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Interactive Sepsis Education Program Improves Nurses' Knowledge and Impact on Patient Outcomes.

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Sepsis is a life-threatening organ dysfunction triggered by a dysregulated host response to infection. Sepsis education is a key initiative to assist nurses and patient care technicians to improve their skills in recognizing a patient in decline with escalating care concerns. This study demonstrated increased knowledge of sepsis through completion of an evidence-based computer learning program.

Sepsis is defined as a life-threatening organ dysfunction triggered by a dysregulated host response to infection (Evans et al., 2021). More than 1.7 million people (about twice the population of Delaware) are diagnosed with sepsis each year in this country. Acute sepsis hospitalization and skilled nursing care costs $62 billion ($190 per person) per year in the United States (Sepsis Alliance, 2020). To improve outcomes, prompt identification and proper management must occur in the early hours after the progression to sepsis (Evans et al., 2020).

Emergency rooms provide care to about 60% of sepsis cases, inpatient hospital units provide about 30%, and intensive care units provide about 10% of sepsis care. Increased length of stay, hospital readmissions, and negative patient outcomes are associated with delays in sepsis treatment. Following sepsis guidelines and care bundles can lead to decreased sepsis mortality. In a rural emergency room, nurse-directed care focusing on early identification and treatment of sepsis improved bundle adherence and timely care provided to patients with sepsis (Laux et al., 2022).

According to Onawola (2021), healthcare facilities continue to struggle to manage sepsis. Various infectious organisms can cause sepsis, and the complexity around its pathophysiology adds to the urgent need to identify sepsis early. Onawola suggested it is vital for nurses to perform a detailed assessment of their patients, and be able to recognize subtle and early signs and symptoms of sepsis. To advocate appropriately for their patients, nurses need to focus their education on recognition and management of sepsis, sepsis guidelines, screening tools, and ways to prevent the spread of infection within the hospital setting.

The Surviving Sepsis Campaign (SSC) was initiated in 2004 and has been updated multiple times, with the most recent update in 2021. The SSC provides guidance for healthcare professionals who care for adults hospitalized with sepsis (or at risk for sepsis). Although this guideline is not intended to replace clinical decision-making, research has shown increased adherence to the guideline or bundled care can reduce mortality (Evans et al., 2021). As sepsis rates continue to rise, nurses must be knowledgeable and competent in recognition, identification, and treatment of patients with sepsis (Delaney et al., 2015).

To assure nurses are competent in early identification, education and training is essential. Traditionally, the focus on sepsis identification has been in the intensive care setting, but a need for this training exists in other settings as well. At a multi-facility Midwest healthcare system, formal sepsis education is limited. All nurses attend orientation days, when they take part in a 30-minute sepsis simulation. In this healthcare system, no other formal sepsis education

Background

Sepsis can lead to organ failure and even death. Improved outcomes require early identification and recognition of decline in a patient.

Aim

Evaluate knowledge gain among nurses and patient care technicians (PCTs) through completion of a didactic computer-based sepsis program.

Method

An interventional study used an online learning program provided through Apex Innovations (Lafayette, LA), comparing pre- and post-test assessments. Nurses and PCTs completed the program called Sepsis 2.0 – A Systemic Response®, which quantified knowledge gain regarding sepsis.

Results

During the 6-month study, 51% of eligible nurses and 92% of PCTs participated. A statistically significant improvement was found in post-test passing percentage and average score percentage for nurses and PCTs.

Limitations and Implications

Nurses and PCTs on medical units benefitted from a standardized sepsis educational program. The program could be used for onboarding and continuous learning, and assist with understanding of early identification of patient decline related to sepsis. Limitations included the inclusion of nurses and PCTs only, limited available computers with sound, and sample recruitment.

Conclusion

Nurses and PCTs benefitted from implementation of a didactic evidence-based computer program focusing on sepsis. The program promoted knowledge gain and was appraised positively by nurses and PCTs.

requirement exists for medical-surgical nurses.

Purpose

The purpose of this study was to evaluate possible knowledge gain and improved proficiency in identification and treatment of sepsis by nurses and PCTs through completion of a didactic computer-based sepsis learning program offered by Apex Innovations (Lafayette, LA, USA).

Review of the Literature

Review of the literature was conducted for January 2017-December 2020 using Medline and CINAHL databases. Keywords included *sepsis*, *online learning*, *knowledge gain*, *computer learning*, *nursing*, and *education*. Criteria required sepsis education to be provided in an online learning environment. The review revealed limited research exists on the effectiveness of a computer-based learning program on the application of knowledge gain related to patients with sepsis and outcomes. The literature search then was expanded beyond the 5-year mark to find relevant supporting literature for this study, with the final review addressing literature for January 2012-August 2022.

Delaney and colleagues (2015) performed a study using online instructive presentations, videos, pre- and post-assessments, and high-fidelity patient simulation scenarios. Results showed no improvement in self-assessed competency scores, although improvements in self-perceived competency behaviors and pre-and post-assessment scores were found. This study was one of the first to assess if use of sepsis-focused computer-based learning would lead to improved knowledge gain.

Chimenti and co-authors (2020) identified benefits of a sepsis-screening protocol by a home health clinician, including its importance in early recognition and treatment of sepsis within home and community environments. A key intervention was providing evidence-based sepsis education to home health staff. Of more than 500 healthcare professionals, not all were able to attend in-person education, so many had to watch a recording of the learning events. Authors found this formal sepsis program improved early identification of sepsis and early collaboration with primary care providers focused on symptoms, and lowered medical costs and hospital readmission rates.

Using multiprofessional educational approaches, Raines and co-authors (2018) focused on identification of sepsis in non-ICU patients using the quick Sequential Organ Failure Assessment (qSOFA) tool. The goal was to evaluate the impact of qSOFA scores on earlier recognition of sepsis, and the impact of using the scores to initiate rapid response team (RRT) to decrease event-to-intervention and treatment time. Results demonstrated this education decreased the recognition of an abnormal qSOFA score and time to call the RRT, along with abnormal qSOFA score to antibiotic time, further increasing antibiotic administration adherence.

Additional literature addressed effectiveness of computer-based learning and knowledge gain. These studies did not focus on sepsis but highlighted the impact of computer-based learning on knowledge gain. Yehle and colleagues (2012) showed a positive effect on student learning related to heart failure self-management through the use of online modules with self-directed learning. This study identified the need to incorporate simulation or case studies along with online learning for nurses and nursing students to master all heart failure key

concepts. De Silva and co-authors (2021) evaluated the impact of online heart failure education modules and standardized simulations to enhance knowledge and ability in nurses to apply heart failure skills with patient interactions. Findings determined using innovative teaching strategies other than classroom/lecture leads to enhanced nursing knowledge gain and improved nurse-patient interactions. Broglio and Bookbinder (2014) demonstrated an online educational program focusing on palliative care led to short-term and sustained knowledge gain. Although these studies did not focus on sepsis knowledge gain, the foundation of these studies supports the need for this study.

Ethics

This study was evaluated and approved by the healthcare system's Institutional Review Board. Participation was voluntary, and consent was obtained by the learner launching the computer-based learning program and choosing "Agree to Participate." A non-identifiable participant number was assigned to track pre- and post-data elements to assure anonymity.

Sample Selection

A sample of 2,377 nurses and PCTs from a multi-facility healthcare system in the midwestern United States was enrolled in this study. The sample consisted of 1,996 nurses and 381 PCTs who were age 18 and older. Recruitment took place via email and flyers on all relevant units by the co-principal investigator at each site.

Design and Method

Methods

This interventional study was conducted using a pre- and post-test assessment for four modules (Apex Innovations; Lafayette, LA) in Sepsis 2.0 – A Systemic Response®. Each module took 1-2 hours to complete on average. Data were collected anonymously using the Apex Innovations database after subjects voluntarily agreed to participate in the study. Nurses and PCTs indicated their role after signing into the program. Apex Innovations collected non-identifiable testing information via the internal testing environment, which then was pulled into a data analytic program (RStudio 2009-2019) for analysis and validation using the R programming language. Testing information included de-identified subject number, facility location, unit location, role, and pre- and post-test scores. Pre- and post-test scores were compared to evaluate knowledge gain. Comparison data were analyzed only for nurse participants who completed all four modules and PCTs who completed module 1.

Procedure

Computer-based learning modules were sent to all clinical nurses (four modules) and PCTs (one module) through the healthcare system's online learning program for completion April-October 2019. Participants completed a pre-test before each module. The program guided them through the modules followed by a post-test. Staff could complete the post-test when convenient, but test completion was mandatory before the end of the study period. The post-test allowed one attempt, with no minimum passing score. A score of 80% or higher represented proficiency.

Findings

Of 2,377 nurses and PCTs who enrolled in the study, 881 nurses (51%) and 423 PCTs (92%) completed full requirements. The number of PCTs increased from those originally enrolled because the healthcare organization hired a substantial number of PCTs during the study period. There was an increase in knowledge based on pre- and post-test data, with 80% (n=703) of nurses demonstrating an improved post-test score in at least one module; 17% (n=152) had improvement in all four modules. For nurses, there was an increased pass percentage ranging from 4.0% (module 1) to 42.9% (module 3) and an increase in average score ranging from 5.0% (module 1) to 16.1% (module 4) (see Figure 1). Of enrolled PCTs, 53% (n=225) demonstrated an improved post-test score percentage (15.4%) and an average score percentage (8.6%) (see Figure 2).

A paired sample t test was conducted for nurses and PCTs over each module to determine evidence of statistical significance within pre- and post-test data. Calculated p-values from the paired sample t tests provided showed statistically significant improvement on users' post-test scores compared to pre-test scores (p<0.0001).

Discussion

Implementation of this multi-didactic computer-based learning program resulted in a majority of nurses and PCTs improving their post-test scores to achieve competency of 80% or higher. For nurses, marked improvement in pass percentage was identified in all four modules. Modules 2 and 4 had the largest improvement (see Figure 1). Improvements also were identified for the average nurse score percentage in all four modules, with modules 2, 3, and 4 showing the largest improvements. Scores for PCTs are represented on Figure 2. Nurses and PCTs also found this computer-based program valuable, as demonstrated through their anonymous evaluations (0 = *strongly disagree*, 10 = *strongly agree*). The four primary evaluation questions and results are depicted in Table 1.

An interesting metric evaluated in this study was the number of nurses and PCTs who spent less than 10 minutes in each program module. To achieve the full benefit of each module, Apex Innovations recommended an average of 45 minutes on module 1, 60 minutes on module 2, 90 minutes on module 3, and 45 minutes on module 4. A significant percentage of nurses (82%) and PCTs (47%) spent less than 10 minutes on each module. Post-test scores may have been affected if nurses and PCTs did not

FIGURE 1.
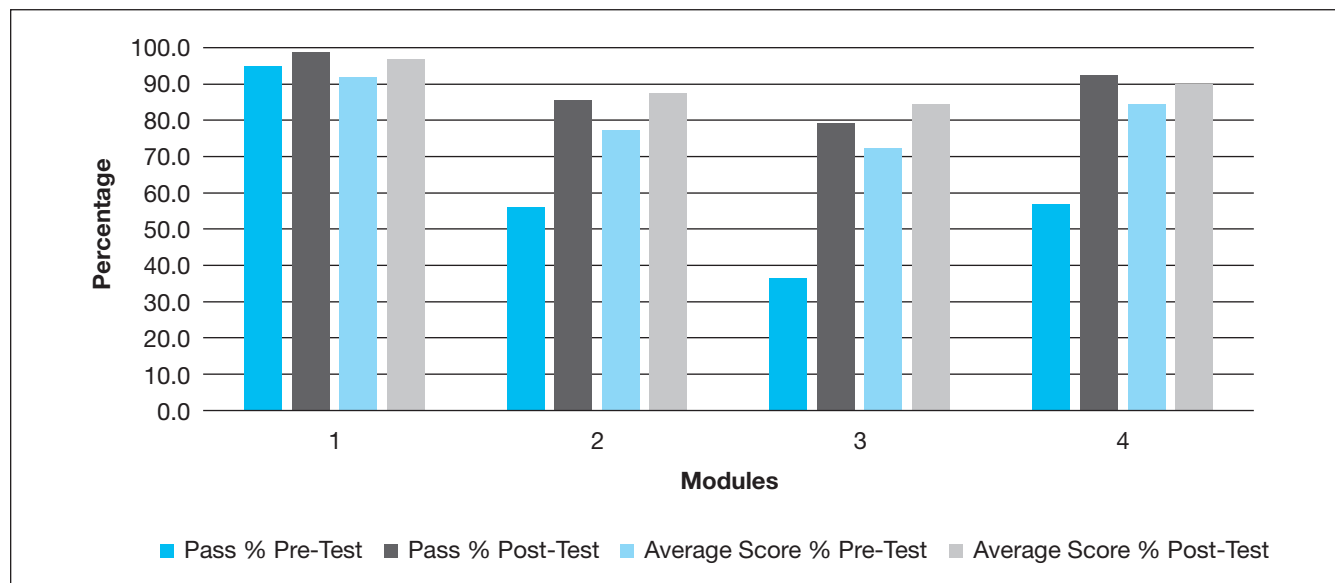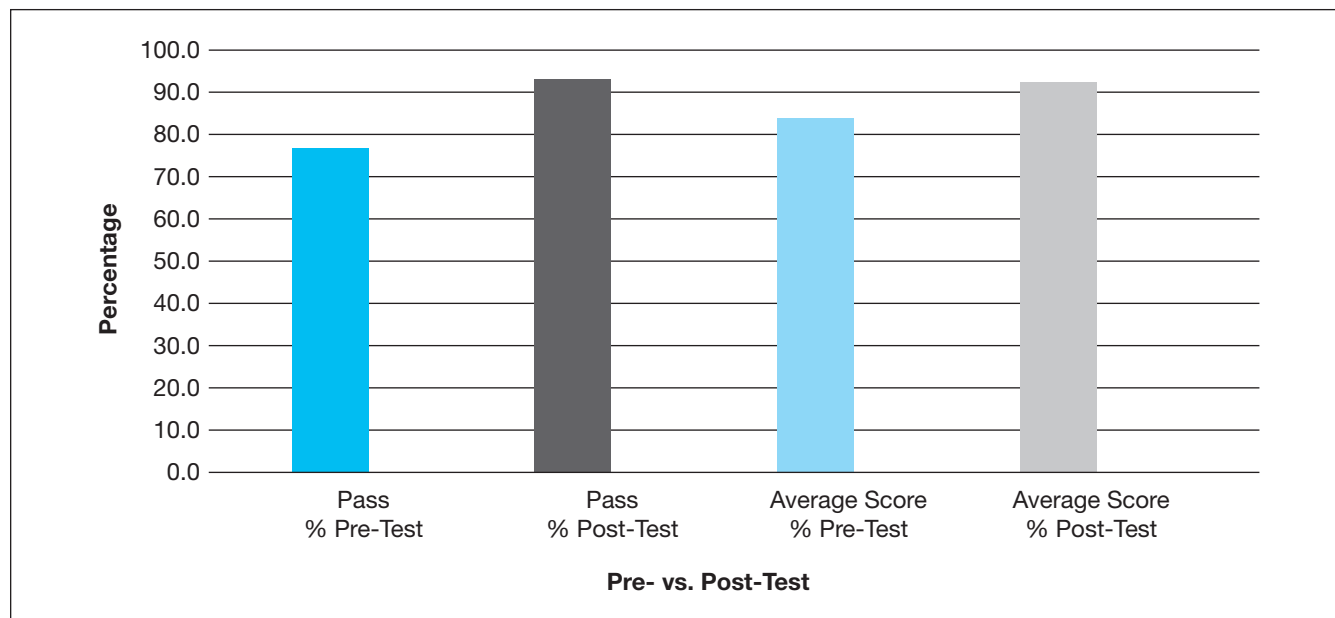**Nurse Passing Percentage and Average Score Percentage by Module and Test**

FIGURE 2.
Patient Care Technician Passing Percentage and Average Score Percentage by Module and Test Type

completely review the module as intended. Perhaps if staff had spent the suggested amount of time on each module, results might have shown greater improvement on the post-test. However, no correlation was calculated.

A foundational knowledge by nurses and PCTs of signs and symp-toms of sepsis for all patient popula-tions may lead to earlier identifica-tion, treatment, and improved patient outcomes (Onawola, 2021). Healthcare professionals need to be well aware of sepsis as a possible complication and early signs of organ dysfunction related to it. If identification of a patient's declin-ing condition can be recognized earlier, it is possible to slow the pro-gression of sepsis or prevent multi-organ failure and reduce mortality. The short-term knowledge gain through this study demonstrated the benefit of sepsis education as one part of providing care to patients with sepsis.

TABLE 1.
Survey Responses by Level

Question	Level 1	Level 2	Level 3	Level 4
Was the education engaging, interactive, and conducive to learning?	8.8	8.9	9.1	8.9
Did the education activity increase your knowledge?	9.7	9.8	10	9.9
Will the education activity improve your patient care?	9.7	9.8	9.8	9.6
Will you make changes in your practice as a result of the education activity?	9.5	9.7	9.9	9.7

Scale 0-10 (0 = *Strongly Disagree*, 10 = *Strongly Agree*)

Limitations

Only nurses and PCTs were included in this study. Other healthcare disciplines, especially but not limited to physicians and pharmacists, have a direct impact on the care provided to patients with sepsis. They could offer an additional perspective. The study also was limited by the availability of proper equipment. To gain the full benefit of this computer-based learning program, a computer with sound was required. Not every computer has sound on the medical units, so nurses and PCTs had to share a limited number of computers. If a computer with sound was not available, then nurses or PCTs used the program without sound or delayed participation while waiting for a computer to be available.

Additional limitations were found in ensuring individual mindful learning occurred. There was no way to manage all nurses or PCTs completing the modules on their own, and there was no set protocol on when or where this study should have been completed. This led to potential variations in staff working on the modules during their direct patient care work hours. The decision nurses and PCTs had to make was to complete the modules while performing patient care or to wait and complete them during unpaid hours. Completion during working hours can lead to limited engagement and decrease the ability to pay full attention to the education because staff must prioritize patient care activities with learning. One explanation for nurses and PCTs spending less than 10 minutes on a module was because they were also responsible for performing patient care. Further, there was no way to determine if nurses or PCTs completed modules as a group or individually, with possible collaborative test-taking or sharing of answers that could impact scores. However, the program randomizes question and answer selections, and disables the ability to go back on previously answered questions to mitigate test-taking concerns. On the other hand, collaborative learning also may have had a positive effect leading to improved engagement and knowledge gain.

Another limitation was variations in recruitment efforts within each facility. Presenting a consistent message in all facilities was challenging. Monthly updates were sent on enrollment numbers and completion numbers of one or all modules based on role, but there was no standard method to communicate information at the facility or unit level. If there had been a standard for communications, updates, and expectations from the beginning of the study, participation in the full study may have increased. Flyers and enrollment details were distributed, but there was no way to verify leaders at each facility posted them within their areas.

Recommendations for Future Research

Future research should include all disciplines within a healthcare system to identify the impact of knowledge gain on patient outcomes, such as the mortality rates or Sep-1 Bundle adherence. Proper identification and adequate treatment of sepsis require an interprofessional team effort; when only a portion of the team participates in an education opportunity, a gap in true data analysis and impact can result. Multiple factors also may affect mortality, hospital length of stay, and Sep-1 bundle adherence; additional research is needed to evaluate if and how education plays a role in these measures.

Additional research on the nursing perspective of knowledge gain retention when using an online learning education program could be beneficial. This study did not assess any follow-up retention data to see the impact of knowledge gain beyond the initial completion of modules. A recommendation would be to provide a post-test right after completion and then have follow-up interval testing to compare sustained knowledge gain. Previous studies incorporated simulation events or case studies with the online learning program. Because this study did not include any simulations or case studies, a recommendation for future research would be to include simulation or case studies to capture maximum knowledge gain and retention through use of various learning styles.

Nursing Implications

Sepsis education is crucial for nurses who provide care on a med-

ical-surgical unit because higher mortality rates have been identified in these settings. One way to improve patient outcomes is through early recognition, identification, and initiation of the Sep-1 bundle. After a review of current sepsis education within this healthcare system and available online sepsis education programs, the didactic computer-based program was chosen for this study. This accredited program was selected because it provided key concepts on how to identify and treat patients with sepsis so concerns regarding a declining patient can be escalated in a timely manner. The content was up to date; the Sepsis 2.0 – A Systemic Response® program is reviewed annually, with a full review every 3 years. Program adjustments are made when new guidelines are released or with content updates. This guaranteed learners were being taught from the most accurate and up-to-date materials. For this organization, this program addressed needed education for nurses and PCTs. It is crucial to ensure the education program implemented within a healthcare system meets the needs of the learners and organization.

This online education program has implications for use when onboarding new graduate nurses, PCTs, or newly hired staff, or when providing ongoing learning for current staff. This study demonstrated a benefit in ongoing implementation of the education program to ensure nurses and PCTs have appropriate knowledge to recognize and collaborate with other disciplines when providing care to a patient with sepsis. Consistent messaging related to online teaching during orientation and annually allows continued staff growth. The program provides the opportunity for healthcare leaders to be able to review high-level data for gaps in knowledge and individual learning.

Though the focus of this research was geared toward the medical-surgical nurse and PCT, this online program provides an overview of sepsis identification and treatment across majority populations and disciplines (e.g., intensive care and emergency settings, labor and delivery or postpartum settings, pediatrics, geriatrics, pre-hospital, and psychiatric health). The ability to gain knowledge across different service lines using the same language allows nurses to gain knowledge from peers outside their area of expertise. This provides the opportunity for meaningful dialogue with the collaborative care team across a healthcare system.

The Sepsis 2.0 – A Systemic Response® program appeals to various learning styles. Use of vivid graphics, 3D visuals and animations, and color-coding helps with knowledge transfer of key content for visual learners. For auditory learners, the content on each page is read; there is the option to pause or repeat the information. Each learner can see, hear, and explore activity content asynchronously, supported by an activity designed appropriately for the online setting. Having multiple learning mechanisms incorporated into one learning activity allows enhanced knowledge gain through appealing to various learning styles of involved nurses and PCTs.

Conclusion

Sepsis continues to be a complex health condition that burdens healthcare systems. Early recognition and identification of patient decline are crucial for the nurse and PCT. Sepsis education is one key initiative to assist nurses and PCTs to improve their skills in recognizing a patient in decline with escalating care concerns. This study demonstrated increased knowledge of sepsis through completion of an evidence-based computer learning program. Passing percentages and average scores improved for nurses and PCTs on post-tests. The Sepsis 2.0 – A Systemic Response® program used for this study met the learning needs of nurses and PCTs within this multi-facility, highly appraised healthcare system. Additional research is needed to identify any correlation of education with patient outcomes. **MSN**

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