Sepsis Early Recognition and Response: Education and Simulation to Increase Knowledge and Confidence in Associate Degree Nursing Students

by

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Abstract

Sepsis kills more than 250,000 people every year in the United States. Immediate treatment is crucial for best patient outcomes but sepsis can be challenging to identify. Nurses may miss signs of sepsis and delay life-saving treatment. The purpose of this quality improvement project was to determine whether an instructional presentation on introduction to sepsis followed by a high fidelity sepsis simulation scenario would improve knowledge and confidence in early recognition of and response to signs of sepsis for final semester associate degree nursing (ADN) students. Tanner's Clinical Judgment Model was used as the theoretical framework for this project. The project administrator used a convenience sample of 32 ADN students at a southeastern United States community college and pre tested them for knowledge and confidence with a sepsis knowledge quiz and C-Scale©. After a sepsis education presentation and high fidelity sepsis simulation scenario and debriefing, 31 students completed post testing with the same two instruments. Independent samples *t*-tests were used to compare changes in pre and posttest group mean scores. Results from both the sepsis knowledge quiz and the confidence scale showed a significant increase ($p < .001$) for group mean scores. These results affirm that there is a positive effect on knowledge and confidence in ADN students who have sepsis education followed by a sepsis simulation scenario and debriefing.

Keywords: sepsis, recognition, simulation, nursing education, knowledge, confidence

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CHAPTER I

INTRODUCTION

Sepsis, resulting from the body's overwhelming response to infection, can lead to tissue damage, organ failure, and death (Cantrell, 2017). Sepsis can be challenging to identify because it lacks a unique, distinguishable set of signs and symptoms and there is no definitive laboratory test. Patients with sepsis often may be under-diagnosed, leading to delayed care resulting in increased incidence of morbidity and mortality (Surviving Sepsis Campaign, 2015). Research supports the use of simulation to teach participants to identify and manage patient clinical deterioration. This quality improvement project used simulation-based education to teach nursing students early recognition and response to signs of sepsis. This introduction will cover the background, needs assessment, purpose, question, definition of terms, and the theoretical framework for the project.

Background

Sepsis

Sepsis is a major healthcare problem worldwide and of the millions of people affected by sepsis each year, approximately 25% die (Rhodes et al., 2017). Sepsis is the third leading cause of death in the United States and every two minutes someone dies from sepsis for a total of more than 258,000 people per year (Sepsis Alliance, 2017). Survivors of sepsis have demonstrated increased cognitive and functional impairments compared to those who have not had sepsis. Risk factors for sepsis include age, male gender, black race, and chronic illness. Especially vulnerable are the immunocompromised, such as those with cancer and human immunodeficiency virus (HIV) (Mayr, Yende, & Angus, 2014) but sepsis can occur in anyone, including healthy

people (Russell, 2016). Sepsis tops the list of the most expensive conditions to treat. According to the most recent Healthcare Cost and Utilization Project (HCUP) statistics from 2013, sepsis accounted for almost 1.3 million hospital stays and $23.663 billion in hospital costs in the United States (Torio & Moore, 2016).

Sepsis can develop quickly and is a medical emergency (Russell, 2016). Immediate treatment is crucial: best practice guidelines for sepsis include collecting two blood cultures followed by initiating intravenous antibiotic therapy, drawing serum lactic acid levels and infusing 30 ml/kg of intravenous fluids when needed within the first three hours of diagnosis (Centers for Medicare & Medicaid Services (CMS), 2018a; Institute for Healthcare Improvement, 2012; Surviving Sepsis Campaign, 2015). Rhodes et al. (2017) recommended starting intravenous antibiotics within the first hour of diagnosis. Some providers also order sepsis biomarker laboratory tests such as serum procalcitonin levels (Szederjesi et al., 2015). Early recognition and treatment of sepsis may prevent shock, multiple organ failure and death (Minasyn, 2017) and improve outcomes (Novosad et al., 2016; Rhodes et al., 2017).

Lack of sepsis knowledge is a problem in the general population: there are few public campaigns for increasing awareness. Even among healthcare personnel there may be lack of awareness of recognition of developing sepsis because it is not confined to a single population or organ system and historically there have been few significant health-improvement initiatives for sepsis (Cantrell, 2017). Recognition of sepsis can be dependent upon a known or suspected infection and indicators of systemic inflammatory response syndrome (SIRS). SIRS criteria are non-specific and include changes in blood pressure, pulse and respiration rates, temperature, and white blood cell counts. When

sepsis is suspected, serum lactate levels may be used for additional evaluation and can indicate decreased tissue perfusion and related organ dysfunction (Cantrell, 2017).

A 2015 review concluded that identification of sepsis was delayed in a third of cases (Goodwin et al., 2015). Nurses are first in line to respond to patient deterioration and can be a critical element of the health care team in recognizing and initiating prompt treatment for patients with sepsis (Lopez-Bushnell, Demaray, & Jaco, 2014; Tazbir, 2012). Cooper et al., (2010) examined nursing students' ability to assess, identify, and respond to deteriorating patients. The students, approaching the end of their pre licensure education program, demonstrated significant deficits in their ability to manage deteriorating simulated patients with hypovolemic and septic shock. Educating nurses in early recognition and treatment of sepsis is key to improving patient care outcomes (Lopez-Bushnell et al., 2014; Russell, 2016; Winterbottom, Smith, & Rice, 2012). Educating nursing students about sepsis recognition and response may better prepare them for practice in sepsis identification and intervention.

Simulation for Learning to Recognize and Respond to Clinical Deterioration

Researchers have identified problems with nurses collecting and interpreting cues of patient deterioration and communicating these to providers when seeking help (Liaw, Scherpbier, Klainin-Yobas, & Rethans, 2011b). Studies provided evidence that simulation is an effective strategy for teaching learners to recognize and respond to clinical deterioration of patients. After engaging in simulation scenarios for learning to identify and manage clinical deterioration, participants have demonstrated significant improvements in knowledge (Cooper et al., 2015; Ozeckin, Tuite, Willner, & Hravnak, 2015), self-confidence (Cooper et al., 2015; Stayt, Merriman, Ricketts, Morton, &

Simpson, 2015; Ozeckin et al., 2015), self-efficacy (Stayt et al., 2015); performance (Cooper et al., 2015; Bell-Gordon, Gigliotti, & Mitchell, 2014; Stayt et al., 2015; Ozeckin et al., 2015; Hart et al., 2014), and self-rated improvement in skill ability and approaching others (Kelly, Forber, Conlon, Roche, & Stasa, 2014).

Connell et al. (2016) conducted a systematic review of the effectiveness of education to recognize and manage deteriorating patients. The authors stated that when simulation was used, it was combined with other educational methods in most of the studies. One study in the review used simulation alone and no significant knowledge improvements in the nurses were detected. Connell et al. (2016) concluded that this might indicate a need for simulation in combination with other educational approaches to increase effectiveness of teaching recognition and management of deteriorating patients.

Problem Statement

Early recognition of, and response to, sepsis is crucial for improved patient outcomes: delayed antibiotic administration after the first hour is associated with increased patient mortality (Ferrer et al., 2014). Signs of sepsis are frequently missed because they are not definitive and many patients are diagnosed late, which significantly increases morbidity and mortality (Tedesco, Whiteman, Heuston, Swanson-Biearman, & Stephens, 2017).

Needs Assessment

The idea for the project originated during a Spring 2017 advisory council meeting when a facility practice partner nurse educator asked if the community college ADN program, the setting for the project, used simulation to teach students to recognize and respond to sepsis. The facility educator stated that rates of sepsis were rising, nurses

were missing identifying cues, and patient death rates due to sepsis were also increasing. Nurse educators from other partner facilities unanimously agreed that increasing education for students in recognizing and responding to sepsis would be an excellent idea.

To determine how and where sepsis was already covered in the ADN curriculum, the project administrator reviewed content plans for each course. NUR 213 Complex Health Concepts, the final course before ADN students graduate from the community college nursing program, was the only course that listed sepsis as an exemplar in 2017. The project administrator learned from the NUR 213 lead course instructor that students learned about sepsis during a lecture about different types of shock. There was no existing content in the curriculum on sepsis early recognition and response.

Graduate Surveys

The project administrator sent four-question surveys via Survey Monkey in July 2017 to 2016 and 2017 associate degree nursing (ADN) graduates with then currently functioning email addresses (n = 42). Of the 22 students who completed the surveys, 91% (n = 20) responded YES to *Do you think it would have been helpful to have had more course content on sepsis recognition and treatment in the ADN Nursing Program*? Eighty-six percent (n = 19) responded YES to *Do you recommend that the ADN Program add more course content to help prepare students to recognize early signs of sepsis?* Of interest is that one 2017 graduate commented, "I remember learning sterile dressing changes but I don't remember any content related to sepsis itself. Maybe it was in the infection concept and I don't remember it? If not, then definitely need more concentration of the concept." Another comment of note from a 2016 graduate: "I would

only add more course content if it will help students pass nclex [sic]. I feel that in the program course work is too strenuous to begin with and if sepsis training is added some other course content should be cut or traded."

Neighboring Hospital Nurse Educators

In addition, the project administrator conducted key informant interviews with a sepsis nurse educator from each of three local hospitals, all of which employ the graduates of this ADN program. The three nurse educators agreed about the need for increasing ADN program curriculum content on sepsis early identification and intervention and emphatically supported the idea for the proposed project.

Purpose Statement

The purpose of this quality improvement project was to determine whether an instructional presentation on introduction to sepsis followed by a high fidelity sepsis simulation scenario would improve knowledge and confidence in early recognition of and response to signs of sepsis for final semester ADN students.

Project Question

The project administrator sought to gain an answer to the following project question:

Does an instructional presentation on introduction to sepsis followed by a high fidelity simulation scenario for students to practice noticing vital signs, interpreting signs of deterioration and need for sepsis screen/SIRS criteria, communicating these to the provider, and anticipating treatment orders improve knowledge and confidence in early recognition of, and response to, signs of sepsis for final semester ADN students?

Definition of Terms

1. Simulation is "a technique that creates a situation or environment to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing or to gain understanding of systems or human actions" (Lopreiato et al., 2016, p. 33).

2. Fidelity refers to the degree of realism in simulation. High fidelity simulation provides a high level of realism and interactivity for learners (Lopreiato et al., 2016). This level of fidelity may apply to different types of simulation, including use of complex computerized manikins (with realistic features such as chest rise and fall, and recorded heart, lung, and abdominal sounds), standardized patients, or virtual reality. Standardized patients are actors trained for education in healthcare. Virtual reality simulation is a recreation of reality displayed on a computer screen (Lopreiato et al., 2016).

3. A confederate is "an individual other than the patient who is scripted in a simulation to provide realism, additional challenges or additional information for the learner" (Lopreiato et al., 2016, p. 6).

4. Debriefing is "a session after a simulation event where educators/instructors/facilitators and learners re-examine the simulation experience for the purpose of moving toward assimilation and accommodation of learning to future situations" (Lopreiato et al., 2016, p. 8). Debriefing for Meaningful Learning (DML) is a "method of debriefing that can be used in simulation environments and other clinical settings to foster student's [sic] reflective thinking and learning . . . it uses Socratic questioning and principles of active learning to uncover thinking associated with actions" (Dreifuerst, 2015, p. 268). The method uses six phases (engage, explore, explain,

elaborate, evaluate, and extend) with the instructor writing on a whiteboard to record and analyze with the students what happened during the scenario. Students are able to see relationships between their assessment, clinical-decision making, nursing interventions, and patient response.

Theoretical Framework

Tanner (2006) reviewed nearly 200 studies to develop The Clinical Judgment Model (TCJM), which represents how experienced nurses use clinical judgment when caring for patients. The research-based process is separated into the four aspects of noticing, interpreting, responding, and reflecting. Noticing includes the nurse's expectations of the situation and is influenced by a number of factors including the nurse's values, experience, and knowledge of the patient and the patient's usual responses. Interpreting includes the nurse's understanding of the meaning of assessment data and determining what appropriate actions need to be taken. Responding is taking those actions. Reflecting includes the nurse's experience of evaluating the patient's response(s) to interventions (reflection-in-action), as well as knowledge and clinical learning gained afterwards from knowing outcomes of actions (reflection-on-action). TCJM has been the theoretical framework for a number of authors when using simulation as an educational methodology or evaluation strategy for nursing students. The Clinical Judgment Model is shown in Figure 1.

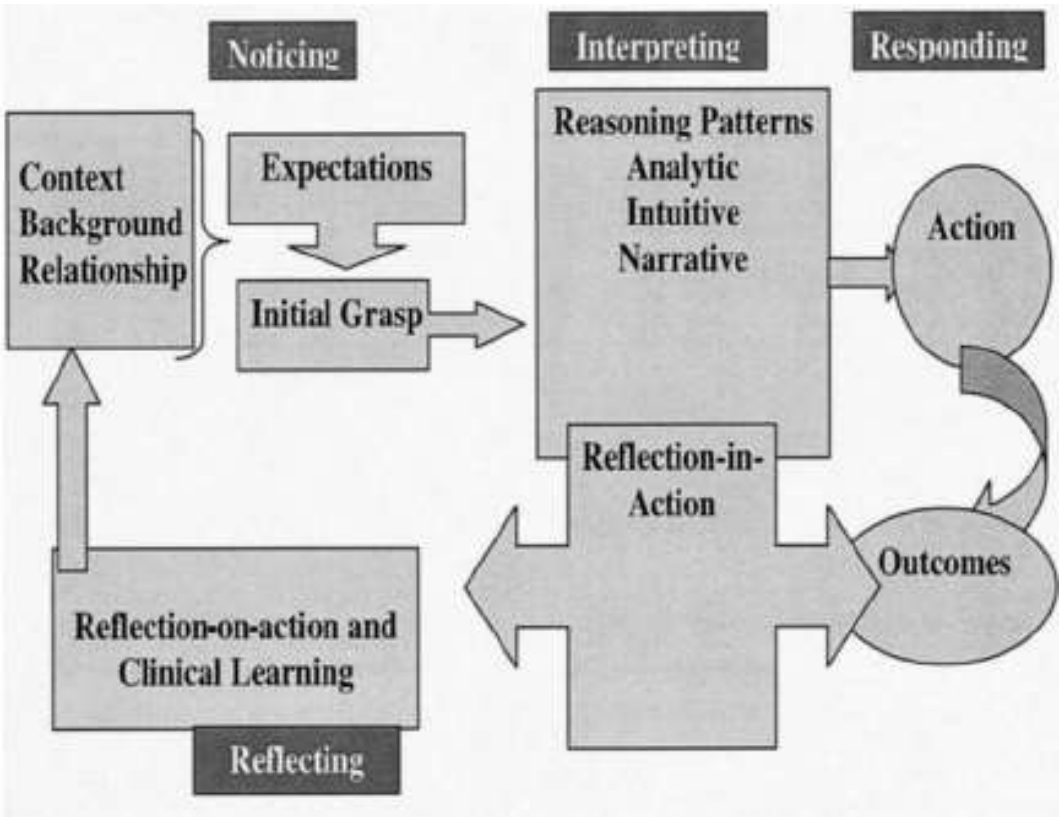

Figure 1. Clinical Judgment Model (Tanner, 2006)

Yuan, Williams, and Man (2014) studied clinical judgment in 113 second and third year nursing students. The students participated in five high fidelity simulation scenarios. The authors used a rubric (Lasater, 2007) based on TCJM and found that overall clinical judgment scores as well as scores for each of the four TCJM components increased for the students over the course of the five scenarios.

Fawaz and Hamdan-Mansour (2016) implemented a quasi-experimental study with 56 nursing students. They compared students participating in simulation experiences to a control group who received traditional classroom instruction only and used the rubric by Lasater (2007). Their conclusion was that the intervention group had

significantly increased scores on all components of TCJM on evaluation of caring for a human patient.

Kelly et al. (2014) studied 57 nursing students and found that they benefitted from participating in two simulated scenarios of a deteriorating patient. Scores on post simulation surveys showed improvements in recognizing deterioration and in willingness to alert the provider compared to pre simulation survey scores. These components aligned with TCJM aspects of noticing, interpreting, and responding.

TCJM has been used as a theoretical framework for simulation studies demonstrating improvements in nursing students' clinical judgment (Fawaz & Hamdan-Mansour, 2016; Yuan et al., 2014) and caring for a deteriorating patient (Kelly et al., 2014). TCJM was chosen for this project because it can be used to identify phases of nurses' recognition of, and response to, patients with sepsis. In order to optimize appropriate care for patients with sepsis, nurses need to learn to notice cues of status deterioration, including thorough assessment data and vital signs. They then need to interpret those cues as needing immediate attention. Next, nurses need to respond by quickly notifying the provider and/or a rapid response team. As part of this project, nursing students engaged in reflection-on-action and clinical learning in the post simulation debriefing session.

Summary

Sepsis is a serious medical problem that can develop quickly and unexpectedly. Early sepsis recognition, diagnosis, and intervention are related to improved patient outcomes and reduced incidence of impairment or death. Healthcare professionals, including nurses, can miss early identification of sepsis because there is no set of

definitive signs, symptoms, or laboratory tests. Educating nursing students in sepsis early recognition and response may help prepare them for practice as graduate nurses to better care for patients with sepsis. Researchers have demonstrated that simulation in combination with other educational methods has been effective for teaching students to recognize and respond to patient clinical deterioration. The project administrator chose TCJM as a theoretical framework for this project to determine whether sepsis education followed by simulation increased knowledge and confidence in sepsis early recognition and response for ADN students.

CHAPTER II

LITERATURE REVIEW

This review includes a search of the literature on the use of simulation to teach sepsis recognition and response for nurses and nursing students. A summary and synthesis of the literature are given for types of participants, use of simulation and debriefing, educational interventions, anticipated sepsis treatment, study instruments and outcomes. Gaps in the literature as well as strengths and limitations of the literature are also explored.

Method

The literature was searched for studies of use of simulation to teach recognition and response to sepsis in nursing using various combinations of the search terms: *sepsis, septic, nurs*, recognition, simulation,* and *education* in CINAHL, Health Source: Nursing/Academic Edition and ProQuest from the years 2012 to 2017. Studies focusing solely on sepsis management/treatment were excluded. Article reference lists were hand searched for additional sources, which resulted in an article published in 2011. In addition, online open source searches were conducted. A total of five relevant papers were found that addressed use of simulation in teaching sepsis recognition and management to nurses or nursing students.

Simulation for Sepsis Early Recognition and Response

Bethel (2015) implemented a quasi-experimental pretest/posttest design study with 71 registered nurses working on medical-surgical units. The author used an investigator-developed knowledge test, and a validated General Self-Efficacy Scale (GSES) with Cronbach's alphas of samples ranging from .76 to .90. Nurses were

provided with educational material after completing the pretest portion of the study. On an annual competency day, there was a PowerPoint presentation reiterating the written materials they had previously received. Nurses were then oriented to their simulation experience and were pre-briefed with patient information. They participated in a simulated experience with a standardized patient (trained patient actor) who assessed their psychomotor skills, including providing the patient with information about anticipated orders for sepsis treatment (blood tests including lactate levels, fluids, blood cultures, and antibiotics). Scripted debriefing followed and focused on recognizing and interpreting signs and symptoms of systemic inflammatory response syndrome (SIRS), sepsis, intervention, and evaluation. Knowledge tests and self-efficacy tools were re-administered along with tools to evaluate effectiveness of the simulation and program satisfaction. There was a statistically significant increase ($p < .001$) in self-efficacy from before (M = 3.07, *SD* = 0.44) compared to after the intervention (M = 3.39, *SD* = 0.44). The dual component educational program effect on knowledge was evaluated and demonstrated a statistically significant ($p < .001$) score increase from before the intervention (M = 61.83, S*D* = 16.5) to after (M = 85.35, *SD* = 11.06). Limitations included a small purposive sample of two units in one facility, use of a researcher-developed tool with no reported validity or reliability, varying time between didactic education and competency days (simulation) between the two different units with possible sharing of testing information, voluntary participation, and lack of a control group.

Delaney, Friedman, and Fitzpatrick (2015) evaluated the impact of a multimodal educational intervention for knowledge and competence in sepsis early recognition and

treatment. They included 82 critical care and emergency department nurses and used a quantitative, quasi-experimental design to evaluate a specialized sepsis education program for nurses. Participants completed four online learning modules, Institute for Health Improvement (2012) severe sepsis bundles, staging sepsis, cultural competency and health literacy, and TeamSTEPPS communication and teamwork. These interactive modules were followed by participation in high fidelity simulation scenarios and debriefing. Participants completed pre and posttests in sepsis knowledge and self-assessment surveys of competence. Validity and reliability information for the knowledge tests were not provided. The Nurse Competence Scale (NCS) that was used had been tested for validity and had Cronbach's alphas of 0.79 to 0.91. The researchers used paired *t*-tests to analyze scores of the four online didactic modules and the NCS. Results of the study demonstrated statistically significant improvement in scores for three of the four modules including staging sepsis ($p < 0.0001$), as well as for self-assessment survey scores in the three sepsis-specific competence statements ($p < 0.0001$). There were no significant improvements in overall or in seven domains of practice (non-sepsis specific) self-assessed competence scores. Author-reported limitations included use of a purposive sample of nurses with similar educational backgrounds and experience, and use of a self-assessment instrument for competency evaluation. Additional limitations noted were lack of reported reliability or validity for the knowledge test.

Elder (2015) implemented a project utilizing a sepsis simulation scenario to assist nurses to improve recognition of early signs of patient deterioration. A pretest/posttest design evaluated 40 nurses' knowledge and self-confidence after a voice over PowerPoint presentation followed by a high fidelity simulation with a septic patient. Nurses had

access to hospital sepsis protocol forms and professional exchange reports. The author used a Detecting Patient Deterioration Education Test developed by a hospital system; no instrument reliability or validity information was provided. The Clinical Decision-Making Self-Confidence Scale, a 12-item Likert scale, was used to evaluate changes in self-confidence. Internal consistency reliability for the Self-Confidence Scale was reported as Cronbach's alphas ranging from 0.93 – 0.96. Performance in simulation was evaluated with the Creighton Competency Evaluation Instrument (Cronbach's alpha of .979) and then a post simulation debriefing was conducted. Statistically significant increases in knowledge scores from pre intervention (M = 5.70, SD = 1.34) to post intervention (M = 7.65, SD = 1.17), t (39) = 10.49, $p < .0001$ (two-tailed) were reported. Statistically significant increases in self-confidence were also reported from pre intervention (M = 45.11, SD = 6.99) to post intervention (M = 50.08, SD = 7.31) t (37) = 6.17, $p < .0001$ (two-tailed). Limitations included small sample size, some participants' lack of previous simulation experience, absence of teamwork practice due to single nurse participation in each simulation scenario, and lack of reported reliability and validity for the knowledge test.

Liaw, Rethans, Scherpbier, and Piyanee (2011a) described a nursing simulation program to develop student competency in assessing, managing, and reporting patient deterioration. Thirty-one third year university nursing students participated in a randomized controlled study of four scenarios including pneumonia, post-surgical hemorrhage, hypoglycemia, and sepsis/septic shock. They received a study guide with learning objectives and reading materials on signs of deterioration but no didactic teaching. Students in the intervention group (n = 15) participated in teams of five (two to

three were active and the remaining were observers) in high fidelity simulation scenarios of assessment, management and seeking medical help, followed by debriefing sessions. The students in the intervention group then repeated the scenario with role reversal so all students had a chance to be active for all four scenarios. Students (n = 16) in the control group received no simulation practice intervention between pre and post testing but did participate in the same simulation program after the post test. The authors gave no information on any anticipated treatment for the deteriorating patients.

All students pre and post tested individually in the simulated environment during a 15-minute videotaped scenario of a deteriorating patient and were scored with the validated Rescuing a Patient in Deteriorating Situations (RAPIDS) – Tool. Liaw et al. (2011a) stated that construct validity of the RAPIDS–Tool had been established in a previous study. Mean post test scores were significantly higher than pre test scores in the intervention group (M = 5.13, SD = 1.72, p = .01) compared to the control group (M = 3.84, SD = 1.35, p = .05) for ratings of global performance on a scale of 1 - 10. Baseline scores for the same global rating tool were M = 3.37, SD = 0.72, p = .01 for the intervention group and M = 3.34, SD = 1.45, p = .05 for the control group. Mean posttest SBAR communication scores were also significantly higher for the intervention group (M = 11.77, SD = 2.83, p = .01) compared to the control group (M = 9.28, SD = 2.76, p = .05). Mean baseline scores for SBAR pretests were M = 8.47, SD = 1.62, p = .01 for the intervention group and M = 8.63, SD = 2.92 (no p value given) for the control group. Limitations included a single site, small sample size, lack of follow-up testing for long-term retention of skills, use of a single scenario for testing, and no measurement of patient outcomes in the clinical setting.

Schubert (2012) studied the effect of simulation on knowledge and critical thinking in failure to rescue events. Fifty-eight medical-surgical nurses participated in groups of three in a high fidelity scenario of rapid deterioration of a patient with sepsis after pre testing with The Learning Transfer Tool (LTT) and an investigator-developed knowledge quiz. The author stated that the knowledge quiz had content validity established by two content experts and the LTT had a reliability of 0.96 for measuring nurses' critical thinking, prioritization, clinical decision making and evaluation. The nurses were expected to recognize decline of the patient and call for provider help. New orders received from the provider during the simulation included pan cultures, arterial blood gases, intravenous fluid bolus, intravenous antibiotics, and high flow oxygen. Post simulation debriefing followed the scenario for discussion of strengths, weaknesses, and strategies for improvement. The participants repeated the same scenario and had a final debriefing and immediate post testing with both tools. A follow-up posttest was mailed two weeks later. Posttest scores showed significant improvements in mean knowledge scores between group pretest and immediate posttest (M = 0.73, $t = 3.16$, $df = 110$, $p = .002$) and two-week follow up posttest (M = 1.762, $t = 4.08$, $df = 68$, $p < .001$) scores. Scores on the LTT analyzed by the Mann-Whitney U test demonstrated significant increases in critical thinking from pretest to immediate posttest only ($U = 1017$, $p = .001$). Limitations included a new critical thinking assessment tool, small sample size, and fatigue of 50% of participants due to working night shift.

Synthesis of the Literature

Participants – Nurses/Nursing Students

Education for learning to recognize and respond to signs of sepsis occurred in hospital settings and a pre licensure nursing education program. Four of the studies included nurses (Bethel, 2015; Delaney et al., 2015; Elder, 2015; Schubert, 2012). One study by Liaw et al. (2011a) involved university undergraduate nursing students.

Use of High Fidelity Simulation and Debriefing

All of the study articles used high fidelity simulation as part of the intervention. Four of the articles used high fidelity manikins (Delaney et al., 2015; Elder, 2015; Liaw et al., 2011a; Schubert, 2012). Bethel (2015) used standardized patients in the simulation component of her study. All studies included post simulation debriefing for participants. Bethel (2015) provided scripted debriefing including sepsis education. Liaw et al. (2011a) provided debriefing after the first simulation scenario and brief feedback after repeating the scenario.

Educational Intervention Structure

Four studies described an educational intervention prior to simulation: newsletter and PowerPoint (Bethel, 2015); four interactive online learning modules (Delaney et al., 2015); voice over PowerPoint (Elder, 2015); and study guide (Liaw et al., 2011a). Schubert (2012) did not mention a specific pre simulation component before the intervention simulation scenario. All authors reported significant increases in measurement outcomes.

Anticipated Sepsis Treatment

Bethel (2015) provided information on sepsis bundles including Institute for Healthcare Improvement (IHI) (2012) recommendations in the didactic portion as well as the simulation component of the study. Delaney et al. (2015) included didactic teaching on IHI (2012) bundles for nurses but did not state whether this information was used during simulation. Elder (2015) had facility sepsis protocol forms for participants available during simulation. Schubert included new orders from the provider during the scenario for arterial blood gases, pan cultures, intravenous fluids, and antibiotics, but not lactate. Liaw et al. (2011a) did not mention any anticipated or ordered treatment for sepsis.

Study Instruments

Several of the researchers used instruments with independently established validity and reliability: the Creighton Competency and Clinical Decision-Making Scale (Elder, 2015), the Nurse Competence Scale (Delaney et al., 2015), the Learning Transfer Tool (Schubert, 2012), and the General Self-Efficacy Scale (Bethel, 2015). Liaw et al. (2011a) used their previously developed RAPIDS-Tool for measuring performance and provided supporting information for construct validity and inter-rater reliability. Elder (2015) used a hospital-developed knowledge tool without providing validity or reliability results. Two researchers developed their own evaluation tools for measuring knowledge (Bethel, 2015; Schubert, 2012).

Study Outcomes

Researchers evaluated the effectiveness of education of nurses and nursing students for recognizing and responding to patients with sepsis and found statistically

significant improvements in the following areas: increased knowledge (Bethel, 2015; Delaney et al., 2015; Elder, 2015; Schubert, 2012) increased self-confidence (Bethel, 2015; Elder, 2015; Liaw et al., 2011a) increased self-efficacy (Bethel, 2015), improved performance (Liaw., 2011a), improved self-reported competence (Delaney et al., 2015) improved critical thinking (Schubert, 2012), and improved SBAR communication (Liaw et al., 2011a).

Gaps in the Literature

A review of the literature revealed a scant number of recent studies on using simulation to teach nurses and nursing students to recognize and respond early to signs of sepsis. One article did report on pre licensure students (Liaw et al., 2011a) in a university nursing program. There is a total lack of published studies involving ADN students learning to recognize and respond to signs of sepsis.

Another obvious gap was the lack of valid and reliable standardized instruments for measuring learning outcomes in nursing education for early recognition and management of signs of sepsis. Very few studies used any of the same tools, which resulted in a lack of consistency in measurement of participant learning outcomes. Several authors developed their own assessment tools to measure knowledge, skills, or attitudes.

Almost no literature was found on long-term retention of knowledge, skills, or attitudes gained from simulation education. Schubert (2012) was the only researcher who attempted to measure long-term retention of information. The author sent a survey to participants two weeks after the initial posttest but due to low numbers of returns had

limitations on interpretation of this data. There is also no data from any of the studies on transferal of learning to actual patient outcomes.

Strengths and Limitations of the Literature

An identified strength in the literature was that simulation has been shown to be effective in teaching knowledge, skills, and attitudes in recognizing and responding to signs of sepsis. High fidelity simulation and debriefing combined with additional educational components such as study guides, didactic presentations, or interactive online learning modules have been shown to be effective in increasing recognition and management of sepsis for both nurses and nursing students. Limitations of the literature include few numbers of randomized control trials, small sample sizes, and large variability between types of interventions.

Summary

This literature review provided evidence supporting the use of a sepsis educational component followed by high fidelity simulation and debriefing for effective learning of early recognition of and response to signs of sepsis for nurses (Bethel, 2015; Delaney et al., 2015; Elder, 2015) and nursing students (Liaw et al., 2011a). Major gaps in the literature included a shortage of published studies on teaching nursing students to recognize and respond early to signs of sepsis and no studies of simulation-based education on sepsis early recognition and response for ADN students were found. Additional research is needed for developing, testing, and standardizing valid and reliable instruments as well as studying long-term retention of learning and transferal of learning to patient outcomes.

CHAPTER III

METHODOLOGY

Early identification and intervention are crucial to improving outcomes for patients with sepsis. There is no current evidence in the literature for using simulation to teach ADN students to identify and intervene early for patients with sepsis. Prior to Spring 2018, nursing students in the community college encountered sepsis content in a single NUR 213 lecture on different types of shock. After confirming a need and reviewing the literature, the project administrator planned and implemented a simulation-based education project for students to learn and practice sepsis early recognition and response.

Statement of Purpose

The purpose of this quality improvement project was to determine whether an instructional presentation on introduction to sepsis followed by a high fidelity sepsis simulation scenario for students to practice noticing vital signs, interpreting signs of deterioration and need for sepsis screen/SIRS criteria, communicating these to the provider, and anticipating treatment orders improved knowledge and confidence in early recognition of, and response to, signs of sepsis for final semester ADN students.

Project Team

The project administrator served as team leader for the project. The Chair of Graduate Nursing Programs at the university where the administrator was a student was the project advisor. Other members of the team included the community college Director of Nursing Programs as practice partner at the project site, a clinical quality sepsis coordinator at an area hospital system, and a doctorally prepared faculty member at a

neighboring university nursing program with expertise and extensive experience in simulation education.

Design

A one group, pretest/posttest design was used for this project. The project intervention consisted of a PowerPoint presentation on introduction to sepsis, later followed by a sepsis simulation scenario and debriefing. Measurements included a sepsis knowledge quiz and a C-Scale to evaluate confidence in recognizing and responding to early signs of sepsis in adults. Each of these tools was used for both pre testing and post testing.

Setting

The setting was a southeastern United States community college ADN program. The sepsis scenario took place in a simulation laboratory room. The lab had a Laerdal SimMan Essential high fidelity manikin in a hospital bed. The manikin had heart, lung, and bowel sounds, as well as pulses, chest rise and fall, and blinking eyes. There was a headwall over the bed for simulated oxygen delivery and a patient monitor for displaying heart rate, rhythm, and oxygen saturation values. Students had equipment and supplies available to administer medications and intravenous fluids and simulate calling providers and ancillary services for collaboration. There was a separate conference room for conducting post simulation debriefing. Students and faculty sat around a central table facing a large wall-mounted whiteboard for documenting, discussing, and analyzing scenarios during debriefing sessions.

Sample

A convenience sample of ADN students was used for this project. Students enrolled in the Spring 2018, NUR 213 Complex Health Concepts course at the community college were required to participate in all learning activities. All students in the class were required to participate in on-campus clinical simulation education as part of the transition to practice experience and were involved in the project.

Protection of Human Subjects

The project administrator completed the Collaborative Institutional Training Initiative (CITI) in October 2017. The community college and university Institutional Review Boards (IRBs) granted approval for the project proposal before the project start date. No deception or incentives were used with students. Only minimal risks of harm to students were identified. The project administrator was not a NUR 213 classroom instructor or responsible for any grading in the NUR 213 course. Measurement tools were anonymous, pre and post test scores were not included in course grades, and students were not graded for participation in the project.

Instruments

Two paper and pencil measurement tools were used before and after the intervention: a project administrator-developed quiz to evaluate sepsis knowledge and the C-Scale to evaluate students' self-rated confidence in their ability to recognize and respond to early signs of sepsis in an adult. During review of the literature, the project administrator searched for sepsis knowledge tests but found no single quiz that measured the salient content in the educational presentation. The administrator-developed sepsis knowledge quiz was based on current sepsis standards and guidelines (Rhodes et al.,

2017; SSC, 2015) and reviewed for face validity by three sepsis expert nurses at a nearby hospital system. The 10 multiple choice items on the sepsis quiz covered SIRS criteria, signs of sepsis, anticipated orders for suspected sepsis, mortality statistics, infection site sources, and risk factors. Six of the 10 items were select all that apply type questions, with no partial credit for answering part of the question correctly. One item about a critical trend to report to the provider was adapted from a quiz on patient deterioration and used with permission from the author (Schubert, 2012). Each item was worth 10 points with possible total scores ranging from 0 to 100.

The C-Scale was a five-item Likert-type survey used to measure self-confidence. The scale was originally developed for measuring confidence in performing physical assessment. Grundy (1993) established reliability and validity with a Cronbach's alpha between .84 and .93 (n = 34) for students and .85 (n = 22) for staff nurses. The C-Scale was adapted with minor word changes and used with permission from the author to evaluate students' self-rated confidence in their ability to recognize and respond to early signs of sepsis in an adult. Each item answer was scaled on a range of 1 = not at all certain; much hesitation; not at all to 5 = absolutely certain; absolutely no hesitation; for absolutely all of it. Scores above the midpoint for each answer indicated increased confidence and those below the midpoint indicated decreased confidence for a possible composite score of between five and 25.

Procedure

Sepsis Educational Presentation

The project administrator developed a 45-minute PowerPoint lecture based on best practices in sepsis early recognition and response and presented it to the NUR 213

class of 32 students during the first week of the semester on January 11, 2018. The lecture topic was listed as *Infection* on the course calendar; students had no advanced notice in order to limit their exposure to content outside of the intervention. Learning objectives included defining sepsis, recognizing signs and symptoms of sepsis, discussing the importance of early treatment, and discussing the nurse's role in sepsis care including infection prevention. The project administrator created badge-sized information cards in clear plastic holders with SIRS criteria, definitions of sepsis and septic shock, and Surviving Sepsis Campaign (SSC) (2015) treatment bundles and distributed these to students during the presentation. Printouts of the PowerPoint slides were handed out to students after pre testing and before the presentation and also posted in the course online platform. The project administrator informed students that they would have a sepsis scenario as part of their transition to practice experience simulation component and gave instructions to wear the sepsis badge cards on their uniforms during simulation. Students were also assigned to review the sepsis PowerPoint lecture content prior to the first day of their on-campus clinical simulation experience.

Sepsis Scenario Learning Outcomes

A simulation scenario of an 85-year old male with signs of sepsis was adapted from two sepsis scenarios developed by and used with permission from the University of South Dakota at Vermillion Department of Nursing (2012). The project administrator revised the scenario according to the International Nursing Association for Clinical Simulation and Learning (INACSL) INACSL Standards of Best Practice: Simulation^{SM} (INACSL Standards Committee, 2016). Sepsis scenario learning outcomes included accurately interpreting patient assessment data to determine current patient status,

demonstrating professional communication using Situation Background Assessment Recommendation (SBAR) format with interprofessional healthcare team members, and performing expected nursing interventions in response to patient status.

Simulation Component of Transition to Practice Experience

This sepsis scenario was one of eight included in the simulation component of the NUR 213 transition to practice experience. These scenarios were chosen for relevance to practice, including content on high acuity situations such as antibiotic reaction, chest pain, blood transfusion reaction, congestive heart failure, hypoglycemia, opioid toxicity, and pulmonary embolism. Students participated in on-campus clinical simulation experiences in six groups of five or six students for four six-hour days: Tuesday and Wednesday for two weeks in a row from January 30 to May 2, 2018. One scenario was scheduled in the morning and another each afternoon for a total of eight simulation experiences for each group. Groups were divided into two smaller subgroups of two or three students. One subgroup actively participated in the morning scenario while the other subgroup observed and recorded the proceedings to share in debriefing. Active students took turns with assessment, medications, interventions, and communication responsibilities. All students, both active and observers, participated in post scenario debriefing. After lunch the small groups switched active and observer roles. The approximately 20 minute sepsis scenario was scheduled for the afternoon of the third simulation day, the sixth scenario in the series of eight.

General simulation learning objectives were posted in the course online platform but students were not given a schedule of specific scenario topics ahead of time. All students were familiar with the process of clinical simulation, had signed simulation

confidentiality agreements, and had participated in high fidelity scenarios and Debriefing for Meaningful Learning (DML) in previous semesters.

The project administrator oriented students to the simulation room, supplies, and equipment on the first day of the four-day experience. Before each scenario, the project administrator gave students patient information via a printed report in SBAR format. Two nursing faculty members were involved in running scenarios as their clinical teaching component for the semester. The project administrator and the second nursing instructor took turns operating the computerized manikin and acting as a confederate for the roles of preceptor, charge nurse, and/or voice of provider, lab, X-ray etc. on the simulated phone as needed.

Each 20 to 30 minute scenario was followed by a post simulation debriefing session lasting an average of two hours. The project administrator and second nurse faculty member facilitated debriefing sessions using the DML method they learned from Dr. Kristina Dreifuerst at a National League for Nursing DML workshop. The instructors listed completed nursing actions and associated client responses on the whiteboard to assist students in understanding the relationship of nursing decisions and their resulting effects for the patient. Writing assessment information on the whiteboard was an excellent way for students to visualize the progression of changing vital signs during the scenario, as well as reveal any information students missed.

Student Participation in Sepsis Scenario and Debriefing

Students in each of the six on-campus clinical groups had one sepsis scenario experience. Three randomly selected students actively participated in the scenario while the remaining two or three students in the group observed and documented the events for

debriefing. All students had access to the SBAR report immediately prior to the scenario. The observers of the sepsis scenario participated in post simulation debriefing but did not repeat the scenario as active participants.

Expected learner actions during the sepsis scenario (with corresponding aspects of The Clinical Judgment Model) included assessing the patient (noticing), noting abnormalities in level of consciousness, O2 saturation levels and vital signs (noticing), increasing oxygen flow (responding), calling for lab results (responding), noting abnormalities in urinalysis and white blood counts (noticing), evaluating the lack of response to increased oxygen flow (reflection-in-action), using SBAR format to consult with preceptor (responding), completing a sepsis screening tool acquired from the preceptor and confirming signs of SIRS and sepsis (interpreting), using SBAR format to call for help from provider (responding), obtaining STAT orders (responding), starting intravenous fluid bolus (responding), and calling the lab, respiratory therapy, and pharmacy to initiate orders (responding). The project administrator completed the checklist of expected learner actions for each group and made notes about both positive and negative unexpected actions. The administrator used the notated checklist along with the listed nursing interventions and associated client responses documented on the whiteboard to address appropriate student actions as well as gaps in performance (reflection-on-action and clinical learning).

Data Collection

The project administrator collected all data for the project. Data collection began on January 11, 2018 when the project administrator gave the sepsis knowledge quiz and C-Scale survey to the entire NUR 213 class of 32 students immediately prior to the sepsis

education presentation. Data collection continued with post testing from February 6 to May 1, 2018 at approximately two-week intervals. Each of the six student groups again completed the sepsis knowledge quiz and C-Scale immediately after post-sepsis scenario debriefing sessions. One student left the program before participating in the simulation scenario; 31 students completed post testing.

Students were instructed not to write their names or any other identifying information on the pretests or posttests in order to maintain anonymity of data. Students were encouraged to use their sepsis badge cards during the sepsis knowledge quiz to practice comparing vital sign data to SIRS criteria but were not allowed to use any other written resources or to discuss questions and answers with each other.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) version 25 (IBM SPSS Inc., Chicago, IL) was used for analyzing data. Independent samples *t*-tests were conducted to determine whether an instructional presentation on introduction to sepsis followed by a high fidelity sepsis simulation scenario improved knowledge and confidence in early recognition of, and response to, signs of sepsis for final semester ADN students. A significance level was set at $p < .05$.

Evaluation Plan

This project was evaluated as part of ongoing quality improvement to determine if sepsis simulation education would become an established component of the community college ADN curriculum. The project administrator conducted quantitative data analysis of changes for group mean scores of knowledge and self-rated confidence in sepsis recognition and response. At the end of the spring semester series of simulation

scenarios, students completed evaluations of simulation. The sepsis scenario was included in student evaluations of clinical simulation.

Summary

This project used a one group, pretest/posttest design with a sample of final semester ADN students at a community college. The purpose of the project was to determine whether sepsis education and simulation improved student knowledge and confidence in sepsis early recognition and response. The project investigator developed a sepsis education PowerPoint lecture and sepsis information badge cards to present to students after pre testing. Small groups of students then participated over the following four months in a sepsis simulation scenario and debriefing followed by immediate post testing. The project was evaluated for quality improvement to determine if this sepsis education and simulation component would be incorporated into future NUR 213 classes as a permanent element of the community college ADN curriculum.

CHAPTER IV

RESULTS

This chapter will report results of the data analysis. Findings from the sepsis knowledge quiz and the C-Scale will be presented. Sample demographics will be described and key findings highlighted.

Sample Characteristics

The sample population included the 32 students enrolled in a Spring 2018 NUR 213 course at a southeastern United States community college. All 32 students completed pre testing. During the semester one student withdrew from the course; 31 students completed post testing. The class was 87.5% female (*n* = 28), 12.5% male (*n* = 4), 84.4% white (*n* = 27), 12.5% African American/black (*n* = 4), and 3% Hispanic (*n* = 1). Ages ranged from 20 to 49 with a mean age of 29.50 (SD = 8.36).

Findings

The purpose of this project was to determine whether a sepsis instructional presentation followed by a high fidelity sepsis simulation scenario improved knowledge and confidence in early recognition of, and response to, signs of sepsis for final semester ADN students. Independent–samples *t*-tests were used to compare the differences between pre and posttest group mean scores for the sepsis knowledge quiz and the five-item C-Scale.

Knowledge

Sepsis knowledge quiz pre test scores (*n* = 32) ranged from 0 to 50 out of a possible 100 with a mean of 25.94, SD = 12.92. Post test scores (*n* = 31) ranged from 30 to 100 with a mean of 65.81, SD 17.08. There was homogeneity of variances for sepsis

knowledge quiz scores as assessed by Levene's test for equality of variances *(p* = .139). The results of the *t*-test indicated a statistically significant difference between the group mean posttest score compared to the group mean pretest score for the sepsis knowledge quiz. The group mean difference in pre and post test scores was 39.868, SD = 3.81, *t* (61) = 10.47, $p < .001$. The statistical results are shown in Table 1.

Confidence

C-Scale pretest composite scores (*n* = 32) ranged from 7 to 19 out of a possible 25 with a mean of 11.91, SD = 3.17. Posttest composite scores (*n* = 31) ranged from 14 to 24 with a mean of 19.03, SD = 2.32. The assumption of homogeneity of variances for the C-Scale group mean scores was violated, as assessed by Levene's tests for equality of variances *(p* = .003). A Welch *t*-test was run to determine if there were differences in pre and post testing of the C-Scale. The results of the Welch *t*-test indicated a statistically significant difference between the group mean post test score compared to the group mean pretest score for the C-Scale. The group mean difference in pre and post test scores was 7.13, SD = 0.67, *t* (56.8) = 10.22, $p < .001$. The statistical results are shown in Table 1.

Table 1

Pre and Post Testing Group Mean Scores

Variable	Pretest Mean (SD) *n* = 32	Posttest Mean (SD) *n* = 31	*t* value
Knowledge quiz	25.94 (12.92)	65.81 (17.082)	10.47**
C-Scale	11.91 (3.12)	19.03 (2.32)	10.22**

** $p < .001$, two tailed

Summary

Students completed pre testing with a 10 item sepsis knowledge quiz and a five-item Likert-type C-Scale to measure self-rated confidence in their current ability to recognize and respond to early signs of sepsis in an adult. After an intervention of a sepsis education presentation and simulation scenario with debriefing, students completed post testing with the same two instruments. Results indicated a statistically significant improvement for group mean scores for both the sepsis knowledge quiz ($p < .001$) and the C-Scale ($p < .001$) after the intervention.

CHAPTER V

DISCUSSION

This chapter will cover a review of the problem, project results, and where they fit in the context of related research. Also discussed will be the project application to the theoretical framework of The Clinical Judgment Model. Project evaluation and sustainability, implications for education, practice, policy and research, as well as project limitations and recommendations will be addressed.

Review of the Problem

Sepsis can develop quickly and is a medical emergency. It can be difficult to identify because there is no single diagnostic test or set of indicators. Delayed sepsis treatment leads to increased patient morbidity and mortality. Best practices include starting sepsis treatment within one to three hours of diagnosis in order to prevent shock, organ failure, and death. Nurses who are able to recognize signs of sepsis and anticipate orders can be key in facilitating prompt diagnosis and treatment. Sepsis education for nursing students may better prepare them for recognizing and responding quickly to patients with sepsis and thus improve patient outcomes.

The purpose of this quality improvement project was to determine whether an instructional presentation on introduction to sepsis followed by a high fidelity sepsis simulation scenario for students to practice noticing vital signs, interpreting signs of deterioration and need for sepsis screen/SIRS criteria, communicating possible sepsis related data to the provider, and anticipating treatment orders improved knowledge and confidence in early recognition of, and response to, signs of sepsis for final semester ADN students.

Findings from this project support the use of didactic introductory sepsis content followed by a high fidelity simulation sepsis scenario and debriefing for increasing knowledge and confidence in sepsis early recognition and response for ADN students. This project adds to the body of knowledge by demonstrating positive results for increased knowledge and confidence in early sepsis recognition and response for ADN students after sepsis education and simulation.

Results

Thirty-two final semester nursing students at a Southeast United States community college were pre tested for knowledge and confidence with a sepsis knowledge quiz and C-Scale. After a sepsis education presentation, high fidelity sepsis simulation scenario and debriefing, 31 students completed post testing with the same two instruments. Independent samples *t*-tests were used to compare changes in pre and posttest group mean scores.

Results from a sepsis knowledge quiz showed a significant increase ($p < .001$) in knowledge between the pretests ($n = 32$, M = 25.94, SD = 12.92) and the posttests ($n = 31$, M = 65.81, SD = 17.08). Results from the C-Scale showed a significant increase ($p < .001$) in confidence between pre testing ($n = 32$, M = 11.91, SD = 3.17) and post testing, ($n = 31$, M = 19.03, SD = 2.32). These results support answering the project question and affirming that there is a positive effect on knowledge and confidence for ADN students who have sepsis education followed by a sepsis simulation scenario and debriefing.

Related Research

Findings from this project support the results of the limited number of previous studies describing use of high fidelity simulation and debriefing for teaching sepsis recognition and response to nurses and nursing students (Bethel, 2015, Delaney et al., 2015; Elder, 2015; Liaw et al., 2011a; Schubert, 2012). Findings also support results of previous studies demonstrating significant increases in measurement outcomes after a pre simulation sepsis educational intervention followed by simulation for knowledge (Bethel, 2015; Delaney et al., 2015; Elder, 2015; Schubert, 2012) and confidence (Bethel, 2015; Elder, 2015; Liaw et al., 2011a).

The results of this project with nursing students support the work of Liaw et al. (2011a) who used a study guide and simulation, including a sepsis scenario, to teach undergraduate nurses to assess, manage, and report patient deterioration. The authors found significant improvements in student performance and communication during the study. The strength of the findings from this project supports the use of sepsis education and high fidelity simulation and debriefing for increasing knowledge and confidence in sepsis early response and recognition for ADN students.

Unexpected Findings

A surprising finding of the project was the low group posttest mean of 65.81 (SD = 17.08) and a low individual score of 30 immediately after simulation and debriefing. These results could be due to a number of factors. Sepsis knowledge quiz scores were excluded from course grades so students may not have been as invested in learning and demonstrating knowledge of the content as they might have been for a quiz that counted in their course grade.

Six of the 10 knowledge quiz items were select all that apply format, which are more difficult because students must choose all of the correct answers in order to earn credit for the question. On test analysis after use, the first question on the quiz left room for misinterpretation: 1. Which of the following are Systemic Inflammatory Response (SIRS) Criteria? (Select all that apply) a. body temperature > 103.4^{o} was scored as a distractor since it was not the specific SIRS criteria of temperature > 100.9^{o}. However, this value would be considered positive for SIRS since it was above the cutoff. A number of students on the posttest marked all five of the answers and did not receive credit for the item. Recommendations for improving similar projects in the future would be to review knowledge quiz items for clarity and perhaps reduce the number of select all that apply items.

Application to Theoretical Framework

The learning experience of the students during simulation and debriefing can be aligned with TCJM framework and its four aspects of noticing, interpreting, responding, and reflecting. All groups of students started screening for sepsis at the beginning of the first scenario in the series. The first patient had a diagnosis of strep throat in the SBAR report and the students were immediately on alert because of the relationship of sepsis to known or suspected infection (noticing). They collected additional assessment data (noticing) to compare to SIRS criteria on their sepsis information badges and correctly determined that the patient did not meet the criteria (interpreting). Students continued to assess for signs of sepsis in the following four scenarios, but none of the patients met the criteria.

When the students started the sepsis scenario, sixth in the series, the majority of the student groups suspected sepsis when they read the SBAR report, which included signs of a urinary tract infection (noticing), and during their initial patient assessment when they found increased temperature, respiration rate, and pulse (noticing). Students used their sepsis badge cards to compare vital signs to the listed SIRS criteria and completed the sepsis screening tool (interpreting). Most groups completed all of the expected learner actions (responding) on the checklist. However, the confederate faculty member, acting as the preceptor, had to coach one group towards suspecting sepsis by active questioning (reflection-in-action) because they were focused on the urinary tract infection alone. A student in another group, acting as communicator, called the provider to report abnormal lab values and vital signs but failed to mention that the group suspected sepsis.

In post simulation debriefing the project administrator asked about these two groups' delays in suspecting sepsis and communicating their findings to the provider. A few of the students answered that they could not believe they had missed the signs after looking for them in the previous five scenarios and that they would be more diligent in their future patient assessment and sepsis screening (reflection-on-action).

Many groups failed to count respiration rates at least some of the time when assessing vital signs. During debriefing this became obvious when the instructor wrote assessment data on the board and then during the analysis phase asked what information was missing. When the students recognized the missing respiration rates, faculty provided the rates that the students would have had if they had counted. The project administrator reiterated that increased respiration rates are one of the first signs of patient

clinical deterioration, and key in suspecting sepsis. Many students said they now realized the importance of counting respirations (reflection-on-action) and, indeed, in the final two scenarios on the following day, almost every time the groups assessed vital signs they included a respiration count. During assessment of the eighth and final patient of the simulation series, one group verbalized the process for checking SIRS criteria and sepsis screening. They correctly determined that the patient, who had congestive failure, was not at risk for sepsis at that time (noticing and interpreting).

Debriefing also allowed for reviewing the importance of prompt treatment to increase chances of patients surviving sepsis. The project administrator asked the students about orders they would anticipate and reminded them that they had the SSC sepsis treatment bundles on the badge card reverse of their SIRS criteria. Students referred to the three hour bundle of drawing lactate levels and blood cultures, preparing to administer broad spectrum antibiotics, and starting fluids for hypotension (reflection-on-action).

Project Evaluation and Sustainability

The project administrator conducted quantitative data analysis of changes for group mean scores of knowledge and self-rated confidence in sepsis recognition and response in ADN students. Group mean scores demonstrated significant improvements in knowledge and confidence in recognizing and responding to sepsis after students participated in this quality improvement project. These findings supported this sepsis education and simulation component becoming an established addition to the community college nursing program curriculum. Second year faculty were in agreement with the project investigator about the benefits of continuing the sepsis education and simulation

content in future NUR 213 courses, as well as adding it to the next practical nurse education (PNE) final course, NUR 103, starting in Summer 2018.

At the end of the spring semester series of simulation scenarios, students completed evaluations of their entire eight-scenario simulation experience. The overwhelming majority of students expressed satisfaction with simulation. Comments included "I enjoyed these sims as they really are what we encounter . . ." "All the simulations were very realistic and I feel like I learned A LOT!" "These were the best simulations by far because they allowed us to apply all of our nursing knowledge to changing situations." None included any specific feedback about the sepsis scenario. Recommendations for future sepsis simulation would be to include scenario-specific evaluations for student feedback regarding suggestions for improvement.

Implications for Education

National Council Licensure Examination for Registered Nurses

Only one study of the use of simulation for teaching undergraduate nursing students to recognize and respond to sepsis was revealed in the literature, and none was found for ADN students. Pre licensure nursing education programs are evaluated in part by graduates' first time pass rates on the National Council Licensure Examination for Registered Nurses (NCLEX-RN). Therefore programs focus their curricula around NCLEX-RN content. The NCLEX-RN 2016 Test Plan (National Council of State Boards of Nursing [NCSBN], 2016) includes eight categories of content: Management of Care, Safety and Infection Control, Health Promotion and Maintenance, Psychosocial Integrity, Basic Care and Comfort, Pharmacological and Parenteral Therapies, Reduction of Risk Potential, and Physiological Adaptation. While there are multiple content areas that are

applicable to caring for a patient at risk for sepsis or with sepsis, such as Safety and Infection Control, Reduction of Risk Potential, and Physiological Adaptation, there is no content area on the test plan that includes a subcategory specifically on sepsis.

The extent of the emphasis placed on NCLEX pass rates in nursing programs is evident in a survey comment (mentioned in the previous Needs Assessment section) by one of the recent community college ADN graduates. The graduate advised against adding additional sepsis course content to the nursing program unless it would help students pass the NCLEX exam. The purpose of the NCLEX is to allow students to apply clinical judgment over broader areas and not focus on one disease process or syndrome. However, it is possible that if the NCSBN revised the NCLEX Test Plan to specifically list sepsis as a subcategory, pre licensure nursing programs might cover more sepsis content in their curricula, including early sepsis identification and intervention.

Pre Licensure Education for Sepsis Prevention

Although early identification and management of sepsis improves outcomes for patients, the focus also needs to be on sepsis prevention when possible. Sepsis may be triggered by any infection acquired from community, healthcare, or hospital sources. Page, Donnelly, and Wang (2015) reviewed 3,355,753 hospital discharges and found that 307,491 patients had diagnoses of severe sepsis. Of those, 193,081 (62.8%) had community acquired severe sepsis, 79,581 (25.9%) had diagnoses of healthcare associated severe sepsis, and 34,829 (11.3%) had hospital acquired severed sepsis. Mortality rates were higher for those with hospital acquired (19.2%) and healthcare associated (12.8%) severe sepsis than for patients with community acquired (8.5%) severe sepsis. Hospital acquired severe sepsis was related to longer lengths of hospital

stay (17 days) compared to healthcare associated (7 days) and community acquired (6 days) severe sepsis.

Healthcare associated and hospital acquired infections may be preventable with good hand (World Health Organization [WHO], 2009) and environmental hygiene (Sepsis Alliance, 2017; WHO, 2009). However, healthcare workers are not always consistent with their use of infection control practices (Cox, Simpson, Letts, & Cavanagh, 2015). Sherwood (2011, p. 277) asserted, "Education is regarded as the bridge to quality, the link to creating the changes needed in the system. Aims to improve quality and safety demand transformation of health professions education by integrating quality and safety science into the curricula".

Infection prevention education is commonly threaded throughout nursing school curricula, with no single discrete infection prevention course. This integration approach may result in variations between nursing programs on time spent on infection prevention education (Carter, Mancino, Hessels, Kelly, & Larsen, 2017). Carter et al. (2017) surveyed 3,678 pre licensure nursing students to study the relationship between methods and duration of infection prevention education and students' knowledge, attitudes, and practices. Survey topics included hand hygiene, personal protective equipment, isolation precautions, and aseptic technique. The authors concluded that students who reported having less than one hour of infection prevention education were significantly more likely to report problems using infection prevention practices when busy than students who had more education ($p < 0.0001$). Students who received most of their aseptic technique education in simulation or clinical settings were more likely to report confidence in inserting and maintaining invasive devices than those who had most of

their education during lectures ($p = 0.0003$). Thirty-eight percent (1324 students) responded that they believed more infection prevention education was needed in their programs.

Cox et al. (2015) identified perceptions of science, health behavior beliefs of perceived risk and self-efficacy, and applied microbiology knowledge as three areas of influence for infection prevention/control knowledge, intentions, and practice for new graduates entering the nursing profession. The authors recommended rethinking infection control education for undergraduate health professionals, including pre licensure nursing students, to improve the infection prevention/control competency and work-readiness of graduates and therefore decrease incidence of healthcare associated infections.

This quality improvement project was conducted with second year students in their final semester of the nursing program. However, the project administrator was responsible for teaching first year students as well. During the first and second semesters, the administrator increased infection prevention content with an emphasis on the relationship of aseptic technique and prevention of sepsis.

Implications for Practice

This project had its origins during a discussion between facility practice partner nurse educators and community college ADN faculty. The mutual goal was to educate nursing students to recognize and respond to sepsis in order to better prepare them for practice in caring for patients with sepsis. If students gained increased knowledge and confidence in recognizing and responding to sepsis during nursing school, they may have increased readiness to identify sepsis, promptly communicate with providers, anticipate

orders, and quickly implement interventions. New graduate nurses who have practice in sepsis recognition and response prior to working with patients may be more likely to facilitate prompt treatment, which is associated with improved morbidity and mortality for patients with sepsis. Therefore educating nursing students in sepsis early identification and intervention has the potential to improve patient outcomes. Healthcare facilities might be able to influence increased knowledge of sepsis early identification and management in newly hired nurses by asking whether nursing education program partners are implementing adequate sepsis education and simulation in their curricula.

Implications for Policy

The Centers for Medicare & Medicaid Services (CMS) and The Joint Commission (TJC) introduced a Sepsis Core Measure (SEP-1) for Joint Commission-accredited U.S. hospitals in October 2015. The purpose of CMS Core Measures is to reduce morbidity and mortality by using evidence-based process measures. SEP-1 involves completing minimum required treatment actions within three and six hour windows after a patient reaches severe sepsis or septic shock. Core measure performance is essential for ongoing TJC accreditation. CMS publicly reports core measure compliance: satisfactory scores are often set at a minimum of 96 percent. Public reporting of SEP-1 for 2017 compliance data is scheduled to begin in July 2018 (CMS, 2018a). Results from a preliminary study of 50 hospital-based emergency departments indicate a 54% SEP-1 compliance (Venkatesh et al., 2018).

SEP-1 is not yet included in the CMS Value-Based Purchasing (VBP) Program, which rewards acute care hospitals with monetary incentives for quality care to Medicare patients (CMS, 2018b). However, SEP-1 is already part of the CMS Hospital Compare

program (CMS, 2018c), which publicly lists hospitals on a 57-measure quality rating system, and thus is a likely candidate for the VBP plan. In addition, published compliance data for this core measure may affect hospital reimbursements by impacting choices of facilities made by potential patients, providers, and insurers (Jaswal, Natanson, & Eichacker, 2018). The influence of the CMS policy exerting increased financial pressure for SEP-1 compliance may raise facility interest in investing in expanded sepsis education for nurses and nursing students. Findings from this project support introductory sepsis education and simulation to increase knowledge and confidence in early sepsis recognition and response for ADN students.

Implications for Research

There is scant research published in the literature on using simulation to teach recognition and response to sepsis for nurses and nursing students. Findings from this project provide quantitative data to further support the use of sepsis education and simulation to increase sepsis knowledge and confidence for ADN students. Further studies could be done with additional ADN as well as Bachelor of Science in Nursing (BSN) students to explore use of simulation education to increase knowledge, confidence, and other outcomes related to caring for patients with sepsis.

Limitations

There were several limitations of this project. The project administrator used a convenience sample of 32 students at one Southeastern United States ADN program. Therefore the results may not be generalizable to students in other types of nursing education programs or in other geographical regions. The sepsis knowledge quiz developed for this project and used for pre and post testing had face validity only and no

demonstrated reliability. Another limitation was that the simulation component of the intervention took place six times over a period of four months with small student groups. Students in the first group had simulation in the fourth week after the sepsis educational presentation; students in the final group had a delay of almost 16 weeks after the presentation. Since post tests were analyzed for the entire class (n = 31) and not within smaller simulation groups, the investigator was not able to determine if student groups participating in the sepsis scenario earlier in the semester had different knowledge and confidence post test scores compared to student groups who had simulation near the end of the semester. Finally, student knowledge was post tested immediately after simulation and debriefing, with no follow up evaluation to study long-term retention of knowledge or ability to transfer knowledge to care for human patients in a clinical setting.

Recommendations

Pre licensure nursing education programs can focus on increasing education in infection control and prevention in order to decrease incidence of hospital acquired sepsis. In order to strengthen the evidence base with future research in simulation education for teaching sepsis recognition and response, investigators could conduct additional studies with nursing students in different regions of the United States and in different types of programs, such as BSN as well as ADN. Studies to establish validity, reliability, and standardization of sepsis knowledge tools are needed. Of special interest would be measurement of long-term retention of sepsis knowledge and transferal of learning to patient outcomes after simulation based sepsis education.

Conclusion

Sepsis kills more than 700 people each day in the United States and can cause long-term psychological and physical problems for those who do survive (Sepsis Alliance, 2017). Patients with signs of sepsis may be identified by a thorough patient assessment and measuring vital signs. Effectively communicating to providers the urgency of new findings of a deteriorating patient situation is vital to early nursing management of sepsis. Knowledge of expected sepsis treatment interventions and anticipating immediate orders are also crucial for improving outcomes for patients with sepsis.

Nurses may miss cues in identifying sepsis, leading to delayed treatment, which can cause increased incidence of complications and death. One way to address gaps in early identification of sepsis is to incorporate education and simulation to teach sepsis early recognition and response into pre licensure nursing education programs. Findings from this project indicate that an educational intervention including simulation and based on the theoretical framework of TCJM can be effective in increasing knowledge and confidence in early sepsis recognition and response for ADN students. However, results from this project are to be interpreted with caution due to the use of a small sample size from a single ADN program as well as a knowledge tool with untested validity and reliability.

Until there is increased emphasis on adequate sepsis education in pre licensure nursing education, early sepsis identification and intervention may continue to be a challenge for nurses and healthcare facilities. Advocacy from facility partners, NCSBN,

and CMS may be necessary to affect improvements in educating nursing students in sepsis early recognition and response.

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