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Sepsis Bundle Completion

Jenna Churnock
University of Missouri-St. Louis, jc772@umsystem.edu

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Jenna M. Churnock, BSN

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Laura Kuensting, DNP, APRN, PCNS-BC, CPNP, CPENChairperson

Roxanne Reid, DNP, MSN-Ed, RN

Natalie Smith, BSN, MBA, RN

Abstract

Background: Sepsis is a serious condition resulting in end organ damage and ultimately, death. Communication techniques for nurses and physicians on septic patients admitted to the hospital from the emergency department was evaluated. Paper communication was used in 2020 to facilitate serum diagnostic acquisition and antibiotic administration (i.e., sepsis bundle), but an electronic communication form was utilized in 2021.

Method: An observational, descriptive design utilizing a medical record review was completed to compare the same time-period in 2020 and 2021. Communication methods for sepsis bundle completion were compared.

Results: A total of 100 medical records were reviewed (N=100). In 2020, 65 (n=65) records were compared with 35 (n=35) records in 2021 for patients meeting sepsis criteria during the same 45-day period for both years. Sepsis bundle adherence was higher when electronic communication was used versus paper communication (z=2.55, p=.011, 95% CI [0.07, 0.57]).

Conclusion: Communication between nurses and physicians when sepsis was suspected or active was positively influenced with the use of an electronic communication method.

Sepsis Bundle Completion

Sepsis is a serious condition and has led to increased use of emergency departments (ED), subsequent inpatient admissions and increasing healthcare expenditures. Sepsis and associated high mortality rates continue to be on the rise in the United States by 13% each year(Ramsdell, Smith, & Kerkhove, 2017). The approximate mortality rate for sepsis is about 30%(Gyang, Shieh, Forsey, & Maggio, 2015). According to the Surviving Sepsis Campaign (SSC),sepsis can kill one in four people diagnosed without appropriate and prompt identification and treatment (Rhodes, Evans, Alhazzani, & Dellinger, 2017). Sepsis involves the body's poor response to infection which can lead to life threatening organ damage (Deis, Whiles, Brown, Satterwhite, & Simpson 2018). According to Peltan et al. (2017), the annual cost of sepsis is approximately $24.3 billion in the United States. The SSC recently redefined sepsis as a dysregulated host response to infection resulting in life threatening organ dysfunction (Deutschman, Hellman, Ferrer, Ricard, De Backer, & Coopersmith, 2020). While there is not adefinitive gold standard for sepsis identification, criteria for the Systematic Inflammatory Response Syndrome (SIRS) have been developed.

Several sets of guidelines have been established in an effort to standardize and ensure effective sepsis diagnosis and management. The SSC has been essential in researching and releasing four sets of guidelines over the past 14-years in the identification and treatment of sepsis, with the most recent guideline published in 2016 (Coopersmith, et al. 2018). Coopersmith et al. (2018) reported following the SSC guidelines has resulted in improved sepsis compliance and outcomes.

Sepsis should be considered an emergent condition. According to the SSC (2016), sepsis is a true medical emergency and should be treated as such. Milano et al.

(2018), found 75% of patients who have sepsis, initially present through the ED. Sepsis identification and bundle compliance is higher in the ED setting than the inpatient setting due to the ability to triage and give rapid care when every second counts (Alsolamy et al., 2018). Baghadi et al. (2019) reported the implementation of sepsis bundles in patients meeting sepsis criteria in the ED has been implicated in lowering mortality rates if done in a timely manner. Delays in initiating sepsis treatment in the ED with patients meeting sepsis criteria can result in delayed initiation of antibiotics and fluids with resultant high mortality rates. Baghadi et al. (2019), reported only 30-50% of health care providers were able to actually implement sepsis bundle sets in a timely manner. In fact, if evidence-based practices were applied to sepsis treatment, the number of deaths due to sepsis complications could decrease by 92,000 per year (Baghadi et al., 2019).

Sepsis bundle adherence is an essential aspect of the new SSC (2016) guidelines. While a physician-initiated sepsis paging system is essential for prompt, effective sepsis treatment initiation, thorough communication between ED nurses and inpatient nurses upon admission isequally important. According to Alsolamy et al. (2018), communication is important in the transition of patient care and future management for the oncoming healthcare providers.

Miscommunication can lead to delayed management and adverse sepsis outcomes in patients(Alsolamy et al., 2018). The purpose of this study is to evaluate the impact of staff educationand visual management instruments on handoff reporting between ED and inpatient nurses in patients who are admitted to the hospital with a diagnosis of sepsis. The hospital the quality improvement (QI) project is being conducted at, has a sepsis paper communication method, but there is a low staff adherence rate to this method. After conducting interviews with ED staff and establishing root causes of failure using the paper communication method, a

preexisting smart phrase, ".smslcoesepsis" (computer communication method) was implemented using the same information contained in the paper communication method. The aim of this study is to improve ED to inpatient handoff communication among ED and inpatient nurses. The primary outcome measure of interest is the use of the computer communication completed by the ED nurses at handoff. Secondary outcome measures include sepsis bundle acquisition (i.e., blood culture time, lactic acid time, crystalloid infusion initiation times.

The question for the study is: in patients 18-years and older in a suburban, midwestern ED, what is the impact of the use of paper communication versus a computer communication method on sepsis bundle adherence over a 45-day period? The framework to guide this study was a Plan, Do, Study,Act (PDSA) cycle from the Institute of Healthcare Improvement's (IHI) Model for Change (IHI, 2020).

Review of Literature

A literature review was conducted utilizing CINAHL, PubMed UMSL, and Medline. Keysearch phrases included "sepsis AND bundle", "sepsis AND bundle AND emergency room", "sepsis AND bundle care AND emergency room", "sepsis in the emergency room AND bundle AND mortality AND inpatient", "sepsis AND bundle AND compliance or adherence", "sepsis orseptic or severe sepsis or septic shock AND tools AND emergency room", and "nurse AND sepsis protocol initiation", and "SBAR tool AND Sepsis" and "sepsis AND patient handoff reporting". Inclusion criteria are free full text, peer reviewed, adults aged 18-years and older, andsepsis diagnosis. Exclusion criteria are publications older than five-years, patients younger than 18-years of age, and abstract texts. Initially 154 publications were retrieved, but after a refined search with inclusion and exclusion criteria, a total of 26 publications were selected for this literature review. The types of studies reviewed included meta-analyses, randomized controlled trials, observational, evidence-based quality improvement

projects, retrospective cohort analyses,quality initiatives, pilot studies, literature reviews, and evidence-based practice guidelines. Sepsis involves an activation of immune cells due to pathogen entry into the human body. Bacterial endotoxins then bind to the immune cells and an intracellular transduction pathwayoccurs, releasing proinflammatory cytokines (Gyawali, Ramakrishna, & Dhamoon, 2019). Resultant release of leukocytes, activation of tissue factor production, activation of the complement system, and release of endothelial adhesion molecules causes dysfunction and deathat a cellular and organ level (Gyawali et al., 2019). Chakraborty and Burns (2020) identified markers for SIRS include at least two ofthe following: temperature greater than 38 or less than 36 degrees Celsius (T), heart rate greater than 90 beats per minute (HR), respiratory rate greater than 20 breaths per minute (RR), and a leucocyte count greater than 12,000 (or less than 4,000 μL) or greater than 10% immature segmented neutrophils or banded neutrophils.

Adherence to SSC (2016) guidelines is important to decrease mortality rates related to sepsis. Timely antibiotic administration is imperative in the treatment for sepsis and prevention of organ damage from SIRS. Strich, Heil, and Masur (2020) retrospectively conducted a medicalrecord review highlighting the importance of appropriate and timely antibiotic administration. A total of 2,154 intensive care unit (ICU) records for the diagnosis of septic shock were reviewed. The results showed for each hour antibiotics were delayed, there was a decrease in survival by 7.6% (Strich et al., 2020). Furthermore, tailored antibiotic administration was recommended for more specific antimicrobial activity against isolated pathogens on culture (Strich et al., 2020). Of5,715 patients with septic shock, tailored antibiotic initiation in 80.1% of cases correlated with survival rates of 52% vs. broad-spectrum antibiotic administration with 19.8% of patients havinga 10.3% survival rate (Strich et al., 2020).

Creating an order set (known as a “bundle”) for critical serum diagnostics,

antibiotic administration, and crystalloid infusion, may improve adherence to the SSC (2016) guidelines. Milano et al. (2018) conducted a retrospective observational study involving 4,582 adults meeting criteria for sepsis. The study attempted to correlate an association between adherence sepsis bundle (lactic acid levels, blood cultures, crystalloid fluids, and antibiotics within three hours of arrival to the ED) and hospital mortality rates in sepsis patients. Patients in the ED who received timely sepsis bundle treatment resulted in a mortality rate of 17.9% vs. 20.4% with non-adherence (Milano et al., 2018). Likewise, Deis et al. (2018), did a retrospective cohort analysis on 5,631 patients who received the 995.92 ICD 9 severe sepsis code with those who did not receive a severe sepsis code. Patients with the ICD 9 code of 995.92 demonstrated an increased bundle adherence from 7.9% to 10.2% (Deis et al., 2018). However, Deis et al. (2018) also founda higher mortality rate 6.3% in the assigned ICD9 code of 995.92 group vs. 2.3% in the patients without an assigned ICD 9 code of 995.92. While the Milano et al. (2018) and the Deis et al. (2018) studies had large sample sizes, they had different outcomes; hence, more study is needed.

Increased bundle adherence is associated with lower mortality rates, but there is a gap in the literature regarding nurse-initiated sepsis bundles. Moore, Vermuelen, Taylor, Kihara, & Wahome (2019), conducted an evidence-based practice improvement project at a 400-bed hospital with 26,000 annual patient visits with approximately 3% of these patients meeting criteria for sepsis. A detect, act, reassess, titrate (DART) instrument was utilized and initiated bynurses. The DART instrument included standing orders when sepsis was detected and administering an initial 500 mL crystalloid bolus with parenteral antibiotics, performing initial and repeating serum diagnostics, and continuous cardiac monitoring with regular blood pressurechecks (Moore et al., 2019). With DART use, the Inpatient Quality Reporting Program (IQR) sepsis metric increased from 30% to 80%, and the average hospital LOS decreased by 2.5 days (Moore et al.,

2019). This is a clinically significant finding demonstrating early recognition by nurses with standing orders to initiate diagnostics and treatments in the case of sepsis can be beneficial.

Nurses are essential in sepsis bundle adherence. Ferguson, Coates, Osborn, Blackmore and Williams (2019) conducted a quality initiative over a seven-year period integrating nurse directed code sepsis and "power hours" which included nurse initiation of blood cultures, lactic acid levels and fluid initiation in patients with suspected sepsis. In this study, physician-initiatedsepsis bundles were associated with bundle adherence rates at 40.5% increasing to 73.3% with nurse-initiated bundle adherence rates. Mortality rates for nurse-initiated sepsis bundles were 8.4% compared to physician-initiated sepsis bundles at 12.5% (Ferguson et al., 2019).

While there was improvement in sepsis bundle adherence rates in the Ferguson et al. (2019) study, Bruce, Maiden, Fedullo, and Chae (2015) conducted a retrospective chart review of nurse initiation for sepsis bundle sets. Bruce et al. (2015) found nurse initiated septic protocolsresulted in significant improvements in door-to-antibiotic times vs. physician initiated septic protocols. Time frames for nurse-initiated sepsis protocols averaged 108 minutes vs. 135 minutesfor physician-initiated sepsis bundles (Bruce et al., 2015). While adherence to lactic acid measurements and blood culture collections reached almost 100% and improvements were seen in door-to-antibiotic time, approximately a quarter of antibiotic administrations exceeded the three-hour target goal. Finally, Bruce et al. (2015) identified barriers to successfully achieving antibiotic and fluid administration goals as a lack of staff education and interdisciplinary collaboration. Likewise, McCaffery, Rodrigopullel, Syed, Mansfield, and Krishma (2016), investigated nurse driven protocols for sepsis finding an 18% increase in adherence to sepsis bundles, especially for serum lactic acid measurements which increased from 23% to 80% acquisition. Clearly, nurse initiated standing orders or

protocols for sepsis is of benefit.

Throughout these studies, education is a variable influencing the success of nurse relatedsepsis interventions. Leon et al. (2018) conducted a quality improvement study in a high acuity hospital with 900 sepsis cases annually. The focus was aimed at training nurses and physicians with daily educational emails and bright yellow cards with sepsis criteria. The results indicated nurses with training were more likely to develop an "eye" for a patient with sepsis and alert the physician sooner. In the pre-intervention phase, the bundle adherence rate was 38%, but in the intervention phase, the bundle adherence increased to 56% (Leon et al., 2018). Kleinpell (2017), did a retrospective analysis reviewing the influence of a four-hour educational course, bundle interventions, and the use of a clinical triage parameter for patients with signs of sepsis. The pre- intervention group was composed of 472 patients with confirmed sepsis and the post-interventiongroup was 409 patients who demonstrated high odds of a 30-day survival rate with a 95% confidence interval. An observational pilot study was conducted involving approximately eight-hours of nurse education on topics covering sepsis in short time blocks in groups of two to three during shifts (Gyang, Shieh, Forsey, & Maggio, 2015). Education for this study was conducted six-months prior to the sepsis screening initiative including recognition of SIRS criteria, recognition of infection source, and subsequent initiation of primary sepsis team actions (Gyang et al., 2015). A new screening tool utilizing SIRS criteria and objective signs of organ dysfunction, was utilized on 245 patients, 39 of whom screened positive for sepsis (Gyang et al., 2015). The results indicated with the new screening tool, those testing positive for sepsis received timely antibiotic treatment and serum diagnostics (Gyang et al., 2015). McCaffrey et al. (2016) indicated education of nursing staff is essential for a highly functioning sepsis protocol. These studies indicate, continuing education of nursing staffis essential for early identification of sepsis.

While education is a huge component of sepsis treatment, identifying barriers is essential. McCaffrey et al. (2016) conducted a literature review implicating a lack of interdepartmental communication, limited staff numbers, and department collaboration as contributing to an inability to initiate sepsis protocols. Staff resistance to change has also beenimplicated with nurse driven sepsis protocols.

There are few studies regarding communication handoffs in the case of sepsis. Pandya et al. (2019) conducted a large-scale study using the PDSA methodology over a one-year time period. A pareto chart was generated to determine the most common communication deficits between handoff reports and was determined to be related to medication errors in 60% of the cases (Pandya et al., 2019). As a result, the intervention included integrating an EMR standardized handoff process over a one-year time frame (Pandya et al., 2019). Medication errorsthen decreased by almost half (32%, p=.07) (Pandya et al., 2019). Hence, a standardized communication handoff process may be beneficial, especially in the case of sepsis.

Research is limited regarding handoff communication and sepsis bundle adherence specifically, however, one case study demonstrated the detrimental effects lack of communication at handoff can have on patient care (Association of Perioperative Registered Nursing [APRN], 2018). The APRN (2018) reported a pregnant female who arrived in the ED and was found to have chorioamnionitis. Antibiotics were administered immediately, with a subsequent emergency Caesarean section. When the patient was dispositioned to the postpartum unit, nursing handoff communication failed to address the need for repeat antibiotics at 24-hours.This communication error and subsequent failure to administer repeat antibiotics resulted in the patient developing sepsis and in need of intensive care unit services (APRN, 2018). Subsequently, a survey in over 500 hospitals in the U.S. was conducted and over 80% of respondents indicated a transition from unit to unit within the hospital was a common source of medicalerrors

(APRN, 2018). Hence, a standardized communication process was recommended to reduce medication errors.

The framework for this quality improvement project is a PDSA cycle from the IHI'sModel for Improvement (IHI, 2020). The PDSA cycle is a method of testing change that involves planning a test to make a change (Plan) instituting the planned test (Do), observingoutcomes and making modifications (Study), and making modifications after observing outcomes (Act) (IHI, 2020).

In summary, nurse-led sepsis protocols decrease mortality rates and improve bundle adherence rates. Education for nurses appeared to impact their ability to recognize early sepsis and alert the medical team. Most importantly, identification of early sepsis impacted antibiotic administration with evidence that for every hour antibiotics were delayed, there was a 7.6% decrease in survival rates (McCaffrey et al., 2016). A major gap in the literature was the lack ofstudies specifically focused on communication between medical personnel in the case of sepsis.Strengths of these studies included variety of types of studies, and in many cases, large sample sizes. Overall, treatment for sepsis must be a priority which includes enhanced communication between medical and nursing team members.

Method

Design

This is a prospective correlational design. This is a quality improvement initiative utilizing a PDSA cycle utilizing a retrospective medical record review. Medical records were reviewed for sepsis bundle adherence in 2020 for baseline data and again from March 14th – April 29th, 2021 after the implementation of emergency department education and the use of visual management tools placed at each nursing station.

Setting

A 584-bed urban, midwestern medical center ED part of a large healthcare system havinga total of 17 hospitals within the region. This healthcare system is one of several systems servinga population of over 3-million residents. The hospital treats approximately 66,000 in-patients annually. The number of sepsis patients treated annually is approximately 1800.

Sample

A random sample of patients aged 18-years and older who were admitted to the in- patient hospital with a diagnosis or suspicion of sepsis. Inclusion criteria are adults aged 18-yearsand older initially treated in the ED, CS initiation, and admission to the inpatient hospital. Exclusion criteria are less than 18-years of age, did not have a CS initiation, and those who weredischarged from the ED.

Approval Processes

Approval has been obtained from the hospital's ED administration. Anticipated approvalsinclude the DNP committee, the university's graduate school, and the hospital and university's institutional review boards. There are minimal risks with this study as this is a retrospective medical record review, staff education, and a visual instrument placed at nursing stations. The benefits of this study include improved communication between medical personnel in the case of sepsis

Data Collection/Analysis

Data was documented using paper communication in 2020 and in 2021 with the use of a computer communication method. Random chart audits occurred on patients admitted through the ED with a diagnosis of or suspected sepsis. This documentation included blood culture times, lactic acid times, crystalloid infusion initiation times, antibiotic administration times, and repeat lactic acid times. All data was de-identified and coded as 20-1, 20-2, 20-3, and so on for those patients in which a medical record review was performed in 2020 for baseline data of the paper chart. Likewise,medical

record reviews performed in 2021 were coded as 21-1, 21-2, 21-3, andso on for those patients in the pilot phase of the smart phrase implementation. All data will be stored on a password protected removable drive and computer owned by the primary investigator and stored for a period of seven-years. Data analysis included simple inferential statistics.

Procedures

A team of key stakeholders convened to include the ED medical director, ED manager, and sepsis review committee director. Methods of communication between ED nurses and inpatient nurses were identified as opportunities for improvement. A preexisting sepsis communication handoff instrument was in place, but a low adherence rate was noted when completing the instrument. Obtaining a signature verifying report between the ED and inpatientnurse was one of the main components of the sepsis handoff tool that was not adhered to. In an effort to resolve this issue and increase sepsis handoff adherence rates, a visual reminder sheet will be placed at each nursing station in the emergency department and staff education about sepsis will be implemented over a three-month period. The education involved three components: sepsis pathophysiology, nursing handoff communication, and the link between ineffective communication and poor sepsis outcomes.

Results

Sepsis bundle adherence rates were compared from 2020 with the use of the paper communication method and in 2021 with the implementation of the computer communication method. The total number of medical records reviewed was 100 (N=100), in 2020, 65 (n=65) patient medical records were reviewed and compared with 33 (n=33) patient medical records in 2021 for patients meeting sepsis criteria over a 45-day period.

In the medical records for 2020 where the paper communication was used, bundle completion was 58% (n=21), and 55% (n=16) did not have a bundle completion within

six-hours. In 2021, with the smart phrase used, bundle completion was nine (*n*=9, 90%) and non-completion was one (*n*=1, 10%); whereas, when the smart phrase was not used, bundle completion was 12 (*n*=12, 52%) and non-completion was 11 (*n*=11, 48%). A two proportions *z*-test was conducted to examine whether there was a difference between the proportions of the sepsis bundle used with the paper communication in 2020 versus the smart phrase in 2021. Based on an alpha value of 0.05, the use of the paper communication was significantly different than the use of the smart phrase (*z*=2.55, *p*=.011, 95% CI=[0.07, 0.57]). Furthermore, a Pearson correlation was conducted between bundle adherence and the paper communication. The value of the Pearson *r* was 0.13 indicating a very weak relationship between bundle completion and use of the paper communication. In addition, a Pearson correlation was conducted between the bundle adherence and smart phrase. The value of the Pearson *r* was 0.36, indicating a moderate relationship between bundle completion and the use of the smart phrase.

Discussion

There was a very weak relationship (*r*=0.13) between bundle completion and the use of the paper communication method in 2020, but a moderate relationship (*r*=0.36) between bundle completion and the use of the computer communication method in 2021. Both cohorts were studied during the Covid-19 pandemic which may have influenced the results overall. In March 2020, when the study period for the first cohort began, volume dropped significantly in the ED and remained low throughout the study period for the second cohort in 2021. Regardless, there was improvement in bundle completion when a smart phrase was used (*p*=.011).

The strengths associated with this study include random sampling during two time periods within the Covid-19 pandemic. Limitations associated with this study include a small sample size and short duration of study.

Recommendations at the conclusion of this study include continued monitoring of sepsis bundle adherence and implementation of the smart phrase in other departments throughout the hospital the study was conducted in. Continued education of staff and trouble-shooting areas where improvements can be made will be an integral part of the continuation of this quality improvement project.

Conclusion

Sepsis continues to be a nationwide health risk associated with increased mortality rates and high healthcare costs. Without appropriate intervention and appropriate sepsis bundle adherence, mortality rates will continue to skyrocket. The smart phrase showed positive changes towards improving sepsis bundle adherence rates. It is the goal to improve sepsis bundle adherence rates and subsequent mortality rates at not only a hospital level, but a nationwide level as well.

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Appendix A:

Figure 1: *Run Chart*