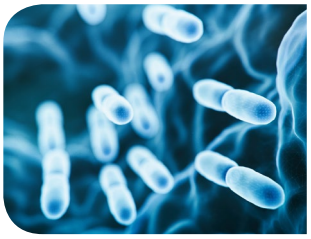

Recognition and Management of Adult Severe Sepsis and Septic Shock

Diagnosis of Severe Sepsis or Septic Shock

Patient presents with suspected infection

Document suspected source of infection

See *Adult Sepsis Bundle Worksheet* to aid documentation

Evaluate for systemic inflammatory response (*Any Two*)

Determine if AT LEAST TWO of the following criteria are met for sepsis.

- ☐ Temperature >38.3 °C or <36 °C
- ☐ Heart rate >90 beats per minute (bpm)
- ☐ Respiratory rate >20 breaths per minute
- ☐ White blood cell (WBC) count >12,000/mm^3, or <4,000/mm^3, or >10% bands

If patient is 20 weeks pregnant to 3 days postpartum determine if AT LEAST TWO of the following criteria are met for sepsis.

- ☐ Temperature ≥38 °C <36 °C
- ☐ Heart rate >110 bpm
- ☐ Respiratory rate >24 breaths per minute
- ☐ WBC >15,000/mm^3 or <4,000/mm^3, or >10% bands

≥2 criteria met?

no → Sepsis criteria *NOT* met; treat infectious condition

yes →

Evaluate for *Any* of the following signs of acute organ dysfunction*

- SBP <90 mm Hg†
- SBP decrease >40 mm Hg from patient's known baseline
- MAP <65 mm Hg
- Creatinine >2 mg/dL†
- Acute respiratory failure requiring new or increased need for invasive or non-invasive mechanical ventilation
- Urine output <0.5 mL/kg/hr for >2 hours
- Total bilirubin >2 mg/dL
- Platelets <100,000/mm^3
- INR >1.5 or PTT >60 sec
- Lactate >2 mmol/L†

ANY sign of acute organ dysfunction?*

no → Sepsis possible; treat infectious condition as necessary

yes →

Severe Sepsis/Septic shock

Treat using *Severe Sepsis/Septic Shock Treatment - 3 hour bundle* (next page)

† If 20 weeks pregnant to 3 days postpartum use alternate criteria below for specified parameters of acute organ dysfunction.

- SBP <85 mm Hg
- Creatine >1.2 mg/dL
- Do not use lactate obtained during peripartum period or delivery

*Note: Organ dysfunction associated with preexisting chronic conditions should not be considered as meeting acute organ dysfunction criteria (e.g. Creatinine >2 mg/dL in patients with end stage renal disease).

INR: *International normalized ratio;*
MAP: *Mean arterial blood pressure*;
PPT: *Partial thromboplastin time;*
SBP: *Systolic blood pressure*

Intermountain Health

Severe Sepsis / Septic Shock Treatment — 3 hour bundle

Patient meets severe sepsis or septic shock criteria

Document and communicate presentation time (this is time zero)

Begin severe sepsis / septic shock 3-hour bundle

The steps below should be completed within 3 hours of time zero.

☐ Draw serum lactate

☐ Draw blood cultures prior to giving antibiotics

☐ Give IV antibiotics according to recommendations in order sets / power plans

- For severe sepsis, antibiotics should be ordered <2 hours after presentation (time zero)
- For septic shock, antibiotics should be ordered <1 hour after presentation (time zero)
- Use source-target antibiotics if possible; if source is unknown, use broad-spectrum antibiotics

Is patient hypotensive* AND / OR lactate ≥4 mmol / L?

no

yes

*Hypotension defined as:

- MAP <65 mm Hg OR
- SBP <90 mm Hg OR
- SBP >40 mm Hg below base line OR
- SBP <85 mm Hg if 20 weeks pregnant to 3 days postpartum

Give 30 mL / kg (actual weight) isotonic crystalloid over 30 – 90 minutes and then reassess blood pressure.

- If BMI is >30 a fluid bolus of 30 mL / kg predicted body weight may be used.
- May give <30 mL / kg fluid bolus if clinical reason is documented in medical record AND a specific amount of isotonic crystalloid is ordered and documented in the note.

Is patient hypotensive* within an hour following fluid bolus?

no

yes

Treat based on patient's initial lactate (mmol / L)

≤2	2.1 – 3.9	≥4.0
Continue sepsis treatment, see *Severe Sepsis / Septic Shock 24-hr maintenance bundle page 4*	Repeat lactate within 3 hours of initial lactate, begin *Severe Sepsis Septic Shock 24-hr maintenance bundle page 4*	Complete all elements of the *Severe Sepsis / Septic Shock Treatment 6-hour bundle page 3*

Continue sepsis treatment, see *Severe Sepsis / Septic Shock Treatment 24-hr maintenance bundle* (page 4)

Begin *Severe Sepsis / Septic Shock Treatment 6- hour bundle* (next page)

Severe Sepsis / Septic Shock Treatment — 6 hour bundle

(completed within 6 hours of time zero)

† Vasopressors
- In refractory septic shock with escalating dose of norepinephrine, vasopressin may be added (up to 0.04 units/ min) to decrease norepinephrine dosage-- while acknowledging that vasopressin added to norepinephrine was not shown to improve survival in septic shock.
- Epinephrine may be added for inotropic support for decreased left ventricular function
- Recommend against using dopamine in septic shock except in situations of bradyarrhythmia.

If initial lactate > 2 mmol / L

Repeat lactate

If SBP or MAP remains low after fluids
(2 sequential BPs with SBP < 90 or MAP < 65 mm Hg),
start vasopressors to maintain MAP ≥ 65 mm Hg

Norepinephrine is the preferred vasopressor for initial therapy starting at 0.02 mcg / kg / min †

If hypotension* or need for vasopressors continues

Repeat volume status and tissue perfusion assessment using *ANY ONE* of the following options

*Hypotension defined as two sequential blood pressures with SBP < 90 or MAP < 65 mm Hg or persistent hypotension defined as one documented SBP < 90 or MAP < 65 mmHg AND vasopressor was administered.

Document that a severe sepsis or septic shock-focused exam was performed

Document 5 of the following 8 elements of the focused exam
- ☐ Vital signs
- ☐ Cardiopulmonary exam
- ☐ Peripheral pulse
- ☐ Capillary refill evaluation
- ☐ Skin examination
- ☐ SaO2%
- ☐ Urinary output
- ☐ Shock index (HR in BPM/SBP)

Document any one of the following
- ☐ Central venous pressure measurement (A) pg 4
- ☐ ScvO2% measurement (B) pg 4
- ☐ Cardiovascular and IVC ultrasound
- ☐ Passive leg raise or fluid challenge using a non-invasive cardiac output monitor

Does patient exhibit persistent elevation in lactate **OR** are vasopressor requirements increasing?

no

Continue sepsis treatment, see *Severe Sepsis/Septic Shock Treatment 24-hr maintenance bundle* (next page)

yes

Perform further fluid resuscitation using non-invasive hemodynamic monitoring until *ANY* of the following occur:
- Patient becomes stable off vasopressors and lactate decreases significantly
- Adequate cardiac volume and filling is shown using cardiac ultrasound
- Patient is no longer fluid responsive (<10% increase in stroke volume index following passive leg raise or 500 mL crystalloid fluid bolus). If patient continues to need support at this time, use vasopressors only.

BP: *Blood pressure*; BPM: *Beats per minute;* HR: *Heart rate;*
IVC: *Inferior vena cava* MAP: *Mean arterial blood pressure*;
SaO2: *Oxygen saturation of arterial blood;* SBP: *Systolic blood pressure;*
ScvO2: *Central venous oxygen saturation*

Severe Sepsis / Septic Shock Treatment — 24 hr maintenance bundle

Perform the following as patient becomes stable and lactate significantly decreases

- □ If on high-dose vasopressors, give hydrocortisone (50 mg IV every 6 hours).
- □ Discontinue steroids when patient is weaned off vasopressors.
- □ Achieve and maintain an average glucose between 90 – 180 mg/dL using bedside measurements performed at least every 4 hours for at least the first 24 hr.
- □ If mechanically ventilated, target tidal volume (VT) at 6 mL/kg predicted body weight (range: 4 – 8 mL/kg PBW) **AND** maintain plateau pressure (P_{plat}) < 30 cm H_2O.

(A) Central venous pressure (CVP) 6-hr bundle

- Measurement of CVP is one of the **Sepsis CMS Core (SEP-1) performance measures** and is included as one option to document the assessment of tissue perfusion in the 3- to 6-hour bundle.
- CVP has been shown in multiple studies to be poorly predictive of fluid responsiveness.
- CVP > 8 mm Hg was a resuscitation target in early goal-directed therapy for septic shock, but was not shown to be an essential component for sepsis resuscitation in the ProCESS, ProMISe, and ARISE trials.

(B) ScvO2 % 6-hr bundle

- Measurement of ScvO2% is one of the **CMS SEP-1 performance measures** included as an option to document the assessment of tissue perfusion in the 3- to 6-hour bundle
- ScvO2% has been shown to be a marker of the adequacy of cardiac output for organ perfusion in patients with septic shock. ScvO2% > 70 % correlates with an SvO2 > 65%
- ScvO2 > 70% was a resuscitation target in early goal-directed therapy for septic shock; dobutamine and blood transfusions were used to increase ScvO2% to > 70% after a CVP > 8 mm Hg was achieved and MAP was maintained > 65 mm Hg with norepinephrine.
- In the ProCESS, ProMISe, and ARISE trials, ScvO2% was shown to not be essential as a target for resuscitation.
- If measured, ScvO2% should be interpreted in the clinical context to assess the adequacy of cardiac output for organ perfusion, and an ScvO2% < 70 % may be acceptable if lactate is normal and other signs of organ perfusion are adequate.
- ScvO2% that is low (i.e. < 60 %), may be due to cardiac insufficiency and should prompt consideration of echocardiography to characterize left and right ventricular function.

Bibliography

Acute Respiratory Distress Syndrome Network, Brower RG, Matthay MA, Morris A, et al. Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. *N Engl J Med.* 2000;342(18):1301-1308.

ARISE Investigators, ANZICS Clinical Trials Group, Peake SL, et al. Goal-directed resuscitation for patients with early septic shock. *N Engl J Med.* 2014;371(16):1496-1506.

Evans L, Rhodes A, Alhazzani W, et al. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021. *Intensive Care Med.* 2021;47(11):1181-1247.

Kumar A, Roberts D, Wood KE, et al. Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. *Crit Care Med.* 2006;34(6):1589-1596.

Leisman DE, Doerfler ME, Ward MF, et al. Survival benefit and cost savings from compliance with a simplified 3-hour sepsis bundle in a series of prospective, multisite, observational cohorts. *Crit Care Med.* 2017;45(3):395-406.

Levy MM, Evans LE, Rhodes A. The surviving sepsis campaign bundle: 2018 Update. *Crit Care Med.* 2018;46(6):997-1000.

Levy MM, Gesten FC, Phillips GS, et al. Mortality changes associated with mandated public reporting for sepsis: The results of the New York State initiative. *Am J Respir Crit Care Med.* 2018;198(11):1406-1412

Liu V, Escobar GJ, Greene JD, et al. Hospital deaths in patients with sepsis from 2 independent cohorts. *JAMA.* 2014;312(1):90.

Marik PE, Baram M, Vahid B. Does central venous pressure predict fluid responsiveness?: A systematic review of the literature and the tale of seven mares. *Chest.* 2008;134(1):172-178.

Mouncey PR, Osborn TM, Power GS, et al. Trial of early, goal-directed resuscitation for septic shock. *N Engl J Med.* 2015;372(14):1301-1311.

Peltan ID, Brown SM, Bledsoe JR, et al. ED door-to-antibiotic time and long-term mortality in sepsis. *CHEST* 2019; 155(5):938-946

ProCESS Investigators, Yealy DM, Kellum JA, et al. A randomized trial of protocol-based care for early septic shock. *N Engl J Med.* 2014; 370(18):1683-1693.

Rhodes A, Evans LE, Alhazzani W, et al. Surviving sepsis campaign. International guidelines for nanagement of sepsis and septic shock: 2016. *Crit Care Med.* 2017;45(3):486-552.

Rivers E, Nguyen B, Havstad S, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. *N Engl J Med.* 2001;345(19):1368-1377.

Russell JA, Walley KR, Singer J, et al. Vasopressin versus norepinephrine infusion in patients with septic shock. *N Engl J Med.* 2008;358(9):877-887.

Townsend SR, Phillips GS, Duseja R. Effects of compliance with the early management bundle (SEP-1) on mortality changes among medicare beneficiaries with sepsis: a propensity score matched cohort study. *CHEST* 2022; 161(2):392-406.

Walley KR. Use of central venous oxygen saturation to guide therapy. *Am J Respir Crit Care Med.* 2011;184(5):514-520.

This CPM presents a model of best care based on the best available scientific evidence at the time of publication. It is not a prescription for every physician or every patient, nor does it replace clinical judgment. All statements, protocols, and recommendations herein are viewed as transitory and iterative. Although physicians are encouraged to follow the CPM to help focus on and measure quality, deviations are a means for discovering improvements in patient care and expanding the knowledge base. Send feedback to Colin Grissom, MD, Senior Medical Director of Medical Specialties Clinical Program, Intermountain Health (*Colin.Grissom@imail.org*).