THE IMPACT OF EVIDENCE-BASED SEPSIS EDUCATION ON THE RECOGNITION OF CLINICAL DETERIORATION AND REDUCING SEPSIS MORTALITY AMONG INPATIENT MEDICAL-SURGICAL UNITS

by

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ABSTRACT

JAIME MOORE. The Impact of Evidence-Based Sepsis Education on the Recognition of Clinical Deterioration and Sepsis Symptoms in Reducing Sepsis Mortality Among Inpatient Medical-surgical Units. (Under the direction of DR. JAMES MONTEGRICO)

Sepsis is one of the leading causes of intensive care unit (ICU) transfers and mortality in the inpatient setting due to delayed recognition and untimely management of sepsis symptoms on non-ICU medical-surgical floors. Educating nurses on units with the highest rates of sepsis mortality and ICU transfers is important to increase confidence and knowledge to promote early recognition of sepsis and implementation of initial management guidelines. There is growing evidence of the effectiveness of escape rooms when used to train or educate individuals; however, most studies have been completed with students in academic settings. Sepsis education is traditionally targeted to the ICU and emergency department (ED) settings, not medical-surgical floors. The lack of education on the medical-surgical floors on sepsis further warrants the need for innovative education delivery on high-risk topics, like sepsis on these units. The purpose of this project was to implement interactive escape room education with evidence-based sepsis content to prepare nurses to identify early warning signs of sepsis and clinical deterioration in medical-surgical patients. A two-group pre-/post-test quality improvement project was conducted with a sample of 17 nurses in the non-ICU medical-surgical units within the medicine service line at the project site. After the interactive escape room educational event, a statistically significant improvement in confidence and increased knowledge was demonstrated. Mean knowledge scores increased from 77.4 (SD=13.7) pre-intervention to 82.4 (SD=14.3) post-intervention. Significant improvements were seen in self-reported knowledge and confidence in identifying sepsis patients ($z=2.33$, $p=.02$), knowing how and what to monitor in sepsis patients ($z=2.714$, $p=.007$), and knowing initial management of patients with sepsis

(z=2.646, *p*=.008). Mean ICU transfers decreased from 13 (SD=1.0) pre-intervention to 8.67 (SD=3.51) post-intervention indicating the project units performed better than the comparison units. Implementing an innovative escape room education intervention for non-ICU medical-surgical nurses is recommended as one potential strategy to improve nurse knowledge and confidence in managing sepsis patients. By increasing nurse knowledge and confidence, earlier recognition of clinical signs of deterioration may assist with reducing ICU transfers related to clinical deterioration due to infections and sepsis.

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LIST OF ABBREVIATIONS

ADN/ASN	Associate Degree in Nursing
BS/BSN	Bachelor of Science/Bachelor of Science in Nursing
CMSRN	Certified Medical Surgical Registered Nurse
CNA	Certified Nurse Assistants
CNCP	Clinical Nurse Credentialing Program
CNS	Clinical Nurse Specialist
DNP	Doctor of Nursing Practice
ED	Emergency Department
EMR	Electronic Medical Record
FMLA	Family Medical Leave Act
HCT	Healthcare Technician
ICU	Intensive Care Unit
IHI	Institute for Healthcare Improvement
IRB	Institutional Review Board
MBA	Master of Business Administration
MEDSURG-BC	Medical-Surgical Nursing Certification
MEWS	Modified Early Warning Score
MHA	Master of Healthcare Administration
MODS	Multi Organ Dysfunction Syndrome
MSN	Master of Science in Nursing
NCPP	Nurse Career Progression Program
NSAQ	Nurses' Sepsis Awareness Questionnaire

O/E	Observed-to-Expected Ratio
PDSA	Plan-Do-Study-Act
PTO	Paid Time Off
RN-BC	Registered Nurse – Board Certified
SIRS	Systemic Inflammatory Response Syndrome
SLE	Service Line Nurse Educator
SPSS	Statistical Package for Social Sciences

CHAPTER 1: INTRODUCTION

Sepsis mortality is a rising issue in United States (U.S.) hospitals (World Health Organization [WHO], 2020). An astounding estimated 11 million cases of sepsis-related global deaths were reported in 2017, with 41,198 deaths in the U.S. in 2021 (Centers for Disease Control [CDC], 2023a; CDC, 2023b; Rudd et al, 2017; WHO, 2020). The Centers for Disease Control reported 1,669 sepsis deaths in North Carolina in 2021 (CDC 2023a; CDC 2023b). According to Semanco et al. (2022) and Robson et al. (2007), a fundamental element that affects outcomes in sepsis patients is rapid identification and immediate aggressive treatment. Yet, a lack of nurse education on sepsis coupled with robust sepsis protocols on non-intensive care (ICU) medical-surgical units contributes to the delay in clinical deterioration identification.

1.1 Background

Sepsis mortality has been an increasing problem at the project site (Project Site, 2022). The project lead researched the cause of sepsis mortality at the project site and determined that of the 24 units that activated rapid responses on deteriorating patients, 38 of the 196 (19.4%) transfers to ICUs occurred from medical-surgical inpatient units in the medicine service line (Project Site, 2023a). These rapid responses were initiated by bedside nurses due to a change in patient condition associated with the presence of an infection causing rapid deterioration. Additionally, there were 351 inpatient mortality cases in 2022; 47 of the patients died with a primary diagnosis of sepsis. Of those sepsis mortality cases, the non-ICU medical-surgical units in the medicine service line accounted for 13, or 27% of all sepsis mortality cases (Project Site, 2023b). While performing these chart reviews and speaking with key stakeholders at the project site, it emerged that many of these patients died after their transfer to the ICU, resulting in

skewed data in relation to unit-level inpatient mortality (A. Matusik, personal communication, November 5, 2022).

Current literature supports measures to recognize the presence of an infection or systemic inflammatory response syndrome (SIRS) criteria; these symptoms manifest as signs of infection while rapidly leading to acute organ dysfunction (Cecconi et al., 2018). The timing of recognition is pivotal in determining the course of patient care and associated outcomes. The emergency department (ED) is typically the first line of defense in treating sepsis patients and as such, ED nurses receive extensive training in sepsis recognition and management (Bruce et al., 2014). However, patient outcomes can differ when the patient acquires an infection while hospitalized, or when the infection is missed in the ED setting (Harley et al., 2019). In this case, inpatient nurses are required to identify SIRS criteria and rapidly initiate sepsis protocols. This is problematic because this task is not frequently used in their daily practice, and inpatient nurses on medical-surgical units do not typically receive in-depth training on sepsis-like those employed in ICU and ED settings. Medical-surgical nurses are managing patients long-term rather than focusing on rapid identification and stabilization (Chua et al., 2022; Loftus et al., 2021). Clinical guidelines, checklists, and electronic medical systems can assist nurses with early and accurate recognition of sepsis, but education is important to better aid the nurse in using clinical competency when treating this patient population (Dugar et al., 2020).

1.2 Problem Statement

In addition to mortality rates, hospital length of stay is 75% greater in sepsis patients, and costs for sepsis disease management average over $18,500 per patient (Paoli et al., 2018). Patients surviving sepsis often sustain cognitive impairment and functional disability and report a decrease in health-related quality of life (Cecconi et al., 2018). The non-ICU medical-surgical

inpatient units at the project site account for 27% of the inpatient sepsis mortalities year-to-date (Project Site, 2022); this is consistent with O'Shaughnessy et al.'s (2017) study showing 25% of patients develop sepsis on medical-surgical units.

According to Semanco et al. (2022) and Robson et al. (2007), rapid identification and immediate aggressive treatment are fundamental elements that affect patient outcomes in sepsis patients. Medical-surgical nurse education on prompt sepsis identification and treatment is suggested to improve patient outcomes (Alberto et al., 2017). Yet, a review of the literature revealed a lack of research and quality improvement projects on focused medical-surgical nurse education and sepsis prevention in inpatient, non-ICU medical-surgical units. Most literature revealed that education or quality improvement work has been focused on the ICU or ED settings; thus, the need for additional focus in medical-surgical units has been recommended (Luna et al., 2020).

Through discussions with multiple internal stakeholders at the project site, it was determined that sepsis education and knowledge of sepsis recognition is a missing link in preventing unnecessary transfers to a higher level of care from medical-surgical units and ultimately, improving sepsis mortality (J. Eichenberger, A. Heffner, and K. Fuller, personal communication, June 19, 2022). This clinical deterioration results in the need for a higher level of care and transferring the patient to an ICU due to delayed recognition of sepsis early warning signs (Loftus et al., 2020). Furthermore, patients with a delay in transfer to the ICU greater than 24 hours have greater illness severity and longer intervals between recognition of an infection to source control, an imperative aspect of managing sepsis and septic shock (Dugar et al., 2020; Loftus et al., 2020). Sepsis has a significantly negative impact on inpatient mortality and morbidity (Brito Borguezam et al., 2021; Cecconi et al., 2018; Fleischmann-Struzek et al., 2020),

resulting in hyper-focused attention to the treatment and management of these patients from physicians, nurses, and hospital administration.

1.3 Clinical Question (PICOT)

For this project, the identified population was nurses who work on non-ICU units in the medical service line. The intervention was an evidence-based, interactive sepsis education intervention. The performance of nurses receiving education was compared to those with experiential knowledge alone, working in non-ICU units in the surgical service line. The desired outcome was for nurses in the intervention units to identify early sepsis more promptly in patients and reduce ICU transfers and sepsis mortality on their units. Thus, the PICOT question was: Are nurses who work in the non-ICU, inpatient units in the medicine service line (P) who complete an evidence-based sepsis education intervention (I) compared to nurses who use experiential nursing knowledge alone in non-ICU units in the surgical service line (C), more likely to identify early sepsis, as evidenced by reduced ICU transfers and sepsis mortality (O), within 90 days (T)?

1.4 Purpose of the Project

Robson et al. (2007) stated that when a patient has a change in condition, the presence of infection is often not immediately considered. Chua et al. (2022) highlighted tachypnea as an early symptom of sepsis that is often missed by nurses. Key stakeholders, a clinical nurse specialist (CNS), and a service line nurse educator (SLE) at the project site confirmed these study findings, stating that recognition of clinical deterioration on the inpatient medical-surgical floors is delayed among sepsis patients (H. Brown & K. Fuller, personal communication, September 20, 2022).

There has been a continued focus on the rapid identification of symptoms of sepsis in the ED, as ED nurses are often the first line of defense in managing patients with an infection or sepsis (Bruce et al., 2014). However, when a patient has an unidentified or hospital-acquired infection following a procedure or lengthy hospital stay, these patients are not in the ED; thus, patients must rely on the expertise of the medical-surgical nurses in the inpatient units for sepsis detection. According to the key stakeholders, clinical experience, staffing, timing of identification, and a change in electronic medical records (EMR) could result in delays in the treatment of sepsis in medical-surgical units. A sepsis education intervention could result in positive patient outcomes including decreasing patient mortality and morbidity.

The purpose of this project was to implement evidence-based education to prepare nurses to identify early warning signs of sepsis and clinical deterioration in medical-surgical patients. This will empower the bedside nurses to identify clinical deterioration earlier and rapidly initiate a sepsis bundle to prevent the required patient transfer to a higher level of care and reduce untimely inpatient mortality.

1.5 Project Objectives

The objectives and desired outcomes of this Doctor of Nursing Practice (DNP) scholarly project were to ensure appropriate and timely recognition of SIRS criteria, clinical deterioration, and sepsis symptoms by nurses in the non-ICU inpatient units within the medical service line at the project site through improved sepsis knowledge following an interactive sepsis education intervention. The first objective was to assess pre- and post-intervention knowledge to determine the quality of education and knowledge retention. Additionally, the desired outcome was a decrease in the number of ICU transfers from the medical service line inpatient units, where, unfortunately, most sepsis patients die because of a delay in symptom recognition. Sepsis

mortality rates were tracked on these units to determine the effectiveness of early symptom detection. Lastly, the overarching measure that was tracked was sepsis mortality. These data were viewed at the unit and service line level to determine changes in volume.

Through the interactive sepsis education intervention, compliance with provider communication when SIRS criteria are identified was anticipated to increase among the nurses on the unit. Additionally, the education had the desired outcome of empowering nurses to notify the providers of a change in condition and the need for antibiotics. A further objective was to gather data and monitor specific metrics, including the number of ICU transfers from the identified units based on sepsis criteria and sepsis mortality rates. The final objective was an increase in non-ICU nurses' knowledge of SIRS and sepsis criteria. The outcome measures identified above assisted in determining the sustainability and impact of the education. If successful, the education could be spread to additional non-ICU units and potentially, other hospitals within the organization's healthcare system within the Southeastern United States.

In conclusion, the absence of nursing education in medical-surgical units contributes to delayed recognition of clinical symptoms of SIRS criteria and sepsis, thus resulting in a transfer to ICU and untimely death (Harley et al., 2019; Kabil et al., 2020; O'Shaughnessy et al., 2017; Paoli et al., 2018). An evidence-based, interactive sepsis education intervention was predicted to reduce ICU transfers and sepsis mortality while increasing medical-surgical nursing knowledge and provider communication (Fusco et al., 2022; Luna et al., 2020; Manzano-León et al., 2021; O'Shaughnessy et al., 2017).

CHAPTER 2: LITERATURE REVIEW

As the PICOT question guides the evidence search, a literature review provides evidence-based information from past research or quality improvement projects to determine the expected outcomes, barriers, and learnings regarding a healthcare problem (Whittemore & Knafl, 2005). This comprehensive understanding gained from the literature review guides research, practice, and policy changes that are essential to developing the practice of bedside nurses (Whittemore & Knafl, 2005).

2.1 Search Terms

A systematic search of the following databases was conducted: PubMed, Cochrane, CINAHL, ProQuest, and Google Scholar. Studies and projects written in the English language were located using the following keywords: *sepsis, education, medical-surgical,* and *sepsis prevention.* Also, combined search terms were as follows: *sepsis* AND *medical-surgical, sepsis* AND *nursing education, sepsis* AND *medical-surgical floor* OR *medical-surgical unit, sepsis* AND *medical-surgical floor* OR *medical-surgical unit* AND *nursing education, sepsis* OR *septic* OR *septic shock* AND *med-surg* OR *medical-surgical nursing* AND *recognition* OR *identification* OR *detection,* and *sepsis* OR *septic* OR *severe sepsis* OR *septic shock* AND *nursing education* OR *nurse education* OR *continuing education* OR *training program* OR *training* OR *nursing instruction* AND *medical-surgical unit* OR *med-surg* OR *hospital unit*. Studies and projects were limited to those published between 2017 and 2023. Forty-one articles were selected; of these, ten studies were systematic reviews, two studies were meta-analyses, one study was a randomized control trial, three studies were mixed methods designs, four were quality improvement projects, two were clinical practice guideline article and nineteen studies were observational, descriptive, or qualitative design. The articles were selected to address

current information on sepsis education for nurses, preventing sepsis mortality, and nursing education delivery.

2.2 Sepsis Outcomes

Several key themes emerged from the literature review regarding the detrimental effects of sepsis on patient outcomes. The most resounding statement was that sepsis is one of the major causes of mortality in critically ill patients, resulting in a global mortality rate of 39% or approximately 11 million deaths annually (Ahiawodzi et al., 2018; Alberto et al., 2017; Bleakley & Cole, 2020; Brito Borguezam et al., 2021; Fleuren et al., 2020; Jones, 2017). Additionally, severe sepsis and septic shock account for over 750,000 inpatient admissions annually in the U.S. (Wardi et al., 2017).

Approximately two-thirds of patients with sepsis are admitted to non-ICU units with infections in the respiratory, genitourinary, and gastrointestinal tracts. Those at higher risk for hospital-acquired sepsis include older adults and those with chronic illnesses such as chronic renal failure and chronic liver disease (McDonald et al., 2018; Zaccone, et al., 2017). However, Wardi et al. (2017) discovered that the mortality rate of patients with an unexpected transfer from non-ICU inpatient units to ICUs was similar to those admitted directly to the ICU from the ED (25% versus 24.6%). Of the 25% who did not survive following the transfer from non-ICU units to the ICU, most had an unexpected transfer to ICU within 48 hours of admission. Patients with a genitourinary source of infection were less likely to transfer to the ICU unexpectedly, whereas patients with pneumonia were most likely to decompensate in the medical-surgical units (Wardi et al., 2017). This information is consistent with internal mortality rates at the project site. Sepsis is the leading cause of mortality at the project site, followed by pneumonia (Project Site, 2023b).

The highest burden of hospital costs develops in the lowest acuity sepsis population (Paolo et al., 2018). Thus, early detection and efficient management are crucial in preventing patient mortality and reducing the economic burden of sepsis (Harley et al., 2019; Kabil et al., 2020; O'Shaughnessy et al., 2017; Paoli et al., 2018). Early recognition prevents the progression of multiple organ dysfunction syndrome (MODS) and death (Hernandez et al., 2019). Sufficient training of nurses and other healthcare clinicians is necessary for effective sepsis protocol implementation (Taj et al., 2022). Thus, this literature review examined articles focused on the recognition of sepsis symptoms and nurses' ability to recognize and act on the signs of early sepsis in their patients.

2.3 Medical-surgical Unit Management of Sepsis

The use of invasive monitoring in the ICU and ED settings can assist with earlier identification of SIRS criteria related to changes in vital signs. Unfortunately, non-ICU units lack the resources and ability to perform this invasive monitoring, and clinicians rely on patient relationships and clinical knowledge to identify a change in a patient condition (Zaccone et al., 2017). When reviewing the literature on the medical-surgical management of sepsis patients, there was a lack of studies and projects regarding the management of sepsis patients in this setting. Yet, the predominant focus of sepsis education on the ICU and ED settings only accounts for one-third of the patients with sepsis and of the nurses caring for patients with a sepsis diagnosis (Zaccone et al., 2017).

Chua et al. (2022) explored nursing confidence and knowledge for recognizing and managing patients with sepsis and compared these variables according to nurse work settings (ICU versus medical-surgical units). There were no significant differences in nurse knowledge and confidence based on their work setting; however, as years of nursing experience increased,

the reported self-confidence and mean knowledge scores also increased in nurses with greater than five years of experience (Chua et al., 2022). Alternatively, Luna et al. (2020) and O'Shaughnessy et al. (2017) identified that clinical nurses within the medical-surgical setting were not recognizing early signs of sepsis, leading to significant delays in sepsis management.

O'Shaughnessy et al. (2017) identified gaps in knowledge based on low pre-survey scores (percentage of correct answers 51% and 56% respectively, for Hospital 1 and Hospital 2) through the use of a knowledge survey on sepsis symptoms and progression of infection; education on prompt recognition of sepsis symptoms and treatment was recommended to improve patient outcomes.

2.4 Clinical Practice Guidelines

There have been significant advances made in the understanding and development of clinical practice guidelines for the effective management of sepsis patients in the last 20 years (Gyawali et al., 2018). The clinical practice guidelines in the 2018 update of the Surviving Sepsis Campaign Bundle have evolved from a recommendation for 3-hour and 6-hour bundles to the new 1-hour bundle (Levy et al., 2018). This change focused on rapid resuscitation and management of sepsis rather than prolonging resuscitation efforts (Levy et al., 2018). Due to changes that occur in the evidence-based knowledge on sepsis, education should be provided to nurses in an ongoing manner. Education that is guided by clinical practice guidelines leads to an improvement in early recognition through more frequent provider notification, a decrease in time to notification and facilitating goal-directed therapy, a decrease in hospital mortality, and a decrease in costs associated with hospital-acquired sepsis diagnoses (Harley et al., 2019; Luna et al., 2020; O'Shaughnessy et al., 2017; Paoli et al., 2018).

2.5 Modes of Nursing Sepsis Education Delivery

The mode of education delivery can assist with increasing nurses' knowledge and retention of materials. Using active learning strategies, such as simulations or game-based education like escape rooms, could potentially improve nurses' long-term knowledge and retention of information (Choy et al., 2021). Incorporating protocol-based education through a review of hospital policies and guidelines can assist with improvements in hospital-based sepsis processes (Choy et al., 2021). Various methods of education delivery, such as gameplay and simulation, facilitate knowledge retention and the ability to apply and practice clinical skills in a controlled and safe environment (Cantrell et al., 2017; Choy et al., 2021).

According to Chaghari et al. (2017), nurses' participation in simulation-based in-service training leads to significant improvement in skill and learning in their specialty. If simulation-based in-service training is unavailable, blended learning, a combination of virtual and in-person education delivery, is an effective alternative (Consuelo Sáiz-Manzanares et al., 2020). However, other articles supported the effectiveness of a virtual learning environment, since accessibility and self-directed learning produce greater knowledge retention (Chaghari et al., 2017; Singh et al., 2021). Singh et al. (2021) reported greater knowledge retention with self-directed learning among 2,225 students from various colleges in 156 different cities in India, and the medical and nursing student education preference was video-based teaching and interactive sessions.

Luna et al. (2020) and O'Shaughnessy et al. (2017) demonstrated significant increases in medical-surgical nurse knowledge after implementing nurse education programs on caring for sepsis patients. Using a pre-/post-test design with sepsis education as the intervention, there was a 50% and a 53% increase in nurses' (N=51) average post-education sepsis knowledge scores from Hospital 1 and Hospital 2, respectively, when compared to pre-survey results, indicating

that nurses' knowledge improved after an education intervention was implemented (O'Shaughnessy et al., 2017). Luna et al. (2020) focused on delays in nurse recognition of sepsis symptoms and roles/responsibilities when implementing a sepsis education program (N=30); there was a significant increase in nurses' knowledge from pre- to post-sepsis education implementation.

As educational needs change, innovative ways to deliver nursing education have been explored. Engaging participants, or students, in novel approaches to education delivery can enhance competency in interprofessional education (Fusco et al., 2022). Escape rooms have become increasingly popular as a means of active learning. Escape rooms are interactive puzzles that are used to solve clues to gain knowledge on a specific topic or "escape" from the room (Fusco et al., 2022; Manzano-León et al., 2021). Fusco et al. (2022) and Manzano-León et al. (2021) explored the use of escape rooms and interactive simulations when delivering education. Escape rooms were shown to increase knowledge and skills when compared to conventional education delivery (Fusco et al., 2022; Manzano-León et al., 2021).

Fusco et al. (2022) used an escape room format for education delivery among interprofessional students using a pre-/post-test design. A 10-question knowledge test was captured at three intervals and contained questions specific to sepsis management and post-operative hip complications. Participants within the intervention group showed a significant increase in mean scores between knowledge test 1 and 2 and between knowledge test 1 and 3, but did not see an improvement in mean scores between knowledge test 2 and 3 ($p>.99$) (Fusco et al., 2022). Following the escape room intervention, participants reported an increase in the expected outcome ($p=.51$) (Fusco et al., 2022) Participants in this study indicated the escape room was an effective way to develop newer skills (90%; N=156) (Fusco et al., 2022).

Manzano-León et al. (2021) highlighted that playful learning environments generate motivation and healthy competition among participants. In this study, authors implemented an escape room to determine effects on academic performance, motivation, and flow among master's degree students in a special education course. As students completed this escape room, results indicated significant improvements in academic performance (p=<.001) and classroom climate (*p*=.008), indicating the effectiveness and benefits of escape room education formats (Manzano-León et al., 2021).

The innovative, interactive mode of education delivery is predicted to improve nurse knowledge and skill among medical-surgical nurses. Thus, the initiation of an interactive, simulated-based sepsis education program was predicted to reduce hospital mortality through improved knowledge retention and application of education, as shown through prior studies (Fusco et al., 2022; Luna et al., 2020; Manzano-León et al., 2021; O'Shaughnessy et al., 2017).

2.6 Conceptual/Theoretical Framework

A theoretical framework guides the planning, delivery, and evaluation of an intervention. Lewin's Change Theory, developed by Kurt Lewin, is a three-stage model that identifies factors of change which relies on driving forces, restraining forces, and equilibrium (Udon & Wagner, 2018). Driving forces push the change into practice; restraining forces counter driving forces. Equilibrium occurs when driving forces and restraining forces are equal; no change occurs in equilibrium (Petiprin, 2023). The purpose of using this theory is to identify factors that prevent changes from occurring, forces that oppose change, and forces that promote or drive change to disrupt equilibrium and promote change (Sutherland, 2013). These three stages include unfreezing, change, and refreezing. Unfreezing is defined as the process of "letting go" of past practices and education to absorb new information (Petiprin, 2023). In Lewin's Change Theory,

change is defined as the process of changing thoughts, behavior, and/or feelings (Petiprin, 2023). The final stage, refreezing, is establishing the new change as a habit (Petiprin, 2023).

Utilizing the first stage, unfreezing, the project lead identified a practice that required change (Lewin, 1951). The disequilibrium in this system assists in identifying driving forces of change. The current standard of how nurses identify sepsis and notify providers requires change to reduce transfers to ICUs and sepsis mortality associated with delayed recognition of symptoms. Collecting data on sepsis mortality from various quality dashboards and databases at the project site guided the project lead in identifying the area of opportunity. This defined the project setting (i.e., the medical units) and expected outcomes (i.e., reduced ICU transfers and sepsis mortality). Then, there was a focus on obtaining buy-in and engagement from the leaders to assist in implementing and sustaining the change. Multiple meetings were held with the nurse managers of the project unit to ensure the project lead had support for this project. Support and buy-in were obtained from the nurse managers, CNSs, and SLEs to assist with project success.

The second stage, change, utilizes the process of a transformation in thoughts, feelings, and behaviors (Udon & Wagner, 2018). This stage is often the most difficult, as changing the practice of nurses can be challenging (Arsenault Knudsen et al., 2021). The resistance to change, and willingness to adopt new evidence-based practice, could lead to mistrust and angst associated with the implementation of a sepsis education program. Transformation occurs through building knowledge and helping nurses feel empowered to communicate changes in their patients with the physician directly. By communicating with physicians directly, this could reduce the need for rapid responses when patients deteriorate quickly, which later reduces transfers to the ICU. Earlier recognition of SIRS criteria will allow the provider to proactively manage the patient rather than react to the rapid change in condition.

Lastly, the third stage, refreezing, involves implementing the new change as a habit (Udon & Wagner, 2018). The targeted change was initiated by implementing a sepsis education intervention to improve the identification of sepsis signs and symptoms in the nurses' daily practice. This will lead to earlier recognition of clinical deterioration, reduced ICU transfers, and reduced sepsis mortality.

Guidelines and education alone will not generate considerable impacts on the metrics of sepsis mortality and ICU transfers, so feedback systems are important (Cecconi et al., 2018). Lewin's Change Theory has limitations because change is unpredictable; therefore, using a linear approach may result in a delay in the expected timeline. Providing feedback to the nurse managers and leaders on ICU transfers and the cause for deterioration will also assist with accountability and identifying knowledge gaps. As feedback is provided to the nurse managers and leader on these ICU transfers, it is important to explore why the ICU transfers are occurring through using the Plan-Do-Study-Act cycle and identifying opportunities for additional education or process change.

The Institute for Healthcare Improvement (IHI) defines the Plan-Do-Study-Act (PDSA) cycle as a short test of change achieved through planning, observing results, and acting on what is learned (IHI, 2022). Utilizing the PDSA cycle assisted in determining pitfalls and making appropriate changes as barriers were identified. Planning the project occurred in initial stages where information was gathered and the need for change was identified. The "do" and "study" phases of PDSA occurred during project implementation. The act portion of the PDSA cycle will occur after the project as the results will be used to identify plans for long-term and larger-scale roll-out of the education intervention. Stakeholders and content experts assisted with refining the

content of the sepsis education intervention. Post-project, their expertise will help to make any changes required prior to the education intervention spreading to other units within the hospital.

CHAPTER 3: METHODS

This scholarly project sought to determine whether evidence-based sepsis education on non-ICU medical-surgical floors within the medicine service line would improve nurses' knowledge, confidence, and identification of early sepsis, as evidenced by reduced ICU transfers and sepsis mortality. It was predicted that a sepsis education intervention would result in an increase in sepsis knowledge, earlier recognition of SIRS criteria, and a reduction in ICU transfers and sepsis mortality in the non-ICU, inpatient medical units within the medicine service line. These data were compared to that of nurses who did not receive the education intervention. Specifically, project data were compared to surgical nurses' experiential knowledge and their ability to prevent ICU transfers and sepsis mortality on two surgical non-project units with comparable ICU transfer volumes and sepsis mortality rates.

3.1 Project Design

This quality improvement project utilized a two-group, pre/post-test design. Subjective outcome measures were collected using a pre-test and post-test to capture the participants' awareness of sepsis and level of confidence in identifying new infections or SIRS. Objective outcome measures were collected through the evaluation of the participants' knowledge using a multiple-choice exam pre- and post-intervention. Data for ICU transfers and sepsis mortality were collected from existing internal dashboards by the Quality Department at the project site.

3.2 Setting

The project occurred in the Southeast United States at an 874-bed tertiary, research, and academic medical center with a Level 1 trauma designation. The project involved nurses on two medical telemetry units within the medicine service line, which will be referred to as Unit Medical A and Unit Medical B. Unit Medical A is a 24-bed medical telemetry unit with

approximately 30 staffed nurses; Unit Medical B is a 36-bed medical telemetry unit with approximately 25 staffed nurses. While both units serve the medical population, Unit Medical B previously served as the COVID unit during the COVID-19 pandemic, and Unit Medical A provides care to a subset of stable, chronic, ventilated patients. The two units chosen are not critical care, do not require specialty experience (cardiac, neuro, oncology, or women's), and are the care sites for many patients after they transition from the medical intensive care unit and/or direct admission from the ED.

The comparison setting for the scholarly project was two units from the surgical service line. Although the patient populations, size of the units, and staffing ratios were not identical, the medical project units and surgical comparison units had comparable ICU transfer volumes and sepsis mortality rates. The patient outcomes data (ICU transfers and sepsis mortality) from Unit Medical A and Unit Medical B were compared to patient outcomes data on two medical-surgical floors within the surgical service line, specifically Unit Surgical A and Unit Surgical B. These units have approximately 60 staff nurses on each unit. Unit Surgical A is a 36-bed post-surgical unit; Unit Surgical B is a 36-bed dialysis/transplant/urology unit. Nurses on these units did not receive the education intervention and did not complete surveys, thus knowledge of nurses was not compared. However, patient outcome data were monitored to compare to the project units.

3.3 Sample

The sample in this project included registered nurses and licensed practical nurses employed on the two medical units, Unit Medical A and Unit Medical B. The delivery of the intervention to these two specific groups of nurses was chosen due to these units accounting for 20% of ICU transfers and 27% of sepsis mortality cases at the project site in 2022. Using

convenience sampling technique, nurses on the project units were invited to participate in the project's education intervention through announcements from their nurse managers and SLEs.

The sample population included inpatient nurses on non-ICU inpatient units within the medical service line who work both day shift and night shift. Travel nurses with a contract greater than eight weeks were included. Nurses with a travel contract of less than eight weeks or who were working as float staff with the resource team were excluded from the intervention. This was due to the inability to gather all survey data and feedback within the intervention timeline due to infrequent staffing on the project units and end-of-contract services. Advanced practice providers, clinical nurse leaders, nurse managers, physicians, and other interdisciplinary staff not practicing as bedside nurses were also excluded. Similarly, nurses from the cardiac, neurosciences, surgical, women's health and obstetrics, oncology, behavioral health, outpatient, pediatrics, critical care, and ED settings were excluded. Lastly, nurses on family and/or medical leave (FMLA), paid time off (PTO), or extended leave were excluded due to absence during the intervention period. Nursing assistants known as certified nurse assistants (CNA) or healthcare technicians (HCT) were included in the education delivery as they support the nurses with some elements of patient care, but they were not asked to complete the surveys to provide the project lead an understanding of the bedside nurse knowledge pre- and post-education.

To obtain the highest number of participants possible, the project lead gathered feedback from the nurse managers on availability of staff and their working schedules. Nurse managers gathered feedback in morning and evening huddles on staff interest in participation. Two months prior to implementation, the education plan was presented to the service line and unit level educators as well as the nurse managers.

Patients with an identified sepsis diagnosis were tracked on the project and comparison units to determine outcomes. In addition, patients who transferred to an ICU were analyzed to determine the cause of their transfer. If the cause of the transfer was not infectious in origin, that patient case was excluded from the review.

3.4 Intervention

The intervention for this project was an educational escape room, which was implemented solely by the project lead to avoid extraneous variables in education delivery. The project lead used the Nurses' Sepsis Awareness Questionnaire developed and validated by Chua et al. (2022) as well as an interactive sepsis education intervention that was developed by the project lead in collaboration with the medical SLE and critical care CNS.

The project lead delivered the education in the form of an interactive case study using an escape room format (Appendix A). An escape room is a clue-based game that requires riddles to be solved to unlock or progress through the "room" until the final clue is solved to escape (Fusco et al., 2022; Manzano-León et al., 2021). Escape rooms are inexpensive and require critical thinking by solving riddles that may contain decrypt messages, finding information in text, and solving basic math equations (Fusco et al., 2022; Manano-León et al., 2021). Key concepts in this interactive case study included sepsis definitions, pathophysiology, management of sepsis patients, and recognizing SIRS criteria or clinical symptoms indicating the patient's condition is declining. These education sessions were approximately 20 minutes long and were delivered in multiple sessions to different participants in the two project units. Sessions occurred during the early mornings to capture both the night shift and day shift nurses over the course of two weeks. Up to five nurses were able to complete the education at one time. Each nurse participant only attended one session.

The escape “room” was a rolling suitcase locked on the outside with five different locked compartments on the inside. A clue or riddle was read to the participants. A box filled with tools was provided to assist with finding the answers; these tools included a blacklight, one liter of intravenous fluids, laboratory tubes, antibiotics, and blood culture bottles. As a clue or riddle was solved, the answer was used to unlock a padlock on the exterior of a box. Each box contained a clue or riddle to unlock the next. The final clue revealed a key, which opened a small metal box with candy. See Figure 1 for a flowchart demonstrating the sequence of events for the case study.

After “escaping” the suitcase, a debriefing session to review the elements discussed and their importance in medical-surgical nursing was performed. This also provided the participants a time to ask questions. The project lead provided additional statistics and information related to sepsis and its impact on the healthcare industry and patients along with the most recent updated clinical practice guidelines.

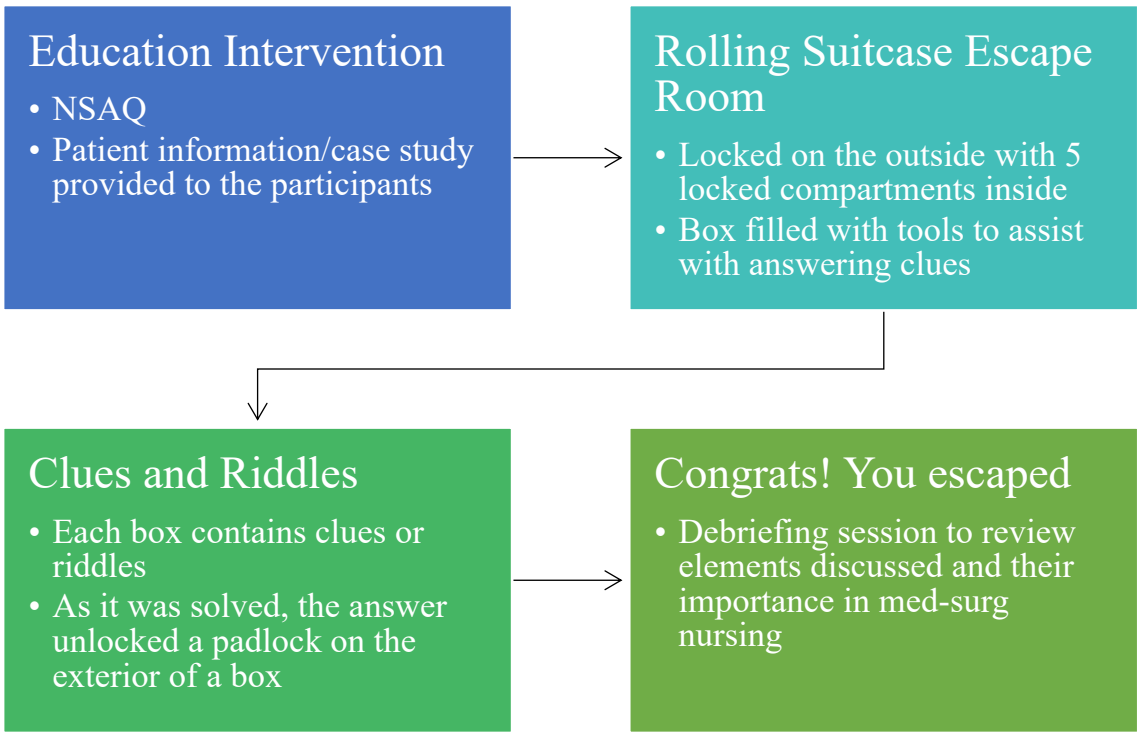

Figure 1

Sequence of Events to Escape During the Suitcase Escape Room

3.5 Measurement Tools

Demographic data were collected using a 10-item survey created by the project lead with branching, resulting in up to 13 items to be answered in the survey. Information collected included years of experience as a nurse, total years of nursing practice, highest level of education, achievement of specialty certification, professional advancement on the clinical ladder at the project site, prior education related to sepsis, recent care for sepsis patients, and the participant's self-reported understanding of sepsis recognition and their role as a nurse (Appendix B). These data were only collected at the first time point, before the initial education, via a personalized, secured link.

To measure nursing knowledge of sepsis, permission was obtained to utilize the Nurses' Sepsis Awareness Questionnaire (NSAQ) by Chua et al. (2022) (Appendix C). It was administered pre- and post-project implementation. This tool has been validated and was used in a multi-site cross-sectional study with the Cronbach's alpha coefficients of the pre-test and post-test confidence items being .968 and .985, respectively (Chua et al., 2022). The knowledge portion includes topics related to the definition of sepsis, risk factors, cause of sepsis, pathophysiology, management of sepsis patients, and early clinical signs of sepsis in patients (Appendix D). It consists of 15 multiple-choice questions. Each item has only one correct answer and items are scored as correct or incorrect. To evaluate overall knowledge of sepsis and identifying SIRS criteria, the percent of items scored correct was summed with higher percentages correct correlating with greater knowledge on sepsis. Another component of this tool is five-questions that utilize a five-point Likert scale survey with responses ranging from 1 (strongly disagree) to 5 (strongly agree) to assess the participant's confidence in caring for sepsis patients (Appendix E). In addition, participant feedback was requested by asking participants to

respond to two open-ended questions post-education asking for a description of how the organization can support the nurse's role in early recognition and response to patients with sepsis, and ways to improve the education.

ICU transfer data and sepsis mortality rates were collected from existing internal dashboards managed by the Quality Department at the project site. Sepsis mortality data are delayed due to billing data being finalized following patient discharge or death. This can result in a one-to-two-month delay in new mortality data being populated. Due to the delay in sepsis mortality data, they were not collected until two months after project implementation, reflecting the final mortality rates from the month of implementation. A baseline period of three months was collected for each measure. After intervention implementation, data were collected from existing internal dashboards for three months and compared in order to see the effects of the education provided. These data were routinely collected by the Quality Department at the project facility and reported to the project lead monthly.

3.6 Data Collection Methods

Data collection occurred after hospital approval for quality improvement projects and university institutional review board (IRB) approval were obtained (Appendix F). Pre-education and immediate post-education data were gathered on the two intervention units, Unit Medical A and Unit Medical B. Prior to implementation, the nurse managers and the project lead met to review the elements of the education, education delivery dates, as well as any final details. Participants were also provided with project disclaimers and consent materials (Appendix G). Consent was obtained before the educational event from the participants and included any disclaimers, conflicts of interest, and an announcement that the intervention would be strictly educational in nature. Lastly, the nurse managers provided the project lead a copy of each

potential participant's schedule to ensure they could receive the education and to reduce the number of missed participants due to scheduling conflicts. One week before implementation, the nurse managers announced to all participants that the educational event would be occurring on their unit.

The initial step was to obtain demographic data from each registered or licensed practical nurse. Secondly, the participants completed a 5-question survey to assess level of confidence in managing sepsis from the NSAQ; the survey used the five-point Likert scale, with 1 meaning "strongly disagree" and 5 meaning "strongly agree". The evaluation of the participants' baseline knowledge was determined by the NSAQ, a pretest with 15 multiple-choice questions about clinical signs and symptoms, pathology, initial medical and nursing interventions, and care of the sepsis patient.

Next, education was provided that was developed by the project lead alongside the facility nurse educator and critical care CNS that included the topics: sepsis pathophysiology, SIRS and sepsis symptoms, and clinical practice guidelines. This education was implemented via escape room format. Lastly, a post-test was administered to all participants using the same pre-test instrument from Chua et al. (2022). The first section again assessed their level of confidence in identifying new infections or SIRS criteria, and the second section of the post-test was the initial clinical knowledge questions that were administered to the participants before the educational event. The total intervention time, including for survey administration, was approximately 45 minutes.

After the completion of the NSAQ participants were provided the opportunity to answer two open-ended questions to gather feedback regarding the education and support needed from

the facility for care of sepsis patients. The post-education data was collected immediately following completion of the education.

The project lead collected the survey data and implemented the education intervention. Participant recruitment occurred over a three-month period (July-September 2023) by speaking about the educational event at unit huddles and disseminating the information via email. Surveys were administered electronically and stored in the Research Electronic Data Capture (REDCap) database, which is a firewall protected, web-based application (Vanderbilt University, n.d.). Data on sepsis mortality and ICU transfers were collected monthly. Each month, a report is generated on the Quality Division dashboard which provides organization, hospital, unit, and patient-level details of mortality. The ICU transfer data is housed on an internal dashboard which refreshes daily. Unit level transfer data can be evaluated and analyzed to determine any new transfers to ICU and their causes on both the intervention and comparison units. Unit level mortalities were filtered, and sepsis patients were identified for the intervention and comparison units. Chart reviews were completed to determine the cause of death and if the patient transferred to ICU from the intervention or comparison unit prior to their death.

3.7 Timeline for Data Collection

Data was collected for five months following project implementation (October 2023 – February 2024). Demographic information and pretest data were collected immediately prior to education implementation. Post-intervention data were collected immediately following the education implementation. Baseline ICU transfer and sepsis mortality data were collected three months prior to project implementation (July 2023– September 2023). Data related to ICU transfers was collected for three months following project implementation (October 2023 – December 2023). Sepsis mortality data is delayed due to billing data being finalized following

patient discharge. This can result in a one-to-two-month delay in new mortality data being populate. Due to the delay in sepsis mortality data, it was not collected until two months after project implementation (October 2023 – February 2024). See Table 1 for a timeline of project events.

Table 1

Timeline of Project Events

Dates	Project Components
July–September 2023	Pre-intervention baseline ICU transfer and sepsis mortality data collection for project setting units and comparison units.
September 2023	Participant recruitment occurred.
September 2023-October 2023	Education intervention implementation. Pre- and post-intervention survey data collection
October 2023 – February 2024	Post-intervention ICU transfer and sepsis mortality data collection for project setting units and comparison units.

3.8 Data Analysis

Data was transferred into IBM Statistical Package for Social Sciences (SPSS) version 28 for analysis. Descriptive statistics were used to describe the participants' demographic data. Descriptive statistics were also used to evaluate the number of correct and incorrect survey items; the number of correct answers was summed. The overall percentage of correctly answered items pre- and post-education implementation were compared. Differences in mean knowledge scores and confidence according to nursing experience, the highest level of education, and whether the participants received prior sepsis education was analyzed using paired *t*-test. To detect statistically significant changes in the mean test scores between the two groups, the Wilcoxon-signed rank test was used due to the non-normal distribution of data and small sample size. Significant pre-post differences in ICU transfer volumes and sepsis mortality rates among

the project and comparison units were detected using the paired *t*-test. All data was presented in graphs, tables, and run charts for the visualization of project results.

3.9 Confidentiality of Data

Ethical practices were maintained throughout the project implementation. Confidentiality was maintained by not collecting personal information (such as employee identification number, name, work-assigned email address, birth date, etc.) from participants in any survey. Data was collected and maintained securely by the project lead by using the REDCap database provided by the project site. These data remained confidential when exported from the REDCap database for analysis in SPSS. Confidentiality was maintained by asking participants to create a personalized numerical code when providing demographic information such as the last five digits of their personal cell phone number; this was used to link results across data collection time points. All demographic information as well as pre- and post-test answers were submitted by following a specific link that was only provided to participants via email. This link provided a direct link to the survey questions for the participant to complete. This ensured the survey data were collected immediately following the education intervention. For purposes of data sharing, all responses were reported in an aggregate form rather than individual participant survey responses.

In summary, an escape room format was used to provide sepsis education to medical-surgical nurses in two non-critical care nursing units (Unit Medical A and Unit Medical B). Demographic information was obtained electronically using a REDCap database, followed by a pre-intervention survey using the NSAQ. Participants were asked to solve various riddles and clues related to sepsis pathophysiology, management, and treatment of sepsis patients. Following the intervention, participants were asked to complete the NSAQ again. Pre- and post-survey

results were analyzed using descriptive statistics for demographic data and the Wilcoxon signed-rank test to determine significance due to the unequal distribution and small sample size. Paired *t*-tests were used to compare total sepsis knowledge and confidence pre- and post-intervention amongst the different workplace characteristics: years of nursing experience, highest level of education, and sepsis education received in the last year. Lastly, ICU transfer and sepsis mortality data was compared to Unit Surgical A and Unit Surgical B and analyzed using paired *t*-test to determine statistical significance.

CHAPTER 4: RESULTS

The results of this DNP scholarly project are demonstrated in four categories: nurse knowledge and confidence, confidence in identifying and managing sepsis patients, ICU transfers and sepsis mortality, and lastly, participant feedback. These four categories highlight the main objectives of the project: to increase nursing knowledge and confidence and reduce ICU transfers and sepsis mortality.

4.1 Characteristics of Sample

A total of 17 nurses working on the project units participated in the project. Tables 2 and 3 present the demographic and workplace characteristics of participants. The demographic data shows that 52.9% (n=9) were greater than 41 years of age and 35% (n=6) had greater than 11 years of experience. Notably, 41% (n=7) of participants had only three to five years of experience in their current specialty. Most of the participants were bachelor's prepared nurses (64.7%, n=11), while 23.5% (n=4) had an associate degree and 11.8% (n=2) were master's prepared. A small number of participants (23.5%, n=4) had achieved a specialty certification with 75% (n=3) of those being a Certified Medical Surgical Registered Nurse and 25% (n=1) an Oncology Certified Nurse. Lastly, the majority of participants (64.7%, n=11) stated they had received prior education related to sepsis.

Table 2

Demographics and Workplace Characteristics of Participants

	Number of participants (n=17)	Percentage
Age Range		
25 and below	1	5.9%
26-30	4	23.5%
31-35	2	11.8%
36-40	1	5.9%
41 and above	9	52.9%
Years of Nursing Practice		
Less than 1 year	0	0.0%
1-2 years	3	17.6%
3-5 years	4	23.5%
6-10 years	4	23.5%
11 years and above	6	35.3%
Years of Experience in Current Specialty		
Less than 1 year	2	11.8%
1-2 years	2	11.8%
3-5 years	7	41.2%
6-10 years	4	23.5%
11 years and above	2	11.8%
Highest Level of Education		
Associate's degree (ASN/ADN)	4	23.5%
Bachelor's degree (BS, BSN)	11	64.7%
Master's degree (MSN, MBA, MHA)	2	11.8%
Doctorate/PhD	0	0.0%
Achievement of Specialty Certification		
Yes	4	76.5%
No	13	23.5%
Certifications held by those who have achieved a specialty certification (n=4)		
CMSRN	3	75.0%
RN-BC	0	0.0%
MEDSURG-BC	0	0.0%
Other	1	25.0%
Level of Clinical Nurse Credentialing (CNCP) currently held at facility		
Clinical Nurse I	9	52.9%
Clinical Nurse II	7	41.2%
Clinical Nurse III	0	0.0%
Clinical Nurse IV	0	0.0%
Neither, I am part of NCPP	1	5.9%

Table 3

Demographics and Workplace Characteristics of Participants, continued

	Number of participants (n=17)	Percentage
Recognition for years of service within current specialty through the Nurse Career Progression Program (NCPP) (n=1)		
NCPP Clinical Nurse II	0	0.0%
NCPP Clinical Nurse III	1	100.0%
Have you received previous education on sepsis?		
Yes	11	64.7%
No	6	35.3%
If you received previous sepsis education, which type did you receive? (Select all that apply).		
Read a journal article	4	23.5%
Case Study	3	17.6%
Webinar or seminar	0	0.0%
Attended conference seminar	1	5.9%
Grand rounds	0	0.0%
Continuing education course	8	47.1%
Other	2	11.8%
Is there a sepsis screening tool in your area of practice?		
Yes	17	100.0%
No	0	0.0%
Unsure	0	0.0%
Is there a sepsis protocol in your area of practice?		
Yes	15	88.2%
No	0	0.0%
Unsure	2	11.8%

Table 4 presents the participants' confidence in identifying and managing sepsis patients. Confidence in identifying and managing sepsis patients was assessed using a 5-point Likert scale with 1=Strongly disagree to 5=Strongly agree. Few participants strongly agreed with the statements on the confidence portion in the pre-intervention period. Fifty-eight percent (n=10) agreed they felt confident identifying sepsis, 64.7% (n=11) felt they were competent in performing a clinical assessment of sepsis patients, and 47.1% (n=8) agreed they knew when to escalate newly identified symptoms. Seventy percent (n=12) agreed they knew what and how to monitor patients with sepsis, and 70.6% (n=12) agreed that they knew the initial management of patients with sepsis making these two categories the ones participants were most confident with when caring for sepsis patients.

Table 4

Pre-Education Confidence in Identifying and Managing Sepsis Patients

	Number of participants (n=17)	Percentage
I am confident in identifying symptoms of sepsis.		
Strongly Disagree	1	5.9%
Disagree	1	5.9%
Neutral	2	11.8%
Agree	10	58.8%
Strongly Agree	3	17.6%
I am competent in performing clinical assessment of patients suspected of sepsis.		
Strongly Disagree	1	5.9%
Disagree	1	5.9%
Neutral	1	5.9%
Agree	11	64.7%
Strongly Agree	3	17.6%
I know when to escalate to the doctor when I identify patients with sepsis.		
Strongly Disagree	1	5.9%
Disagree	0	0.0%
Neutral	1	5.9%
Agree	8	47.1%
Strongly Agree	7	41.2%
I know how and what to monitor in patients with sepsis.		
Strongly Disagree	1	5.9%
Disagree	0	0.0%
Neutral	2	11.8%
Agree	12	70.6%
Strongly Agree	2	11.8%
I know the initial management of patients with sepsis.		
Strongly Disagree	1	5.9%
Disagree	0	0.0%
Neutral	2	11.8%
Agree	12	70.6%
Strongly Agree	2	11.8%

4.2 Nurse Knowledge and Confidence Results

Analysis of the NSAQ item results (range of responses and mean scores) indicate there was an increase in participants' sepsis knowledge (pre-intervention [M=77.6, SD=13.7], post-intervention [M=82.4, SD=14.3]) following the sepsis education intervention (Table 5). Wilcoxon matched pairs rank test was conducted to determine whether this was a statistically significant difference in knowledge scores. Results of that analysis showed that the improvement in knowledge scores from pre- to post-intervention was not statistically significant ($z=1.863$, $p=.068$). Though the result approached significance, the sample size of the project impacted statistical power. Wilcoxon-signed rank test (Table 7) showed that there were difference in knowledge and statistically significant differences in self-reported confidence in identifying sepsis patients ($z=2.33$, $p=.02$), knowing how and what to monitor in sepsis patients ($z=2.714$, $p=.007$), and knowing initial management of patients with sepsis ($z=2.646$, $p=.008$). Additionally, while all participants were knowledgeable in sepsis risk factors (100%, n=17), only 23.5% (n=4) of the participants were knowledgeable in early manifestation (n=4) and 35.3% (n=6) were knowledgeable in escalation of nursing care in septic shock induced hypotension, both key pieces to reducing sepsis mortality and recognizing early clinical signs of deterioration (Table 6).

Table 5

Wilcoxon-Signed Rank Analysis of Sepsis Knowledge and Confidence Mean Scores Pre- and Post-Intervention (n=17)

	Pre-intervention		Post-intervention			
	M	SD	M	SD	z	p-value
Overall Knowledge Scores	77.6	13.7	82.4	14.3	1.86	.068
Overall Confidence Scores	3.88	.911	4.25	1.00	2.68	.007

Table 6

Nurses' Item-Level Knowledge Performance, based on number of correct answers (n=17)

	Pre-Intervention		Post Intervention		
Item's Topic	% correct	SD	% correct	SD	*p*-value
General Sepsis Knowledge					
Sepsis definition	58.8	.507	58.8	.507	1.00
Sepsis risk factors	100	.000	100	.000	-
Sepsis causes	82.4	.383	76.5	.437	.332
Epidemiological data of sepsis	82.4	.393	88.2	.332	.579
Case scenario 1					
Predisposing factors	100	.000	100	.000	-
Early manifestation	23.5	.437	41.2	.507	.269
Blood culture as most essential	70.6	.470	94.1	.243	.041
Serum lactate as biomarker	94.1	.243	94.1	.243	.332
Case Scenario 2					
Prioritized management of sepsis	94.1	.243	88.2	.332	.332
Antibiotics administration as key to improve sepsis outcomes	70.6	.470	88.2	.332	.188
Monitoring of sepsis patients	70.6	.470	64.7	.493	.668
Case scenario 3					
Source of infection causing sepsis	100	.00	88.2	.332	.163
Escalation of nursing care for septic-shock induced hypotension	35.3	.493	52.9	.514	.188
Blood culture prior to administration of intravenous antibiotics	100	.000	100	.000	-
Assessment and evaluation of septic shock treatment	82.4	.393	94.1	.243	.163

4.3 Confidence in Identifying and Managing Sepsis Patients Results

Analysis of individual confidence items for identifying and managing patients with sepsis demonstrated an increase in mean confidence scores from pre- to post-intervention. Pre-education, a small number of participants reported high confidence in identifying sepsis symptoms (17.6%, n=3), competency in performing clinical assessment (17.6%, n=3), knowing when to escalate care to the provider (41.2%, n=7), knowing how and what to monitor in sepsis patients (11.8%, n=2), and knowing the initial management of patients with sepsis (11.8%, n=2). Participants were most confident in their ability to escalate care to the provider (41.2%, n=7) and competency in performing the clinical assessment (17.6%, n=3).

Wilcoxon-Signed rank test showed there was significant difference between post-test scores and pre-test scores in three out of the five questions (Table 7). Post-test scores were higher for all five questions but showed a greater increase in confidence in identifying sepsis patients ($z=2.33$, $p=.02$), knowing how and what to monitor in sepsis patients ($z=-2.714$, $p=.007$), and knowing initial management of patients with sepsis ($z=-2.646$, $p=.008$).

Table 7

Wilcoxon-Signed Rank Analysis of Self-Reported Confidence Pre- and Post-Intervention (n=17)

	Pre-intervention		Post-intervention			
	M	SD	M	SD	z	p-value
Identifying sepsis	3.76	1.03	4.18	1.02	2.33	.020
Clinical assessment of sepsis	3.82	1.02	4.12	.933	1.67	.096
Escalating care to the provider	4.18	1.02	4.35	1.06	1.34	.180
Knowing how and what to monitor in sepsis patients	3.82	.883	4.35	1.06	2.71	.007
Knowing initial management of sepsis patients	3.82	.883	4.24	1.03	2.64	.008

4.4 Differences in Sepsis Knowledge and Confidence Among Different Workplace Characteristics

The differences between total sepsis knowledge scores and confidence by nurses' workplace characteristics are presented in Table 8. Differences in sepsis knowledge scores and confidence were analyzed using paired *t*-tests and were observed between nurses of different years of nursing experience, education level, and previous sepsis education. Nurses with 6-10 years of experience scored higher mean scores in sepsis knowledge tests and confidence than those with any other experience. However, nurses with three to five years of nursing experience reported significantly higher confidence post-intervention ($t(3)$ -3.29, p=.046). Total sepsis knowledge scores were observed to be higher among those with a master's degree (M=90.0, SD 4.7), but the small sample size (n=2) limits the generalizability of the results. There was a significantly higher difference in total sepsis knowledge scores ($t(10)$ -3.32, p=.008) and total self-confidence (t(10) -3.11, p=.011) scores among those who were bachelor's prepared. Lastly,

significant differences were seen in total confidence in relation to sepsis education received in the last year ($t(10)$ -3.24, p=.009).

Table 8

Paired t-test Analysis of Total Sepsis Knowledge Scores and Confidence by Nurses Workplace Characteristics

Variables	N	Total sepsis knowledge score Mean (SD) Pre-Intervention	Total sepsis knowledge score Mean (SD) Post-Intervention	*p*-value	Total self-confidence score Mean (SD) Pre-Intervention	Total self-confidence score Mean (SD) Post-Intervention	*p*-value
Years of Nursing Experience							
<1 year	0	-	-	-	-	-	
1-2 years	3	77.7(3.8)	86.6(11.5)	.383	4.33(.56)	4.53(.50)	.423
3-5 years	3	81.6(8.3)	91.6(6.3)	.103	4.05(.19)	4.65(.47)	.046
6-10 years	4	85.0(13.7)	80.0(10.8)	.661	4.15(.83)	4.55(.52)	.353
>11 years	6	70.0(17.7)	75.5(19.1)	.185	3.36(1.24)	3.63(1.5)	.082
Highest Level of Education							
Associate's	4	83.3(11.5)	78.3(13.7)	.661	4.00(.28)	4.25(.30)	.368
Bachelor's	11	73.3(13.9)	82.4(15.2)	.008	4.00(1.1)	4.36(1.2)	.011
Master's	2	90.0(4.7)	90(14.1)	1.00	3.0(.0)	3.6(.84)	.500
PhD/Doctorate	0	-	-	-	-	-	
Received Sepsis Education in the Last Year							
Yes	11	81.2(15.7)	84.8(15.8)	.412	3.65(1.0)	4.12(1.2)	.009
No	6	71.1(5.4)	77.7(10.8)	.253	4.30(.54)	4.46(.45)	.185

4.5 Participant Feedback

Thirty-two comments were received on the post-intervention survey. Participant feedback from the open-ended questions in the surveys was limited but demonstrated appreciation for the education provided on sepsis and addressed how the organization can better support their educational needs related to sepsis. One overarching theme emerged from this feedback: education delivery. This theme was separated into two categories: how the organization can support the nurse's role in identifying and managing sepsis and recommendations for education

delivered. Three subcategories emerged: in-service training, methods of education delivery, and recommendations for sepsis education. A summary of these qualitative data is shown in Table 8.

Table 9

Qualitative Data from NSAQ Questions

Theme	Categories	Subcategories	Comments
Education Delivery	Organization support	In-service training	*"Provide in-services on the unit"*
			"More in-service education"
			"Continuous education"
		Methods of education delivery	*"Provide mandatory education that is not in front of a computer"*
			"Frequent education"
			"Continue as it helps patient outcomes"
	Recommendations for education delivery	Recommendations	*"No recommendations. This was a relevant and well thought out project"*
			"Frequent education outside the sepsis month"

4.6 ICU Transfer Volumes

Analysis of ICU transfer volumes related to infections demonstrated a decrease in the project units between pre- and post-intervention (Figure 2). Pre-education, Unit Medical A had a total of 20 ICU transfers and Unit Medical B had a total of 19 ICU transfers for a combined pre-intervention ICU transfer volume of 39 patients due to infections. In the comparison units, Unit Surgical A had a total of 12 ICU transfers and Unit Surgical B had a total of 16 ICU transfers for a combined pre-intervention ICU transfer volume of 28 patients due to infections. In the post-intervention period, Unit Medical A had eight ICU transfers and Unit Medical B had 18 ICU transfers for a combined post-intervention transfer volume of 26 patients. Notably, more

participants completed the intervention who worked on Unit Medical B (n=11) when compared to the number of participants who that worked on Unit Medical A (n=6). Unit Medical A did have better staffing ratios during this time with more healthcare technician coverage than Unit Medical B which could have contributed to the increase in ICU transfers. In the comparison unit, Unit Surgical A had 16 ICU transfers and Unit Surgical B had 23 ICU transfers due to infections in the post-intervention period with a combined ICU transfer volume of 39 patients.

Paired *t*-test showed no significant difference in ICU transfer volumes on the project (t(1) =1.66, *p*=.238) or comparison units (t(0)=-.500, *p*=705). ICU transfer volumes decreased for the project units after the intervention, but Unit Medical B only showed a slight decrease in ICU volumes. The comparison units showed an increase in ICU transfers for both units. See Figure 2 for ICU transfer volumes and Table 10 for paired *t*-test results of ICU transfers for the project and comparison units.

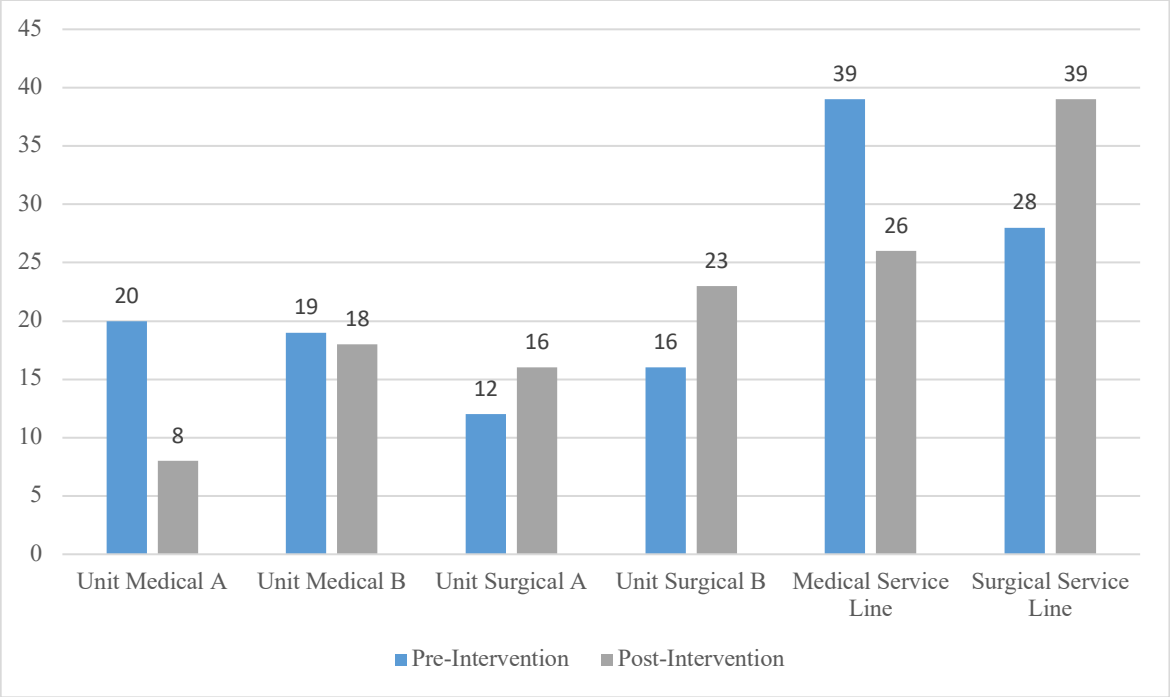

Figure 2

ICU Transfer Volumes per Unit and Service Line

Table 10

Mean ICU Transfer Volumes Between Project and Comparison Units

	Pre-intervention ICU Transfers		Post-intervention ICU Transfers		
	M	SD	M	SD	*p*-value
Unit Medical A	6.67	1.53	2.67	3.79	.225
Unit Medical B	6.33	1.53	6.00	1.73	.423
Unit Surgical A	4.00	2.65	5.33	.577	.383
Unit Surgical B	5.33	1.53	7.67	4.16	.296
Medical Service Line	13.0	1.0	8.67	3.51	.238
Surgical Service Line	9.50	2.12	11.5	3.54	.705

4.7 Sepsis Mortality Rates

Table 11 shows the sepsis mortality rates by quarter and Figure 3 presents the observed to expected (O/E) sepsis ratios pre- and post-intervention. An O/E is an interpretation of the expected number of mortalities based on the patient diagnosis divided into the observed number of mortalities based on patient diagnosis. If a facility's O/E is greater than 1, then the hospital performed worse than the referenced population (Agency for Healthcare Research and Quality [AHRQ], n.d.). Notably, when comparing quarterly rates of sepsis mortality for all patients on the intervention units, the sepsis mortality rate was 0% on each unit in Quarter 3 2023 (pre-intervention data) but ranged from 0% to 4.5% in Quarter 4 2023 (post-intervention data). This indicated a reduction in sepsis mortality from the baseline data of 2022 that was 6.95%. The quarterly O/Es were 0.0 (pre-intervention) and 0.293 (post-intervention). In the comparison units, there was also a decrease in sepsis mortality rates from pre-intervention (11.1%) to post-intervention (0%). The O/E for these comparison units decreased from 0.99 to 0.0 pre- and post-intervention.

Table 11

Sepsis Mortality Rates by Quarter

	2022 Baseline	2023 Quarter 1	2023 Quarter 2	2023 Quarter 3	2023 Quarter 4
Unit Medical A	3.8%	0%	0%	0%	0%
Unit Medical B	9.2%	0%	4.3%	0%	4.5%
Unit Surgical A	8.1%	6.67%	0%	8.3%	0%
Unit Surgical B	5.4%	11.1%	0%	13.3%	0%

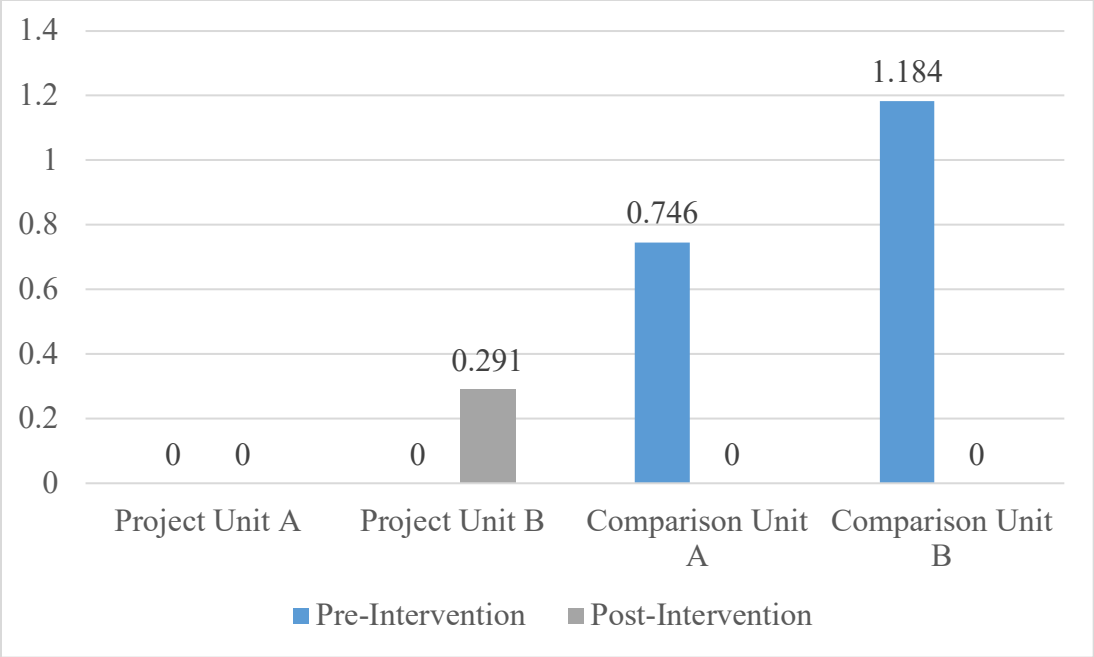

Figure 3

Sepsis Mortality Observed-to-Expected Ratio (O/E) Pre- and Post-Intervention

Summary

In summary, an increase in knowledge and confidence was observed pre- to post-intervention. Mean knowledge scores increased from 77.4 (SD=13.7) pre-intervention to 82.4 (SD=14.3) post-intervention. Self-reported knowledge and confidence in identifying sepsis patients showed significant differences (z=2.33, *p*=.02), knowing how and what to monitor in sepsis patients (z=2.714, *p*=.007), and knowing the initial management of patients with sepsis (z=2.646, *p*=.008). Nurses with three to five years of nursing experience and those who previously had sepsis education had reported improved confidence between pre- and post-intervention (*t*(3) -3.29, *p*=.046; *t*(10) -3.24, *p*=.009). Additionally, there was a significant change in total sepsis knowledge scores (*t*(10) -3.32, *p*=.008) and total self-confidence (t(10) -3.11, *p*=.011) scores among those who were Bachelor's prepared compared to nurses with an associates or masters degree. Mean intensive care unit transfers decreased from 13 (SD=1.0) pre-

intervention to 8.67 (SD=3.51) post-intervention, indicating the project units performed better than the comparison population.

CHAPTER 5: DISCUSSION

The results presented in this project provide insight into the sepsis education needs of nurses working on non-ICU medical-surgical floors. Results indicate that the patient outcomes related to ICU transfers and sepsis mortality were improved on the medical project units that participated in the innovative escape room education on sepsis. Recommendations for future studies and clinical practice were gathered, and this project strives to provide awareness on the need for sepsis education for medical-surgical nurses. To the author's knowledge, this is the first project to explore an escape-room education's impact on clinical nurse knowledge and confidence in medical-surgical units.

5.1 Impact of an Interactive Escape Room Education for Medical-Surgical Nurses

This two-group pre-/post-test project explored the knowledge and confidence of medical-surgical nurses in recognizing and managing patients with sepsis. The objective and subjective results revealed an increase in nurse knowledge and confidence in identifying and managing sepsis patients following the interactive escape room education, as well as a decrease in ICU transfers. The results are consistent with previous studies despite the sample populations having been critical care nurses with different education delivery methods (Choy et al., 2022; Chua et al., 2022; Luna et al., 2020; O'Shaughnessy et al., 2017). The findings of this project support prior study findings indicating gaps in sepsis knowledge are present in the inpatient setting which results in delayed recognition, thus causing ICU transfers and an increase in patient mortality and morbidity (Harley et al., 2019; Hernandez et al., 2019; Kabil et al., 2020; O'Shaughnessy et al., 2017; Paoli et al., 2018). Additionally, active learning and incorporating the use of escape rooms was met with improved knowledge outcomes on the post-test, providing an opportunity for meaningful dialogue with a collaborative care team (Rechter et al., 2022).

While results showed that nurses displayed a good baseline understanding of sepsis risk factors, an initial lack of awareness of sepsis definitions was present. This may suggest a lack of awareness to the severity of sepsis as a life-threatening medical condition, which could result in negative patient outcomes. The findings also suggest a knowledge gap among nurses in recognizing a change in respiratory status, such as an increase in respiration rate, as an early symptom or manifestation of sepsis which was consistent with Chua et al.'s (2022) findings. This knowledge gap corresponded with the participants' self-reported confidence in identifying and knowing how and what to monitor in sepsis patients. The insufficient understanding of sepsis care and lack of confidence was unexpected given that more than 60% of participants reported receiving education about sepsis in the past year. However, it is important to note that the nurses reported a desire for further sepsis education and in-service training to improve their knowledge. Further, the quality of their prior education on sepsis is not known. To support knowledge retention in just-in-time education, the development and implementation of policies into nursing practice is crucial (Mamabolo & Fombad, 2023). Engraining the education and early recognition techniques into policies or practices could be passed down to new hires through orientation and annual skills training each year. This is important for the non-ICU units in the medicine service line because there is currently no standard or protocol to support sepsis patients in these units.

In this project, nursing education level was not shown to be a predictor for nurses' sepsis knowledge and confidence. Nurses who were master's prepared were more likely to achieve a higher mean knowledge score both pre- and post-intervention but notably had a lower reported confidence score pre- and post-education. However, these data findings were limited to only two participants. This should be further explored with a larger nurse sample. Makarem et al. (2019) stated that nursing confidence is highest during the middle years of nursing practice, defined as

10-20 years of experience, which was not reflected in this project's findings. It is possible that the low confidence in the master's prepared nurses could be a representation of reservation when reporting their confidence levels. It would also be interesting to explore the number of bedside shifts the masters' prepared nurses work as they may be part-time, per diem, or work in a role outside of the bedside (charge nurse) as this could potentially alter their self-perceived confidence. It is worth noting that in this project, bachelor-prepared nurses showed the largest increase in nursing knowledge pre- and post-intervention.

Additionally, years of nursing practice was not found to be a predictor of the nurse participants' sepsis knowledge as nurses with six to ten years of nursing experience, regardless of education level, had a higher mean knowledge score pre-intervention compared to their post-intervention scores. This could also be due to the increase in cognitive load during the educational intervention or dual tasking during the post-intervention knowledge survey while continuing to care for patient needs (Rogers & Franklin, 2021). Nurses with one to two years of experience and three to five years of experience showed a greater improvement in nursing knowledge pre- and post-intervention. Nurses with three to five years of experience also had a higher increase in self-reported confidence pre- to post-intervention, which could be due to having greater nursing experience when compared with nurses that had one to two years of experience. Lastly, prior sepsis education in the last year was noted to be an indicator of self-confidence, as the participants who had received prior education had a significant increase in self-confidence pre- to post-intervention.

Despite the variability in nursing groups as predictors of knowledge and confidence, overall knowledge and confidence increased among the sample. This is consistent with articles that found education provided to nurses on sepsis improves confidence in identifying and

managing sepsis (Choy et al., 2022; Chua et al., 2022). An increase in knowledge and confidence can impact patient care by empowering the nurse to practice to the fullest extent of their license scope and stay up to date with new evidence-based guidelines. As nurses are most confident during the middle years of nursing practice, it is promising that an increase in nursing confidence would result in better patient outcomes through executing appropriate and safe interventions for their patients (Abu Sharour et al., 2022; Makarem et al., 2019).

The findings of the project revealed that medical units that received sepsis education experienced a decrease in ICU transfers occurred when compared to ICU transfer volumes on units where nurses had experiential knowledge alone. Although the change was not statistically significant, the clinical significance of reducing ICU transfers is important to note. This assists with decreasing hospital LOS, mortality, and morbidity of sepsis patients, and reducing hospital costs (Paoli et al., 2018). Since the highest burden of costs is often associated with the lower acuity sepsis population, understanding the importance of earlier recognition could prevent the increase in hospital-associated costs directly related to an increase in ICU transfers and extended LOS. As previously stated, delayed recognition results in the progression to MODS and death (Hernandez, et al., 2019). With the knowledge gained from sepsis education, an improvement in critical thinking can assist with various situations outside of sepsis to make important clinical decisions (Papathanasiou et al., 2014).

Lastly, a decrease in sepsis mortality was not seen in the project units (Unit Medical A and Unit Medical B), but there was a reduction in sepsis mortality in the comparison units. Unit Medical A had zero sepsis mortalities throughout 2023, and Unit Medical B had zero sepsis mortality cases in the pre-intervention timeframe. A decrease in sepsis mortality was observed in the comparison units. This could be related to the increase in ICU transfers from those units to

the ICUs, thus skewing the mortality values if the patients expired in the ICU rather than in the medical-surgical units. While multiple studies demonstrated a reduction in sepsis mortality following sepsis education delivery, many of the studies also had extensive sepsis management protocols in place (Fusco et al., 2022; Luna et al., 2020; Manzano-León et al., 2021; O'Shaughnessy et al., 2017), which was not the case for this project.

5.2 Recommendations for Practice

Based on the project findings, the process for educating nurses on identifying and managing patients with sepsis is recommended to change to interactive formats and bring education to the bedside rather than provide traditional didactic education that would remove nurses from their patient assignments in light of the current nursing shortage. Implementation of interactive education would be dependent on engagement and staffing to be able to consistently provide education on a more frequent basis. Next, since the volume of sepsis patients in the non-ICU medical-surgical units is low, the use of sepsis knowledge may be infrequent. This indicates it may be beneficial to implement quarterly mock sepsis events to support nurses on those units to sustain their knowledge. Additionally, exploring what is available in the EMR to support earlier sepsis identification would be helpful in supporting the novice nurse or medical-surgical nurses who may care for sepsis patients less frequently than critical care units. An example of EMR support could be adding the modified early warning score (MEWS) to the nurses' patient assignment list. The MEWS is calculated using temperature, blood pressure, pulse, respiratory rate, and level of consciousness to detect changes in the patient's condition (Zegrean et al., 2023). Since recognizing a change in patient condition using the respiratory status was a knowledge gap for this project's sample, combining other values to identify a change in condition could guide the nurse in prompt assessment and prevent ICU transfers due to

progressive clinical deterioration. The findings of this project will be utilized to support the need and process recommendations for sepsis education at the project site.

5.3 Recommendations for Future Projects and Studies

It would be beneficial to expand future projects and studies to include a broader sample of medical-surgical nurses, as the population of this project was limited to a medical-focused service line. Sepsis occurs in all areas of the hospital; therefore, it is important to understand it is not limited to only medical patients or those within the project setting, as the project site is a part of a larger organization in many geographic regions within the United States. It would also have been beneficial to repeat data collection at an additional time point to observe the retention of sepsis knowledge and confidence levels. This can be addressed by future projects through implementation of a multi-site project expansion or through obtaining a larger sample.

The NSAQ used for this project focused on the application of sepsis knowledge using case scenario questions. Chua et al. (2022) and Luna et al. (2020) similarly used interactive case scenarios to educate nurses on sepsis, but further explanation of how the education was interactive was not shared in those studies. Additionally, Chua et al. (2022) focused on the knowledge and confidence of nurses in all settings, not specific to the non-ICU medical-surgical units and not specific to other disciplines. Expanding this project to critical care areas could highlight differences in knowledge and confidence between ICU and ED settings compared to non-ICU or non-ED settings at the project site. Expanding the project to include interprofessional members of the patient care team, such as physicians, nurses, and paramedics would be helpful to provide insight into the variances in sepsis knowledge and confidence. Lastly, exploring sepsis outcomes (ICU transfers and mortality) when comparing didactic or online education with the

escape room intervention would provide further insight into retention or understanding of education provided to nurses as it relates to sepsis.

5.4 Limitations

Three limitations were observed in this project: a small sample size, a homogenous sample of nurses with mostly greater than six years of experience, and implementation on only two units in one healthcare facility. Additionally, a 37% attrition rate contributed to the small sample size. Staffing shortages and competing education and quality initiatives were a challenge, impairing the ability to pull nurses away from the bedside. This limited nurse participation. The delivery of education in the middle of both day and night shift hours was not explored but may help overcome this challenge to participant recruitment. Further study with a large and diverse sample is justified. The low participation and attrition rates limit the generalizability of the project findings to a wider population of nurses working in non-ICU medical-surgical units as well as those working in ambulatory spaces or outside of the project site. Lastly, although the project and comparison units had comparable sepsis data (such as ICU transfer rates), they differed in patient population, bed size, and staffing. Future comparisons of like units are warranted.

5.5 Conclusion

Moving out of COVID-19 and social distancing, interactive education delivery is a way to engage staff in education on high-risk topics like sepsis that may otherwise be missed. It is important to consider the number of educators needed to support initiatives on a larger scale with the growing need for innovative education and competing educational or quality needs. With competing priorities at the bedside, staffing and capacity challenges, and high nursing turnover, a call for resources to support education for high-risk topics like sepsis is warranted. An increase

in nursing educational support to ensure nurses are supported in their education and updates in evidence-based guidelines can assist with increasing nurse knowledge and confidence to ultimately improve patient outcomes.

Nurses are placed in an opportunistic position to notice changes in a patient's clinical condition. This project revealed gaps in the nurse participants' clinical knowledge and confidence in sepsis management and demonstrated a need for medical-surgical nurse support for sepsis education. Efforts should be made to continually educate medical-surgical nurses on updated evidence-based clinical practice guidelines in their specific clinical areas to prevent poor patient outcomes. Additionally, each healthcare facility can consider developing a multidisciplinary sepsis protocol that is specific to non-ICU clinical areas to work in tandem with the EMR and deliver efficient and effective care to the infected patient. This will empower the bedside nurse to confidently escalate care to the physician to prevent an untimely ICU transfer or mortality and rapidly initiate the sepsis management protocol on their unit.

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APPENDIX A: SUITCASE ESCAPE ROOM CASE STUDY FACILITATOR GUIDE

Suitcase Study: Sepsis

Facilitator Reads: You are caring for a 65-year-old female admitted with w/ *X (diagnosis based upon unit or could say post-op)*. During your assessment, you note the patient is altered and only oriented self and place. The patient is restless and diaphoretic. The healthcare technician notified you earlier in your shift of an elevated heart rate (112) and respirations (28); breath sounds are coarse. The chest x-ray performed yesterday evening showed right lung infiltrates.

Facilitator can give clues throughout the scenario if requested – use 1 hour bundle.

Code Answers:

Question	Learner Action	Type of Lock & Code Answer
What do we need to do STAT?	Find stat orders location in suitcase	Word lock: NoTify provider, rapid response Team activation, Antibiotics, intravenouS fluids → STAT
Which SIRS criteria indicate the patient may be septic?	Can circle values high or low, HR high, BP low, RR high, lactate elevated	Directional lock: ^ v ^ ^
What is something we do prior?	Find blood culture bottle, locate highlighted numbers	Blue & grey lock: 4492
What should we do to get this patient stable?	Vancomycin bag with code written on back; must use blacklight	Small grey lock: 180
What is something else we should get going?	IVF bag, locate highlighted numbers	Bright blue lock: 5253
How much IVF should we bolus to start?	30mL/kg x 90kg	Red lock: 2700
If patient is not improving with IVF and antibiotics, what is the next step?	Locate ICU on the map and locate highlighted room number	Green lock: 1700

Debrief: The patient's elevated WBC, temp, lactic, AMS, HR/RR, etc. were all clinical indicators of sepsis. The CXR revealed a right lung infiltrate, so this is likely sepsis secondary to pneumonia. After sepsis was diagnosed, we focus on the 1-hour bundle. It is imperative to quickly notify the provider so we can initiate antibiotics (get blood cultures first) and bolus fluids. When the patient is not improving and requires vasopressor support, the patient is transferred to ICU.


Time is ticking - we only have one hour. This patient is looking dire. Before we give antibiotics, what is something we do prior?


SuitCase
Study

APPENDIX B: DEMOGRAPHIC SURVEY

Demographic Survey
Complete these questions collect the basic information of your demographic profile.

Age	◯ 25 and below ◯ 26 - 30 ◯ 31 - 35 ◯ 36 - 40 ◯ 41 and above
Years of Nursing Practice	◯ Less than 1 year ◯ 1 - 2 years ◯ 3 - 5 years ◯ 6 - 10 years ◯ 11 years and above
Years of Experience in Current Specialty	◯ Less than 1 year ◯ 1 - 2 years ◯ 3 - 5 years ◯ 6 - 10 years ◯ 11 years and above
Highest level of education? Please select one.	◯ Associate's Degree (ASN/ADN) ◯ Bachelor's Degree (BSN, BS) ◯ Master's Degree (MSN, MBA, MHA) ◯ Doctorate/PhD
Achievement of specialty certification (such as Certified Medical Surgical Registered Nurse [CMSRN], Medical Surgical Nursing Certification [RN-BC], Medical Surgical Nursing Board Certification [MEDSURG-BC], Critical Care Registered Nurse [CCRN] etc.)	◯ Yes ◯ No
If yes to the previous question, please indicate which certification.	◯ CMSRN ◯ RN-BC ◯ MEDSURG-BC ◯ Other
If you chose "other" in the previous question, please indicate which certification:	_____
What level of clinical nurse credentialing (CNCP) do you currently hold at Atrium Health?	◯ Clinical Nurse I ◯ Clinical Nurse II ◯ Clinical Nurse III ◯ Clinical Nurse IV ◯ Neither. I am part of NCPP
If you have been recognized for your years of service within this currently specialty through the Nurse Career Progression Program (NCPP), which level do you currently hold?	◯ NCPP Clinical Nurse II ◯ NCPP Clinical Nurse III
Have you received prior education related to sepsis?	◯ Yes ◯ No
If yes to the previous question, which type of education have you received? Select all that apply.	☐ Read a journal article ☐ Case study ☐ Webinar or seminar ☐ Attended conference seminar ☐ Grand rounds ☐ Continuing education course ☐ Other
Is there a sepsis screening tool in your area of practice?	◯ Yes ◯ No ◯ Unsure
Is there a sepsis protocol in your area of practice?	◯ Yes ◯ No ◯ Unsure

APPENDIX C: PERMISSION TO USE NURSES SEPSIS AWARENESS QUESTIONNAIRE

Jaime Moore <jmoor263@uncc.edu> Tue, Mar 21, 8:35 PM (6 days ago)
to chuaweiling

Hello Dr. Chua,

My name is Jaime Moore, and I am currently a Doctor of Nursing Practice student at the University of North Carolina at Charlotte. I am writing to you today because I found your article titled "Nurses' knowledge and confidence in recognizing and managing patients with sepsis: A multi-site cross sectional study" in the Journal of Advanced Nursing. I really liked the tool you developed to assess nursing confidence. My current DNP project focuses on inpatient medical surgical nurse confidence and knowledge when caring for sepsis patients. This project is unique in that it excludes critical care and emergency department nurses.

I was wondering if you would be willing to share the tools the participants used to capture sepsis knowledge and confidence in caring for these patients? With your permissions, I would love to use those tools and potentially adapt them for my DNP project. I think this collaboration would be beneficial in developing my own project, but using your validated tool would provide better outcomes and data.

Thanks so much, and I look forward to hearing from you.
Jaime

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Jaime Moore, MSN, RN, CEN, TCRN, NE-BC
University of North Carolina - Charlotte | Doctoral Candidate
School of Nursing | Doctor of Nursing Practice - Post-Masters
m: (706) 669-6936 | **e**: jmoor263@uncc.edu | **Student ID**: 801169966

C

Chua Wei Ling Wed, Mar 22, 10:54 PM (5 days ago)
to me

Dear Jamie,

Thank you for your interest in our sepsis questionnaire for nurses. You have our permission to use the questionnaire for your project. Items in Section 2: Confidence in identifying and managing sepsis are rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The total confidence scores ranged from 1 to 25, with higher scores indicating higher confidence in caring for patients with sepsis.
Section 3 and 4 measured nurses' knowledge about sepsis, with 1 point awarded for every correct answer to the question. Total score = 15.

Feel free to contact me if you require further information.

Thank you and all the best!

Best regards,
Wei Ling

APPENDIX D: NURSES' SEPSIS AWARENESS QUESTIONNAIRE

Knowledge of Sepsis

Please read each question carefully and choose the one best answer.

What is sepsis?	◯ Bacteria in blood ◯ Chronic systemic inflammation ◯ Infection ◯ The body's dysregulated response to an infection
Who are at higher risk for sepsis?	◯ Adults aged 65 and above ◯ People with human immunodeficiency virus ◯ People with no spleen ◯ All of the above
Which one of the following does NOT lead to sepsis?	◯ Animal bites ◯ Cancer ◯ Coronavirus ◯ Urinary tract infection
Which of the following statements about sepsis is correct?	◯ Sepsis kills more people annually than heart attack or stroke ◯ The risk of mortality from sepsis decreases with age ◯ Sepsis only affects people who already have a pre-existing condition ◯ Women have a higher risk of mortality from sepsis compared to men

Please read case study 1 and answer the following questions.

Case Study 1

Mr. James, 55-year-old male, presented with type 2 diabetes mellitus and had an ulcer overlying the first metatarsophalangeal joint on the right foot. He was alert and oriented. His past medical history includes hypertension and atrial fibrillation.

On examination, there was a 2cm x 2cm ulcer extending through skin and muscle. The ulcer was sloughly, and the surrounding area was painful, red, and swollen.

His vital signs were temperature 38.0*C (100.4* F), HR 97 beats per minute, RR 28 breaths per minute, BP 102/53mmHg, SpO2 97% on room air.

Page 4

Which one of the following is the MOST IMPORTANT risk factor that predisposes Mr. James to sepsis?	◯ Age ◯ Gender ◯ Hypertension ◯ Diabetes Mellitus
Which one of the following parameters is an early indicator of sepsis for Mr. James?	◯ Temperature 38.0*C (100.4* F) ◯ Heart rate 97 beats per minute ◯ Respiratory rate 28 beats per minute ◯ Blood pressure 102/53mmHg
Which one of the following will be the most ESSENTIAL septic workup for Mr. James?	◯ Wound culture ◯ Blood culture ◯ Urine culture ◯ Chest x-ray
Which of the following biomarkers is a concern for patients with sepsis?	◯ Serum lactate level 4.0 mmol/L ◯ Serum potassium level 4.8 mmol/L ◯ White blood cell count 9.5 x 10^9/L ◯ Blood glucose 12.4 mmol/L

Please read case study 2 and answer the following questions.

Case Study 2

Ms. Robinson, 45-year-old female, presented to the Emergency Department with right sided back pain, dysuria and altered urine frequency for 2 days.
Her vitals signs were temperature 39.0*C (102.2* F), HR 135 beats per minute, RR 28 breaths per minute, BP 85/50 mmHg, SpO2 97% on room air. She is noted to be drowsy and have decreased urine output today.

What is the next most appropriate IMMEDIATE management for Ms. Robinson?	◯ Insert and indwelling urine catheter ◯ Administer intravenous fluid ◯ Initiate oxygen therapy ◯ Place patient in a fowler's position
Which of the following would improve Ms. Robinson's outcome?	◯ Cooling blanket ◯ Anti-pyrexia medication ◯ Antibiotics ◯ High flow oxygen therapy
The following should be monitored to assess Ms. Robinson's response to initial treatment EXCEPT	◯ Blood pressure ◯ Pain score ◯ Level of consciousness ◯ Urine output

Please read case study 3 and answer the following questions.

Case Study 3

Mr. Williams, 76-year-old, recently started chemotherapy for colon cancer. He has a peripherally inserted central catheter (PICC) line on his right arm. He presented to the Emergency Department with a fever and complained of chills. He has had a fever with severe headache for the past three days. He denied having a cough and did not have any other gastrointestinal, cardiovascular, or urinary symptoms.
His vitals were temperature 38.7*C (101.6*F), HR 146 beats per minute, RR 32 beaths per minute, BP 79/40 mmHg, SpO2 95% on room air. Fluid resuscitation of IV ringer's lactate was initiated.

What is the most likely source of infection for Mr. Williams?	◯ Pneumonia ◯ Cellulitis ◯ PICC line-related infection ◯ Urinary tract infection
Mr. Williams remains hypotensive with blood pressure of 89/43 mmHg despite receiving 2 liters of crystalloids. What is the next likely treatment option?	◯ Albumin ◯ Blood transfusion ◯ Further fluid boluses ◯ Continue work with rounding team and provider to consider advanced treatment measures in the ICU
Which of the following investigations need to be obtained before starting IV antibiotics?	◯ Arterial blood gas ◯ Serum lactate ◯ Blood cultures ◯ Full blood count
Mr. Williams is receiving aggressive treatment for septic shock. Which one of the following may suggest that treatment is NOT successful?	◯ Serum lactate 1.5 mmol/L ◯ Respiratory rate 24 breaths per minute ◯ Blood pressure 85/40 mmHg ◯ Urine output of 80mLs of 2 hours

APPENDIX E: NURSE CONFIDENCE IN IDENTIFYING AND MANAGING SEPSIS

Confidence in Identifying and Managing Sepsis

This section asks about your confidence in identifying and responding to patients with sepsis. There is no right or wrong answer. Please select the option which best reflects your confidence/competence in identifying and managing sepsis.

I am confident in identifying symptoms of sepsis.	◯ Strongly disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly agree
I am competent in performing clinical assessment of patients with suspected sepsis.	◯ Strongly disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly agree

I know when to escalate to the doctor when I identify patients with sepsis.	◯ Strongly disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly agree
I know how and what to monitor in patients with sepsis.	◯ Strongly disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly agree
I know the initial management of patients with sepsis.	◯ Strongly disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly agree

APPENDIX F: IRB APPROVALS

To:	Jaime Moore University of North Carolina at Charlotte
From:	Office of Research Protections and Integrity
Approval Date:	27-Jul-2023
RE:	Notice of Determination of Exemption
Exemption Category:	1~4
Study #:	IRB-23-0959
Study Title:	The Impact of Evidenced-Based Sepsis Education on the Recognition of Clinical Deterioration and Sepsis Symptoms in Reducing Sepsis Mortality Among Inpatient Medical-surgical Units

This submission has been reviewed by the Office of Research Protections and Integrity (ORPI) and was determined to meet the Exempt category cited above under 45 CFR 46.104(d). This determination has no expiration or end date and is not subject to an annual continuing review. However, you are required to obtain approval for all changes to any aspect of this study before they can be implemented and to comply with the Investigator Responsibilities detailed below.

WAKE FOREST
UNIVERSITY
HEALTH SCIENCES

Office of Research
INSTITUTIONAL REVIEW BOARD

MEMORANDUM

To: Kim Pate
Atrium/Carolinas Healthcare System

From: Brian Moore, Chair
Institutional Review Board

Date: 8/22/2023

Subject: Exempt Protocol: IRB00099795
The Impact of Evidence-Based Sepsis Education on the Recognition of Clinical Deterioration and Sepsis Symptoms in Reducing Sepsis Mortality Among Inpatient Medical-surgical Units

No protected health information will be used or disclosed in this research proposal; therefore the requirement for individual Authorization does not apply.

Exemption Category 4 - Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. null (Category null).

Note that only the Wake Forest University School of Medicine IRB can make the determination for its investigators that a research study is exempt. Investigators do not have the authority to make an independent determination that research involving human subjects is exempt. Each project requires a separate review and approval or exemption. The Board must be informed of any changes to this project, so that the Board can determine whether it continues to meet the requirements for exemption.

APPENDIX G: PARTICIPANT DISCLAIMER

Sepsis Initiative Surveys

Project Information and Participation Disclaimer

You are invited to participate in a research study. Participation in this research study is voluntary. The information provided is to help you decide whether or not to participate. If you have any questions, please ask.

This is a description of the project and important information related to your participation:

Title of Quality Improvement Project: The Impact of Evidence-Based Sepsis Education on the Recognition of Clinical Deterioration and Sepsis Symptoms in Reducing Sepsis Mortality Among Inpatient Medical-surgical Units

Affiliations: Project in conjunction with the University of North Carolina at Charlotte and Carolinas Medical Center.

Personnel: Project lead is Jaime Moore, DNP Candidate. Mrs. Moore can be contacted at jmoor263@charlotte.edu or 706-669-6936 should you have any questions or concerns about participation in this project. You may also contact the student's advisor Dr. James Montegrico at jmontegr@charlotte.edu should you have questions or concerns about the project. For questions regarding the rights of participants, any complaints, or comments regarding the manner in which the project is being conducted, please contact the UNC Charlotte Office of Research Protections and Integrity at uncc-irb@charlotte.edu.

Why are we doing this study?
The purpose of this project is to determine the impact of providing simulation-based sepsis education materials to nurses on non-critical care medical surgical units within the Medical Service Line on their knowledge and confidence in managing sepsis patients and identifying clinical deterioration.

Why are you being asked to be in this research study?
We are asking you to participate in this project because you are a nurse at Carolinas Medical Center who works on a non-critical care medical surgical unit within the Medicine Service Line. To participate, you also must be at least 18 years old and able to speak and read in English. Your participation is voluntary. Choosing not to participate will not affect the care that you provide to patients. There are no direct benefits to participating in this project, but you may gain additional knowledge about sepsis recognition and clinical deterioration. If you choose to participate, it will require approximately 1 hour, 25 minutes of your time.

What will happen if I take part in this study?
We will be conducting an analysis of the education by asking you to answer a series of questions about you and your nursing background, your knowledge of caring and managing sepsis patients, as well as your confidence in taking care of sepsis and infected patients. We will ask you about

your confidence and knowledge at two points in time (each survey will take less than 20 minutes to complete). Your participation will involve:

- Timepoint #1: You will be asked to answer 13 questions about yourself and your nursing background. You will then be asked to complete 5 questions about your confidence in identifying and managing sepsis patient. Lastly, you will be asked to answer 15 questions assessing your knowledge of sepsis pathophysiology, management of patients, and identification of clinical deterioration. This will occur today during your pre-education session today on your unit and will take less than 20 minutes to complete.
- Timepoint #2: You will then receive simulation-based sepsis education on caring for sepsis patients, management of these patients, and identifying clinical deterioration using an escape room case-study format. This will take approximately 45 minutes to completed.
- Timepoint #3: Following the completion of the education session, you will be asked to complete 5 questions about your confidence in identifying and managing sepsis patients. You will be asked to answer 15 questions assessing your knowledge of sepsis pathophysiology, management of patients, and identification of clinical deterioration. Questions. This will occur post-education while on your unit and will take less than 20 minutes to complete.

What are the benefits of this study?

Benefits may include an increase in nursing knowledge related to sepsis can assist with a reduction in ICU transfers and mortality. This will decrease hospital length of stay, increase patient satisfaction, empower the nurses in their practice and improve their confidence in managing patient care for those with sepsis, decrease sepsis related morbidity, and decrease hospital associated costs for patients.

What risks might I experience?

Some psychological risks could occur when completing the knowledge survey due to embarrassment or lack of confidence. This is rate. No social, economic, legal, or physical risk is expected to occur. To prevent or minimize psychological risks associated with this project, confidentiality will be maintained when participants complete the knowledge survey.

How will my information be protected?

We will not be collecting any data that can link you to the answers you provide, and personal information will not be linked in any way to information you provide during participation in this study. To link your surveys together, you will only be asked to report the last 5 digits of your telephone number. Confidentiality of your responses will be protected as much as possible. If you are uncomfortable answering any question or participating in any part of the surveys, you may choose to not answer that question or to stop your participation and have any notes, data recordings or hard copy answers destroyed. To further protect the confidentiality of your responses, we will not be collecting a signed consent form but will instead consider your participation in the study as consent permitting us to collect the data you provide.

How will my information be used after the study is over?

After this study is complete, identifiers will be removed from the data and the data could be used for future research studies or distributed to another investigator for future research studies without additional informed consent.