Impact of Nurse-Initiated ED Sepsis Protocol on Compliance With Sepsis Bundles, Time to Initial Antibiotic Administration, and In-Hospital Mortality

Authors: Heather Rose Bruce, MSN, RN, ACNS-BC, CCRN, Jeanne Maiden, PhD, RN, Peter F. Fedullo, MD, and Son Chae Kim, PhD, RN, Lakewood, WA, San Diego, CA, and Round Rock, TX

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Introduction: Emergency nurses play a key role in the initial triage and care of patients with potentially life-threatening illnesses. The aims of this study were to (1) evaluate the impact of a nurse-initiated ED sepsis protocol on time to initial antibiotic administration, (2) ascertain compliance with 3-hour Surviving Sepsis Campaign (SSC) targets, and (3) identify predictors of in-hospital sepsis mortality.

Methods: A retrospective chart review investigated all adult patients—admitted through either of 2 academic tertiary medical center emergency departments—who were discharged with a diagnosis of severe sepsis or septic shock (N = 195). Pre– and post–protocol implementation data examined both compliance with 3-hour SSC bundle targets and patient outcomes. Multivariate logistic regression analysis identified predictors of in-hospital mortality.

Results: Serum lactate measurement (83.9% vs 98.7%, $P = .003$) and median time to initial antibiotic administration (135 minutes vs 108 minutes, $P = .021$) improved significantly after protocol implementation. However, one quarter of antibiotic administration times still exceeded the 3-hour target. Significant predictors of in-hospital mortality were respiratory dysfunction, central nervous system dysfunction, urinary tract infection, vasopressor administration, and patient body weight ($P < .05$). There were no in-hospital mortality rate differences between the pre– and post–protocol implementation groups.

Discussion: Compliance with serum lactate measurement and blood culture collection goals approached 100% in the post-protocol group. However, compliance with medical interventions requiring multiple health care-provider involvement (ie, antibiotic and fluid administration) remained suboptimal. Efforts focused on multidisciplinary bundle elements are necessary to achieve full compliance with SSC targets.

Key words: Sepsis; Bundles; Protocol; Compliance; Mortality; Predictors

Introduction

Severe sepsis or septic shock is present when sepsis progresses to acute organ dysfunction and tissue hypoperfusion.[1] Although early identification and aggressive treatment can improve patient outcomes by preventing deterioration, sepsis frequently goes unrecognized or undertreated in emergency departments.[2] Severe sepsis is a life-threatening syndrome responsible for approximately 500,000 United States ED visits each year.[3] Among all patients hospitalized, severe sepsis is the discharge diagnosis in 2.26% of patients, about half of whom require an intensive care unit stay.[4] The in-hospital severe sepsis mortality rate is 28.6%, with an estimated annual US cost of $16.7 billion.[4]

The 2012 Surviving Sepsis Campaign (SSC) guidelines recommend that 4 key elements (bundles) be completed within 3 hours of the ED admission of a patient with sepsis:

Heather Rose Bruce is Clinical Nurse Specialist, St. Clare Hospital, Lakewood, WA.

Jeanne Maiden is Professor, School of Nursing, Point Loma Nazarene University, San Diego, CA.

Peter F. Fedullo is Professor of Medicine, University of California San Diego Health System, San Diego, CA.

Son Chae Kim is Professor, St. David's School of Nursing, Texas State University, Round Rock, TX.

For correspondence, write: Son Chae Kim, PhD, RN, St. David's School of Nursing, Texas State University, 1555 University Blvd, Round Rock, TX 78665–8017; E-mail: sck30@txstate.edu.

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(1) measure the serum lactate level, (2) obtain blood cultures before antibiotic initiation, (3) administer broad-spectrum antibiotics, and (4) infuse 30 mL/kg of an intravenous (IV) crystalloid solution in patients with hypotension or a lactate level of 4 mmol/L or greater.[5] The guidelines also recommend protocol-driven management of ED patients with sepsis, in conjunction with regular training and performance feedback to improve provider compliance.

Studies of admitted patients indicate that the use of a guideline-based sepsis protocol improves compliance with SSC targets and decreases in-hospital mortality rates.[6–8] Similarly, a guideline-based sepsis protocol has been shown to reduce time to initial antibiotic administration by 84 minutes among ED patients with severe sepsis.[9] Delayed antibiotic administration, however, increases the likelihood of in-hospital morality.[10] In a meta-analysis of 8 trials, SSC bundle implementation was associated with decreased time to initial antibiotic administration, as well as significantly increased odds of patient survival (odds ratio [OR], 1.91; 95% confidence interval, 1.49-2.45).[11]

Despite documented benefits of initiating SSC bundles for patients with severe sepsis or septic shock, guideline compliance remains low in many ED settings.[12] Reported barriers to compliance include poor interdisciplinary collaboration and lack of sepsis knowledge among health care providers.[12,13] Although nurse-initiated ED sepsis protocols improve guideline compliance, nurses' roles have not been clearly formalized.[14,15] There remains an information dearth regarding the impact of nurse-initiated protocols on ED patients with severe sepsis.

The aims of this study were to (1) evaluate the impact of a nurse-initiated ED sepsis protocol on (a) time to initial antibiotic administration, (b) compliance with 3-hour SSC bundle targets, and (c) in-hospital mortality rate and (2) identify in-hospital mortality predictors in admitted ED patients diagnosed with severe sepsis or septic shock. In this study ED triage nurses used established screening criteria to identify patients who potentially had sepsis and then initiated serum lactate and blood culture studies, inserted IV catheters, ordered chest radiographs, and obtained electrocardiograms to facilitate timely compliance with the sepsis protocol. Only the 2008 SSC guidelines were available at the time of protocol initiation; the study aims were subsequently updated after the publication of the 2012 guidelines.

Methods

This investigation involved a retrospective chart review of patients admitted to the hospital (between September 2011 and May 2012) through either of 2 ED research sites. Patients included all adults with an *International Classification of Diseases, Ninth Revision* discharge diagnosis of severe sepsis or septic shock. The 2 Southern California emergency departments, both associated with a single academic tertiary medical center, have a combined total of 37 beds and a patient volume of approximately 52,000 per year.

A nurse-initiated ED sepsis protocol was developed by a multidisciplinary health care team to implement the 2008 SSC guidelines. The protocol stipulated that the triage nurse would initiate a diagnostic workup and notify the ED charge nurse and attending physician whenever a patient met 2 or more systemic inflammatory response syndrome criteria (fever, hypothermia, tachycardia, or tachypnea) in association with suspected infection and signs of hypoperfusion. If the physician identified probable sepsis, a sepsis code was activated, following a stepwise evaluation and treatment algorithm.

The study protocol involved (1) serum lactate level measurement, (2) blood culture collection before antibiotic initiation, (3) broad-spectrum antibiotic administration, and (4) a weight-based IV fluid bolus infusion (≥20 mL/kg of 0.9% sodium chloride solution over a period of 30 minutes). Although the protocol used in this study was based on 2008

TABLE 1
Criteria for organ dysfunction

Organ system	Criteria
Cardiovascular	MAP <65 mm Hg, SBP <90 mm Hg, or SBP decrease >40 mm Hg from baseline
Respiratory	Bilateral pulmonary infiltrates with new or increased oxygen requirement to keep oxygen saturation >90%, Pa_{O_2}/F_{IO_2} ratio <250 in absence of pneumonia, or Pa_{O_2}/F_{IO_2} ratio <200 in presence of pneumonia
Renal	Urine output $<0.5\ mL \cdot kg^{-1} \cdot h^{-1}$ for >2 h or serum creatinine doubling or increasing >2 mg/dL over baseline
Hepatic	Bilirubin >4.0 mg/dL
Hematologic	Platelet count <80,000/μL or platelet count >50% reduction from baseline
Coagulation	PT INR >1.5 or aPTT >60 s
Metabolic	Acidosis on arterial blood gas pH <7.30 or serum lactate level ≥4 mmol/L
CNS	Acute alteration in mental status

aPTT, Activated partial thromboplastin time; *CNS*, central nervous system; F_{IO_2}, fraction of inspired oxygen; *INR*, international normalized ratio; *MAP*, mean arterial pressure; Pa_{O_2}, partial pressure of oxygen in arterial blood; *PT*, prothrombin time; *SBP*, systolic blood pressure.

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