



# IMPLICATIONS OF THE NEW INTERNATIONAL SEPSIS GUIDELINES FOR NURSING CARE

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Sepsis is a serious worldwide health care condition that is associated with high mortality rates, despite improvements in the ability to manage infection. New guidelines for the management of sepsis were recently released that advocate for implementation of care based on evidence-based practice for both adult and pediatric patients. Critical care nurses are directly involved in the assessment of patients at risk for developing sepsis and in the treatment of patients with sepsis and can, therefore, affect outcomes for critically ill patients. Nurses' knowledge of the recommendations in the new guidelines can help to ensure that patients with sepsis receive therapies that are based on the latest scientific evidence. This article presents an overview of new evidence-based recommendations for the treatment of adult patients with sepsis, highlighting the role of critical care nurses. (*American Journal of Critical Care*. 2013;22:212-222)

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**S**epsis is the body's systemic response to infection and is a serious health care condition that affects neonatal, pediatric, and adult patients worldwide. Severe sepsis (sepsis that has progressed to cellular dysfunction and organ damage or evidence of hypoperfusion) and septic shock (sepsis with persistent hypotension despite adequate fluid resuscitation) are associated with high mortality rates, despite improvements in the ability to manage infection.<sup>1</sup> The cellular processes that occur as a result of inflammatory responses in sepsis, including impaired perfusion and microcirculatory coagulation, can lead to organ system dysfunction. Early recognition of sepsis can help to ensure prompt treatment to improve patients' outcomes.

The updated Surviving Sepsis Campaign guidelines were recently published and serve as the basis for evidence-based care for the treatment of patients with sepsis. Nurses play an important role in promoting optimal care for patients with sepsis, so awareness of the new guidelines and their implications for nursing care is essential for nurses working in acute and critical care settings. This article highlights relevant recommendations from the new sepsis guidelines, focusing on implications for nursing care of adult patients with sepsis, and is intended to be read in conjunction with the updated Surviving Sepsis Campaign guidelines.<sup>1</sup> The Surviving Sepsis Campaign guidelines also outline the specific recommendations for pediatric patients.

## Overview

Sepsis is defined as a systemic inflammatory response initiated by a source of infection. The incidence, hospitalization rates, and mortality of sepsis remains one of the leading causes of morbidity and mortality worldwide.<sup>2,5</sup> In sepsis, stimulation of the innate immune system, activation of white blood cells, and response of endothelial cells can lead to the release of a number of mediators or cytokines. This activation causes a variety of physiological changes including vasodilation, enhanced expression of

adhesion molecules, increased capillary permeability, increased clot formation, and decreased fibrinolysis. Although the immune system response is protective in nature, aimed at combating infection in sepsis, overactivity of mediators has been cited as a causal factor contributing to endothelial cell damage, microcapillary permeability changes, capillary leak, and profound vasodilation and hypotension.<sup>6,7</sup> These responses play a role in the progression of severe sepsis and influence the development of multiple organ system dysfunction. Importantly, early recognition and treatment of sepsis is crucial for clinicians to improve outcomes and decrease sepsis-related mortality.<sup>8</sup>

## Surviving Sepsis Campaign Guidelines

New evidence-based guidelines for the management of sepsis, the Surviving Sepsis Campaign guidelines, outline recommendations for the medical treatment of sepsis. These update the prior guidelines<sup>9</sup> published in 2008 and represent the work of a committee of 68 international experts representing 30 international organizations. The guidelines use the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) system to establish the quality of evidence from high (A) to very low (D) and to determine the strength of recommendations as strong (1) or weak (2).<sup>10</sup> Groups were formed to work on individual guideline recommendations, and several working meetings were held along with teleconferences and electronics-based committee discussions. This article's authors served on the guideline revision task force as nursing representatives.

## Guideline Components

The Surviving Sepsis Campaign guideline recommendations are organized in 3 categories:

Early recognition and treatment is crucial to improve outcomes and decrease sepsis-related mortality.

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**Table 1**  
**Surviving Sepsis Campaign care bundles<sup>a</sup>**

**Within 3 hours of severe sepsis**

1. Measure lactate level
2. Obtain blood cultures before administration of antibiotics
3. Administer broad-spectrum antibiotics
4. Administer 30 mL/kg crystalloids for hypotension or lactate  $\geq 4$  mmol/L

**Within 6 hours of initial signs and symptoms of septic shock**

5. Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation to maintain a mean arterial pressure  $\geq 65$  mm Hg)
6. In the event of persistent arterial hypotension despite volume resuscitation (septic shock) or initial lactate  $\geq 4$  mmol/L (36 mg/dL):
  - Measure central venous pressure<sup>b</sup>
  - Measure central venous oxygen saturation<sup>b</sup>
7. Remeasure lactate level if initial lactate level was elevated<sup>b</sup>

<sup>a</sup> Adapted from Dellinger et al.<sup>1</sup>

<sup>b</sup> Targets for quantitative fluid resuscitation included in the guidelines are a central venous pressure of 8 mm Hg or greater, central venous oxygen saturation of at least 70%, and return of lactate level to normal.

(1) recommendations directly targeting the management of severe sepsis, (2) recommendations targeting high-priority general care considerations, and (3) pediatric considerations.

### Initial Resuscitation and Diagnosis

A primary focus of the guidelines relates to initial resuscitation and diagnosis of sepsis, based in part on the results of research that have established the importance of early recognition and treatment of sepsis in reducing mortality rates. A primary recommendation in the new guidelines is the use of a protocolized approach to resuscitation in patients with sepsis-induced tissue hypoperfusion (defined as hypotension persisting after initial fluid challenge or blood lactate concentration  $\geq 4$  mmol/L). Methods for augmenting perfusion should be implemented as soon as possible and not delayed until the patient is admitted to the intensive care unit (ICU). This change has implications for nursing care of patients in emergency departments and patients in general clinical units awaiting transfer to the ICU. Within the guidelines, it is highlighted that the goals of initial resuscitation during the first 6 hours of sepsis-induced hypoperfusion should include all of the following (grade 1C):

- (a) Central venous pressure 8–12 mm Hg
- (b) Mean arterial pressure (MAP)  $\geq 65$  mm Hg
- (c) Urine output  $\geq 0.5$  mL/kg · per hour
- (d) Central venous (superior vena cava) oxygen saturation 70% or mixed venous oxygen saturation 65%.

The guidelines advocate use of blood lactate levels as a marker of tissue hypoperfusion, targeting

returning lactate levels to normal as rapidly as possible (grade 2C). In addition, if a central venous oxygen saturation less than 70% or a mixed venous oxygen saturation less than 65% persists during the first 6 hours of resuscitation despite adequate repletion of intravascular volume, dobutamine infusion (to a maximum of 20  $\mu\text{g}/\text{kg}$  per minute) or transfusion of packed red blood cells to achieve a hematocrit of at least 30% are additional options to achieve the oxygen saturation goals.<sup>1</sup> Barriers to initiating and monitoring early quantitative resuscitation have been associated with limited availability of equipment and competence of clinicians. Although controversy surrounds the use of central venous pressure and oxygen saturation as end points of resuscitation, protocols that use central venous pressure and venous blood gas levels are easily established in both the emergency department and the ICU.<sup>11</sup> Additional technologies to measure flow and volumetric indices are available. However, these techniques have limited effectiveness in influencing the clinical outcomes of early resuscitation to treat sepsis.<sup>1</sup>

### Sepsis Bundles

Specific recommendations for the management of sepsis are outlined in the sepsis bundles (Table 1). The sepsis bundle measures have direct implications for nursing care as nurses are often responsible for obtaining blood samples for measurement of lactate levels and for cultures, as well as administering antibiotics and vasopressor therapy. The new guidelines indicate that lack of early recognition of sepsis is a major obstacle to initiation of sepsis bundles. Screening for sepsis as part of a performance improvement process improves early identification of sepsis and decreases sepsis-related mortality.<sup>8,12-16</sup> The guidelines identify the benefit of routine screening of potentially infected patients for severe sepsis to allow earlier implementation of therapy (grade 1C).<sup>1</sup> Performance improvement involves education, protocol development and implementation, data collection, measurement of indicators, and ongoing feedback to clinicians, administrators, quality improvement staff, clinical educators, and others. Sepsis care requires a multidisciplinary team (physicians, nurses, pharmacy, respiratory, dieticians, and administrators) and multispecialty collaboration (medicine, surgery, and emergency medicine) to promote achievement of goals. As a result, nurse-driven quality improvement projects to target sepsis can be used to improve the identification of sepsis and to implement the new guidelines, targeting multidisciplinary and multispecialty involvement.

## Diagnosis

Obtaining appropriate cultures before initiating antimicrobial therapy is recommended, provided that doing so does not delay the administration of antimicrobial agents longer than 45 minutes (grade 1C). In order to optimize identification of causative organisms, at least 2 sets of blood samples (both aerobic and anaerobic bottles) should be cultured before antibiotic therapy is started. As outlined in the guidelines, at least one of the blood samples for culture should be obtained percutaneously and one sample should be obtained through each vascular access device, although a blood sample need not be obtained through a vascular device if the device was inserted less than 48 hours earlier.<sup>1</sup> Other samples such as urine, respiratory secretions, wounds, or other body fluids that may be the source of infection should also be collected for culture before antibiotic therapy if obtaining such samples is not associated with significant delay in administration of the antibiotic (grade 1C).

Nurses play a direct role in obtaining samples for culture and in administering antibiotic therapy and can therefore have a significant impact on maximizing the identification of the source of infection as well as ensuring that patients receive prompt antibiotic therapy. As outlined in the guidelines, if various culture results show the same organism, the likelihood that the organism is causing the severe sepsis is enhanced.<sup>1</sup> The importance of obtaining 2 samples from different sources to maximize the potential of obtaining a positive culture result cannot be underestimated. Ensuring that samples are obtained by using appropriate technique to prevent contamination of the culture results also is important.

## Source Control

Identifying the source of infection is an essential step in the management of sepsis so as to contain the inflammatory and mediator responses. Once identified, appropriate interventions should be undertaken quickly, when possible within the first 12 hours after the diagnosis is made (grade 1C).<sup>1</sup> Measures for source control include surgical debridement for an abscess or infected necrosis, removal of infected intravascular access devices, or other measures to remove the potential source of infection. General assessment of the patient during routine procedures such as bathing may reveal areas of redness and inflammation that may help to identify the presence of an abscess, or drainage at the insertion site of a vascular access catheter may suggest a potential catheter-associated bloodstream infection and the need to discontinue the catheter. Astute clinical assessment and reporting

of signs and symptoms that may help to identify the source of infection are nursing measures that can additionally promote source control.

## Infection Prevention

The use of careful infection control practices including hand hygiene, barrier precautions, catheter care, head-of-bed elevation, comprehensive oral care with use of subglottic suctioning, and other measures should be maintained to prevent further complications. Selective oral decontamination and selective digestive decontamination should be considered as methods to reduce the incidence of ventilator-associated pneumonia (grade 2B). In addition, oropharyngeal decontamination with oral chlorhexidine gluconate is suggested to reduce the risk of ventilator-associated pneumonia in ICU patients with severe sepsis (grade 2B).<sup>1</sup>

An outline of infection prevention measures as a prime area of focus of nursing care in patients at risk for infection potentially leading to sepsis has been provided in "Nursing Considerations to Complement the Surviving Sepsis Campaign,"<sup>17</sup> the companion document to the 2008 Surviving Sepsis Campaign guidelines. Critically ill patients are at high risk of acquiring a hospital-associated infection because of the presence of invasive catheters and tubing, drains and tubes, wounds, and other complex therapies they receive. Infection prevention measures relate to accountability, education, surveillance of nosocomial infection, hand hygiene, and prevention of respiratory, central catheter-related, surgical site, and urinary tract infections.<sup>17</sup> Although the literature indicates that the incidence of antimicrobial resistance does not change appreciably with current selective digestive decontamination regimens,<sup>18-20</sup> the use of oral chlorhexidine gluconate is relatively easy, decreases the risk of nosocomial infection, and reduces potential concern over promotion of antimicrobial resistance by selective digestive decontamination regimens.<sup>1</sup>

## Hemodynamic Support and Adjunctive Fluid Therapy of Severe Sepsis

Crystalloids have been recommended as the initial fluid of choice in resuscitation of patients with severe sepsis and septic shock (grade 1B), whereas the use of hydroxy ethyl starches for fluid resuscitation in patients with severe sepsis and septic shock is not supported (grade 1B). The use of albumin to

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**Crystalloids should be the initial choice in resuscitation of patients with severe sepsis and septic shock.**

resuscitate patients with severe sepsis and septic shock is indicated when patients require substantial amounts of crystalloids (grade 2C). Fluid challenges, as a dynamic test to assess patients' responsiveness to fluid replacement, have been advocated for fluid administration, provided that hemodynamic improvement continues, as measured by dynamic (eg, change in pulse pressure, stroke volume variation) or static (eg, arterial pressure, heart rate) variables.<sup>1</sup> If hemodynamic improvement does not continue, fluid challenges should be discontinued and mechanisms to improve hemodynamic function, such as vasopressors, may be required.

Nurses are fundamental to facilitating early optimal resuscitation through administration and monitoring the patients' response to fluids during the treatment of severe sepsis and septic shock. The fluid recommendations are based on recent randomized controlled trials evaluating the use of crystalloids and artificial colloids (modified gelatins, hydroxyethyl starches, dextran) for initial fluid resuscitation. These studies did not show a survival benefit of artificial colloids compared with other fluids.<sup>21,23</sup>

#### **Vasopressors**

Vasopressor therapy should be initiated to target a mean arterial pressure (MAP) of 65 mm Hg (grade 1C).<sup>1</sup> Vasopressor therapy is often required in severe sepsis/septic shock to maintain perfusion in the face of life-threatening hypotension, even when hypovolemia has not yet been resolved. Below a threshold MAP, autoregulation in critical vascular beds can be lost, and perfusion can become linearly dependent on pressure.<sup>1</sup> Norepinephrine is recommended as the first-choice vasopressor (grade 1B). Epinephrine (added to and potentially substituted for norepinephrine) is recommended when an additional agent is needed to maintain adequate blood pressure (grade 2B). Vasopressin up to 0.03 units per minute can be added to norepinephrine with the intent of increasing MAP to the target level or decreasing the dosage of norepinephrine. Low-dose vasopressin is not recommended as the single initial vasopressor for treatment of sepsis-induced hypotension, and vasopressin doses higher than 0.03 to 0.04 units per minute should be reserved for salvage therapy (failure to achieve adequate MAP with other vasopressor agents).<sup>1</sup>

Dopamine should be used as an alternative vasopressor agent to norepinephrine only in highly selected patients (eg, patients with low risk of

tachyarrhythmias and absolute or relative bradycardia; grade 2C). Phenylephrine is not recommended in the treatment of septic shock except in circumstances where (a) norepinephrine is associated with serious arrhythmias, (b) cardiac output is known to be high and blood pressure persistently low, or (c) as salvage therapy when combined inotropic/vasopressor drugs and low-dose vasopressin have failed to achieve the MAP target (grade 1C).<sup>1</sup> Another guideline recommendation is that low-dose dopamine should not be used for renal protection (grade 1A). Additionally the guidelines recommend that all patients requiring vasopressors have an arterial catheter placed as soon as practical if resources are available.<sup>1</sup>

Oversight of vasopressor therapy and response to therapy is a direct care role of critical care nurses. As nurses administer and titrate dosages of vasopressors, monitoring the response to therapy is important. This monitoring includes assessment of clinical end points such as blood pressure, regional and global perfusion (including blood lactate concentrations and skin perfusion), mental status, and urine output. Although adequate fluid resuscitation is a fundamental component of the hemodynamic management of patients with septic shock and should ideally be achieved before vasopressors and inotropic agents are used, vasopressor therapy is frequently needed along with fluids for patients with severe shock.<sup>1</sup> Ensuring that patients receiving vasopressor therapy have an arterial cannula to provide continuous analysis of blood pressure is a new focus of the guidelines; doing so also enables immediate and accurate blood sampling.

#### **Inotropic Therapy**

A trial of dobutamine infusion up to 20 µg/kg per minute is recommended (in addition to a vasopressor if in use) 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 achievement of adequate intravascular volume and adequate MAP (grade 1C).<sup>1</sup> The use of dobutamine as a first-choice inotrope for patients with measured or suspected low cardiac output in the presence of adequate left ventricular filling pressure (or clinical assessment of adequate fluid resuscitation) and adequate MAP is supported by evidence.

In addition, increasing cardiac index to predetermined supranormal levels is not recommended (grade 1B). This recommendation is based on clinical trial data that included critically ill ICU patients who had severe sepsis and failed to demonstrate benefit from increasing oxygen delivery to supranormal targets by use of dobutamine.<sup>1</sup>

Intravenous hydrocortisone is supported only in patients in whom hemodynamic stability is not achievable. When used, a dose of 200 mg per day is recommended (grade 2C).<sup>1</sup> The use of steroids in severe sepsis/septic shock has been a topic of controversy for many years. Although some randomized controlled trials have demonstrated mortality benefit with steroid therapy for patients in vasopressor-unresponsive septic shock (hypotension despite fluid resuscitation and vasopressors for more than 60 min), other studies, including a large European multicenter trial (Corticosteroid Therapy of Septic Shock [CORTICUS]) failed to show a mortality benefit.<sup>24</sup> A review<sup>25</sup> on the use of steroids in adults with septic shock emphasized the importance of study selection for systematic analysis and confirmed the lack of evidence that the use of low-dose hydrocortisone improves the patients' outcome.

In addition, the use of the corticotropin-releasing hormone stimulation test to identify the subset of adult patients with septic shock who should receive steroid therapy is no longer supported (grade 2B), as randomized controlled trial data have not substantiated a benefit of this intervention.<sup>1</sup> Awareness of the new guideline recommendations has direct implications for nursing care related to the administration of steroid therapy as a component of care for severe sepsis/septic shock.

### Administration of Blood Products

There is a general move toward less use of blood products in patients with sepsis. Specifically, red blood cell transfusion is recommended only for patients with a hemoglobin level less than 7 g/dL to target a hemoglobin concentration of 7.0 to 9.0 g/dL in adults (grade 1B), erythropoietin is not recommended as a specific treatment of anemia associated with severe sepsis (grade 1B), and fresh frozen plasma is not recommended to correct laboratory clotting abnormalities in the absence of bleeding or planned invasive procedures (grade 2D).<sup>1</sup> In contrast, platelet therapy is advocated for patients with severe sepsis when counts are 10 000/mm<sup>3</sup> or less ( $\leq 10 \times 10^9/L$ ) in the absence of apparent bleeding or when counts are 20 000/mm<sup>3</sup> or less ( $\leq 20 \times 10^9/L$ ) if the patient has a significant risk of bleeding. Higher platelet counts ( $\geq 50\,000/mm^3$  [ $50 \times 10^9/L$ ]) are advised for active bleeding, surgery, or invasive procedures (grade 2D).<sup>1</sup> The rationale for limiting the use of blood products is that few benefits have been observed in patients with severe sepsis or septic shock and the potential complications of transfusion therapies should be avoided where possible. As nurses are responsible for the administration of transfusion

therapies, awareness of the new recommendations can help to decrease the overall risks associated with transfusions.

### Supportive Therapy for Severe Sepsis — Mechanical Ventilation in Patients With Sepsis-Induced Respiratory Distress Syndrome

A tidal volume of 6 mL/kg rather than 12 mL/kg predicted body weight is recommended for patients with sepsis-induced acute respiratory distress syndrome (ARDS; grade 1A). Maintaining plateau pressures at 30 cm H<sub>2</sub>O or less (grade 1B) and applying positive end-expiratory pressure (PEEP) to avoid alveolar collapse at end expiration (atelectotrauma) (grade 1B) should also be considered in the respiratory care of patients with sepsis.<sup>1</sup> These recommendations remain consistent with mechanical ventilation strategies identified from the American European Consensus Criteria Definition for Acute Lung Injury (ALI) and ARDS,<sup>26</sup> and studies that have shown decreased mortality in patients with a pressure- and volume-limited strategy for established ARDS.<sup>27</sup>

Use of recruitment maneuvers for patients with severe refractory hypoxemia due to ARDS (grade 2C) and prone positioning in patients with sepsis-induced ARDS who have a ratio of Pao<sub>2</sub> to fraction of inspired oxygen (FiO<sub>2</sub>) of 100 mm Hg or less (grade 2B) are supported, although the latter recommendation is limited to facilities that have experience with prone positioning. Although prone positioning can help in the optimization of ventilation and perfusion, it can be associated with potentially life-threatening complications, including accidental dislodging of the endotracheal and chest tubes, as well as the development of pressure ulcers.<sup>28</sup> Maintenance of patient safety during recruitment maneuvers and prone positioning is therefore essential.

General principles of caring for any patient undergoing mechanical ventilation continue to be relevant to patients with sepsis. These principles include maintaining the head of the bed at an elevation of at least 30° to 45° to limit aspiration risk and to prevent the development of ventilator-associated pneumonia (grade 1B), use of noninvasive mask ventilation in appropriate patients (grade 2B), having a weaning protocol in place, and ensuring that patients undergo spontaneous breathing trials regularly to evaluate whether mechanical ventilation can be discontinued (grade 1A). Criteria to be used to activate a spontaneous breathing trial include the

**Nurse-directed weaning off of mechanical ventilation is effective in reducing duration of mechanical ventilation.**

patient (a) being arousable; (b) being hemodynamically stable (without vasopressor agents); (c) having no new potentially serious conditions; (d) having low ventilatory and end-expiratory pressure requirements; and (e) having low  $\text{FiO}_2$  requirements that can be met safely when oxygen is delivered with a face mask or a nasal cannula.

Nurse-directed weaning off of mechanical ventilation is effective in reducing duration of mechanical ventilation.<sup>29,30</sup> In a recent international study

from 8 countries in which decisional responsibility for mechanical ventilation and weaning was assessed, researchers found that nurses were more likely to make and implement decisions related to weaning, such as changing settings for pressure support and  $\text{FiO}_2$ , independently.<sup>31</sup> The new guideline recommendations for mechanical ventilation

and supportive therapies aim to maximize oxygenation in patients with severe sepsis/septic shock. Nurses play an important role in promoting adequate oxygenation and ventilation, as well as in weaning patients off of mechanical ventilation.

### **Sedation, Analgesia, and Neuromuscular Blockade in Patients With Sepsis**

Sedation, whether continuous or intermittent, should be minimized in sepsis patients receiving mechanical ventilation, targeting specific titration end points (grade 1B). In addition, neuromuscular blocking agents should be avoided if possible, or used in limited doses for less than 48 hours (grade 1C) where necessary. If a neuromuscular blocking agent is required, train-of-4 monitoring of the depth of blockade should be used (grade 1C).<sup>1</sup>

It is well recognized that limiting the use of sedation in critically ill patients can reduce the duration of mechanical ventilation and lengths of stay in the ICU and hospital.<sup>32,33</sup> Monitoring patients' response to sedation with validated sedation scales such as the Richmond Agitation Sedation Scale (RASS) is important. The strategies to effectively minimize sedation may be different in each country or region but should include consideration of how to monitor and deliver sedation to patients in ways that enable patients to be as awake as possible while still tolerating their treatment. Strategies such as daily sedation interruption, although initially showing promise,<sup>34</sup> have now been shown to provide no benefit in a recent study.<sup>35</sup> The use of protocols such as the Awakening Breathing Coordination Delirium monitoring and management and Early mobilization or "ABCDE" bundle, which

incorporates evidence-based practice concepts to standardize care processes, can help to break the cycle of oversedation and prolonged mechanical ventilation that can lead to immobility and delirium.<sup>36</sup> Integration of additional monitoring assessments including the Confusion Assessment Method for the ICU<sup>37</sup> can also help to promote early detection of delirium, a syndrome that can further complicate the course of severe sepsis/septic shock. Further detail regarding management of pain, agitation, and delirium in all critically ill patients, including those with sepsis, is provided in the recently released guidelines from the Society for Critical Care Medicine.<sup>38</sup>

### **Glucose Control**

A protocolized approach to blood glucose management in ICU patients with severe sepsis is recommended; insulin dosing should begin when 2 consecutive blood glucose levels exceed 180 mg/dL. This protocolized approach targets an upper blood glucose level of 180 mg/dL or less rather than an upper target blood glucose level of 110 mg/dL or less (grade 1A). This new target is based on clinical trial evidence that demonstrated mortality risk with tight glycemic control. The NICE-SUGAR trial included more than 6000 patients randomized to intensive or conventional glycemic control and showed that intensive glucose control increased hypoglycemic events and mortality among adults in the ICU.<sup>39,40</sup>

Blood glucose values should be monitored every 1 to 2 hours until glucose values and insulin infusion rates are stable, then every 4 hours thereafter (grade 1C). Glucose levels obtained with point-of-care testing of capillary blood should be interpreted with caution, as such measurements may not be accurate estimates of arterial blood or plasma glucose values.<sup>1</sup> As a result, a protocolized approach to insulin therapy is recommended to ensure consistent management of blood glucose levels. Research has shown that glucose-insulin protocols controlled by nurses are feasible, safe, and likely to result in better adherence to a target range for blood glucose.<sup>41-43</sup>

Nurses in ICUs titrate intravenous insulin therapy for patients with severe sepsis, monitor patients' response, and obtain and assess for trends in blood glucose values. As a result, critical care nurses can help to ensure adherence to the use of established insulin protocols or computer-based algorithms for controlling blood glucose concentrations and blood glucose variability in patients with severe sepsis.

### **Renal Replacement Therapy**

Continuous renal replacement therapies and intermittent hemodialysis are considered equally effective

**Insulin dosing should begin when 2 consecutive blood glucose levels exceed 180 mg/dL.**

in patients with severe sepsis and acute renal failure because they yield similar short-term survival rates (grade 2B). Where appropriate, continuous therapies should be used to facilitate management of fluid balance in hemodynamically unstable patients with sepsis (grade 2D).<sup>1</sup>

In many ICUs, nurses manage renal replacement therapy; prepare the patient, the circuit, and fluids; adjust fluid settings to provide fluid balance; prepare electrolyte additives; monitor acid base and electrolyte levels; monitor patients' and machines' "vital signs," and diagnose circuit failure when necessary.<sup>44</sup> These are crucial components of renal replacement therapy for patients with severe sepsis, many of whom may show hemodynamic instability.

### Prophylaxis of Deep Vein Thrombosis

Patients with severe sepsis should receive daily pharmacoprophylaxis against venous thromboembolism (VTE; grade 1B), preferably using daily subcutaneous low-molecular weight heparin (LMWH) (grade 1B) rather than unfractionated heparin 2 or 3 times daily (grade 2C). Importantly, if creatinine clearance is less than 30 mL/min, the use of dalteparin (grade 1A) or another form of LMWH that has a low degree of renal metabolism (grade 2C) or unfractionated heparin (grade 1A) is recommended.<sup>1</sup>

Additionally, patients with severe sepsis benefit from a combination of pharmacologic therapy and intermittent pneumatic compression devices whenever possible (grade 2C). Consistent with all critically ill patients, if patients with sepsis have a contraindication for heparin use (eg, thrombocytopenia, severe coagulopathy, active bleeding, recent intracerebral hemorrhage), they should not receive pharmacoprophylaxis until the contraindication is resolved (grade 1B), but are likely to benefit from mechanical prophylactic treatment, such as use of graduated compression stockings or intermittent compression devices (grade 2C), unless contraindicated.<sup>1</sup> Implementation of prevention measures and monitoring for signs of VTE is a standard practice in critical care. Institution of early mobilization is an additional measure to prevent the incidence of VTE in all critically ill patients, including those with sepsis. The potential consequences of VTE in the setting of sepsis, specifically an increased risk of potentially fatal pulmonary emboli in an already hemodynamically compromised patient, are dire.

Instituting measures for prevention of deep venous thrombosis has become a standard practice in the ICU. Nurses administer pharmacoprophylaxis as ordered, initiate use of intermittent pneumatic compression devices, and institute early mobilization

in the ICU as measures to prevent deep venous thrombosis from occurring in all critically ill patients, including those with sepsis. As a result, the role of the critical care nurse in implementing prevention measures and monitoring patients for signs of deep venous thrombosis is instrumental in the prevention and management of that problem.

### Stress Ulcer Prophylaxis

A histamine<sub>2</sub> blocker or proton pump inhibitors should be given for stress ulcer prophylaxis to patients with sepsis who have bleeding risk factors (grade 1B), with a preference given to the use of proton pump inhibitors (grade 2D). Prophylaxis in patients without risk factors is not necessary (grade 2B).<sup>1</sup> Administration of stress ulcer prophylaxis is an accepted ICU standard of care in reducing events of gastrointestinal bleeding. Clinically significant gastrointestinal bleeding can cause hemodynamic instability, increase the need for red blood cell transfusions, increase length of stay in the ICU, and affect mortality rates for patients with sepsis.

### Nutrition

Oral or enteral feeding, as tolerated, is recommended rather than either fasting or provision of only intravenous glucose within the first 48 hours after a diagnosis of severe sepsis (grade 2C). Low-dose feeding in the first week (eg, up to 500 kcal per day) is suggested, advancing only as tolerated to achieve full caloric feeding (grade 2B). Both use of intravenous glucose and enteral nutrition rather than total parenteral nutrition alone or parenteral nutrition in conjunction with enteral feeding in the first 7 days after a sepsis diagnosis (grade 2B) and use of nutrition with no specific immunomodulating supplementation (grade 2C) are recommended.<sup>1</sup>

The use of enteral feeding in critical illness has been established as beneficial for maintaining the integrity of gut mucosa and prevention of bacterial translocation and organ dysfunction.<sup>45</sup> However, some concern exists about the risk of ischemia with early feeding, mainly in hemodynamically unstable patients.<sup>1</sup> The use of enteral nutrition in critically ill patients has been debated in the nursing literature, especially with respect to the optimal time to begin enteral feeding, gastric versus small-bowel tube placement, and what markers should be used to measure intolerance to enteral nutrition.<sup>46</sup> Often, feeding is withheld unnecessarily in the ICU,<sup>47</sup> and although assessing the patient's tolerance is important, feedings should continue if gastric residual volumes are

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not considered excessive. Additionally, gastric residual volumes should be used in conjunction with clinical assessment to determine risk for aspiration.<sup>46</sup> It is essential for nurses to know the recommendations related to enteral nutrition for patients with sepsis so as to promote optimal nutritional status during critical illness.

### Setting Goals of Care

The last recommendation of the guidelines relates to addressing treatment goals for patients with severe sepsis. Severe sepsis is associated with high mortality rates, making identification of realistic treatment goals after the resuscitation period a priority. This section of the 2008 guidelines was focused on limitation of life support. Since publication of the 2008 guidelines, knowledge and understanding in this area of practice have grown.

The need for goals of care and prognosis to be discussed with patients and families is highlighted (grade 1B) with guidance that goals of care be incor-

porated into treatment and end-of-life care planning, using palliative care principles where appropriate (grade 1B), and that goals of care be addressed as early as feasible, but no later than within 72 hours of ICU admission (grade 2C).<sup>1</sup>

Previously labeled as “Consideration for Limitation of Support,” the new recommendation for “Setting Goals of Care” focuses on an active process of discussion of prognosis with patients and their

families within 72 hours of ICU admission. The value of family care conferences, identification of treatment goals, flexible visiting, and integration of consultations for palliative care and end-of-life care for critically ill patients is now well recognized.<sup>48-50</sup>

Family members often struggle to understand the implications of critical illness in patients with severe sepsis, and nurses can improve family members’ understanding through frequent interaction with the family. Although the outcome of intensive care treatment in critically ill patients may be difficult to predict accurately, establishing realistic treatment goals is important in promoting patient-centered care in the ICU.<sup>51</sup> Discussing prognosis in the context of goals of care has been identified as an important component of surrogate decision making in the ICU.<sup>52,53</sup> Such discussion promotes communication and understanding between the patients’ family and the treating team, which leads to improved

satisfaction among family members; decreased stress, anxiety, and depression in surviving relatives; improved end-of-life decision making; and shorter length of stay in the ICU for patients who die in the ICU.<sup>54-58</sup> In addition, limitation of care to appropriately reflect the patient’s prognosis and goals of care can help reduce critical care nurses’ moral distress.<sup>59</sup>

In highlighting the importance of establishing goals of care with integration of palliative care principles and end-of-life care planning, the new guidelines can help to improve care in the ICU. Critical care nurses have a vital role in helping sepsis patients’ families understand the rationale for medical treatments and procedures, as well as reinforcing information discussed in family care conferences regarding prognosis and treatment options.

### Additional Resources to Guide Nursing Care for Patients With Severe Sepsis/Septic Shock

In recognition of the crucial role that nurses play in the treatment of patients with sepsis, the World Federation of Critical Care Nurses (WFCCN) published a companion guide to the 2008 Surviving Sepsis Campaign guidelines in 2011 that outlines a number of additional recommendations for nursing care of patients with sepsis. That publication<sup>17</sup> represents the work of an international task force and is available full text on the WFCCN website ([http://en.wfccn.org/resources\\_sepsis.php](http://en.wfccn.org/resources_sepsis.php)) to promote dissemination of this key document to improve nursing care for patients with sepsis. A total of 63 recommendations related to the nursing care of patients with sepsis were outlined, including prevention measures addressing education, accountability, surveillance of nosocomial infections, hand hygiene, and prevention of respiratory, central catheter-related, surgical site, and urinary tract infections, with infection management recommendations focused on both control of the infection source and transmission-based precautions.<sup>17</sup>

Recommendations related to initial resuscitation include improved recognition of those patients whose condition is deteriorating and initiation of early resuscitation measures (interventions that are consistent with the focus of rapid response teams), the use of early warning systems to identify patients at risk for clinical deterioration, and use of ICU outreach nursing interventions.<sup>17</sup> The nursing companion guide<sup>17</sup> to the Surviving Sepsis Campaign guidelines can be used, along with this article highlighting nursing care considerations of the new guidelines, to implement strategies for integrating the new guidelines in nursing practice (Table 2).

Prognosis should be discussed with patients and their families within 72 hours of admission to the intensive care unit.

**Table 2**  
**Strategies for integrating the Surviving Sepsis Campaign guidelines in nursing practice**

- Disseminate information on the new guidelines to members of the critical care team, including staff in the emergency department, where sepsis care measures are implemented before patients arrive in the intensive care unit
- Include discussion of the guidelines during unit clinical care meetings and clinical rounds
- Formulate a multidisciplinary/cross-departmental team and outline a timeline for implementing the guidelines
- Use the new guidelines as a performance improvement initiative for clinicians in critical and noncritical care areas to improve recognition and treatment of patients with sepsis
- Enlist nurse champions to spearhead components of the performance improvement process as many of the recommendations involve aspects of nursing care; nurses can therefore play an important role in promoting implementation of the guidelines

**Specific areas include:**

- Aid in the early identification of sepsis, including recognizing patients at risk for sepsis developing (eg, patients who are elderly, immunocompromised, have undergone surgical/invasive procedures, have indwelling catheters, are receiving mechanical ventilation) and monitoring physical assessment parameters including vital signs and perfusion status (eg, urine output, mental status changes, skin color)
- Provide comprehensive sepsis treatment (circulatory support with fluids, inotropic agents, and vasopressors; supportive treatment with oxygenation and ventilation; antibiotic administration; use of measures recommended in sepsis guidelines; monitoring and reporting patients' response to treatment)
- Promote patient- and family-centered care (patient and family teaching, addressing the needs of families of critically ill patients, setting goals of care, and holding family care conferences to discuss goals of care)

<sup>a</sup> Adapted from Kleinpell.<sup>60</sup>

## Conclusions

Nurses play a critical role in the process of early recognition, diagnosis, and treatment of sepsis. The new International Surviving Sepsis Campaign guidelines provide updated evidence-based practice recommendations that help to promote best practices for patient care. Critical care nurses' knowledge of the new guideline recommendations can help to ensure that patients with sepsis receive therapies that are based on the latest scientific evidence. Although this article has highlighted implications of the new guidelines, readers are referred to the specific guideline recommendations, which provide a comprehensive overview of each recommendation and the associated research evidence base along with the GRADEpro summary of evidence tables.<sup>1</sup>

By initiating resuscitative measures and indicated sepsis care that are based on the new guidelines, critical care nurses can improve care for patients with sepsis.<sup>60</sup> Integration of the new recommendations into nursing practice can help ensure that critically ill patients with sepsis receive expert nursing care to promote optimal outcomes.

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### FINANCIAL DISCLOSURES

None reported.

### eLetters

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