

REVIEWS

The development and implementation of a nurse practitioner sepsis screening team: Impact on transfer mortality

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Abstract

Background: Sepsis is a potentially deadly but treatable condition that occurs as a result of the systemic manifestations of infection. Despite large healthcare expenditures, patient outcomes can be poor, and survivors may still suffer from permanent organ damage, cognitive impairment, and physical disability. Failure to recognize and implement early goal-directed therapy leads to increased mortality. A review of hospital mortality identified that sepsis among inbound transfer patients to acute care units significantly contributed to the overall hospital mortality. As part of a multipronged, multidisciplinary approach, a nurse practitioner sepsis screening team was implemented to improve early diagnosis and treatment of sepsis and decrease mortality in this high-risk population.

Methods: A large academic medical facility located in the Texas Medical Center in Houston accepts a significant number of transfer patients requiring a higher level of care from other institutions. A nurse practitioner sepsis screening team was created to focus on this highly vulnerable group. A validated, electronic screening tool was utilized to screen patients and facilitate early identification and treatment of sepsis. The nurse practitioner team screened and evaluated 3,268 inbound transfer patients from 10/01/2009 to 06/30/2012. When a high suspicion for sepsis was appreciated, or another acute condition was identified, the nurse practitioner collaborated with the attending physician and initiated appropriate treatment. The data analyzed were part of an Institutional Review Board (IRB) approved prospectively collected data set. The data were collected over a 57 month period spanning from 09/30/2007 through 06/30/2012 on all inbound transfer patients to the facility, which include pre-screening baseline statistics. Basic demographics including the patient's age, gender, and race were collected. The outcome variable was status at discharge from the facility (alive or dead). After verifying assumptions of the chi-square test were met, a Pearson's chi-square was run against the data set. All data were analyzed using IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.

Results: There was a significant association between inbound transfer patients who were evaluated upon arrival at this institution by the nurse practitioner sepsis screening team and mortality in this population regardless of their diagnoses (χ^2 (1) 115.04, $p < .001$). A patient not screened by the team was more likely to die during the hospitalization than a transfer patient that was screened.

Conclusion: In this institution, the development and implementation of a nurse practitioner sepsis screening team has contributed to reducing mortality among the inbound acute care patient transfer population regardless of diagnoses. Further investigation is needed to understand the exact mechanisms that have contributed to this outcome.

Key words

Sepsis, Sepsis screening, Transfer mortality, Nurse practitioner screening team

1 Background

Sepsis affects over 26 million people worldwide each year resulting in a death every three to four seconds ^[1]. An epidemiologic study by Angus *et al.* ^[2] reported severe sepsis in the United States is very common, consumes considerable healthcare resources, and is associated with a high mortality rate, almost 30%. In the United States, the incidence of sepsis has dramatically increased over the past few decades with estimates of more than 1,000,000 cases diagnosed annually in hospitalized patients ^[3]. The prevalence of sepsis varies among the different racial and ethnic groups but appears to be highest among African-American males and is also greatest during the winter, probably due to the increased likelihood of respiratory infections ^[3, 4]. Currently more people are hospitalized for sepsis than myocardial infarction ^[5]. Septic patients are eight times as likely to die in the hospital when compared to patients with other diagnoses. Additionally, patients who survive sepsis may suffer from permanent organ damage, cognitive impairment, and physical disability ^[6]. As the incidence increases, so does the economic cost of treating sepsis ^[5]. The Agency for Healthcare Research and Quality ^[7] reported that the United States spent \$15.4 billion in 2009 for hospitalizations with a principal diagnosis of sepsis.

Sepsis is a treatable condition that occurs as a result of systemic manifestations of infection; however, it is potentially deadly if it is not identified early and treated promptly ^[1]. Diagnostic criteria include a known or suspected infection and some of the following: general signs and symptoms, inflammatory signs, hemodynamic changes, organ dysfunction, and altered tissue perfusion ^[8]. The response to infection becomes generalized, and normal tissues remote from the site of infection become involved ^[9]. Proinflammatory and anti-inflammatory cytokines serve an essential protective function in fighting infection and modulating the immune response. However, sepsis disrupts the balance between proinflammatory mediators and anti-inflammatory mediators and, therefore, causes damage to the body's own tissues and organs that trigger a cascade of events that can lead to shock, multiple organ failure, and death ^[10]. In spite of advances in modern medicine like vaccines, antibiotics, and intensive care, sepsis remains one of the leading causes of death around the world and a leading cause of hospital mortality ^[1]. In order to address sepsis mortality at Houston Methodist Hospital, a multi-pronged interdisciplinary intervention including a nurse practitioner sepsis screening team was implemented to improve early diagnosis and treatment of sepsis.

2 Methods

In 2008 a review of hospital mortality identified that sepsis significantly contributed to the overall mortality. In order to improve the recognition and treatment of sepsis and decrease untoward sequelae for patients at Houston Methodist Hospital (HMH), the Vice President of Quality Operations and Medical Director of Critical Care initiated and led the interdisciplinary Sepsis Care Management Performance Improvement (CMPI) team. Members of the Sepsis CMPI include critical care physicians, nurses, nurse practitioners, internists, pharmacists, infectious disease specialists, performance improvement specialists, nurse leaders, medical coders, and others. The team determined that the most vulnerable patient populations accounting for sepsis mortality were those patients from the emergency department (ED) (50%), the transfer center (27%), and direct physician referrals (23%).

The Sepsis CMPI team subdivided into four workgroups to facilitate efficient planning, implementation, and evaluation of specific processes related to the group's overall goal. The workgroups were education and awareness, screening implementation, resuscitation, and measurement. The Director of the Nurse Practitioner (NP) Program led the screening implementation workgroup with the goal of developing a process for sepsis screening.

The ultimate goal was to screen all inpatients; however, the high volume of patients necessitated a staged approach. Initial priority was given to admissions via the ED and the transfer center. The ED physicians and nurses managed sepsis screening in the ED, and the NP Program Director focused on developing a plan for sepsis screening that addressed the

population with the next highest mortality: the inbound transfer patients. Ultimately, an operational plan for a nurse practitioner-led sepsis screening team (SST) was created. A proposal was presented to the members of the Sepsis CMPI and the Chief Nurse Executive, along with the hospital's leadership team, who approved the concept and plan for the SST. Acute Care Nurse Practitioners (ACNPs) were selected to lead the screening initiative based on their advanced physical assessment skills and ability to diagnose and treat acute illnesses. Individuals with strong communication skills were sought as this is an essential competency when collaborating with attending physicians and critical care teams.

Review of transfer patient data suggested that more than 70% of acute care transfers arrived to HMH between the hours of noon and midnight. This analysis led to the determination of the work hours for the team. Presence of the SST during the peak transfer hours would greatly increase the likelihood that patients would be screened in a timely fashion and receive early goal-directed therapy or other interventions when indicated.

It is well recognized that early identification of sepsis and implementation of early goal-directed therapy improves outcomes and decreases sepsis-related mortality^[11]. However, early recognition of sepsis is often the challenge as seen with Moore *et al.*^[1]. A screening tool was created at HMH and validated to improve early identification of sepsis because this was a major obstacle to protocol implementation for the management of sepsis in the surgical intensive care unit (SICU). Utilization of this tool and sepsis protocol decreased sepsis-related mortality in the SICU by one third by ensuring early appropriate interventions^[12]. Furthermore, an internal quality analysis by the physician team attested that the electronic screening tool was sensitive for acute care patients as 77% of septic SICU admissions from the surgical acute care unit had a positive retrospective screen for an average of 25 hours before sepsis was diagnosed. These results prompted the use of the screening tool by the SST for the acute care patients.

The resuscitation workgroup of the Sepsis CMPI evaluated best practices and generated treatment order sets which guided care delivery for patients with a high suspicion of sepsis. Once the sepsis protocol or other treatment was initiated, the team continued to monitor the patient on the acute care unit unless the patient's condition warranted transfer to a higher level of care. The SST also provided clinical support to the nursing staff during initial stabilization.

On October 1, 2009, the SST began to evaluate patients that transferred to the acute care units at HMH from outside facilities excluding psychiatry and labor and delivery. The team assessed the patients and utilized the tool to aggregate the clinical assessment elements such as heart rate, respiratory rate, minimum and maximum temperature, white blood cell count (if known), and mental status. The transfer record was also reviewed for other pertinent clinical data. In some cases positive screens do not indicate sepsis, rather some other type of acute condition. The ACNP collaborated with the attending physician and initiated the hospital-approved sepsis protocol when there was a high suspicion for sepsis or other appropriate treatment. The degree of monitoring and follow up was dictated by the patient's clinical status. If for any reason such collaboration is delayed, the ACNP had full authority as a member of the allied health staff to implement medically indicated therapy.

The data analyzed were part of an Institutional Review Board (IRB) approved prospectively collected data set. The data were collected over a 57-month period spanning from 09/30/2007 through 06/30/2012. Data were collected on all patients transferred into HMH from outside hospitals, intra-institutional transfers from our community based facilities, skilled nursing facilities, nursing homes, law enforcement agencies, ambulatory surgery center, hospice, and rehabilitation centers. Basic demographic data including the patient's age, gender, and race were collected. The outcome variable was status at discharge from the facility (alive or dead). A total of 17,153 unique transfer patients met inclusion criteria. If a patient had multiple admissions during the study period, only the last admission during the study interval was included in the analysis. Ninety-three cases were censored due to missing discharge status, leaving a total of 17,061 cases in the mortality analysis.

After verifying assumptions of the chi-square test were met, a Pearson's chi-square was run against the data set. All data were analyzed using IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp. (see Table 1).

Table 1. Chi-Square Results

	Chi-Square Tests				
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	115.038 ^a	1	.000		
Continuity Correction ^b	114.281	1	.000		
Likelihood Ratio	137.065	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-linear Association	115.031	1	.000		
McNemar Test				.000 ^c	
N of Valid Cases	17061				

Notes. a. 0 cell (0.0%) have expected count less than 5. The minimum expected count is 269.70.

b. Computed only for a 2*2 table

c. Binomial distribution used.

3 Results

Screened transfer patients tended to be older with a median age of 61 years (95% CI: 59.08-60.33) compared to the non-screened group with a median age of 60 years (95% CI: 57.98-58.61), $p < .001$. As illustrated in Table 2, of the patients screened by the SST, 49.4% were male compared to 49.5% of the patients that were not screened by the team. Table 3 shows there was a significant association between whether or not a transfer patient was screened upon arrival at this institution by the SST and mortality in this population, $\chi^2 (1) 115.04, p < .001$. A transfer patient that was not screened by the team was 2.59 times more likely to die during the hospitalization than a transfer patient that was screened (95% CI: 2.154-3.115).

Table 2. Inbound Transfer Patient Data

Attribute	Screened by NP		Total (%)
	No (%)	Yes (%)	17,153
Gender			
Male	6,877 (49.5)	1,617 (49.4)	8,494 (49.5)
Female	7,006 (50.5)	1,653 (50.6)	8,659 (50.5)
Ethnicity			
Caucasian	8,075 (58.2)	1,926 (58.9)	10,001 (58.3)
Black	2,314 (16.7)	479 (14.6)	2,793 (16.3)
Hispanic	1,478 (10.6)	309 (9.4)	1,787 (10.4)
Asian	351 (2.5)	70 (2.1)	421 (2.5)
Native American	14 (0.1)	1 (0.0)	15 (0.1)
Hawaiian/Pacific Islander	6 (0.0)	1 (0.0)	7 (0.1)
Other	1,620 (11.7)	476 (14.6)	2,096 (12.2)
Unknown	26 (0.2)	8 (0.2)	34 (0.2)
Age Categories			
19 and under	237 (1.7)	38 (1.2)	275 (1.6)
20 – 39 years	2,282 (16.4)	492 (15.0)	2,774 (16.2)
40 – 59 years	4,336 (31.2)	981 (30.0)	5,317 (31.0)
60 – 69 years	2,672 (19.2)	651 (19.9)	3,323 (19.4)
70 – 79 years	2,385 (17.2)	612 (18.7)	2,997 (17.5)
80 – 84 years	1,065 (7.7)	274 (8.4)	1,339 (7.8)
85+ years	907 (6.5)	222 (6.8)	1,129 (6.6)
Mortality			
Dead	1,290 (9.4)	118 (3.6)	1,408 (8.3)
Alive	12,503 (90.6)	3,150 (96.4)	15,653 (91.7)
Totals	13,793 (80.8)	3,268 (19.2)	17,061 (100)

Table 3. Risk Estimate

	Value	Risk Estimate	
		95% Confidence Interval	
		Lower	Upper
Odds Ratio for Screened By NP (No/Yes)	2.754	2.272	3.339
For cohort Mortality = DEAD	2.590	2.154	3.115
For cohort Mortality = ALIVE	.940	.932	.948
N of Valid Cases	17061		

4 Conclusion

As with any new initiative, several challenges quickly emerged. Twenty-four hour screening coverage was not possible at the inception of the sepsis screening team. Initially, two full-time ACNPs were employed for the SST and covered 12 hours a day. Despite having two full-time ACNPs, approximately two days a month were not covered. Time from patient arrival to evaluation by the SST increased when patients arrived during uncovered hours. In these instances, the patient was screened as soon as possible. All inbound transfers arriving during uncovered SST hours are reviewed for initial bed location to confirm the originating unit and identify any missed transfers. Teamwork and flexibility is required to accommodate for scheduled time off from both team members and management. As the program has grown, coverage has been extended with the ultimate goal to provide around-the-clock screening by dedicated members of the SST.

The intent is to screen every inbound transfer patient as soon as possible after arrival. However, given the high volume of transfers, there are occasions when patients arrive in clusters and are assigned to rooms in several different buildings. The extensive geographic footprint of the institution affects the screening response time. Occasionally, patients do not get screened as they may have been discharged or relocated to the intensive care unit or operating room, for example. Each missed opportunity for screening is logged and reviewed to identify potential areas for improvement.

In addition, identification of septic patients can be sporadic and may result in a significant number of consecutive negative screens. The interval between positive screens and initiation of the sepsis protocol or intervention for other acute conditions can become monotonous. Any of these factors contribute to screening fatigue. Sharing experiences and “good catches” generates enthusiasm and screening momentum among the team.

Easily identifying inbound transfer patients warranting screening in such a large facility accepting multiple transfers throughout the day and night proved to be another challenge. Unfortunately there is no mechanism for automatic notification of patient arrival. Separate electronic systems are used to identify the inbound transfer patients while another system is necessary to ascertain the patient’s physical location and complete the sepsis screen. Although technology is intended to be convenient and supportive, it can be frustrating and time consuming for the clinician, as in most areas of clinical practice, especially when these electronic systems do not communicate with each other. The electronic patient management and tracking systems are updated periodically; therefore, the SST ACNP must frequently access this database throughout the shift. Ultimately, after several meetings with the information technology department and transfer center, the SST was able to establish a system to identify the patient and bed assignment.

The ACNP screens patients admitted to all specialties. Initially some physicians expressed concerns about the role of the ACNP screening their patients. This required cooperation from the medical staff to foster a collaborative approach to patient care. Support from hospital leadership is imperative, including medical staff, executives, and nursing in order to develop and nurture the cultural change required for this type of initiative. Thorough and concise communication and education is necessary to avoid conflict between hospital staff and the team. A clear plan for educating the physicians and nurses about the process and expectations is essential.

Nurse practitioners are clinical leaders and valued members of the patient care team. In addition to their clinical role, ACNPs have added responsibilities such as presenting at state and national conferences, publishing, contributing to staff education, participating on committees, and providing support to nursing staff. It is imperative that the team has protected time for these activities in conjunction with their clinical responsibilities.

Measuring outcomes is essential when evaluating the quality and effectiveness of a new initiative. Data collection and review is a rigorous, time-consuming process that requires a concise plan and dedicated staffers. When developing a new initiative, it is imperative to include a plan to allow for the data collection and outcome review. A lack of case reviews may leave team members without the feedback necessary to facilitate change in processes to support the evolution of the goal.

Early identification of sepsis and prompt implementation of evidence-based therapies improve outcomes and decrease sepsis-related mortality^[8] The Surviving Sepsis Campaign guidelines^[9] recommend routine screening for severe sepsis and prompt fluid resuscitation, cultures, serum lactate level, antibiotics, and source control. The SST is one of many programs implemented at HMH to address sepsis-related mortality. Inbound transfer patients evaluated by the SST were 2.5 times more likely to survive to discharge. As previously described, sepsis significantly contributes to HMH's overall hospital mortality. The data reflect that having a dedicated team of nurse practitioners specially trained and focused on sepsis leads to improved survival to discharge.

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