Sepsis Screening and Bundle Adherence: Staff Education as an Intervention to Increase Knowledge in a Medical Surgical Clinical Microsystem

Nicole Elise Maheu
University of New Hampshire, Durham, nicolemaheu.12@gmail.com

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Sepsis Screening and Bundle Adherence: Staff Education as an Intervention to Increase Knowledge in a Medical Surgical Clinical Microsystem

Nicole Maheu

University of New Hampshire

Faculty Mentor: Deborah Simonton EdD, RN, CNL

Practice Mentor: Bronwyn Gallant, MS, RN, CNL

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Abstract

Background: Sepsis related deaths outnumber those caused by opioids, breast cancer and prostate cancer combined (Nguyen, 2020). Sepsis places a significant health burden and cost burden on both an individual and a systemic level, emphasizing the need for proper care of the sepsis patient in all inpatient settings.

Local Problem: Within a medical-surgical microsystem, it was found that care of the sepsis patient was inadequate. A pre-intervention survey was conducted which demonstrated a lack in knowledge of the inpatient sepsis workflow, including use of the sepsis best practice advisory (BPA) within EPIC® and the sepsis bundle of care. Additionally, according to hospital compare, proper care of the sepsis patient within this macrosystem fell short of benchmark across the state where the macrosystem is located.

Methods: This model is based on the Plan, Do, Study, Act model of quality improvement. An assessment of the microsystem and a survey of baseline nursing knowledge about sepsis was conducted during the “plan” phase and an educational poster was posted in the microsystem during the “do” phase.

Interventions: The intervention includes an educational poster presented within the clinical microsystem. Effectiveness of the intervention was analyzed by differences in responses between a pre-intervention nursing knowledge survey and a post-intervention survey.

Results: The specific aim of this project to increase self-reported staff competence and knowledge of the sepsis BPA within EPIC® and the sepsis bundle of care by 10% was achieved based on data collected from the post-intervention survey.

Conclusion: This quality improvement project saw a positive impact in self-reported nursing knowledge of the sepsis BPA in EPIC® and the sepsis bundle of care. This positive impact
shows promise for the effect of educational interventions but should be used to design further projects rather than draw definitive conclusions.

*Key words: sepsis, sepsis bundle of care, sepsis BPA EPIC®, nursing education, nursing knowledge*
Introduction

Problem Description

Sepsis, which is defined by the Centers for Disease Control (CDC), as a dysregulated host response to an infection that causes life threatening organ dysfunction, is a leading cause of hospital related mortality and hospital readmission (US DHHS, 2024; Ferguson et. al., 2019). Infections that can cause sepsis are commonly of bacterial origin, but can also be fungal or viral, such as coronavirus-2019 (COVID-19) (US DHHS, 2024). In fact, the COVID-19 global pandemic drew significant attention to the global burden of sepsis as it is a common complication of severe COVID-19 (Choy et. al, 2022). Of bacterial origin, the most common infections that precipitate to sepsis are lung infections, which make up 35% of sepsis cases and urinary tract infections, which make up 25% of sepsis cases (Nguyen, 2020). Deaths caused by sepsis outnumber those caused by opioids, breast cancer and prostate cancer combined (Nguyen, 2020). As such annually in the United States, it is estimated that there are 1.7 million sepsis cases and 350,000 of those cases result in patient death in the hospital or discharge from the hospital on hospice services (US DHHS, 2024). For individuals that survive sepsis, the risk of negative health outcomes, disability, hospital readmission and eventual death is significantly increased (US DHHS, 2024; Ferguson et. al., 2019). Specifically, the all-cause mortality rate for survivors of sepsis is 60% in the first 3 years following inpatient admission for sepsis (Nguyen, 2020). Additionally, sepsis is a source of a significant cost burden on the healthcare system in the United States and worldwide. Sepsis presents a serious burden on individuals diagnosed and the healthcare system, making it essential that healthcare providers are properly prepared to treat people with sepsis.
It is important to note that sepsis is the body’s response to an infection, not the actual infection itself. Under normal circumstances, infectious processes trigger an acute inflammatory response within the body. This is characterized by a vascular response (vasodilation) that occurs due to cellular mediators, which produce the cardinal signs of inflammation: erythema, edema, heat, and pain (Dlugash & Story, 2021). The most notable innate cellular mediators in the acute inflammatory response are mast cells, which secrete histamines, causing the vascular response described above (Dlugash & Story, 2021). The goal of vasodilation at the area of infection is to dilute toxins and concentrate this area with oxygen, nutrients, and immune cells; however, increased vasodilation leads to increased capillary permeability (Dlugash & Story, 2021). When the inflammatory response stays localized and acute, the body is effectively able to address the invader and defend against the pathogen. In the case of sepsis, this inflammatory response becomes dysregulated and systemic. As the inflammatory response becomes systemic, capillary permeability increases throughout the body, causing a shift in fluid from the intravascular space to the interstitial space, which in turn decreases organ perfusion (i.e., distributive shock) and can lead to multisystem organ dysfunction and death (Butterworth, Machkey & Wasnick, 2022).

Clinical manifestations of sepsis and septic shock are directly related to the pathophysiology described, and include abrupt onset of fever and chills, change in mental status, nausea and vomiting, tachypnea, tachycardia, and hypotension (Butterworth, Machkey & Wasnick, 2022). Additionally, serum lactate levels are indicators of sepsis and septic shock. This is an essential lab to monitor in patients where sepsis is suspected or confirmed, because it is a direct indicator of tissue hypoxia. In order to understand the importance of lactate levels in representing tissue hypoxia, it is crucial to understand basics of cellular respiration, which is the metabolic process by which energy is produced in aerobic cells. When cells are properly
oxygenated, cellular respiration functions normally, and adenosine triphosphate (ATP) is produced in high levels and used as the source of cellular energy. However, when cells are not properly oxygenated, they still require energy, and that is produced in smaller amounts through anaerobic respiration, or lactic acid fermentation. The same precursor to cellular respiration, pyruvate, is utilized in lactic acid fermentation, but the byproduct, lactate is produced. In the context of sepsis, lactate is a strong marker for tissue hypoxia as it is an indication that anaerobic respiration is active, and cells do not have adequate supplies of oxygen. As capillary permeability increases due to systemic inflammation, tissues are not adequately oxygenated, which forces cells to start anaerobic respiration to produce cellular energy. The more cells that are cycling through anaerobic respiration, the more serum lactate levels increase, indicating that cells and tissues are hypoxic. Lactate levels that are less than or equal to 1 mmol/L indicate adequate tissue perfusion (Nguyen, 2020). Lactate levels greater than 2 mmol/L indicate severe sepsis and lactate levels greater than or equal to 4 mmol/L indicate septic shock (Nguyen, 2020). Because lactate is a direct report of tissue hypoxia, studies have shown that elevated lactate levels are predictive of increased mortality (Nguyen, 2020).

Risk factors for development of sepsis or septic shock are individuals with weakened immune systems: adults older than 65, neonates, children younger than 6 months, those with large wounds or severe injuries, pre-existing infections, pre-existing comorbidities like diabetes, alcoholism, etc., those who chronically take steroids, presence of invasive lines, drains or other tubes, those admitted to inpatient hospital units, and people who have had surgery or other invasive procedures (Nguyen, 2020). Each of these examples described precipitate an increased risk for sepsis or septic shock because the risk factors indicate an immune system at baseline that is dysregulated, which can lead to a severe inflammatory response. It is important in caring for
patients to understand their risk factors and screen for sepsis appropriately based on patient specific risk factors.

Early recognition of sepsis and prompt treatment is associated with improved health outcomes for those diagnosed as well as reduce the risk of mortality related to sepsis (Cull et. al., 2023). In fact, studies have shown that prompt intervention and escalation of care when sepsis is suspected or confirmed leads to improved health outcomes, measured in decreased length of stay and decreased rate of mortality (Cull et. al., 2023). Despite the significant correlation between early recognition and treatment of sepsis and reduced mortality, the CDC cites that knowledge of sepsis among the healthcare community is lacking (US DHHS, 2024). Indeed, studies have shown that nurses self-report that they are not confident or adequately prepared to recognize and promptly address sepsis (Rababa et. al., 2022). In terms of in-hospital sepsis cases, bedside providers (nurses, doctors, patient care technicians, etc.) are the front line of care and therefore must be equipped to promptly recognize and escalate care for suspected or confirmed sepsis cases. Certain warning signs, such as changes in vital signs must be recognized as abnormal. Such vital signs may include temperature (hyperthermia or hypothermia), blood pressure (hypotension – late sign), heart rate (tachycardia) and respirations (tachypnea). Notably, respiratory rate is one of the first vital signs to change in the sepsis patient (Nguyen, 2020). Bedside staff must be competent in taking accurate vital signs and recognizing clinical deterioration based on results. In recent year, electronic medical records (EMR) such as EPIC® have designed artificial intelligence (AI)-based screening tools for sepsis that account for patient vital signs, labs such as white blood cell counts, lactate levels, and other parameters to score the patient’s risk for sepsis. These screening tools are designed to aid in early recognition and
treatment of sepsis, but do not replace the clinician’s assessment and judgement of the patient situation (Evans et. al., 2021).

The Surviving Sepsis Campaign (SSC), launched in 2002, with the most recent update in 2021, is an internationally established set of clinical guidelines describing best practice management of patients with sepsis (Milano et. al., 2018). These guidelines include bundles of care that encourage early and consistent screening, administration of antibiotics, drawing lactate levels at set intervals, fluid resuscitation and others (Milano et. al., 2018). The sepsis 1-hour bundle includes guidelines to measure lactate levels and remeasure in 2 hours if the initial level is above 2 mmol/L; to obtain blood and source cultures (urine, sputum, stool, etc.) before the administration of broad spectrum antibiotics; to being rapid administration of crystalloid fluids (30 mL/kg body weight) for fluid resuscitation of the hypotensive patient (systolic blood pressure <90, mean arterial pressure <65) or a patient with a lactate greater than 4 mmol/L; and administration of vasopressors if hypotension persists during fluid resuscitation (Nguyen, 2020).

The SSC has defined this 1-hour bundle as “standard care” for the sepsis patient and studies have shown that hospitals with increased adherence to the sepsis bundle have lower sepsis-related mortality rates (Evans et. al., 2021).

It was identified through an assessment of the purpose, patients, professionals, processes, and patterns (5Ps) of a medical-surgical clinical microsystem that care of the sepsis patient is inadequate. This gap in proper care is a hospital-wide problem but is evident in this clinical microsystem. Specifically, according to Hospital Compare, 38% of patients in the macrosystem receive appropriate sepsis care (Hospital Compare, n.d.). Comparably, in the state where the macrosystem is located, 63% of patients receive appropriate sepsis care (Hospital Compare, n.d.). Because of these statistics and others, the board of directors for the macrosystem set a goal
for the 2023 fiscal year to address sepsis rates and sepsis care. The first step taken to address sepsis care in this macrosystem was hardwiring a sepsis assessment into the documentation system, run by EPIC® (B. Gallant, personal communication, February 16, 2024). The assessment in EPIC® is flagged on certain patients based on an artificial intelligence (AI) generated program that monitors changes in clinical signs and alerts nursing that based on specific patient data within the chart that they should be conducting additional sepsis related assessments (B. Gallant, personal communication, February 16, 2024). Additionally, there is an audit team within the macrosystem that looks at the sepsis bundle and examines mortality and fallout of sepsis patient situation and develops ways in which care can be improved (B. Gallant, personal communication, February 16, 2024).

Regardless of this initiative by the board of directors at the macrosystem, there is still a knowledge gap among members of this microsystem the sepsis best practice advisory (BPA) that flags on EPIC® and the sepsis bundle/order set for the sepsis patient. An 8-question survey of staff on this clinical microsystem was conducted via email by the nurse educator to gather baseline data regarding staff knowledge of the sepsis BPA and sepsis bundle. There were 28 responses to the initial survey, represented in Appendix A. Based on these responses, it was determined that there is a knowledge gap in staff self-reported ability to completely address a sepsis BPA and knowledge of the sepsis 1-hour bundle. Specifically, 46% of respondents said they do not feel as though they can competently address a sepsis BPA in EPIC® and 43% of respondents said they do not know what interventions are included in the sepsis 1-hour bundle. The educational intervention of this quality improvement project is designed to educate staff on the EPIC® sepsis BPA, what to do if it fires for a patient, and the sepsis bundle.
Available Knowledge

Sepsis is a complex, life threatening condition that requires healthcare providers to be properly equipped to recognize and treat. Early recognition may be aided by EMR screening tools such as the sepsis BPA within EPIC® but also require clinical judgement and ability to recognize clinical deterioration. Treatment of sepsis via the utilization of the sepsis 1-hour bundle shows improved health outcomes and reduction in mortality rates, pointing to the significance of staff understanding these best practice advisories. The problem-intervention-comparison-outcome (PICO) examined the current evidence published regarding the sepsis bundle, sepsis BPA within EPIC® and effective previous approaches for educating nurses about sepsis with a goal of improving patient care. With that goal in mind, a review of the literature was conducted to address the question: does education for medical-surgical nurses increase knowledge regarding sepsis BPA and sepsis bundle, thus improving quality of sepsis care provided within this clinical microsystem?

Search Methods

Databases utilized to research this PICO include PubMed, Medline on EBSCO, and Cumulative Index to Nursing and Allied Health Literature (CINAHL). Additional resources were also included, such as a continuing education course from the Sepsis Alliance, called “Sepsis 101 for Nurses”, pathophysiology background, CDC guidelines, and best practice advisories (Nguyen, 2020; Butterworth, Machkey & Wasnick, 2022; Dlugash & Story, 2021; US DHHS, 2024; Cull et. al., 2023).

The Boolean phrases used to search databases applicable to this PICO is as follows: “sepsis bundle”; “sepsis AND nursing education OR nurse education OR continuing education OR training program OR training OR nursing instruction”; “sepsis BPA”; “sepsis BPA EPIC®”;
“sepsis AND nursing interventions”. Limits within search criteria that were used for this PICO are studies published between 2014-2024, studies within the United States or the United Kingdom, and linked full text available.

**Variation in Methods**

As represented in the PRISMA diagram in Appendix B, there were 2519 records obtained in the original search and after exclusions for full text availability, year of publication after 2014, and not from academic sources were noted, 1029 records were screened by title and abstract. Of these, another 1023 were excluded due to research not being strong (meta-analysis, systematic review, controlled trial, or applicable QI project), research out of scope of PICO topic and research not conducted in US or UK. In total, there were six studies included in the review of the literature for this PICO question. There were two systematic reviews included, two quasi-experimental studies, one retrospective intervention study and one applicable quality improvement project included.

**Hierarchy of Evidence**

Strong evidence was included in the PICO regarding nursing education, adherence to sepsis bundle, use of sepsis BPA and improved care of the sepsis patient. Specifically, there is strong evidence to support that the use of the sepsis bundle in a timely manner related to diagnosis of sepsis is associated with positive health outcomes. Additionally, the literature supports the idea that educational materials improve nurses’ perceived ability to recognize sepsis and competently handle care of the sepsis patient. Of the studies in this PICO literature review, there were two systematic reviews considered level 1 evidence, three quasi experimental or retrospective studies considered level 3 evidence and one quality improvement project considered level 6 evidence.
Choy et. al. (2022): Sepsis Education for Healthcare Professionals and Students

Choy et. al. (2022) conducted a systematic review with the purpose of examining and evaluating sepsis education among healthcare professionals and students pursuing careers in healthcare. Thirty-two studies were included in their review, seven of which evaluated interprofessional teamwork in communication, and all studies involved some form of education or training on sepsis delivered to professionals and/or students (Choy et. al., 2022). Studies excluded from this systematic review were those that did not evaluate the effectiveness of sepsis education and studies that did not have an educational intervention (Choy et. al., 2022).

The systematic review found that most educational programs examined had a positive effect on staff knowledge and immediate patient outcomes, but this positive effect was further improved by the implementation of a sepsis care bundle. Authors noted that sole implementation of a sepsis care bundle or an educational intervention does not improve patient outcomes as significantly as implementation together, a conclusion drawn from previous systematic reviews and supported in this one (Choy et. al., 2022). Additionally, authors found that an educational intervention generally improved nurses’ knowledge and confidence in competently caring for the sepsis patient (Choy et. al., 2022). Seven of the studies included in this systematic review discussed interprofessional communication and collaboration, and based on evaluation of these studies, authors found that patient outcome is directly related to the interprofessional healthcare teams’ ability to coordinate care in an efficient and timely manner (Choy et. al., 2022). These findings highlight the significance of teambuilding and an environment that facilitates teamwork as much as education and implementation of best practice care guidelines (Choy et. al., 2022).

The authors highlighted a significant limitation to their systematic review as the inability to study the direct effect that some of the educational interventions had on the improvement in
patient care because when the hospitals initiated the educational interventions, they also implemented a sepsis-bundle protocol (Choy et. al., 2022). The authors stated that because of the confounding variables in multiple studies reviewed, and the heterogeneity in design of educational interventions, it was difficult to determine how much one educational intervention solely affected patient care and patient outcomes, but that strong conclusions can be drawn about the effect of the combination intervention (i.e., some form of education + sepsis bundle protocol) (Choy et. al., 2022). Additionally, the authors noted that only seven of the included studies mentioned interprofessional communication and teamwork as part of the educational intervention, pointing to the need for further studies on interprofessional collaboration and its effect on the care of the sepsis patient (Choy et. al., 2022).

Rababa et. al. (2022): Assessment and Management of the Adult Sepsis Patient

Rababa et. al. (2022) conducted a systematic review examining the literature on sepsis assessment and management of care in adult patients. 31 studies were included in the review where authors examined the literature published regarding knowledge, practice, and attitude of nurses in the care of the sepsis patient as well as different interventions employed to improve nurses’ management of the sepsis patient (Rababa et. al., 2022). Authors guided their systematic review and inclusion of studies by three questions relevant to sepsis assessment and management of the sepsis patient: (1) What are nurses’ knowledge, attitudes and practices related to sepsis assessment and management in adult critical care patients? (2) What are the perceived facilitators of and barriers to the early identification and effective management of sepsis in adult critical care units? (3) What are the interventions directed at improving nurses’ sepsis assessment and management? Based on these three questions, studies were included that were written in English, published within the last ten years, were conducted in adult critical care units, and had nurses as
the target population (Rababa et. al., 2022). Studies were excluded if they involved pediatric
critical care units or non-intensive care units; documents that were dissertations, reviews, reports,
brief communications, and editorials were also not included (Rababa et. al., 2022).

This systematic review found that there were three major barriers to effective assessment
and care of a sepsis patient: staff shortages, delayed initiation of antibiotics, and poor teamwork
skills. Further, studies examined showed that nurses’ knowledge and confidence in competently
recognizing and caring for a patient with sepsis was lacking. The knowledge deficit includes
misunderstanding or poor knowledge base on early physiological warning signs of sepsis, and
inadequate training of steps to take when sepsis is suspected or diagnosed (Rababa et. al., 2022).
Additionally, authors found that a requirement of proper sepsis care is early identification, which
suggests that nurses need to be properly educated and trained on early warning signs and steps to
take (such as implementing the sepsis bundle order set) when a patient is suspected or diagnosed
with sepsis. Authors reviewed studies that explained interventions for nurses to help improve
sepsis care which included educational sessions, patient simulation sessions, clinical decision
support, evidence-based treatment protocols, and screening tools within EMRs (Rababa et. al.,
2022). Based on these interventions, authors found that the three most common facilitators of
proper assessment and care of the sepsis patient are the presence of standard sepsis management
protocols, training programs for providers and positive reinforcement with stories of successful
management of a sepsis patient (Rababa et. al., 2022). One limitation in analysis of data via a
meta-analysis was because of the heterogeneity of studies selected for the review (Rababa et. al.,
2022). Authors also stated that there is limited evidence regarding nurses’ attitudes’, knowledge,
and practice and the influence those factors have on outcomes of the sepsis patient such as
mortality and disability (Rababa et. al., 2022).
Delaney et. al. (2015): Influence of Sepsis Education on Nurse Competence

Delaney et. al. (2015) conducted a quasi-experimental study to determine if a sepsis education program influenced nurses’ perceived ability to identify and care for the sepsis patient. This study included 82 critical care and emergency department nurses that took a one-year critical care training program, and perceived ability was measured by self-reported survey answers (Delaney et. al., 2015). Nurses involved were all staff at the same hospital and had similar educational and experience backgrounds before enrolling in the one-year course (Delaney et. al., 2015). While this study was not specific to a medical-surgical microsystem, it was included in the review because nursing education programs are applicable to different microsystems, and the information can be applied to the educational intervention of this quality improvement project.

This quasi-experimental study found in the posttest of nurses after the yearlong critical care course that there was an improvement in participant scores of the 3 sepsis-specific competence statements. The three statements were: (1) competence in early identification of patients with sepsis; (2) competence in caring for a patient with sepsis and (3) competence in mobilizing the healthcare team (Delaney et. al., 2015). This improvement in scores highlights the efficacy of educational interventions in increasing knowledge and competence among healthcare providers. This is important because nurses are at the center of sepsis care and play a key role in recognizing early warning signs of sepsis in their patients and responding accordingly. One limitation of this quasi-experimental study is the selection of nurses; most of the nurses that participated come from similar educational backgrounds and clinical experiences, making it difficult to draw conclusions about all nurses. Further, the results of this study were based on
self-assessments and self-reporting, which limits generalizability of the results to draw conclusions from as well as introducing response bias (Delaney et. al., 2015).

**Cull et. al. (2023): EPIC® Sepsis Predictive Tool**

Cull et. al., (2023) conducted a quasi-experimental study to determine whether there was an association between the EPIC® sepsis model and sepsis-related mortality. The EPIC® sepsis model is a screening tool which automatically screens patients based on information in the EMR and alerts providers of their risk for developing sepsis, in theory allowing for prompt diagnosis and care (Cull et. al., 2023). This study was conducted in one urban 746 bed academic level 1 trauma center and included inpatients discharged between January 12, 2018, and July 31, 2019 (Cull et. al., 2023). Authors utilized the definition of sepsis from the international classification of disease where any patient identified to have the sepsis diagnosis code was counted as sepsis positive and involved in this study (Cull et. al., 2023). The primary outcome measure of this study was mortality during hospitalization and secondary outcome measures were utilization of the sepsis order set, length of stay, and timing of administration of antibiotics related to diagnosis of sepsis/start of sepsis bundle (Cull et. a., 2023).

The conclusions supported the idea that early identification and treatment of sepsis leads to decreased mortality among patients diagnosed, but that there are several barriers. Such barriers include system process issues, difficulty implementing different processes and lack of cohesion between early warning systems and electronic health records (Cull et. al., 2023). The EPIC® sepsis alert system is designed to be easily integrated into the EMR and generalizable to many different healthcare settings because EPIC® is the largest health information provider in the United States (Cull et. al., 2023). Specifically, to this study, there was an absolute unadjusted 8% reduction in mortality rate in patients that had not received antibiotics before the EPIC® alert,
and 4% reduction in mortality in patients with a sepsis diagnosis and an EPIC® alert (Cull et. al., 2023). These findings indicate that the alert is beneficial in kickstarting treatment and utilizing sepsis bundle order sets, i.e., more timely care of the sepsis patient, directly decreasing mortality rates in this one hospital setting.

This study was based in one single hospital setting, which may limit generalizability of results as differences in populations and healthcare practice might affect results (Cull et. al., 2023). Importantly, authors also highlighted that critics of EMR screening and alerts argue that these could lead to overreliance on the computer and decrease in use of clinical judgement (Cull et. al., 2023). Another limitation to reliance on EMR screening is alarm and alert fatigue, as a warning based on a screening would be another alert that if not properly managed could over fire and lead to fatigue which could negatively affect practitioners’ response the alert (Cull et. al., 2023). Additionally, there is no gold standard for the use and sensitivity of EMR screening and tracking of outcomes relate to sepsis (Cull et. al., 2023). Improved standardization of the definition of sepsis, outcome measures, and proper use of EMR screening would yield results that strong conclusions could be drawn from.

**Milano et. al. (2018): Effect of Sepsis Bundle Adherence on Rate of Survival**

Milano et. al. (2018) conducted a retrospective intervention study that examined the relationship between sepsis bundle adherence and improved rate of survival of the sepsis patient. The study was conducted within one hospital and examined adult patients with hospital diagnoses of severe sepsis or septic shock between January 2012 and December 2014 where the primary outcome of interest was the association between adherence to the sepsis bundle and the in-hospital rate of mortality and secondary outcomes included location of sepsis declaration within the hospital and in-hospital mortality by source of infection (Milano et. al., 2018). Bundle
adherence in this study required five criteria to be met, if one criterion was missed, it was determined that for that specific case, the sepsis bundle was not adhered to (Milano et al., 2018). The five criteria for bundle adherence are as follows: (1) lactate levels drawn within four hours pre-declaration [of severe sepsis or septic shock] or six hours post-declaration; (2) blood cultures drawn prior to administration of antibiotics; (3) minimum of 20 mL/kg body weight of crystalloid fluids administered within six hours of pre-declaration or six hours post-declaration; (4) administration of antibiotics within three hours of declaration in the emergency department and within one hour of declaration in the inpatient setting; (5) administration of vasopressors if necessary, i.e., hypotension not relieved by fluid resuscitation (Milano et al., 2018).

This retrospective study found that generally bundle adherence in patients diagnosed with severe sepsis or septic shock resulted in decreased mortality rates, but that there was a discrepancy in bundle adherence depending on the unit in the hospital where the patient was located (Milano et al., 2018). Explicitly, in the intensive care unit, there was a 7% absolute decrease in mortality related to staff adherence to the sepsis bundle, while in the emergency department there was no associated improvement in mortality rate related to use of the bundle (Milano et al., 2018). One theory is that patients that present to the emergency department might have waited longer to seek help, making the start of the sepsis bundle later than a patient that was diagnosed in the hospital and treatment was started earlier in the progression of the condition (Milano et al., 2018). Nevertheless, the absolute decrease in mortality in the intensive care unit supports a significant trend in the findings of these studies that adherence to the sepsis bundle in a timely manner related to diagnosis of sepsis improves survival rates and patient outcomes.

The authors stated that limitations to this retrospective study are related to one hospital setting, noting that there are inherent differences between hospitals that could affect study results
and patient outcomes (Milano et. al., 2018). Further, the authors cited that the adherence to the sepsis bundle might have been affected by the severity of illness of a specific patient, thus stating that patients more severely ill might have been treated differently (Milano et. al., 2018). Conclusions were not drawn either way about the effect of severity of illness, but this does weaken the study results (Milano et. al., 2018). Nevertheless, the anecdotal evidence from this study is strong and should be taken into consideration when designing further studies and quality improvement projects.

Ferguson et. al. (2019): QI Initiative to Promote Early Recognition and Treatment of Sepsis

Ferguson et. al. (2019) conducted a QI initiative with the goal of promoting early recognition and treatment of the sepsis patient within one hospital by establishing a multidisciplinary healthcare team that utilized and leveraged nursing skills and expertise to escalate care when the nurse felt it necessary. All patients with a diagnosis of sepsis, severe sepsis, or septic shock in one hospital over a one-year period starting in 2012, and staff involved in the care of the sepsis patient were included in the initiative (Ferguson et. al., 2019). This was a retrospective cohort study where results of the initiative were measured against the rate of in hospital sepsis related mortality. Metrics within the QI initiative tracked were initiation of a “code sepsis”, inpatient power hours, use of the sepsis bundle order set and the number of sepsis related rapid response team calls (Ferguson et. al., 2019).

From this QI initiative, authors found that nurse directed sepsis care led to increased bundle adherence and reduction in sepsis-related mortality in the hospital where the project was conducted. Part of the initiative was allowing nurses to independently initiate the sepsis bundle order set, which authors found increased adherence to the bundle and decreased time it took for patients to start receiving antibiotics (Ferguson et. al., 2019). Additionally, this project found that
nurse directed care facilitated effective communication among the interdisciplinary healthcare team and that part of the success of the project was due to empowering and supporting nursing staff in their roles (Ferguson et. al., 2019). Over the course of the study, it was noted in the hospital that there was a reduction in inpatient sepsis-related mortality, highlighting the significance of proper staff education and supporting nurses in their role of caring for patients through the course of a disease process (Ferguson et. al., 2019).

The authors of this QI project cited limitations related to the project occurring in one hospital (Ferguson et. al., 2019). The authors also stated that there were multiple different components implemented during this project, making it difficult to draw strong conclusions about the effect of one intervention on patient outcomes. Additionally, the authors noted that staff turnover was a suspected barrier for the educational component of this QI project. To combat this barrier, those in charge of the project made the training related to the project (about the nurse directed sepsis order set, code sepsis, etc.) a requirement of new hire orientation (Ferguson et. al., 2019).

**Important Themes**

The studies and QI project detailed in this review support the significance of early recognition and treatment of sepsis. In order for this to occur, however, nursing staff needs to be properly educated and trained on recognition of sepsis and steps to take if a patient has sepsis. Additionally, the literature reviewed supports the use of screening tools for sepsis, such as the BPA in EPIC®, utilized in this clinical microsystem. Many studies included found that sepsis-related mortality decreased with timely recognition and implementation of treatment regimens. In fact, one study cited that the risk of mortality increases 7.6% for every hour that treatment initiation is delayed after diagnosis (Delaney et. al., 2015). Bedside staff must be able to
recognize physiologic changes in patients, even if it is as subtle as a change in respiratory rate and escalate care. This early recognition can be aided by screening tools such as the sepsis BPA within EPIC®, but staff must be properly educated on the use of the BPA, so alerts are not dismissed or ignored. Once it is suspected or confirmed that a patient has sepsis, treatment must immediately start. Initiation of antibiotics quickly after diagnosis and adherence to the sepsis bundle evidence-based recommendations of care are associated with decreased rates of sepsis-related mortality. Nurses have such a critical role in the care of the sepsis patient. Therefore, nurses must be competent in the care of the sepsis patient in order to improve health outcomes for those diagnosed with sepsis, and to work towards decreasing the burden of disease on both the individual and the system.

**Implications for QI Project**

The limitations of the studies and QI project included are very similar and point to important aspects to consider in designing new studies or projects. First, if possible, one intervention implemented at a time will allow for conclusions to be drawn about the singular effectiveness of each intervention. For example, the first step to a practice improvement initiative might be one educational intervention. Patient outcomes could be tracked for a set time after the educational intervention before another intervention is implemented, such as utilizing a sepsis bundle or a nurse-directed order set. Further, evaluation of educational interventions should be approached in a way that does not solely rely on self-assessment. Self-assessment may be a beneficially component of evaluation of the intervention, but another test of knowledge or evaluation of care of the sepsis patient should be considered to make results more generalizable and applicable to clinical practice guidelines. Finally, if possible, studies and QI projects should involve multiple different clinical microsystems across macrosystems and different metasystems.
This would allow for determination of the effect (if there is one) of factors such as different patient populations, different backgrounds of practitioners, and differences in clinical practice.

The literature examined in this review highlighted the significance of sepsis education initiatives and the direct effect that increased knowledge has on improved care and decreased sepsis-related mortality in the inpatient setting, supporting this quality improvement project. While not all studies were specific to medical-surgical microsystems, the anecdotal evidence about the effect of education on nursing care and patient outcomes is important in supporting this quality improvement project. Using the recommendations and findings from this literature review, a quality improvement project based on nursing education about EMR sepsis screening, recognition of sepsis, and use of the sepsis bundle was designed and presented to staff. By improving staff knowledge of sepsis warning signs, the sepsis BPA in EPIC® and the use of the sepsis bundle of care after diagnosis, it is expected that care of the sepsis patient within this microsystem may improve.

Rationale

The purpose of this project was to increase staff knowledge of the sepsis BPA and bundle of care for the sepsis patient. This project utilized a plan-do-study-act (PDSA) outline where the planning (i.e., “plan” stage) started with a 5P assessment of the microsystem and included a review of the literature regarding nursing staff education and sepsis evidence-based practice. The intervention, study of the intervention, and analysis of the intervention is detailed in the methods section. An 8-question survey of staff on this clinical microsystem was conducted via email by the nurse educator in the macrosystem to gather baseline data regarding staff knowledge of the sepsis BPA and sepsis bundle (Appendix A). Notably, there was a knowledge gap in staff in self-reported ability to competently address a sepsis BPA and knowledge of the sepsis 1-hour bundle.
The “do” stage was an educational poster presented to staff regarding the sepsis BPA and the sepsis bundle. The “study” stage involved a second survey after the educational intervention where the effectiveness of the intervention was examined. Metrics studied are differences in survey scores and other staff comments to examine the effectiveness of the intervention.

We aim to improve staff knowledge and competence of the sepsis BPA and sepsis bundle in the medical-surgical microsystem. The process begins when the sepsis BPA is flagged on a patient’s chart in EPIC®. The process ends with the diagnosis of sepsis and the sepsis bundle being ordered by the provider. By working on this process, we expect staff to feel increased confidence and competence in their ability to care of the sepsis patient. This includes staff knowing how to address the sepsis BPA and what to expect regarding orders from the sepsis 1-hour bundle. This quality improvement initiative is important to this clinical microsystem as well as the macrosystem of the hospital in improving patient care and patient outcomes, helping to achieve the goal that the board of directors of the macrosystem set for the 2023 fiscal year.

**Specific Aim**

The specific aim for this project was to increase self-reported staff competence and knowledge of the sepsis BPA and sepsis bundle by 10% by July 2024. By May 30, 2024, design of the educational poster begun based on recommendations from the literature regarding nursing education of sepsis. The educational poster was presented to staff and posted in the microsystem by June 30, 2024. The second survey was sent to staff members by July 12, 2024. Finally, the evaluation of the intervention and final write up of the project was completed by July 26, 2024.
Methods

Context

A 5P assessment was conducted of the clinical microsystem. This assessment along with the goal to improve sepsis care set by the macrosystem board of directors for the 2023 fiscal year established the need for this quality improvement project.

Purpose

The microsystem is a medical-surgical unit that strives to care for patients by treating illness and injury and preparing patients for safe discharge either home or to a rehabilitation facility (B. Gallant, personal communication, February 16, 2024). The microsystem aims to emphasize safety of patients while on the unit and improve health outcomes. The microsystem meets patients where they are, and providers work with all members of the interdisciplinary healthcare team to create care plans that are individualized and have positive impacts on patients (B. Gallant, personal communication, February 16, 2024).

Patients

The patient population seen in the microsystem are adults of any age from 18 to end of life. The microsystem has a maximum capacity of 41 patients, and the unit is at capacity most of the time. When patients are discharged or transferred to different units, the rooms are cleaned and filled up quickly. The average length of stay for a patient in the microsystem is 7.23 days and there is a 1.67% risk of mortality of patients in the microsystem (B. Gallant, personal communication, February 16, 2024). There are a wide variety of patient situation seen and treated; the top ten diagnoses are sepsis, acute abdominal pain, acute respiratory disease, syncope, shortness of breath, acute vomiting, acute constipation, nausea/vomiting unspecified, asthma exacerbation, and alcohol abuse/withdrawal (B. Gallant, personal communication,
February 16, 2024). Additionally, there are postoperative patients within the microsystem including those with total hip arthroplasties and abdominal surgeries such as cholecystectomies, appendectomies, and others. The readmission rate for patients from the microsystem is 12.57% (B. Gallant, personal communication, February 16, 2024). Patient satisfaction information is racked monthly via surveys; however, surveys are only sent out to patients who are being discharged home (B. Gallant, personal communication, February 16, 2024). This method of sending out patient surveys does not capture the entire population seen in the microsystem, as many patients discharged from the unit go to an acute or long-term rehabilitation facility. To combat this gap in patient feedback from surveys, the leadership team rounds on the unit and visits patients to ask about satisfaction and ways that staff can improve patient stays. The goal for the leadership team is to talk to at least five patients per day, and that data is tracked monthly (B. Gallant, personal communication, February 16, 2024). Current patient satisfaction data is shown in Appendix C.

Professionals

Patient care staff in the microsystem is made up of individuals who are macrosystem staff members and traveling nurses. There are 70 registered nurses (RNs) that are microsystem staff, and 14 of those are per diem staff members (B. Gallant, personal communication, February 16, 2024). There are 34 licensed nursing assistants (LNAs) including unit secretaries and 12 of those are per diem staff members (B. Gallant, personal communication, February 16, 2024). There are also 10-15 traveling nurses working in the microsystem. The microsystem staff members also work on a different unit of the hospital where patients tend to go before and after orthopedic surgeries. Staff satisfaction is tracked via a yearly survey sent out by the management team (B. Gallant, personal communication, February 16, 2024). Additionally, there are many members of
the interdisciplinary healthcare team that interacts with patients in the microsystem including physical therapists, occupational therapists, speech-language pathologists, case management staff, physicians, social work, phlebotomy staff, respiratory therapy, wound care nurses and the diabetic educator.

**Patterns**

Metrics currently tracked by the CNL and other members of the leadership team in the microsystem are reflected in Appendix D. Some notable metrics tracked include falls, pressure injuries and hospital acquired infections. Additionally, the macrosystem has set hospital-wide goals that are tracked on all units, including pain reassessment, care plan accuracy and sepsis rates (B. Gallant, personal communication, February 16, 2024). The macrosystem board of directors set a goal for the 2023 fiscal year to address inpatient sepsis rates. According to hospital compare, 38% of patients at this macrosystem receive appropriate sepsis care (Hospital Compare, n.d.). When compared to neighboring states and facilities, the percentage of patients who receive appropriate sepsis care in the state is 63% (Hospital Compare, n.d.). However, this macrosystem falls short of this benchmark. The first step that the macrosystem has taken to address sepsis rates has been utilizing the sepsis BPA alert within EPIC® (B. Gallant, personal communication, February 16, 2024). The BPA in EPIC® is flagged based on an artificial intelligence (AI) generated program that monitors signs of clinical deterioration, and alerts nursing that they should be conducting additional sepsis assessments and contact the provider to potentially escalate care (B. Gallant, personal communication, February 16, 2024). Additionally, there is an audit team in the macrosystem that examines sepsis bundle adherence, mortality, and fallout in relation to sepsis patient situations, and uses that data to determine ways in which care can be improved (B. Gallant, personal communication, February 16, 2024).
Processes

A flowsheet that outlines the workflow for a patient with risk for developing/suspected development or confirmed diagnosis of sepsis in the microsystem is represented in Appendix E. The sepsis BPA in EPIC® is a predictive model scoring tool which assigns a number to represent the patient’s risk of developing sepsis. The data that this AI generated predictor pulls from includes patient diagnosis, lab values, medications, vital signs, assessment, demographic information and more (S. Tber, personal communication, April 8, 2024). This score is automatically updated every 15 minutes and numbers coordinate with color coded groups of risk: red – a high level/actionable risk, yellow – a potential risk and green – a low level risk (S. Tber, personal communication, April 8, 2023). When a patient’s numerical risk reaches a certain threshold, the BPA will fire and flag within the patient’s chart that action needs to be taken. The BPA has two types of flags: sepsis watch and sepsis alert, which are based on predictive scores of a patient’s risk of developing sepsis, and the steps a nurse must take depending on which flag is fired (S. Tber, personal communication, April 8, 2024). A sepsis watch means that a patient has a red level predictive model score but does not meet infection and escalation criteria. According to the microsystem workflow requirements, the nurse is to fill out the sepsis screen within EPIC®, shown in Appendix F, message the provider, document communication with the provider, take vital signs within the hour of the alert and order a lactic acid with reflex (S. Tber, personal communication, April 8, 2024). A sepsis alert means a patient has a current infection present or suspected or at least one known risk factor plus two or more escalation criteria and/or a red level predictive model score. Microsystem workflow requirements direct the nurse to document the sepsis alert in the sepsis screen navigator (Appendix F), initiate nurse driven sepsis protocol orders, call the provider, document communication with the provider, take vital signs
every hour for four hours, and order a lactic acid with reflex (S. Tber, personal communication, April 8, 2024). A small notecard with sepsis watch and sepsis alert nursing protocol printed and posted on computers within the microsystem is shown in Appendix G. Additional actions are patient specific and depend on provider orders.

Cost-Benefit Analysis

The costs for this quality improvement project include supplies to build an educational poster on the EPIC® sepsis BPA and the sepsis bundle; the total cost of materials was $30. In total, 500 hours were spent on pre-educational data collection (initial survey), reviewing the literature for best practice, education, post-education data collection (second survey) and data analysis.

The main perceived benefit of this quality improvement project is the improvement in care of the sepsis patient in this microsystem, decreasing the burden of disease on the individual and the system. The idea behind the project is that if staff knowledge of sepsis BPA and sepsis care is improved, then care of the sepsis patient may improve within the microsystem. In 2019, it was estimated that the cost for all inpatient hospitalization and skilled nursing related to sepsis in the United States was around $62 billion (Nguyen, 2020). This estimated cost includes the cost of readmission for someone diagnosed with sepsis, as it is the leading cause of hospital readmission (Nguyen, 2020). Additionally, the average cost of a hospital stay with a diagnosis of sepsis is twice the average cost of a hospital stay for any other diagnosis, speaking to the significant burden that treating sepsis places on the individual hospital and the healthcare system (Nguyen, 2020). If education increases knowledge of the care of the sepsis patient, and improves care, then the money lost caring for the sepsis patient may decrease.
Interventions

The intervention for this project was an educational poster that was be placed in the unit breakroom. This specific location for posting is beneficial because all staff gathers in the breakroom during pre-shift huddles. The team involved in this project were nursing staff in the microsystem, the unit nurse educator, and the microsystem clinical nurse leader (CNL).

Sepsis BPA and Sepsis Bundle Education

A review of current literature supported staff training/education programs and the utilization of a sepsis care protocol bundle as a facilitator to proper sepsis care within clinical microsystems (Rababa et. al., 2022). The literature also supported the use of screening tools for sepsis, like the EPIC® BPA utilized within this clinical microsystem. Additionally, the literature supported educational interventions as a way to improve staff knowledge and competence in the care of the sepsis patient (Delaney et. al., 2015). There was not one set conclusion on how to best deliver education, but the literature suggested that education as a first step intervention in improving care is beneficial. The literature also suggested that self-assessment is beneficial to evaluating educational interventions, which is utilized in this project. The literature stated that other evaluation tools are also beneficial such as a post test, but that will not be utilized for this specific project. Through conversations with the nurse educator and microsystem CNL, it was decided that an educational poster about the sepsis BPA and sepsis 1-hour bundle was the most effective intervention to address staff knowledge and competency. The poster was in the staff breakroom for one month before post-intervention survey data is collected. The poster included information from the macrosystem specific workflow for the sepsis patient including use of the sepsis BPA, steps to take when it is flagged on a patient and information about the sepsis 1-hour bundle of care.
Study of Intervention

The goal of this project was to improve staff knowledge of the sepsis BPA in EPIC® and the sepsis bundle, which may lead to improved care of the sepsis patient within the macrosystem. The intervention effectiveness was studied based on a staff survey after the educational intervention, and responses were compared to baseline survey data gathered before the intervention. Initial survey was sent out to microsystem staff via email, and post intervention survey is attached to the educational poster via QR code.

Measures

In April, the two months before the educational intervention, pre-survey data was collected from the nurse educator in the clinical macrosystem (Appendix A). Based on this survey data, it was established that there was a deficiency in staff self-reported ability to competently address sepsis BPA and knowledge of the sepsis 1-hour bundle. After the educational intervention, another survey was available to staff via QR code on the educational poster, and changes in survey answers were measured to determine effectiveness of the intervention.

Analysis

Survey questions are both yes/no based and open ended, making statistical analysis required both qualitative and quantitative. For the yes/no questions a quantitative analysis via the Likert scale was used to analyze data, where the number 1 will be assigned to a yes answer and 2 will be assigned to a no answer, which will allow for analysis of percentage of each result. For the open-ended questions, a qualitative analysis will be utilized where themes will be identified. The overall change in survey answers was examined to determine effectiveness of the educational intervention.
Ethical Considerations

This project was be reviewed by the University of New Hampshire’s Quality Review Committee for determination of quality improvement work exempt from full Institutional Review Board review. It is also recognized that the author of this project will be an employee of the microsystem at the completion of this project, which may influence staff interaction. Surveys both pre-intervention and post-intervention are conducted via emailing a link to microsystem nursing staff and responses are voluntary and anonymous.
Results

Process Measures and Outcomes

For this quality improvement project, a post-intervention survey was available, and those responses were used to measure the impact of the intervention toward achievement of the specific aim. The post-survey questions and responses can be seen in Appendix H. Post-intervention survey questions were a mix of yes/no and open-ended questions, like the pre-intervention survey questions. The questions in the post-intervention survey were not the same as the pre-intervention survey as they were designed to specifically test knowledge gained from the educational poster. Based on the post-intervention survey responses, there was an increase in self-reported knowledge by more than 10% of those who participated in the survey.
Contextual Elements

Contextual elements for this quality improvement project involved developing an educational intervention that was specific to knowledge gaps discovered in the pre-survey of staff. Based on survey data, it was decided to focus the educational poster on the sepsis BPA and the actions of the nurse if that fired for their patient. To best model this, a case study was created that walked nurses through the steps that they would take on a real patient if the BPA fired and the sepsis screen needed to be filled out. Additionally, it was decided that a general refresher on sepsis pathophysiology and key points such as the significance of lactate would be beneficial in the poster. A picture of the educational poster is shown in Appendix I.

Outcomes Relationship to Intervention

The post-intervention survey had 13 responses from members of the microsystem staff. A statistical analysis was not able to be performed due to such a low sample pool of post-intervention survey responses. While there was an increase in self-reported knowledge about sepsis, the BPA in EPIC® and the bundle of care, determining statistical significance was impossible because of the small sample size. Therefore, there are not concrete conclusions drawn about the effect of the intervention on nursing knowledge within the clinical microsystem, rather suggestive evidence of a positive effect on nursing knowledge and competence when an educational intervention is applied.

Unintended Consequences

Unintended consequences of this quality improvement project revolve around the lack of involvement and engagement of nurses in the education. Additionally, there are competing priorities within the microsystem which makes it difficult for complete focus on this educational intervention. Face to face conversations with nursing staff about the sepsis BPA and bundle of
care were proposed to increase engagement with the project and the educational poster. After conversations, staff were encouraged to look at the poster and utilize the QR code posted to complete the post education survey.

**Discussion**

**Summary**

The goal of this project was to utilize an educational poster to improve staff knowledge of the sepsis BPA in EPIC® and the sepsis bundle of care, which in turn might improve care of the sepsis patient within this microsystem. The educational poster (Appendix I) was displayed in the staff breakroom from June 21, 2024, until July 5, 2024. The project lead engaged multiple different registered nurses in discussions about sepsis care and the BPA found in EPIC®, while using the educational poster as a resource for questions that came up in discussion. After registered nurses reviewed the education and engaged in discussion, they were encouraged to take the post survey. The specific aim for data gathered from the post survey was to see a 10% increase in self-reported staff competence and knowledge of the sepsis BPA and bundle of care. Key findings from this quality improvement project included improved knowledge of nursing action when sepsis BPA fires on a patient, improved knowledge of the difference between a sepsis watch and a sepsis alert and improved understanding of the inpatient sepsis workflow for this macrosystem.

**Key Findings**

The most significant finding of this quality improvement project was an increase in self-reported ability for nurses to competently address the sepsis BPA if it were to fire on their patient. Prior to the intervention, 53.5% of pre-survey respondents stated that they felt as though they can competently address the sepsis BPA. After the intervention, 76.9% of post-survey
respondents state that they felt as though they could competently address the sepsis BPA. Additionally, this quality improvement project saw an increase in nurses’ self-reported knowledge of a sepsis watch and a sepsis alert. Prior to the intervention 53.5% of pre-survey respondents stated that they understood the difference between a sepsis watch and sepsis alert. After the intervention 91.7% of post-survey respondents state they understand the difference.

This quality improvement project also noted an increase in nurses’ self-reported understanding of the sepsis predictive score and use of sepsis screening within EPIC®. Prior to the intervention, 57% of pre-survey respondents stated that they know when and where to fill out a sepsis screening. After the intervention, 84.6% of post-survey respondents stated that they know when it is indicated to fill out a sepsis screening and 100% of post-survey respondents stated that they know where to find the sepsis screening within EPIC®. Finally, this quality improvement project saw an increase in nurses’ understanding of the sepsis 1-hour bundle of care. Prior to the intervention, 53.5% of pre-survey respondents stated that they know what interventions are included in the 1-hour sepsis bundle. After the intervention, 100% of respondents stated that they know what the sepsis 1-hour bundle is.

In each of these findings, it was noted that the increase between pre-survey and post-survey self-reported knowledge and competence was >10%, which was the goal for this project. There was a 23.4% increase in self-reported ability to competently address the sepsis BPA; a 38.2% increase in self-reported understanding of the difference between a sepsis watch and sepsis alert; a 27.6% increase in knowledge of where and when to fill out the sepsis screening within EPIC®; and a 46.5% increase in knowledge of the sepsis 1-hour bundle.
Strengths

One strength of this quality improvement project was involvement of key stakeholders including nurses at the bedside, clinical nurse leaders and macrosystem leadership. The macrosystem board of directors set a goal for the 2023 fiscal year to address inpatient sepsis rates and care of the sepsis patient. This quality improvement project was well received by microsystem staff because many were aware of the goal set by leadership to improve care across the macrosystem. Part of the goal from the board of directors was utilizing the sepsis BPA within EPIC®, however many inpatient nurses did not understand the workflow associated, as shown by the pre-survey data. It was the goal of this quality improvement project to increase staff knowledge by addressing the confusion related to the BPA and the workflow.

Interpretation

The association of intervention and outcome in this project showed that an educational poster can help improve nurses self-reported knowledge of key aspects of caring for the sepsis patient. Literature supports the idea that educational interventions are associated with improved staff knowledge and improved patient outcomes, however interventions are more beneficial for patient outcomes when they combine a care bundle and education (Choy et. al., 2022). For this microsystem, a nurse-driven order set was already in place, so this quality improvement project focused solely on nurse education.

This project impacted nurses on the microsystem level but was based on a goal set by the macrosystem board of directors. The pre-survey responses indicated areas of focus for education including the difference between a sepsis watch and sepsis alert, the sepsis 1-hour bundle of care and certain steps the workflow of caring for the sepsis patient such as filling out the sepsis screening in EPIC® and addressing the sepsis BPA when it flags. Using responses from staff
members to direct education helped this project as it specifically addressed areas of confusion and concern from key stakeholders. Additionally, literature highlights a major barrier to care of the sepsis patient as poor knowledge base of early physiological warning signs of sepsis (Rababa et. al., 2022).

Ongoing education such as a poster creates a low-cost, low-stakes opportunity to engage nurses in critical thinking and increase their knowledge of certain patient situations, like caring for the sepsis patient. Improved knowledge and timely care of the sepsis patient decreases mortality and morbidity associated with sepsis (Cull et. al., 2023). This statement highlights the importance of educational interventions aimed at improving nurses’ knowledge of sepsis and care of the sepsis patient, which is why it was expected that care of the sepsis patient may improve with increased knowledge.

Based on post-survey results, this quality improvement project positively impacted nurses’ knowledge of sepsis and caring for the sepsis patient within this microsystem. It is important to note that the data collected for this quality improvement project only represents members of the microsystem who responded to the pre and post survey. A challenge of this quality improvement project was engagement of all critical members of the microsystem. More robust staff involvement would likely produce stronger results, but the data here is significant for an improvement among some members of the microsystem. This quality improvement project is one step [of many] towards improving the care of the sepsis patient within this microsystem and macrosystem. The data collected and challenges faced during this project can help with design of future educational measures that might include different approaches to increase staff engagement in the education. For example, literature notes that education is increasingly effective when it utilizes teamwork and teambuilding (Choy et. al., 2022; Rababa et. al., 2022). Future sepsis-
related educational interventions in this microsystem might aim to include teambuilding and teamwork, rather than just a poster.

Limitations

The limitations of this quality improvement project include lack of staff participation and engagement in the post-intervention survey. The project lead engaged in numerous conversations with members of the microsystem about the educational poster and encouraged those members to take the post-intervention survey, but participation in that survey was optional and staff engagement was limited. Because of the minimal engagement in the post-intervention survey, statistical analysis of the data could not be conducted, and strong conclusions could not be drawn. While the data indicates an increase in self-reported knowledge, it only represents a small sample of members of the microsystem.

Additionally, the post-intervention survey questions were written with the idea that most answers would be either yes or no. This limits data collection and analysis of the educational intervention because it does not truly test knowledge, rather relies on participants to evaluate themselves and self-report their knowledge and competence. Finally, self-reporting knowledge does not necessarily correlate with clinical skills and clinical decision making, and therefore does not guarantee that those that reported an increase in knowledge will take all proper steps in caring for a sepsis patient within the clinical microsystem.

Conclusions

Usefulness of the Work

Prior to the start of this quality improvement project, a 5P assessment of a medical surgical microsystem demonstrated that care of the sepsis patient was not adequate. It was found from a pre-intervention survey that staff was lacking in knowledge regarding use of the sepsis
BPA in EPIC®, the sepsis bundle of care and the workflow within the microsystem when sepsis is suspected or diagnosed. This quality improvement project sought to increase self-reported staff competence and knowledge of the sepsis BPA and sepsis bundle by 10%. This specific aim was met; however, it is important to note that the post-intervention survey data where that conclusion was drawn had limited participation from members of the microsystem.

**Sustainability**

Continued education and sepsis-related improvement initiatives will aid in sustainability of the increased knowledge observed in this project. For example, a quarterly sepsis-related continuing education model that includes information on the sepsis BPA and bundle of care might be beneficial in sustaining the positive impact observed among members of the microsystem that participated in the post-intervention survey.

**Potential for Spread to Other Contexts**

Education is a fundamental role within nursing including nurse to patient education and nurse to nurse education. This project shows positive benefits of educational interventions in self-reported knowledge and can be used to model other educational interventions in different clinical microsystems. The literature supports the positive benefits of education shown through this project and offers other ways education can be beneficial such as hands on training and case studies.

**Implications for Practice and Further Study**

This quality improvement project shows promise for the benefits of educational interventions regarding sepsis care within this microsystem but should not be the last initiative to improve nursing knowledge and effectively nursing care related to the sepsis patient. Rather, this
project should act as a guide towards development of further educational interventions that might improve care of the sepsis patient within this microsystem.

**Suggested Next Steps**

The next logical step related to sepsis education and this quality improvement project would be to design and implement a more hands on educational experience for staff. Such experience could include hours in the skills lab and step by step training of the inpatient sepsis workflow starting from patient admission, through the BPA in EPIC® firing and until the bundle of care is activated. Hands on training and skills lab time might also benefit the sustainability of the increased knowledge reported in this quality improvement project. Another aspect of next steps would be development of a test to evaluate the effectiveness of education that does not rely on self-reporting. Such an evaluation would remove bias associated with self-reporting and allow for stronger conclusions to be drawn about effectiveness of an intervention.
References


https://doi.org/10.1016/j.jhin.2022.01.004


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[https://www.cdc.gov/sepsis/core-elements.html](https://www.cdc.gov/sepsis/core-elements.html)
Appendix A

Pre-Intervention Survey Responses (S. Tber, personal communication, April 8, 2024)

Do you feel like you can competently address a sepsis BPA?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

1. If not, why not?
   a. “misfires many times”
   b. “If the answer is to reach out to the provider each time, then yes”
   c. “complicated screening and difficult to understand process”
   d. “Contacting provider”
   e. “Its not clear, it fires too often and its become just one more alert”
   f. “Its very confusing”
   g. “Don’t do it often enough”
   h. “Understanding”
   i. “No its constantly firing and its up to nursing to delete after hunting down a provider”
   j. “Not always clear why BPA is firing. Protocol not always clear”
   k. “I don’t always know what criteria information to convey to the provider, the sepsis screen criteria ex) fever, tachycardia is often very different from what the criteria is that often causes the BPA to fire in the first place ex) absolute lymphocyte counts”
   l. “The busyness and tasks of the unit really inhibits the ability to critically think. SO many disruptions -call bells, bed alarms, chair alarms, med passes. The resources on the sepsis BPA are great but I have never seen someone utilize it. I unfortunately think its easier for the nurse to just page the doctor instead of trying to troubleshoot.”
3. Do you feel competent in your knowledge of what sepsis is?

- YES
- NO
- Other

4. Can you describe the difference between a sepsis watch and sepsis alert?

- YES
- NO
- Other
Do you understand the meaning/purpose of the sepsis predictive score?

- YES
- NO
- Other

Do you know where and when to fill out the sepsis screening?

- YES
- NO
- Other
8. Any questions about the sepsis BPA or sepsis in general?
   a. “I feel like as a charge RN we are still not being told when sepsis BPAs fire. I specifically need to ask RNs each shift if they had the sepsis BPA fire. I don’t feel like the whole thing is super user friendly or straight forward.”
   b. “I think we’re missing a big opportunity. I think the culture of a hospital setting inhibits us from performing adequately. Everyone (including MDs) are just so task oriented and trying to get their “own work” done. I feel like a lot of MDs are not receptive to the nursing piece of the BPA and they question us, yet they don’t want to be bothered when we question them about it. I feel like its hard for nurses to take the sepsis BPA seriously when most of the doctors don’t – it’s kind of like
   c. “Is there a way to make it easier to address or involve the MD/first line of defense”
Appendix B

PRISMA Flowsheet

Identification of studies via databases and registers

Records identified from*: Databases (n = 3)
- CINAHL (n = 380)
- MEDLINE (n = 777)
- PubMed (n = 2397)
- Other sources (n = 4)

Records removed before screening (n = 2519):
- Duplicate records removed (n = 1)
- Records marked as ineligible by automation tools – linked full text not included (n = 2338)
- Records removed because publication not within time frame 2014-2024 (n = 160)
- Record not considered an academic journal (n = 21)

Records screened (n = 1529)

Records excluded** (n = 0)

Reports sought for retrieval (n = 1529)

Reports not retrieved (n = 0)

Reports assessed for eligibility (n = 1529)

Reports excluded, with reasons (n = 1023):
- Reason 1: Not strong research (meta-analysis, systematic review, controlled trial, or applicable CI project) (n = 745)
- Reason 2: Research out of scope of PICO Topic (n = 249)
- Reason 3: Research not conducted in US or UK (n = 29)

Studies included in review (n = 0)

Reports of included studies (n = 0)
Appendix C

Current Patient Satisfaction Data (B. Gallant, personal communication, February 16, 2024)

<table>
<thead>
<tr>
<th>Question</th>
<th>YTD</th>
<th>Last 3 Months</th>
<th>Last Month</th>
<th>n-size</th>
<th>Score</th>
<th>Benchmark</th>
<th>Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfort talking with nurses</td>
<td>87.9</td>
<td>74.2</td>
<td>84.0</td>
<td>20</td>
<td>90.0</td>
<td>80.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Family involved in stay</td>
<td>80.0</td>
<td>78.3</td>
<td>79.2</td>
<td>17</td>
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<td>72.0</td>
<td>20</td>
<td>80.0</td>
<td>76.5</td>
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<td>Care provider explain-if not better</td>
<td>70.3</td>
<td>59.2</td>
<td>67.9</td>
<td>22</td>
<td>72.7</td>
<td>64.4</td>
<td>8.3</td>
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<td>Had enough input/say in care</td>
<td>75.6</td>
<td>67.8</td>
<td>80.0</td>
<td>20</td>
<td>65.0</td>
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<td>Good communication b/w staff</td>
<td>68.8</td>
<td>56.8</td>
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<td>56.1</td>
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<td>Set expectations for home</td>
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<td>54.9</td>
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<td>-4.4</td>
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<td>Trust providers w/care</td>
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<td>59.4</td>
<td>57.1</td>
<td>22</td>
<td>59.1</td>
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<td>-22.8</td>
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<td>Worked together to meet needs</td>
<td>64.9</td>
<td>64.1</td>
<td>67.9</td>
<td>22</td>
<td>59.1</td>
<td>82.0</td>
<td>-22.9</td>
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<td>Care providers listened</td>
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<td>22</td>
<td>54.5</td>
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## Appendix D

Current Microsystem Metrics Tracked (B. Gallant, personal communication, February 16, 2024)

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<th>Category</th>
<th>Metric Name</th>
<th>Target</th>
<th>Aug</th>
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<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
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<tr>
<td><strong>Patient Experience</strong></td>
<td>Leadership Rounds</td>
<td>90%</td>
<td>77%</td>
<td>83%</td>
<td>74%</td>
<td>79%</td>
<td>81%</td>
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<td></td>
<td>Facility would recommend</td>
<td>52.7%</td>
<td>52%</td>
<td>61.9%</td>
<td>42.3%</td>
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<tr>
<td></td>
<td>Worked together to meet needs</td>
<td>53.6%</td>
<td>68.3%</td>
<td>68.2%</td>
<td>57.1%</td>
<td>65.8%</td>
<td>61.2%</td>
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<tr>
<td></td>
<td>Care Providers listen carefully to you</td>
<td>53.8%</td>
<td>13.3%</td>
<td>62.5%</td>
<td>57.1%</td>
<td>56.6%</td>
<td>53.8%</td>
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<tr>
<td></td>
<td>Comfortable talking with nurses about your worries or concerns</td>
<td>63.8%</td>
<td>58.3%</td>
<td>71.4%</td>
<td>68.0%</td>
<td>66.7%</td>
<td>72.1%</td>
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<td><strong>Quality/Safety</strong></td>
<td>Staff injuries</td>
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<td></td>
<td>Assault to Staff w/Injury</td>
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<td></td>
<td>Falls (total)</td>
<td>64 (15% reduction total)</td>
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<td>8</td>
<td>6</td>
<td>6</td>
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<td>Falls w/ Injury (moderate of higher)</td>
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<td></td>
<td>Pressure Injuries (all harm)</td>
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<td>Hospital Acquired pressure Injuries (Stage 2 or greater)</td>
<td>3/year (15% reduction)</td>
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<td>Hospital Readmission rate</td>
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<td>Medication Scanning Compliance</td>
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<td>Cases that went for review</td>
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<td>Cases that went review that require action</td>
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Appendix E

Nursing Workflow Related to Sepsis Risk/Suspect/Diagnosis (S. Tber, personal communication, April 8, 2024)
Appendix F

Sepsis Screens in EPIC® (S. Tber, personal communication, April 8, 2024)
Appendix G

Workflow Notecard Posted on Computers within Microsystem (S. Tber, personal communication, April 8, 2024)
Appendix H

Post-Intervention Survey Responses

Do you feel like you can competently address a sepsis BPA in EPIC when it flags on your patient?
13 responses

- Yes: 76.9%
- No: 23.1%

1. 

If not, why? Are there still areas of confusion?
3 responses

- why it flags
- when to start nurse driven protocol
- Unclear protocol

2. 

Do you understand the difference between a sepsis watch and a sepsis alert?
12 responses

- Yes: 91.7%
- No: 8.3%

3. 


4. Do you know where in EPIC to find the sepsis screening?
13 responses

5. Do you know when it is indicated to fill out the sepsis screening?
13 responses

6. Do you know what the sepsis 1-hour bundle is?
13 responses
Do you understand the pathophysiology of sepsis?
13 responses

Do you feel that you could recognize signs of clinical deterioration related to sepsis in your patients?
13 responses

Are there still areas of confusion where the sepsis workflow is concerned? What else do you feel needs to be clarified?
8 responses

No

sepsis watch vs sepsis alert is still confusing
Are there any other concerns related to sepsis care that you wish to share?

8 responses

<table>
<thead>
<tr>
<th>Response</th>
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<tbody>
<tr>
<td>No</td>
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<td>not workflow related but communication with providers is sometimes difficult</td>
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Appendix I

Educational Poster