Severe Sepsis Beyond the Emergency Department and ICU: Targeting Early Identification and Treatment on the Hospital Floor

C. A. Schorr, J. Sebastien, and R. P. Dellinger

Introduction

The Surviving Sepsis Campaign (SSC) was created in 2002 with the intent to decrease mortality in severe sepsis through educating the public/influencing public policy (Phase I), defining best practice though the creation of guidelines (Phase II), and improving patient management with the development of a sepsis performance improvement program (Phase III). Phase I included introduction of the Campaign at several major international critical care medicine conferences, beginning with the European Society of Intensive Care Medicine (ESICM) meeting in Barcelona, Spain, in 2002. Phase II was designed to create evidence-based guidelines for managing severe sepsis and septic shock through an international consensus committee, including representation from scientific organizations with interest and expertise in sepsis. Phase III included a performance improvement program designed to measure severe sepsis management and outcomes with focus on diagnosis and management in the emergency department (ED) and the intensive care unit (ICU).

The first SSC sepsis management guidelines were published in 2004, with revisions in 2008 and most recently in 2013 [1–6]. The Campaign has continued to evolve over the past 12 years and is now moving forward in 2014 to Phase IV, early identification and management on the hospital floors. This initiative is sponsored by an unrestricted grant from the Gordon and Betty Moore Foundation.

History of the Surviving Sepsis Campaign

In 2002, the SSC announced a goal of reducing mortality in severe sepsis by 25%, laudable given that mortality from severe sepsis was reported to range from 40–

C. A. Schorr ✉ · J. Sebastien · R. P. Dellinger
Division of Critical Care Medicine, Dept of Medicine, Cooper University Hospital, Camden, USA
e-mail: Schorr-christa@cooperhealth.edu

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80% [7, 8]. The SSC leaders developed a volunteer program in 2005 for hospitals throughout the world to participate in the severe sepsis performance improvement initiative. The program provided web-based resources to participating hospitals to include help in identification of administrative and unit-based healthcare provider champions, severe sepsis education tools, methodology to apply the severe sepsis bundles to clinical practice, and the electronic means (SSC software program) developed to capture data on severe sepsis management and outcomes. Participating sites electronically collected data on compliance with the severe sepsis quality indicators. The database was designed to track compliance with the then 6-hour (resuscitation) and 24-hour (management) performance improvement bundles. The de-identified data were submitted to a central repository housed at the Society of Critical Care Medicine (SCCM). Patients included in the database were admitted to the ICU with severe sepsis or septic shock or were in the ICU for a diagnosis other than severe sepsis and subsequently developed severe sepsis or septic shock during their ICU stay. Patients were classified into one of three categories based on their origin at the time of presentation: Presenting to the ICU from the ED; presenting to the ICU from an area other than the ED (floors/wards); previously admitted to the ICU for a diagnosis other than sepsis and subsequently developed severe sepsis during their ICU stay. The primary champions for the Phase III performance improvement program were physicians and nurses from the ED and the ICU.

Phase III Reveals Poor Outcome when Severe Sepsis Develops on the General Floor

The results of the SSC performance-improvement program revealed a sustained improvement in compliance with both the 6- and 24-hour quality indicators with longer participation in the campaign [9, 10]. A significant decrease in mortality was also observed. Interestingly, the mortality for patients presenting to the ICU from the ED was 27% compared to 44.3% for those presenting to the ICU from the wards. Despite the association with an overall observed decrease in mortality, the SSC leadership realized that the primary efforts in Phase III focused on the ED and the ICU. Noteworthy, was that although the group of patients admitted from the floors accounted for only 34.8% of patients, the mortality was close to 2-fold that of those admitted from the ED [9, 10]. The Campaign is now choosing to focus on patients on the hospital floors in hope of further improving survival. The SSC Phase IV program is created to draw attention to early identification of severe sepsis on hospital floors, hopefully driving the initiation of more timely management and resulting in improved outcomes.

Efforts Targeting Hospital Floors

The hospital floors initiative is called Phase IV and is currently underway with close to 60 hospitals participating in collaborative groups in four regions across

the United States. The Phase IV effort includes application of the new 3- and 6-hour severe sepsis bundles based on the most recent SSC guidelines (Box 1) and built into the long-established SSC performance improvement program. The focus of the floors initiative is the 3-hour bundle, which includes obtaining a serum lactate, obtaining blood cultures before administration of antibiotics, administration of broad-spectrum antibiotics and administration of 30 ml/kg crystalloid in those patients with a lactate ≥ 4 mmol/l and/or hypotension. The 6-hour bundle may be started on the hospital floors, but typically requires transfer to a higher level of care to accomplish.

Box 1. Surviving Sepsis Campaign Sepsis Bundles
To be completed within 3 and 6 hours of time of presentation to emergency department or diagnosis on floors or in ICU.

3 hours:
1. Measure lactate level
2. Obtain blood cultures prior to administration of antibiotics
3. Administer broad spectrum antibiotics
4. Administer 30 ml/kg crystalloid for hypotension or lactate ≥ 4 mmol/l (36 mg/dl)

6 hours:
5. Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation to maintain a mean arterial pressure (MAP) ≥ 65 mmHg)
6. In the event of persistent arterial hypotension despite volume resuscitation (septic shock) or initial lactate ≥ 4 mmol/l (36 mg/dl):
   - Measure central venous pressure (CVP)
   - Measure central venous oxygen saturation ($ScvO_2$)
7. Re-measure lactate if initially elevated

The Phase IV initiative is concentrating on hospital floors, with an emphasis on severe sepsis screening (minimum of twice daily and labelled "every patient, every shift"), focused communication for early identification and initiation of timely management of severe sepsis. Nurse and physician champions from hospital floors are encouraged to work with their ED and ICU counterparts jointly to facilitate promotion and support of the program. Similar to Phase III, this program provides tools to facilitate educational sessions with nursing and physician staff (focus on early identification of severe sepsis), including evaluation for presence of active or newly suspected infection, systemic manifestations of infection, and presence of new organ dysfunction. When patients are identified as meeting the criteria for severe sepsis, data are reviewed and confirmed with the clinical team (time zero or T_0) in an expedited manner with focus on implementation of the 3-hour bundle indicators and facilitation of entry into the 6-hour bundle if indicated.

Possible Reasons Patients Admitted to the ICU from Hospital Floors Have a Worse Prognosis

There are several potential reasons for a worse prognosis in severe sepsis patients presenting to the ICU from the floors. One possible reason may be that patients are admitted from the ED to the floor with severe sepsis but without it being identified in the ED, e. g., organ dysfunction or tissue hypoperfusion that was not recognized until deterioration occurs on the floor. A second possible reason may be that patients can present to the ED with severe sepsis and may be determined by the ED clinician to be stable for the floor (not require an ICU bed) but over time clinical status declines and then the patient is transferred to the ICU. In a single center study of 1,853 patients admitted to the hospital with severe sepsis over a 5 year period, 45% were initially admitted to a non-ICU setting [11]. Adverse outcomes in this group of patients were linked to older age, higher burden of comorbid conditions, an oncology diagnosis, and a do-not-resuscitate order at admission, and the patients were more severely ill, described as an initial serum lactate > 4 mmol/l and a higher APACHE II score [11]. Patients with severe sepsis admitted to a non-ICU setting commonly experience a new functional disability, regardless of their baseline functional status [12]. In severe sepsis patients requiring ICU care, 37.5% were discharged home compared to 54.2% of those not requiring ICU care; 37.5% died compared to 4.2% [12].

In a study of 22 inpatient wards in Scotland, Marwick and colleagues sought to improve time to antibiotic administration within 4 hours of sepsis onset [13]. Prior to the intervention, 241 episodes of sepsis with antibiotic administration were reviewed. The mean time between sepsis onset and receipt of antibiotics was 11 hours with a median of 6 hours. Analysis of the steps involved in antibiotic delivery revealed a significant delay from medical review to prescription of antibiotics with little delay from antibiotic prescription to administration. The intervention focused attention on junior doctors' decision making. The number of sepsis cases was infrequent with a median of 2 (range 0–6) across general medical wards, 4 (0–10) across general surgical wards and 1 (0–3) on orthopedic wards. The low number of cases made feedback a challenge. Also studied was a questionnaire to assess physician knowledge on sepsis identification. Doctors who were confident that they could determine when a patient had severe sepsis were no more likely than those who were not confident to correctly identify which clinical features would or would not indicate severe sepsis. The conclusion was that sepsis is not recognized and treated early [13].

Physicians may be reluctant to diagnosis sepsis as it would dictate treatment in the presence of antibiotic restrictions in place to reduce *Clostridium difficile* infection. Additionally, some may be hesitant to order antibiotics unless cultures return a positive result despite the patient displaying systemic manifestation of sepsis and infection [13]. It is unlikely that one or two doses of antibiotics, while in search of a non-infectious etiology of organ dysfunction will increase antibiotic burden significantly.

Initiating Support for a Hospital Floor Sepsis Performance Improvement Program

Respected leadership through designated champions is crucial to enable a hospital floors sepsis program to gain administrative attention, and is needed to drive support from frontline caregivers. Administrative support facilitates educational requirements, information technology support and data collection needs. A viable Phase IV severe sepsis program requires support on multiple levels in order to facilitate change in clinical behavior. This includes twice daily nurse screening, development of a script for staff to communicate findings supporting severe sepsis, and potentially developing an order set for severe sepsis. Initiatives to help move the early identification process forward may include 24/7 severe sepsis surveillance via the electronic medical record (alerts) using a modified electronic warning system (score to alert clinicians of a change in clinical status). A sepsis response team may also be deployed (discussion to follow). The early inclusion of nursing staff and hospitalists in the planning of this program is essential. Additional members of the team should include medical informatics, pharmacy, critical care and emergency medicine providers, unit-based medical technicians and if applicable a sepsis response team leader.

The significance of administrative backing early in the program can help to facilitate downstream needs for clinical, information technology (IT) and data collection support. Support may include allowing the program leadership time away from their clinical responsibilities to provide educational sessions and serve as a resource for frontline staff. IT support may include the development of a screening tool in the electronic medical record (EMR) and in the creation of a sepsis alert. Data collection is essential for success of this performance improvement program, allowing for reporting compliance with the bundle indicators and outcomes as well as providing feedback to the clinical team.

Engaging Frontline Caregivers

Methods to streamline procedures geared toward patient identification and implementation of a severe sepsis protocol are needed. During the planning process, institutions may choose to use standardized improvement methodologies (e. g., Lean Six Sigma or plan-do-study-act [PDSA] cycle) [14, 15]. The process owners (unit-based champions) for the program should be a nurse and a physician leader both with a vested interest in the floor units involved in the performance improvement program. Key members of the floor severe sepsis program should walk through the steps (workout) on how to identify a severe sepsis patient using a formal protocol. The intervention should focus on plotting out the steps necessary to identify areas that work well (e. g., medical technician obtains vital signs every shift within 1 hour of arrival of all admitted patients), require clarification (e. g., when in the process is the physician notified) or need a more efficient method to perform a specified task (e. g., administer antibiotics). Findings from the workout can provide information

to help the team simplify the overall process and potentially eliminate areas where inefficiencies may occur.

Education is essential when starting any new program but the odds of retaining the information over time remains minimal. Even in the presence of a strong foundation in medicine, diagnosing sepsis is not an easy task for most clinicians. Often the systemic manifestations of sepsis may go unnoticed or when recognized may not appear to need urgent intervention, often influenced by individual physician diagnostic capability and workload. The systemic manifestations of sepsis that should raise awareness for physicians may be overlooked or managed from a distance. Even when notified by nursing staff, physicians in training may not recognize the physiologic changes that can lead to a more severe infectious process [16].

Nursing engagement may be key to improving sepsis survival, especially if educated and resourced with the capability to recognize systemic physiologic changes in patients early, leading to early intervention and reduced organ dysfunction with improvement in outcomes. Floor nurses have a patient load that may range from 4–8 patients depending on the type of unit and hospital size. Caring for an average of 6 patients requires a great deal of organizational skill. A full assessment in these 6 patients is generally completed at the start of each shift. Incorporating a sepsis screening tool alongside the daily shift assessment may be an efficient and effective method to identify sepsis early. Unlike the emergency department where patients are assessed soon after arrival by a triage nurse, nurses practicing in units outside the ED may not get to the assessment of all of their assigned patients until 2–3 hours into the shift. Built-in electronic record warning systems to alert the nurses to which patients should receive priority evaluation may facilitate early identification and initiation of treatment.

Screening Methods

Screening for severe sepsis may be achieved with a paper screening tool, an electronic sepsis alert, or a hybrid of paper and electronic screening. Although somewhat easy to complete, paper data collection has limitations in that another staff member typically confirms that the screening was positive and data collection is required for feedback to the team. Electronic severe sepsis screening may be accomplished through 24/7 automated surveillance of electronic data capture including vital signs and laboratory data [17]. The surveillance method requires that specified parameters be written so that the screening method is consistent. This automated process may be linked to a sepsis alert in which the 24/7 electronic surveillance triggers an alert message to the nurse indicting that the patient may have sepsis. This may be done via a message to a smart device or a pop-up alert on the EMR for the specific patient. Although there is a sense of efficiency with electronic surveillance, it is equally important to include the clinician assessment and confirmation of sepsis criteria. Once the assessment for infection is completed, the surveillance system can be designed to review blood pressure readings and laboratory data to determine if organ dysfunction is present. The clinicians should review the information and

determine whether the organ dysfunction is chronic or if it is related to the infection. Once confirmed that the organ dysfunction is new and related to the infection, proceeding with confirmation and implementation of the severe sepsis bundles should follow.

Although not specific to sepsis, the use of modified early warning signs may be incorporated into the daily care plan to help the clinician determine if there has been a significant change in clinical condition based on specified criteria, primarily vital signs and laboratory data. The changes in clinical condition may or may not be due to sepsis but can aid with early identification.

Effective Clinician Communication

Nurse-to-physician communication can be a challenge, as nurses are trained to communicate in a narrative style whereas physicians are taught to report in brief bullet type points. Effective communication creates a more effective work environment in addition to building a safe quality environment [18]. Basic to any performance improvement program is mutual respect among the team members. For this program to excel, the clinical team (physicians and nurses) will need to acknowledge the competence of the nurse to identify a severe sepsis patient requiring rapid intervention. On the other hand, the nurse needs to develop appropriate skills to assess a patient for severe sepsis and communicate his/her findings to the physician.

The communication method may be scripted using situation, background, assessment and recommendation (SBAR). The SBAR technique for healthcare professionals promotes quality and patient safety through effective communication with common agreed upon expectations [19].

Example

Introduction: Dr. Jones, this is Mary Smith RN. I am calling about your patient Mr. Black.

Situation: Mr. Black is experiencing fever with chills and is complaining of severe pain in his right leg.

Background: The background information is that he was admitted yesterday with cellulitis of his right lower extremity. At 8 am today, he reported that the redness had extended 2 inches outside the markings placed on admission. His temperature is 101.5°, heart rate is 98 and respiratory rate is 24. He is complaining of severe pain.

Assessment: My assessment of the situation is that he may be experiencing a worsening of his soft tissue infection.

Recommendation: I recommend that you see him immediately and that we order a serum lactate, blood cultures and a basic metabolic panel. Do you agree?

The physician should confirm, clarify and request additional information and then work with the nurse to take appropriate action with this patient.

Incorporating Protocols and Order-Sets

A progressive next step in the sepsis performance improvement evolution is to enable the nurse to initiate a pre-approved order set. This may be completed in one of two ways, either with or without physician confirmation. In the first scenario, the nurse may initiate orders after confirmation by the clinician. Alternatively, the nurse may choose to initiate orders after his/her assessment and prior to calling the physician. In this case, the laboratory specimens may be obtained, with pending results, prior to calling the physician. Based on the order set and protocol, the nurse may elect to call the physician after the laboratory results are received using SBAR to report the recent laboratory values. Sepsis order sets when used appropriately, save time and improve patient outcomes [20, 21].

Role of Response Teams

Rapid response teams have emerged over the years for acute issues on the hospital floors that could be but are not necessarily serious. At some institutions this has evolved into sepsis response teams. The sepsis team responds to calls similar to a rapid response team. However, the sepsis response team comes equipped with antibiotics, fluids and even the potential equipment to obtain central venous access in the presence of shock. The team may also be equipped to provide respiratory support in the event that mechanical ventilation is required (similar to a rapid response team). The team may be composed of a critical care nurse, physician and a respiratory therapist. Rapid transport to the critical care area is then facilitated by the rapid response/sepsis response team when vasopressors and/or mechanical ventilation are needed. Utilization of the response team along with early initiation of therapy may improve outcome [22].

Data Collection and Feedback

In order to assess progress with performance improvement, data capture and analysis feedback to clinicians is key. Methods to capture and evaluate data may be as simple as searching discharge codes for severe sepsis and septic shock with associated mortality (administrative data). However, when evaluating process measures, such as lactate measurement, blood cultures before antibiotics and antibiotic administration, administrative data are somewhat limiting. If administering antibiotics earlier and earlier following recognition of severe sepsis improves outcomes, then capturing details of severe sepsis identification and time of antibiotic administration is crucial.

Addressing the Challenge in Sepsis Identification

Troubleshooting problems soon after they occur should be a part of any valid performance improvement program. Meaningful definitions of sepsis and severe sepsis that are easily understood by both junior and senior physicians and nurses are essential. Despite clinicians expressing understanding of sepsis, documentation review often yields a poor understanding of sepsis. In some cases, determining the source of infection can be a challenge and cause a delay in initiation of treatment. However, once a source is identified, the team needs to evaluate for source control issues. For example, if the patient develops new systemic manifestations of infection and/or new organ dysfunction, a system to review the antibiotic regimen and/or evaluate the patient for a new source of infection should be in place. Stressing the importance of differentiation between a patient with an active infection that is being treated with antibiotics versus a patient with a new or suspected infection should be an essential educational component for nurses on the medical/surgical floors. Complex patients with various chronic health conditions also present a challenge to clinicians in determining if the organ dysfunction is new versus pre-existing. Consideration should be given to infection in patients with worsening chronic organ failure.

When evaluating patients for sepsis and severe sepsis, false positive screen patients will be reported by protocol. However, circumstances will also arise wherein the clinical team does not believe the patient has sepsis despite a positive screen, but in review of the case the patient did indeed meet the criteria and should have been treated. Unfortunately, this type of patient when not identified as having sepsis and appropriately treated often progresses to develop organ dysfunction with transfer to a higher level of care.

Electronic Alert Fatigue

Alert fatigue has long been identified as problematic. It is particularly pervasive when using EMRs and may lead to a decrease in healthcare provider responsiveness to new events. Studies have shown that a substantial number of alerts are ignored by health care providers, for example, drug interaction (up to 95% in some instances) [23, 24]. This well-known phenomenon occurs because of the lack of specificity of such alerts, their lack of major impact on clinical care and their multiplicity.

Success Includes a Change in Workflow and Adoption of the Change

When we look at the entirety of running a successful hospital floor sepsis initiative there are two major issues to be addressed: The change in work flow and the willingness of health care providers to adopt that change.

Any change can be difficult. Changes in the health care system setting can be even more difficult because of the complexity of systems interactions and unantic-

Table 1 Heterogeneity of healthcare providers on medical floors

	Residents in training	Attending physician	Registered nurse	Medical assistant	Unit-based pharmacist
Years in training	8 years+	11 years+	4 years+	1 year	8 years
Patient contact	Yes	Yes	Yes	Yes	No
Schedule	24/7 8 to 10 hours overlapping shifts	24/7 12 hours overlapping sifts	24/7 12 hours non-overlapping shifts	24/7 8 hours non-overlapping shifts	8 am–4 pm No overlap
Entering medical orders	Yes need co-signature	Yes	No	No	No
Number of patients	Regulated ACGME rule	Not regulated	Regulated union contract	Institution bylaws	Unit based
Scheduled vital signs	No	No	Yes	Yes	No
Give medications	No	No	Yes	Yes	No
Monitoring of clinical plan	Yes	Yes	Yes	No	No

ACGME: Accreditation Council for Graduate Medical Education.

ipated consequences and the heterogeneity of background, people and work flow (Table 1). For example, a change in the order pattern for patients in the radiology suite could impact the throughput in the ED (upstream effect) and delay results delivered to primary care offices (downstream effect). Looking at a process in isolation may not reflect the entire complexity of a situation. Things as simple as a patient transported for a routine chest radiograph from the floor to the radiology department involves systems that include clinicians, nurses, transport, finance, informatics, maintenance, information technology. Education/awareness sessions followed by periodic feedback are needed. Projects may not be successful because following the initial education effort there was no reinforcement training sessions

Table 2 Barriers and solutions to implementing a sepsis performance improvement program on the hospital floors

Barrier	Solution
Lack of personnel engagement	Use of 'influence' methods
Lack of education and awareness	Using repeated education sessions
Personnel turnover	Using repeated education sessions
Alert fatigue	Making the alert more specific than sensitive
Complexity of medical decisions	Re-engineering of process
Unintended consequences	Close monitoring and modification as needed

to follow. Healthcare provider turnover also creates performance improvement education problems. Barriers and potential solutions relevant to this type of initiative are presented in Table 2.

Process Improvement Steps

Lessons can be learned from our hospital's experience with a hospital floors severe sepsis initiative. As described by Kotter in his seminal article, the first step was to create a burning platform [25]. The initial message was quite simple as data clearly showed that patients on our medical floors did worse than others in regards to identification and treatment of sepsis. The second step was to create a guiding coalition that would lead this effort. This led to gathering all stakeholders: Administration, nurses, physicians, medical assistants, medical informatics, quality and pharmacists. The next step was to share and communicate the vision to a broader group. Once the vision was shared, the next step was to proceed to process re-engineering.

Process Change

When it comes to change, there are two major ways process change evolves over time: Either through rapid process re-engineering or with incremental change over time. Process re-engineering is a radical quick change that may be required in certain situations. There could be a need to rapidly implement a solution, such as with new regulatory requirements. Downside effects of this method are the resource intensive aspects and need for engagement from all players which may be associated with resistance.

Incremental changes over time may be chosen with the purpose of realizing change over a longer period of time with no sudden major changes in the environment. Obviously a combination of both methodologies can also be used.

Some of the most commonly used methods for change are Lean Six Sigma or the Toyota Methods. Lean Six Sigma is a continuous process improvement methodology that aims at reducing waste (Lean method) and eliminating defects (Six Sigma). It has been used in several major companies, such as Motorola and General Electric, and over the last decade has made its way into the health care industry with major successes reported, reducing cost and improving quality of care [26].

Influence Methods

After the process has been optimized by the stakeholders it may still not be fully embraced and adopted. In this circumstance, 'influence' methods and tactics can be very powerful tools for success. A substantial amount of work has been done in this domain by sociologists. Some of the most widely accepted methods are built on the work of Cialdini [27]. Applying sources of influence to this performance im-

provement program may include: Liking (selecting several champions that are well respected and liked by all providers), endorsement (peer pressure), concession (by involving all providers and tweaking the process periodically), consistency (highlighting successes and giving timely feedback to providers who did not comply) and scarcity (one of the first hospitals involved in such a project).

Conclusion

The 2005–2008 SSC performance improvement program was adopted around the world and the resulting increase in compliance with the 6-hour and 24-hour sepsis bundles' quality indicators was associated with a decrease in mortality. Analysis of the data, however, revealed that mortality was unacceptably high in patients admitted from the hospital floors to the ICU. This was particularly troubling since the 2005–2008 initiative concentrated on building ED-ICU relationships to tackle the majority of admissions with severe sepsis that came from the ED.

With the above information in hand, the SSC has embarked on a hospital floors sepsis performance improvement initiative targeting early identification and treatment of floor patients with a new diagnosis of severe sepsis. The new initiative features the new 3-hour sepsis bundle (measure lactate, blood cultures, antibiotics and give fluids for hypotension or lactate ≥ 4 mmol/l). The Moore Foundation grant-funded program spreads across 4 US hospital performance indicator collaboratives (60 + hospitals), builds on lessons learned from the earlier SSC initiative, encourages a process change methodology and hopes to decrease mortality in this patient population.

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