6702.02 SEPSIS SYNDROME

INTRODUCTION

Sepsis is a leading cause of death and arises when the body's response to an infection injures its own tissues and organs.[1] Sepsis may lead to shock, multiple organ failure and death, especially if not recognized early and treated promptly.

Severe sepsis accounts for 20% of adult admissions to ICUs, has a reported mortality rate of 20-42%[2] and is the leading cause of death for adults in non-cardiac ICUs. An admission with severe sepsis places the patient at a level of risk 6-10-fold greater than if the patient were admitted with an acute myocardial infarction and 4-5 times greater than if the patient had suffered a stroke.[3] In pediatric cases, the overall mortality rate is approximately 10%, with the highest reported risk in infants in the first month of life.[4]

Sepsis starts as a Systemic Inflammatory Response Syndrome (SIRS) and can progress to severe sepsis and/or septic shock if left unrecognized and untreated. The increase in absolute mortality associated with an hour's delay in antibiotic administration is reported to be 0.3% for sepsis, 0.4% for severe sepsis, and 1.8% for shock.[5] Paramedic approach to sepsis should focus on early recognition, pressure support and efforts to reduce the time to antimicrobial treatment.

SAFETY

Consider the source of infection and wear appropriate personal protective equipment.

Be conscious that septic patients may decompensate rapidly, develop an altered level of consciousness, or become hypotensive. Patients should be monitored closely and be transferred by stretcher or stair chair.

After transfer of care, ensure to follow procedures for doffing of PPE followed by cleaning/disinfection and hand hygiene.

ASSESSMENT

During the assessment of a patient with possible sepsis, any signs of infection should be noted as well as the presence of any SIRS criteria.

SIRS

SIRS is deemed to be present if 2 or more of the following criteria are met (see Figure 1 and below for abnormal HR in pediatric patients):

- Temperature greater than 38°C or less than
- 36°C
- Heart Rate greater than 90 bpm
- Respiratory Rate greater than 20 or $PaCO_2$ less than 32 mmHg
- White Blood Cell Count greater than 12,000 or less than 4,000 or greater than 10% immature white blood cells

As white blood cell count cannot be determined in the prehospital setting, temperature, heart rate and respiratory rate are the three components used during prehospital assessment for SIRS. Keep in mind that infection may present atypically in older adults, patients on medication that attenuate heart rate or blood pressure response, or immunocompromised patients.

There may be some patients that meet the SIRS criteria but do not have a clear source of infection, however should be treated as potentially septic until ruled out. SIRS may also be caused by trauma, burns, toxins, and other medical conditions.

Once it has been established that a patient meets the SIRS criteria in the setting of infection, further assessment can be done to determine whether the patient has sepsis, severe sepsis, or septic shock.

Sepsis

Sepsis is diagnosed when a patient meets the SIRS criteria in the presence of infection. Sources of infection may include (but are not limited to):

- Urinary tract infections
- Respiratory tract infections
- Skin (e.g., pressure sores, cellulitis)
- Gastrointestinal tract infections
- Recent surgeries or indwelling lines

6702.02 SEPSIS SYNDROME

A detailed history is helpful for assessing for presence of infectious etiologies. Determining the source of the infection should not delay treatment and transport. The presence of cough, fever/chills, shortness of breath, urinary symptoms, GI symptoms, skin changes, headache, or EENT symptoms (e.g., sore throat) should be assessed and documented. The respiratory and urinary tract are the most common sources of infection. Changes in the patient's diet or activity level as well as travel, recent infection or possible sick contacts may also provide useful information.

Severe Sepsis

A patient is deemed to have severe sepsis when they have met the sepsis criteria (SIRS plus infection) and have signs of hypoperfusion. Signs of hypoperfusion can include:

- Altered mental status
- Cardiovascular dysfunction (may be seen as delayed capillary refill, mottling and/or cool extremities)
- Acute respiratory distress/hypoxia
- Decreased urine output (normal output is 0.5-1 mL/kg/hr in adults and 1-1.5 mL/kg/hr in children)

Literature suggests that patients having a decreased oxygen saturation and body temperature, increased serum glucose level and altered mental status during prehospital care are at risk of a poorer patient prognosis and adverse outcome.[6]

Septic Shock

Septic shock is a type of distributive shock. Please refer to the Shock CPG for more details about distributive shock. Septic shock is defined by the presence of severe sepsis and hypotension [systolic blood pressure < 80 mmHg for adults (Mean Arterial Pressure (MAP) less than 65 mmHg) or systolic blood pressure less than the 5th percentile for age in pediatric patients (see Figure 2)]. Septic shock is associated with a very high mortality so the patient should be managed as critically ill.

Age	Systolic BP (mmHg)
Term neonate (0-28 days)	<60
Infants (29 days - <12 mo)	<70
Children (1 - <10 years)	<70 + (age in years x 2)
Children (>10 years)	<90

Figure 2. Pediatric Definition of Hypotension*
*Defined as <5th percentile for age
(Source: American Heart Association Inc.)

Physical Exam

The physical exam should include:

- Vital signs (including temperature and SpO_2)
- Assessment of perfusion (capillary refill)
- Signs of distributive shock (flash capillary refill, warm extremities)
- Assessment of mental status: serial GCS assessments
- Blood glucose reading
- Head-to-toe exam for signs of infection
- 12 lead ECG (if undifferentiated SIRS/shock)

CTAS

Patients presenting with sepsis have a time-sensitive condition and should be assigned a CTAS score of at least 2. CTAS 1 would be appropriate for patients in septic shock.

MANAGEMENT

During sepsis, tissue oxygen demand is very high and tissue hypoxia may lead to multi-organ failure and possibly death. This is further complicated by the fact that during sepsis, mediators of infection also cause peripheral vasodilation resulting in hypotension and hypoperfusion.

Overall management of sepsis involves balancing tissue oxygen delivery with oxygen demand while also treating the source of infection. A systematic approach to treating sepsis and septic shock can help improve survival. In the prehospital setting, therapy is focused on supporting oxygenation and tissue perfusion by titrating oxygen, replacing intravascular volume, and using medications to maintain peripheral vascular resistance.

Oxygen Therapy

In order to maximize oxygenation, the EHS provider should titrate oxygen to maintain an SpO_2 between 94-99% and avoid hyperoxia. Aggressive oxygenation and hyperoxia is associated with increased mortality.[7]

Fluid Therapy

Rapid correction of hypovolemia for patients with sepsis is lifesaving. An IV should be established and a fluid bolus of 20 mL/kg given over 5-10 minutes using blood pressure as a guide (**PEP 1 supportive**). This may need to be repeated if no change in patient presentation. See TREKK notes below for details on pediatric sepsis management. If available without delay, a balanced crystalloid (e.g., Lactacted Ringer's) is preferable to normal saline (**PEP 2 Supportive**). Frequent

reassessment will allow the clinician to judge if the patient is responding to fluid boluses or if signs of volume overload develop and adjust the treatment strategy accordingly.

In cases of septic shock, if an IV cannot be established after two attempts, consider obtaining intraosseous (IO) access. The IO route can be used for both fluid resuscitation and medication administration.

A common error in sepsis management is inadequate fluid resuscitation. Sepsis may occur in patients with congestive heart failure and/or in the presence of pre-existing pulmonary edema. This should not deter titrated fluid administration if there is hypotension or signs of inadequate perfusion.

Patients who are normotensive, with adequate perfusion do not benefit from receiving additional fluid. [8]

Vasopressors

If hypotension does not respond quickly to fluid resuscitation, or the patient has already received 30 mL/kg of crystalloid, the clinician should initiate **vasopressors**[9] (e.g., dopamine or norepinephrine[10]) (**PEP 1 supportive**) to increase contractility and optimize afterload. The infusion should be titrated to achieve a MAP greater than 65 mmHg. In a critically ill adult, the MAP may be a better representation of tissue perfusion. Early initiation of vasopressors decreases mortality in septic shock.[11] For pediatric patients, epinephrine is the vasopressor of choice.

Emergency department management will include antibiotics, fluid resuscitation, vasopressors and source control if required. Further care may include blood transfusion, monitoring of central venous pressure (CVP), MAP, and lactate.

Early Notification

Early notification to the receiving facility is important for patients with suspected sepsis. When EHS providers state the term 'sepsis' in their communication with the receiving facility as well as in their PCR, it has been shown that there is a significantly reduced time to definitive treatment, including appropriate antibiotics. For every hour delay in receiving appropriate antibiotic therapy, the chance of survival decreases by 12%.

Pediatric Sepsis

Pediatric sepsis should be suspected when the child has a critical heart rate which varies by age.

Pediatric Heart Rate Guidelines

Age	Low	Normal	High
0 to <3 mo	<95	110 - 160	>180
3 to <6 mo	<105	120 - 160	>180
6 to <12 mo	<100	110 - 150	>160
1 to <4 y	<75	85 - 140	>145
4 to <10y	<60	70 - 115	>125
≥ 10y	<45	60 - 100	>105

Source: TREKK

Septic pediatric patients may have a fever > 38°C or hypothermia < 36°C and/or signs of local infection. Risk factors for infection include age <3 months, immunocompromised, chronic heart/lung/neuromuscular disease, recent hospitalization/surgery and indwelling lines or catheters. To make the diagnosis of severe sepsis, you need either:

1. Altered mental status (confusion, lethargy, irritability)

OR

2. Poor perfusion (capillary refill time > 2 seconds, SpO_2 <94%, mottled skin, cold extremities)

A low blood pressure is an extremely late finding for pediatric sepsis and may only be present in the immediate pre-arrest scenario in septic shock. Recognizing severe sepsis by looking for a critical heart rate and signs of poor perfusion or altered mental status is key.

A petechial, pinpoint bruise-like rash that does not blanch, or purpura (purple, non-blanching rash) *may* be a physical finding in some children with severe sepsis.

Initial management consists of administering oxygen, providing 3 x 20 mL/kg boluses (IV/IO) over 5-10 minutes with reassessments between each bolus. Early administration of fluids reduces mortality in pediatric sepsis. When administering crystalloids, watch for signs of fluid overload, such as crackles, hepatomegaly, or JVD. If the hypotension and/or poor tissue perfusion continues

(i.e., fluid-refractory shock), initiate inotropes or vasopressors.

Sepsis Syndrome: Assessment and Care Goals for the EMR

The EMR should focus on:

- Obtaining a thorough history and full set of vitals
- Assessing for signs of infection
- Considering if the patient meets SIRS criteria
- Maintaining oxygen saturations between 94-99%
- Providing acetaminophen or ibuprofen when indicated
- Understanding the difference between SIRS, Sepsis, Severe Sepsis and Septic Shock

TRANSFER OF CARE

When presenting a patient with suspected sepsis to the ED staff the following information should be clearly communicated in the radio patch and report:

- SIRS criteria present
- Level of sepsis
- Detailed history including possible source of infection
- Treatments provided and patient response

CHARTING

When documenting care of a patient with suspected sepsis, it is important to document the word 'sepsis' on the PCR. SIRS criteria, sepsis level, CTAS level, and all treatments provided should also be documented.

Key Points – Sepsis Syndrome

Early recognition and notification is imperative

IV access should be gained and 30 mL/kg fluid bolus administered over 5-10 minutes

A vasopressor should be administered for patients unresponsive to 30 mL/kg bolus

Decreasing time to antibiotic is crucial

Using appropriate terminology (i.e., SIRS, Sepsis, Severe Sepsis, Septic Shock) when communicating with the receiving hospital may help expedite their response

KNOWLEDGE GAPS

Discussion is required regarding the possible role of trip destination policies specific to patients with suspected sepsis. Further research is required regarding the optimal role of the pre-hospital clinician in Early Goal Directed Therapy (e.g. antibiotics, lactate measurement, etc.)[12]

EDUCATION

Clinicians should continually review the criteria to help identify sepsis in the prehospital setting to improve recognition and early intervention.

QUALITY IMPROVEMENT

Important elements in sepsis are: [1] early identification of sepsis, [2] supporting oxygenation and perfusion, and [3] aim to reduce time to antibiotics.

CONTRIBUTORS

The following individuals were the primary authors/contributors of this Clinical Practice Guideline:

EHS Medical Director

- Dr. Andrew Travers

EHS Medical Oversight Physician Group

- Dr. Jason Emsley
- Dr. Jen McVey
- Dr. Jolene Cook
- Dr. Yves Leroux

EHS Ambulance Operations management

- Daniel Gould
- Janel Swain
- Mark Walker
- Jennifer Greene

REFERENCES

1. Hotchkiss RS, Karl IE. The pathophysiology and treatment of sepsis. N Engl J Med. 2003;348:138–50.

2. Rosser CJ, Bare RL, Meredith JW. Urinary tract infections in the critically ill patient with a urinary catheter. Am J Surg. 1999;177:287–90.

3. Daniels R. Surviving the first hours in sepsis: getting the basics right (an intensivist's perspective). J Antimicrob Chemother [Internet]. 2011

4. Harper, MB and Fleisher, GR. Infectious Disease Emergencies. In Fleisher and Ludwig (Eds). Textbook of Pediatric Emergency Medicine (6th Edition). Wolters Kluwer. 2010.

5. Liu VX.; Fielding-Singh V.; Greene JD.; Baker JM.; Iwashyna TJ.; Bhattacharya J.; Escobar GJ. The Timing of Early Antibiotics and Hospital Mortality in Sepsis. American journal of respiratory and critical care medicine Oct 2017;196(7):856-863 2017 Oct

6. Olander A.; Andersson H.; Sundler AJ.; Bremer A.; Ljungström L.; Andersson Hagiwara M. Prehospital characteristics among patients with sepsis: a comparison between patients with or without adverse outcome. BMC emergency medicine 08 2019;19(1):43 2019 08

7. Jouffroy R., Saade A., Saint ML., Philippe P., Carli P., Vivien B. Prognosis value of partial arterial oxygen pressure in patients with septic shock subjected to pre-hospital invasive ventilation. Am J Emerg Med. 2018; S0735-6757(18)30332-2

8. Lane DJ, Wunsch H, Saskin R, et al. Association Between Early Intravenous Fluids Provided by Paramedics and Subsequent In-Hospital Mortality Among Patients With Sepsis. JAMA Netw Open. 2018;1(8):e185845. doi:10.1001/jamanetworkopen.2018.5845

9. SSC: International guidelines for management of severe sepsis and septic shock 2012, 2016

10. Permpikul C, Tongyoo S, Viarasilpa T, Trainarongsakul T, Chakorn T, Udompanturak S. Early Use of Norepinephrine in Septic Shock Resuscitation (CENSER). A Randomized Trial. Am J Respir Crit Care Med. 2019; 199(9):1097-1105.

11. Li, Li et al. Timing of norepinephrine initiation in patients with septic shock: a systematic review and meta-analysis.CritCare. 2020. Aug 6;24(1):488

12. Alam N, Oskam E, Stassen PM, Exter PV, van de VP, Haak HR, et al. Prehospital antibiotics in the ambulance for sepsis: a multicentre, open label, randomised trial. The Lancet Respiratory medicine 2018; 6(1):40-50

Chameides L, & Samson R. (Eds.) (2011) Pediatric Advanced Life Support Provider Manual. American Heart Association.

Walchok JG.; Pirrallo RG.; Furmanek D.; Lutz M.; Shope C.; Giles B.; Gue G.; Dix A. Paramedic-Initiated CMS Sepsis Core Measure Bundle Prior to Hospital Arrival: A Stepwise Approach. Prehospital emergency care: official journal of the National Association of EMS Physicians and the National Association of State EMS Directors ;21(3):291-300

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

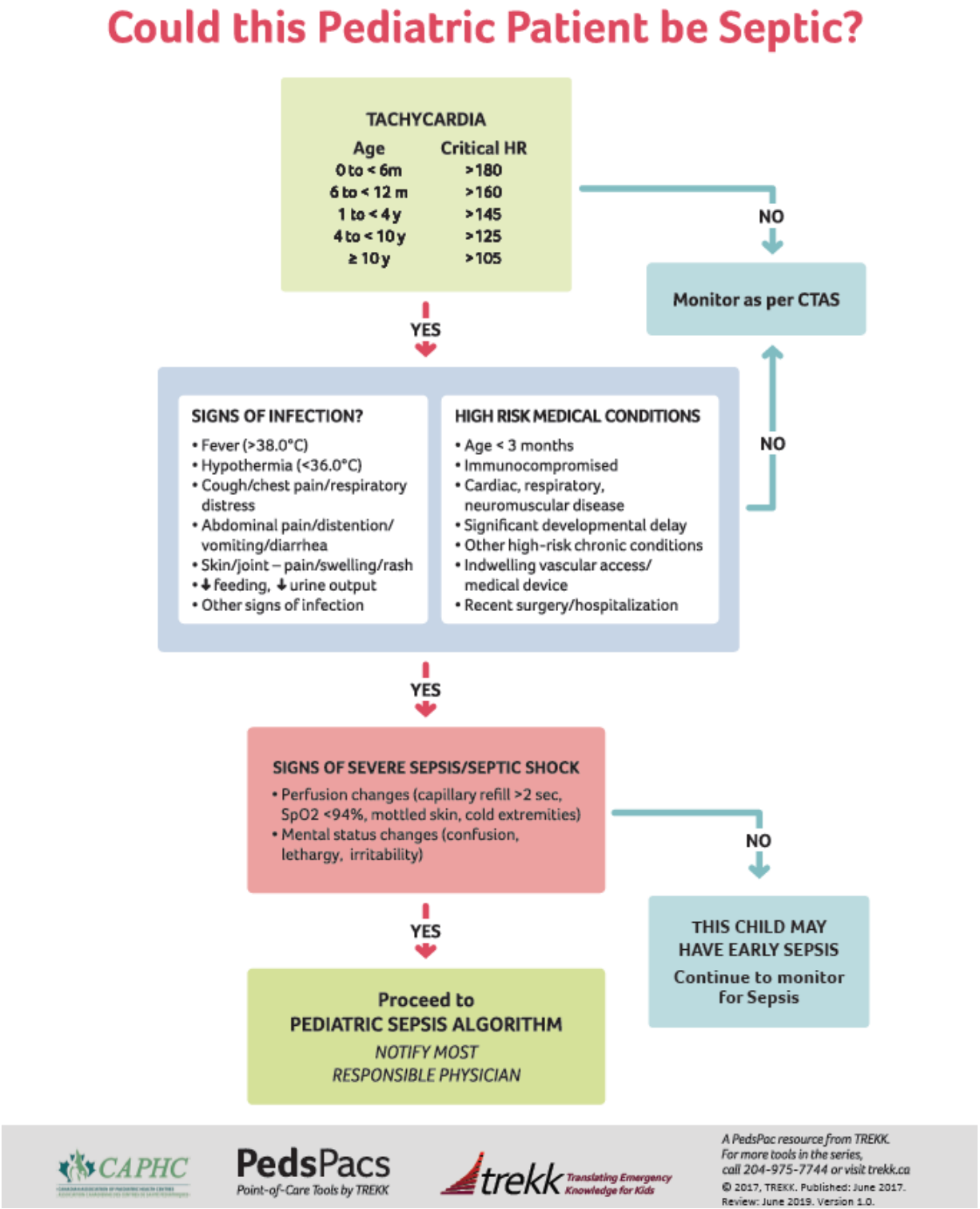
Rivers E, Nguyen B, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. N Eng J Med. Nov 2001; 345(19): 1368-77
Goldstein B, Giroir B, et al. International pediatric sepsis consensus conference: Definitions for sepsis and organ dysfunction in pediatrics. Pediatr Crit Care Med. 2005; 6(1): 2-8

Morris E.; McCartney D.; Lasserson D.; Van den Bruel A.; Fisher R.; Hayward G. Point-of-care lactate testing

for sepsis at presentation to health care: a systematic review of patient outcomes.
The British journal of general practice: the journal of the Royal College of General Practitioners Dec 2017;67(665):e859-e870 2017 Dec

https://emspep.cdha.nshealth.ca/

Figure 1. Pediatric Sepsis Triage Poster – TREKK



PEP 3x3 TABLES for SEPSIS

Throughout the EHS Guidelines, you will see notations after clinical interventions (e.g.: **PEP 2 neutral**). PEP stands for: the Canadian **P**rehospital **E**vidence-based **P**rotocols Project.

The number indicates the Strength of cumulative evidence for the intervention:
1 = strong evidence exists, usually from randomized controlled trials;
2 = fair evidence exists, usually from non-randomized studies with a comparison group; and
3 = weak evidence exists, usually from studies without a comparison group, or from simulation or animal studies.

The coloured word indicates the direction of the evidence for the intervention:
Green = the evidence is supportive for the use of the intervention;
Yellow = the evidence is neutral;
Red = the evidence opposes use of the intervention;
White = there is no evidence available for the intervention, or located evidence is currently under review.

PEP Recommendations for Sepsis Interventions, as of 2024/04/17. PEP is continuously updated. See: https://emspep.cdha.nshealth.ca/Default.aspx for latest recommendations, and for individual appraised articles.

Sepsis Syndrome

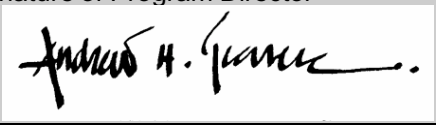
Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF EVIDENCE FOR INTERVENTION	1 (strong evidence exists)	• Identification tools- qSOFA • Identification tools-NEWS • Identification tools-SIRS • Prenotification	• Early Goal Directed Therapy • Prehospital Antibiotics		
	2 (fair evidence exists)	• Identification tools (other) • Oxygen-titrated • Point of Care Lactate • Temperature Monitoring		• Oxygen-high flow	
	3 (weak evidence exists)				

Septic Shock

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF EVIDENCE FOR INTERVENTION	1 (strong evidence exists)	• Liberal fluid management • Norepinephrine • Titrated fluid management	• Colloid Infusion • Crystalloid Infusion • Dopamine		• Hypertonic Saline
	2 (fair evidence exists)	• Balanced crystalloids • Shock Prediction Tool			
	3 (weak evidence exists)	• Dobutamine • Epinephrine	• Trendelenburg		

Program Document Number Management System

PDN: 6702.02	**Title:** Sepsis Syndrome	**Type:** CPG
Effective Date: October 11 2013	**Revision Date:** May 5 2024	
Approval Date: October 11, 2013	**Revision Date:**	
Review Date: August 12, 2013	**Revision Date:**	
Replaces: 6702.01	**Revision Date:**	
Signature of Program Director 	Signature of Program Document Coordinator Teena Robinson *Electronically Signed*	

PDN: 6702.99.01.01	**Title:** Sepsis Syndrome	**Type:** Field Guide
Effective Date: October 11 2013	Revision Date:	
Approval Date: October 11 2013	Revision Date:	
Review Date: September 11 2013	Revision Date:	
Replaces: new	Revision Date:	
Signature of Program Director 	Signature of program Document Coordinator Teena Robinson *Electronically Signed*	