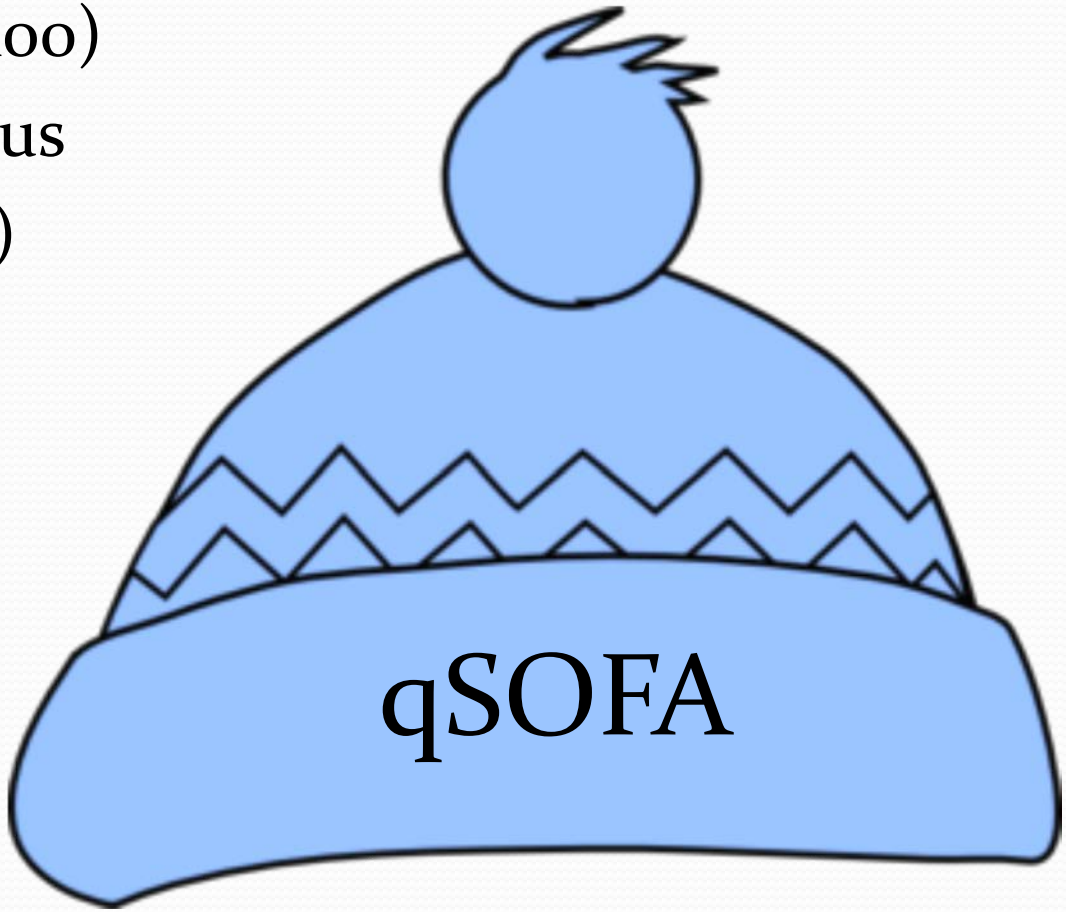
- Used to:
  - Quickly identify patients, at the bedside, with a suspected infection who are likely to have poor outcomes
  - Prompt clinical staff to further investigate organ dysfunction
  - Start therapy as appropriate
  - Consider referral to higher level of care or increase frequency of monitoring



Singer, m. et al. (2016). The third international consensus definitions for sepsis and septic shock (sepsis-3). *The Journal of the American Medical Association, 315*(8), 801-810. doi: 10.1001/jama.2016.0287

Remember qSOFA = HAT

- **H**ypotension (BP <100)
- **A**ltered Mental Status
- **T**achypnea (RR >22)



Clinical criteria of sepsis

It is the primary case of death from infection, especially if not recognized and treated promptly. Its recognition ***mandates*** urgent attention.
Organ Dysfunction is defined as:

- Change in SOFA score ≥ 2 pts.
  - Baseline can be assumed as 0 in patients with no preexisting organ dysfunction
  - SOFA score is not intended to be use as a tool for patient management but as a means to clinically characterize a septic patient.
  - SOFA ≥ 2 reflects an overall mortality risk of approx. 10% in general hosp. patient pop.

Singer, m. et al. (2016). The third international consensus definitions for sepsis and septic shock (sepsis-3). *The Journal of the American Medical Association, 315*(8), 801-810. doi: 10.1001/jama.2016.0287

Clinical criteria of septic shock

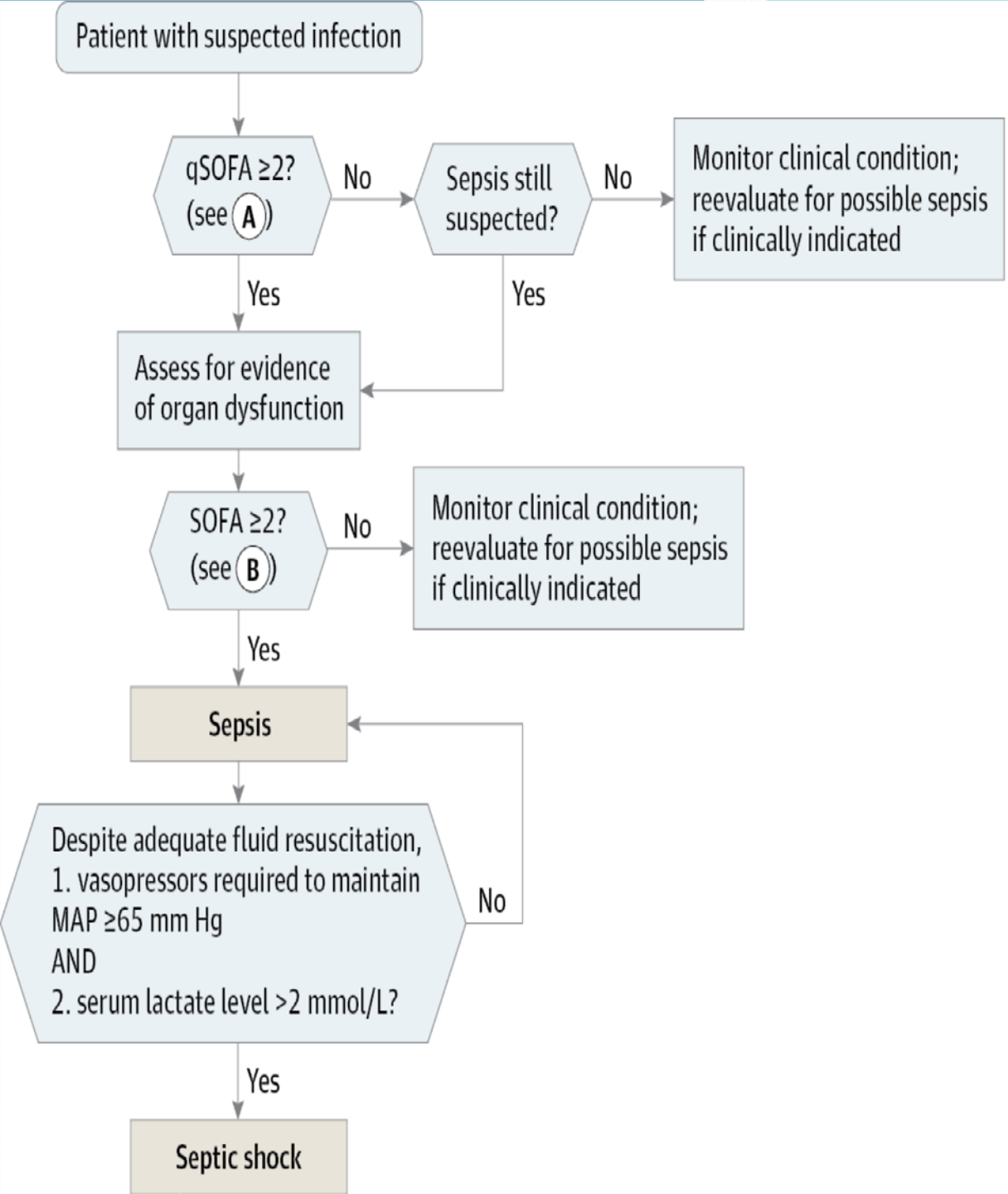
Patients with septic shock can be identified as:

- Persisting hypotension requiring vasopressors to maintain a MAP ≥ 65 mmHg
- Having serum lactate > 2 mmol/L despite adequate vol. resuscitation

*With these criteria hospital mortality is > 40%

Singer, m. et al. (2016). The third international consensus definitions for sepsis and septic shock (sepsis-3). *The Journal of the American Medical Association, 315*(8), 801-810. doi: 10.1001/jama.2016.0287

Sepsis & Septic Shock Algorithm



A qSOFA Variables

- Respiratory rate
- Mental status
- Systolic blood pressure

B SOFA Variables

- PaO_2/FiO_2 ratio
- Glasgow Coma Scale score
- Mean arterial pressure
- Administration of vasopressors with type and dose rate of infusion
- Serum creatinine or urine output
- Bilirubin
- Platelet count

Organ dysfunction in sepsis

Altered LOC
&/or Confusion

Acute lung injury
RR ≥ 22/min
PaO_2/FiO_2 <400

Liver dysfunction
Bilirubin > 1.2
INR > 1.5

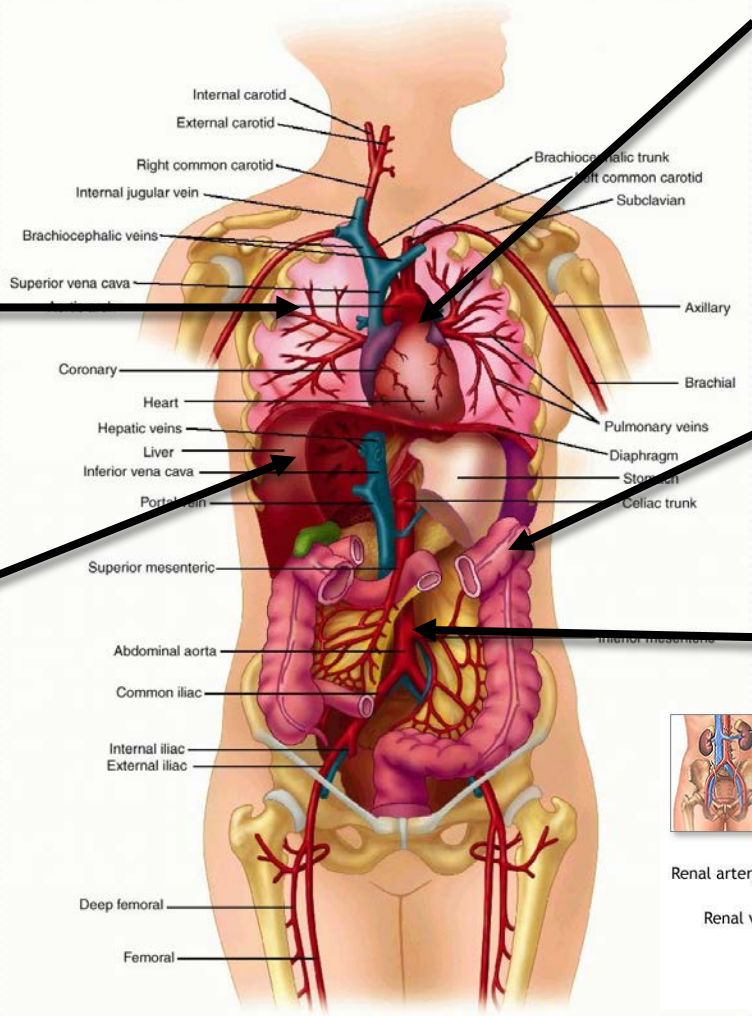
Lactate (+)

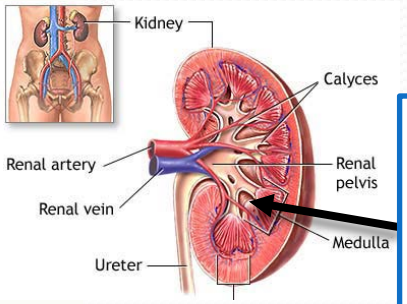
Tachycardia
↓CO_2
Hypotension
- SBP ≤ 100mmHg
- MAP < 70mmHG

Ileus
Peritonitis
Pancreatitis

Thrombocytopenia
Platelets < 150K

Oliguria
Cr > 1.2
Urine output < 500 ml/d





Sequential Organ Failure Assessment Score (SOFA) criteria

Table 1. Sequential [Sepsis-Related] Organ Failure Assessment Score[a]

	Score				
System	0	1	2	3	4
Respiration					
Pao_2/Fio_2, mm Hg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
Coagulation					
Platelets, $\times 10^3/\mu L$	≥150	<150	<100	<50	<20
Liver					
Bilirubin, mg/dL (μmol/L)	<1.2 (20)	1.2-1.9 (20-32)	2.0-5.9 (33-101)	6.0-11.9 (102-204)	>12.0 (204)
Cardiovascular	MAP ≥70 mm Hg	MAP <70 mm Hg	Dopamine <5 or dobutamine (any dose)[b]	Dopamine 5.1-15 or epinephrine ≤0.1 or norepinephrine ≤0.1[b]	Dopamine >15 or epinephrine >0.1 or norepinephrine >0.1[b]
Central nervous system					
Glasgow Coma Scale score[c]	15	13-14	10-12	6-9	<6
Renal					
Creatinine, mg/dL (μmol/L)	<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/d				<500	<200

Abbreviations: Fio_2, fraction of inspired oxygen; MAP, mean arterial pressure; Pao_2, partial pressure of oxygen.

[a] Adapted from Vincent et al.[27]

[b] Catecholamine doses are given as μg/kg/min for at least 1 hour.

[c] Glasgow Coma Scale scores range from 3-15; higher score indicates better neurological function.

- SOFA assists in predicting patient mortality
- It does require a blood gas
- Not appropriate for all clinical situations, i.e. Emergency Department where early recognition is key

Singer, m. et al. (2016). The third international consensus definitions for sepsis and septic shock (sepsis-3). *The Journal of the American Medical Association, 315*(8), 801-810. doi: 10.1001/jama.2016.0287

Sequential Organ Failure Assessment (SOFA) Score

Predicts ICU mortality based on lab results and clinical data.

US

Welcome Sepsis-3 readers! We've also added the qSOFA Score with a summary of the new definitions and recommendations.

Note: Use the worst value in a 24-hour period for the SOFA Score.

Partial Pressure of Oxygen	60	mm Hg
Fraction of Inhaled O2	40	%
Platelet Count	120	$\times 10^3/\mu L$
Glasgow Coma Scale	13	points
Bilirubin	1.2	mg/dL

Level of Hypotension (Vasopressor Status For ≥ 1 Hr)

- (•) No Hypotension 0
- ( ) MAP < 70 +1

7

points

An initial SOFA score <9 predicted a mortality <33%, while an initial score >11 prediction of mortality of 95%.

Surviving Sepsis Campaign

"Surviving Sepsis Campaign" is an international effort organized by physicians who developed and promoted widespread adoption of practice improvement programs grounded in evidence based guidelines"

- Building awareness of sepsis
- Improving Diagnosis and appropriate treatment
- Educating Health care professionals
- Developing guidelines for care

Surviving Sepsis Campaign Bundles

- Surviving sepsis care bundles are core of sepsis improvement efforts

- A bundle is selected set of elements of care distilled from evidence-based practice guidelines that, when implemented as a group, *have an impact on outcomes beyond implementing the individual elements alone*

Early treatment = improved outcomes

3 Hour Bundle
To be completed within 3 hours of time of presentation

Measure lactate level

↓

Obtain blood cultures prior to administration of antibiotics

↓

Administer broad spectrum antibiotics

↓

Administer 30 ml/kg crystalloid for hypotension or lactate ≥ 4mmol/L

Surviving sepsis campaign. (2015). Bundles. Retrieved from: http://www.survivingsepsis.org/Bundles/Pages/default.a

Why lactates

- What does an elevated lactate mean?
  - Marker of cellular/metabolic stress
  - Can also occur with liver disease, catecholamine Rx, other drugs (metformin)
  - Independent predictor of mortality

Early treatment = improved outcomes

6 Hour Bundle
To be completed within 6 hours of time of presentation

Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a mean arterial pressure (MAP) ≥ 65 mmHg

↓

In the event of persistent hypotension after initial fluid administration (MAP < 65 mmHg) or if initial lactate was ≥ 4 mmol/L, reassess vol. status and tissue perfusion & document findings.

↓

Re-measure lactate if initial lactate is elevated

Surviving sepsis campaign. (2015). Bundles. Retrieved from: http://www.survivingsepsis.org/Bundles/Pages/default.a

Reassessment documentation

DOCUMENT REASSESSMENT OF VOLUME STATUS AND TISSUE PERFUSION WITH:

EITHER:

- Repeat focused exam (after initial fluid resuscitation) including vital signs, cardiopulmonary, capillary refill, pulse, and skin findings.

OR TWO OF THE FOLLOWING:

- Measure CVP
- Measure $ScvO_2$
- Bedside cardiovascular ultrasound
- Dynamic assessment of fluid responsiveness with passive leg raise or fluid challenge

Surviving sepsis campaign. (2015). Bundles. Retrieved from: http://www.survivingsepsis.org/Bundles/Pages/default.a

When to transfer

Lactate > 4 mmol/ml

Unresponsive to 30ml/kg fluid (no increase in UOP or BP)

2 or more of the following:

- SaO_2 <90% or increase in O_2 requirements
- SBP < 90 mmHg or decrease by 40 mmHg from baseline or MAP < 65 mmHg
- UOP < 30 ml/hr, increase in creatinine > .05 mg/dl from baseline or ≥ 2.0 mg/dl
- Altered mental status, GCS ≤ 12
- Platelets < 100,000, INR > 1.5, PTT > 60 secs
- Serum total bilirubin ≥ 4mg/dl or plasma total bilirubin > 2.0 mg/dl or 35 mmol/L
- Progression of symptoms despite treatment

https://www.mnhospitals.org/Portals/0/Documents/ptsafety/sepsis%20tool%20kit/9_Seeing%20Sepsis%20Act%20Fast%20Poster.pdf

Timeline of the SSC Guidelines

- First edition in 2004
- Previous Revisions in 2008 and 2012

- Current revision started in 2014
- Jointly sponsored by ESICM and SCCM

CONFERENCE REPORTS AND EXPERT PANEL

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Andrew Rhodes[1*], Laura E. Evans[2], Waleed Alhazzani[3], Mitchell M. Levy[4], Massimo Antonelli[5], Ricard Ferrer[6], Anand Kumar[7], Jonathan E. Sevransky[8], Charles L. Sprung[9], Mark E. Nunnally[2], Bram Rochwerg[3], Gordon D. Rubenfeld[10], Derek C. Angus[11], Djillali Annane[12], Richard J. Beale[13], Geoffrey J. Bellinghan[14], Gordon R. Bernard[15], Jean-Daniel Chiche[16], Craig Coopersmith[8], Daniel P. De Backer[17], Craig J. French[18], Seitaro Fujishima[19], Herwig Gerlach[20], Jorge Luis Hidalgo[21], Steven M. Hollenberg[22], Alan E. Jones[23], Dilip R. Karnad[24], Ruth M. Kleinpell[25], Younsuk Koh[26], Thiago Costa Lisboa[27], Flavia R. Machado[28], John J. Marini[29], John C. Marshall[30], John E. Mazuski[31], Lauralyn A. McIntyre[32], Anthony S. McLean[33], Sangeeta Mehta[34], Rui P. Moreno[35], John Myburgh[36], Paolo Navalesi[37], Osamu Nishida[38], Tiffany M. Osborn[31], Anders Perner[39], Colleen M. Plunkett[25], Marco Ranieri[40], Christa A. Schorr[22], Maureen A. Seckel[41], Christopher W. Seymour[42], Lisa Shieh[43], Khalid A. Shukri[44], Steven Q. Simpson[45], Mervyn Singer[46], B. Taylor Thompson[47], Sean R. Townsend[48], Thomas Van der Poll[49], Jean-Louis Vincent[50], W. Joost Wiersinga[49], Janice L. Zimmerman[51] and R. Phillip Dellinger[22]

SSC Guidelines and Sepsis-3 Definitions

- *"**Sepsis**"* in place of *"**Severe Sepsis**"*

- Sepsis-3 clinical criteria (i.e. qSOFA) were not used in studies that informed the recommendations in this revision
  - Could not comment on use of Sepsis-3 clinical criteria

JAMA. 2016;315(8):801-810. doi:10.1001/jama.2016.0287

Sepsis-3 Definitions

- ***Sepsis***: Life-threatening organ dysfunction caused by dysregulated host response to infection

- ***Septic Shock***: Subset of sepsis with circulatory and cellular/metabolic dysfunction associated with higher risk of mortality

JAMA. 2016;315(8):801-810. doi:10.1001/jama.2016.0287

Recommendations

- 93 Recommendations
  - 32 **Strong** recommendations: *"**We recommend**"*
  - 39 **Weak** recommendations: *"**We suggest**"*
  - 18 Best Practice Statements

Best Practice Statements

- Strong but ungraded statements
- Use defined criteria

Criteria for Best Practice Statements
Is the statement clear and actionable?
Is the message necessary?
Is the net benefit (or harm) unequivocal?
Is the evidence difficult to collect and summarize?
Is the rationale explicit?
Is the statement better if formally GRADEd?

Guyatt GH, Schünemann HJ, Djulbegovic B, et al: *Clin Epidemiol* 2015; 68:597–600

Screening for Sepsis And Performance Improvement

- **We recommend that hospitals and hospital systems have a performance improvement program for sepsis, including sepsis screening for acutely ill, high risk patients (BPS)**

- Earlier recognition of sepsis via formal screening effort

- Meta analysis of 50 observational studies demonstrated that performance improvement programs were associated with increase compliance with SSC bundles and reduction in mortality

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Initial Resuscitation

Sepsis and septic shock are medical emergencies and we recommend that treatment and resuscitation begin immediately (BPS)

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Initial Resuscitation

- We recommend that, in the resuscitation from sepsis – induced hypo perfusion, ***at least 30mL/kg of IV crystalloid fluid be given within first 3 hours***

- We recommend that, following initial fluid resuscitation, additional fluids be guided by ***frequent reassessment of hemodynamic status (BPS)***

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Initial Resuscitation

- We recommend an ***initial target mean arterial pressure (MAP) of 65 mm Hg*** in patients with septic shock requiring vasopressors

- We suggest guiding resuscitation to ***normalize lactate in patients with elevated lactate levels as a marker of tissue hypo perfusion***

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Fluid Therapy

- We recommend ***crystalloids as the fluid of choice for initial resuscitation and subsequent intravascular volume replacement*** in patients with sepsis and septic shock

- We suggest using albumin in addition to crystalloids for initial resuscitation and subsequent intravascular volume replacement in patients with sepsis and septic shock when patients require substantial amounts of crystalloids

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Vasoactive Medications

- We recommend ***norepinephrine as the first-choice vasopressor***

- We suggest adding either vasopressin (up to 0.03 U/min) or epinephrine to nor epinephrine with the intent of raising MAP to target, or adding vasopressin to decrease nor epinephrine dosage.

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

If shock is not resolving quickly…..

- **We recommend further hemodynamic assessment (such as assessing cardiac function) to determine the type of shock if the clinical examination does not lead to a clear diagnosis.** (Best Practice Statement)

- **We suggest that dynamic over static variables be used to predict fluid responsiveness, where available.**

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Diagnosis

- **We recommend that *appropriate routine microbiologic cultures (including blood) be obtained before starting antimicrobial therapy* in patients with suspected sepsis or septic shock if doing so results in no substantial delay in the start of antimicrobials (BPS)**

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Diagnosis

- Appropriate routine microbiologic cultures always include ***at least two sets of blood cultures (aerobic and anaerobic)***
- ***In patients with suspicion of intravascular catheter associated infection***, at least one blood culture set should be obtained from the catheter along with simultaneous peripheral blood culture.
- ***In patients without suspicion of intravascular catheter associated infection at least*** one blood culture should be obtained peripherally

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Diagnosis

- Obtaining cultures prior to antimicrobials significantly ***increases yield of cultures.*** Several retrospective studies have suggested it to be associated with improved outcomes
- Isolation of infecting organisms allows ***for de-escalation of antimicrobial therapy.*** De escalation has been associated with improved survival in several observational studies
- "Pan culture' of all sites should be discouraged unless source of sepsis is not clinically apparent

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Antimicrobial Therapy and Stewardship

- **We recommend that administration of IV antimicrobials be initiated as soon as possible after recognition and *within one hour for both sepsis and septic shock***

- Each hour delay in administration of appropriate antibiotics is associated with measureable increase in mortality

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Antimicrobial Therapy and Stewardship

- **We recommend *empiric broad-spectrum* therapy with one or more antimicrobials for patients presenting with sepsis or septic shock to *cover all likely pathogens* (including bacterial and potentially fungal or viral coverage)**

- Site of infection, underlying diseases/immunosuppression
- Recent known infection/colonization with specific pathogens and use of antimicrobials
- Patient location at the time of infection (community, acute care hospital, chronic care institution)
- Presence of invasive devices
- Susceptibility patterns of common local pathogens (community and hospital)

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Antimicrobial Therapy and Stewardship

- **We recommend *that empiric antimicrobial therapy be narrowed* once pathogen identification and sensitivities are established and/or adequate clinical improvement is noted (BPS)**

- One third of patients with sepsis do not have a causative organism identified. A thoughtful de-escalation based on adequate clinical response is recommended
- When no infection found, antimicrobial therapy should be stopped promptly

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Antimicrobial Therapy and Stewardship

- **We recommend against sustained systemic antimicrobial prophylaxis in patients with severe *inflammatory states of noninfectious origin* (e.g., severe pancreatitis, burn injury) (BPS)**

- **We recommend that *dosing strategies of antimicrobials be optimized* based on accepted pharmacokinetic/pharmacodynamic principles and specific drug properties in patients with sepsis or septic shock (BPS).**

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Antimicrobial Therapy and Stewardship

- **We suggest empiric combination therapy (using at least two antibiotics of different antimicrobial classes) aimed at the most likely bacterial pathogen(s) for the *initial management of septic shock***

- **We suggest that combination therapy not be routinely used for ongoing treatment of most other serious infections, including *bacteremia and sepsis without shock***

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Antimicrobial Therapy and Stewardship

- **We recommend against combination therapy for the routine treatment of *neutropenic sepsis/bacteremia***

- **If combination therapy is initially used for septic shock, we recommend de-escalation with discontinuation of combination therapy within the first few days in response to clinical improvement and/or evidence of infection resolution. This applies to both targeted (for culture-positive infections) and empiric (for culture-negative infections) combination therapy (BPS)**

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Antimicrobial Therapy and Stewardship

We recommend *daily assessment for de-escalation of antimicrobial therapy* in patients with sepsis and septic shock (BPS)

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Antimicrobial Therapy and Stewardship

- **We suggest that an antimicrobial treatment *duration of 7 to 10 days* is adequate for most serious infections associated with sepsis and septic shock**

- **We suggest that *longer courses are appropriate in patients who have* a slow clinical response, undrainable foci of infection, bacteremia with Staph aureus, some fungal and viral infections, or immunologic deficiencies, including neutropenia.**

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Antimicrobial Therapy and Stewardship

- **We suggest that *measurement of procalcitonin levels can be used to support shortening the duration of antimicrobial therapy in sepsis patients***

- **We suggest *that procalcitonin levels can be used to support the discontinuation of empiric antibiotics* in patients who initially appeared to have sepsis, but subsequently have limited clinical evidence of infection**

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Source Control

- **We recommend that a *specific anatomic diagnosis of infection* requiring emergent source control be identified or excluded as rapidly as possible in patients with sepsis or septic shock, and that *any required source control intervention be implemented as soon as medically and logistically practical after the diagnosis is made (BPS).***

- **We recommend *prompt removal of intravascular access devices that are a possible source of sepsis or septic shock* after other vascular access has been established (BPS).**

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Source Control

- **Foci of infection readily amenable to source control include**
  - Intra abdominal abscesses
  - Gastrointestinal perforation
  - Ischemic bowel or volvulus
  - Cholangitis, cholecystitis
  - Pyelonephritis associated with obstruction or abscess
  - Necrotizing skin and soft tissue infections
  - Deep space infections (empyema or septic arthritis)
  - Implanted device infections
- **Least invasive effective option for source control should be pursued**

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Corticosteroids

- We suggest against using IV hydrocortisone to treat septic shock patients if adequate fluid resuscitation and vasopressor therapy are ably to restore hemodynamic stability. If this is not achievable, we suggest IV hydrocortisone at a dost of 200 mg per day (weak recommendation, low quality of evidence).

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Mechanical Ventilation

- We suggest using ***higher PEEP over lower PEEP*** in adult patients with sepsis-induced moderate to severe ARDS

- We suggest using ***lower tidal volumes over higher tidal volumes*** in adult patients with sepsis-induced respiratory failure

- We recommend using ***prone over supine position*** in adult patients with sepsis-induced ARDS and a PAO_2/FIO_2 ratio < 150

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Mechanical Ventilation

- We recommend ***against using high-frequency oscillatory ventilation (HFOV)*** in adult patients with sepsis-induced ARDS

- We recommend ***against the use of β-2 agonists*** for the treatment of patients with sepsis-induced ARDS without bronchospasm

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Glucose Control

- We recommend a ***protocolized approach to blood glucose management*** in ICU patients with sepsis, commencing insulin dosing when ***two consecutive blood glucose levels are > 180 mg/dL***. This approach should target an upper blood glucose level ≤ 180 mg/dL rather than an upper target blood glucose level ≤ 110 mg/dL (strong recommendation, high quality of evidence).
- We recommend that blood glucose values be monitored every 1 to 2 hours until glucose values and insulin infusion rates are stable, then every 4 hours thereafter in patients receiving insulin infusions (BPS).

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Glucose Control

- We recommend that glucose levels obtained with point-of-care testing of capillary blood be interpreted with caution because such measurement may not accurately estimate arterial blood or plasma glucose values (BPS).
- We suggest the use of arterial blood rather than capillary blood for point-of-care testing using glucose meters if patients have arterial catheter

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Renal Replacement Therapy

- We suggest against the use of RRT in patients with sepsis and acute kidney injury for increase in creatinine or oliguria without other definitive indications for dialysis

- We suggest that either continuous RRT (CRRT) or intermittent RRT be used in patients with sepsis and acute kidney injury

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Nutrition

- We recommend ***against the administration of early parenteral nutrition alone or parenteral nutrition in combination with enteral feedings*** (but rather initiate early enteral nutrition) in critically ill patients with sepsis or septic shock who can be fed enterally

- We recommend against the administration of parenternal nutrition alone or in combination with enteral feeds (but rather to initiate IV glucose and advance enteral feeds as tolerated) over the first 7 days in critically ill patients with sepsis or septic shock for whom early enteral feeding is not feasible

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Nutrition

- We suggest against routinely monitoring gastric residual volumes (GRVs) in critically ill patients with sepsis or septic shock However, we suggest measurement of gastric residuals in patients with feeds intolerance or who are considered to be at high risk of aspiration

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Setting Goals of Care

- We recommend that goals of care and prognosis be discussed with patients and families (BPS).
- We recommend that goals of care be incorporated into treatment and end of life care planning, utilizing palliative care principles where appropriate
- We suggest that ***goals of care be addressed as early as feasible, but no later than within 72 hours of ICU admission***

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

Summary

- **Earlier Recognition**
- **Start resuscitation early with source control, intravenous fluids and antibiotics.**
- **Frequent assessment of the patients' volume status is crucial throughout the resuscitation period.**
- **We suggest guiding resuscitation to normalize lactate in patients with elevated lactate levels as a marker of tissue hypoperfusion.**

Resources

Minnesota Hospital Association

MHA patient safety resources
https://www.mnhospitals.org/patient-safety/current-initiatives/sepsis-and-septic-shock#/videos/list

Surviving Sepsis Campaign

http://www.survivingsepsis.org/Pages/default.aspx

Society of Critical Care Medicine
The Intensive Care Professionals

http://www.sccm.org/Pages/default.aspx

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016