Impact of a Sepsis Educational Program on Nurse Competence

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Sepsis is an emerging life-threatening entity and a worldwide epidemic. Nurses are in key positions to identify patients with sepsis, mobilize the medical team, and implement interventions. A study of self-assessed nurse competence was conducted to determine the influence of a specially designed sepsis education program on nurses’ perceived ability to identify early, intervene, and care for patients with sepsis. The program was a multimodal design incorporating online interactive didactic presentations, video vignettes, pre- and postknowledge tests, and high-fidelity medical simulation scenarios. A sample of 82 critical care and emergency department nurses in a 1-year critical care nurse training program was used for this study. Pretest and posttest module knowledge scores and self-assessed competence data were collected and analyzed. No improvement in the overall self-assessed competence scores was found; however, self-perceived frequency of use of competence behaviors improved. Participants felt more competent on three sepsis-targeted statements, and posttest knowledge scores showed significant improvement.

have the competencies necessary to care for these patients. The American Nurses Association describes nurse competence as a right and an expectation of the public. Nurses also have a professional responsibility to maintain competence, and employers must support competent practice in the work environment (American Nurses Association, 2012). The American Association of Critical Care Nurses has also recognized sepsis as a major health care problem facing nurses and issued a practice alert indicating that the incidence of sepsis is anticipated to double in the next 25 to 30 years (American Association of Critical Care Nurses, 2012).

A specialized sepsis education program for nurses was developed by one large health system in response to the sepsis epidemic. The program provided an opportunity for nurses to engage in learning opportunities that foster the acquisition of the knowledge and tools deemed essential to the early identification and care for patients with sepsis. This program, the Taming Sepsis Educational Program® (TSEP™), had a multidimensional platform. It included online didactic PowerPoint® presentations, with voiceover, on the clinical aspects of sepsis, teamwork and communication, interactive discussions and video vignettes on health literacy and cultural competency, and high-fidelity medical simulation case scenarios. A teamwork and communication module, using TeamSTEPPS® concepts, was included as part of this program to reinforce communication and patient advocacy strategies that foster communication among multidisciplinary professionals. A health literacy and cultural competency (HLCC) module was also incorporated into the program, as the health system serves culturally diverse and varied socioeconomic communities.

STUDY PURPOSE

This study was designed to evaluate the impact or influence of a multimodal sepsis educational program for critical care and emergency department nurses on knowledge acquisition and self-assessed competence in the early recognition and treatment of patients with sepsis.

BACKGROUND

Self-Assessed Nurse Competence
Several studies have used self-assessment surveys of competence as a methodology to determine levels of perceived competence. Meretoja and Leino-Kilpi (2003) and O’Leary (2012) found that as years of experience increased, self-reported competency increased. Also, according to the research of Meretoja and Leino-Kilpi, work experience and educational level distinguished top and medium performers, particularly in their first year of employment. In a follow-up study of nurses’ percep-

Competence and Targeted Educational Programs

Liou, Chang, Tsai, and Cheng (2013) examined the effect of a deliberate practice program on the self-assessed competence of 256 experienced nurses in 17 core skills deemed essential for clinical competence. Flexible and self-scheduled skill practice sessions were offered, along with instructional clinical skills videos and instructor-mediated practice sessions. A significant increase in the posttest clinical competence scores was found in those nurses who used the additional learning resources. Liou et al. (2013) summarized that engaging in deliberate practice increases competence.

High-fidelity medical simulation has been used as a teaching methodology across many disciplines to replicate real clinical situations. Evidence-based guidelines for severe sepsis and septic shock have been established to assist practitioners in treating patients with sepsis (Dellinger et al., 2008; Dellinger et al., 2013). Nguyen et al. (2009) evaluated the use of simulation as an educational strategy to teach medical students about severe sepsis and septic shock. The educational plan included a 5-hour didactic session, a skills workshop on intubation and central line placement, and a high-fidelity medical simulation scenario about severe shock. The initial posttest and the 2-week posttest scores were significantly higher than the pretest scores for all levels of medical students. In addition, the postcourse confidence levels were significantly higher than the precourse confidence levels (p < 0.05). Li et al. (2012) conducted a similar study but used a blended learning model of simulation and lecture. Results supported the use of blended learning, with better overall performance when didactic content was presented first.

In summary, a few studies were found that examined the effect of a specific educational program targeted for nurses’ knowledge outcomes or self-assessed compe-
tence. Research literature was found that supports the effectiveness of educational strategies using high-fidelity medical simulation. Only two studies were found that evaluated the use of simulation in education programs in the treatment of severe sepsis and septic shock. No research literature was found on sepsis educational programs for nurses or on nurses’ self-assessed competence in caring for patients with sepsis. No studies were found that evaluated the impact of an educational program for nurses on perceptions of competence in the identification and care of patients with sepsis.

**METHOD**

Three research questions were used in this study: Is there a difference in knowledge regarding sepsis before and after the sepsis educational program? Is there a difference between the nurses’ self-assessed competence scores before and after the sepsis educational program? Is there a relationship between the posttest knowledge scores and the nurses’ self-assessed posteducational program competence scores?

**Design and Setting**

A quantitative, quasi-experimental design was used. The research was conducted at a large health system in the northeastern United States. Approval from the appropriate institutional review boards was obtained.

**Sample**

A purposive sample of RNs who were completing a 1-year training fellowship in critical care and emergency nursing was obtained. These nurses, who were from various critical care specialty units and emergency departments within five hospitals of the health system, were in their second trimester of the training program. G²Power software was used to calculate a sample size of at least 64 for an alpha significance of <0.05, a statistical beta power of 0.08, and an effect size of 0.3, using a one-tailed t test.

**Recruitment**

Part of the year-long training program included the nurse fellows returning to the simulation education center for 2 days at approximately 4 and 8 weeks into their second trimester. The nurse fellows completed the TSEP program at these times. Participation was voluntary and did not impact their involvement in the fellowship training program.

The intervention, the TSEP educational program on sepsis, was developed and written by content experts and reviewed by medical leadership and health literacy and cultural competency departmental experts for appropriateness and accuracy. TSEP knowledge scores were operationalized as pretest and posttest scores for each of the following sections of the program: Institute for Healthcare Improvement (IHI) bundles (five questions), health literacy and cultural competency (10 questions), TeamSTEPPS communication and teamwork (five questions), and staging sepsis (10 questions).

The Nurse Competence Scale (NCS) by Meretoja, Isoaho, and Leino-Kilpi (2004) was used to measure self-assessed competence. The NCS is composed of a 73-item scale to measure nurses’ self-reported perceptions of competence across seven domains: the helping role, the teaching–coaching function, diagnostic and patient monitoring role, effectively managing changing situations, administering and monitoring therapeutic interventions, ensuring the quality of health care practices, and tasks related to organizational and work-role competencies. A visual analog scale is used for the individual to rate each metric response on a 1 to 100 scale. A visual analog scale score of 0 to 25 is low, 26 to 50 is moderate, 51 to 75 is good, and 75 to 100 is very good. The frequency of use of each item is also captured on a 4-point scale, with a range of 1 (not applicable) to 4 (use very often). Reliability testing of the NCS revealed Cronbach’s alphas of 0.79 to 0.91. Concurrent validity testing was performed using the 6-dimensional scale, which measured 52 items on subscales of leadership, critical care, teaching and collaboration, planning and evaluation, interpersonal relations and communications, and professional development (Meretoja et al., 2004). Three additional sepsis specific statements were added to the NCS instrument: I feel competent to identify patients exhibiting early signs and symptoms of sepsis; I feel competent in my ability to care for patients diagnosed with systemic inflammatory response syndrome, sepsis, severe sepsis, and septic shock; I feel competent to mobilize the health care team to begin early goal-directed therapy.

Demographic data collected included age, number of years working as an RN, specialty area, number of years working in the specialty area, and highest level of nursing education.

**Intervention Procedure**

The TSEP had a two-part design and was completed in two educational sessions. The program began with an introduction to the health system’s commitment to fight sepsis and a rationale for the sepsis program for nurses. Part one consisted of four interactive online learning modules: the IHI (2012) bundles; staging sepsis clinical content and case studies; health literacy and cultural competency (HLCC); and TeamSTEPPS communication and teamwork concepts. Video vignettes of patient
and staff encounters were also presented to demonstrate and conduct interactive discussions of HLCC concepts. Pre- and posttests assessed comprehension of the IHI bundles concept, teamwork and communication, HLCC, and staging sepsis clinical content. Part two consisted of active participation in videotaped, high-fidelity medical simulation scenarios, using human patient simulators, and debriefing sessions. TSEP components from part one of the program were incorporated into the simulation scenarios.

The nurse competence surveys were accessed and completed via an online link to an electronic survey provider, with each participant using a unique identification (ID) code. Qualtrics® was used as the online survey provider for the NCS survey, and the researcher (M.M.D.) obtained the NCS survey aggregate data from Qualtrics. Both the NCS surveys and the online TSEP modules were completed on the computer banks at the corporate university site.

**Research Procedure**

The statistical analysis of the data was completed using Statistical Analysis System® (SAS) software, version 9.3. Descriptive statistics, *t* tests, and correlation analysis procedures were used. Additional analysis was conducted on the overall scores of each of the NCS domains and data related to the frequency of use of competence behaviors for each of the domains.

### RESULTS

#### Sample Characteristics

The sample included 87 RNs: 70 women (80.5%) and 17 men (19.5%). Four participants were eliminated from the sample due to duplication of participant IDs; NCS data from one participant was eliminated due to failure to complete the post-NCS survey, resulting in a final sample size for the NCS of 82. For the knowledge examinations, incomplete pretests and posttests resulted in sample sizes that varied from 79 to 83. Discrepancies in the ID codes used by participants for access to the online NCS survey and the online TSEP program modules resulted in a reduction of the sample size available for the correlation analysis of the postcompetence scores and the posttest scores (*n* = 54). The demographics of this subsample are reported separately.

The mean age of the study participants was 27.6 years; most (96.3%) of the participants had a baccalaureate degree in nursing. The majority (*n* = 54, 65.9%) of the sample worked in an intensive care unit (ICU); 24 (29.3%) worked in an emergency department; and four (4.9%) worked in a postanesthesia care unit.

#### Analysis Related to Research Question 1

A one-tailed paired *t* test was used to analyze the pretest and posttest knowledge scores of the participants in the four online didactic modules. Those with a complete set of pre- and posttests for each of the content areas
were used for the analysis. The resulting sample sizes were 83 (IHI), 82 (staging sepsis), 81 (TeamSTEPPS), and 79 (HLCC). A statistically significant improvement ($p < 0.0001$) was found in knowledge posttest scores for the IHI bundles, staging sepsis, and TeamSTEPPS modules, but no significant differences were found between the pre- and postknowledge scores for HLCC. These results are presented in Table 1.

### Analysis Related Research Question 2

Paired $t$ tests were used to analyze the pre-NCS and post-NCS scores. No statistically significant difference was found on the NCS total or individual domain scores. These results are presented in Table 2.

### Sepsis-Specific Competency Statements

Statistically significant increases in ratings were found on the post-NCS survey, compared with the pre-NCS survey. For the first statement, “I feel competent to identify patients exhibiting the early signs and symptoms of sepsis,” the pre-NCS mean score of 65.89 ($SD = 23.40$) increased to a post-NCS mean score of 87.34 ($SD = 15.31$). The mean difference between these two scores was 21.45 ($df = 72$, $SD = 25.00$, $t = 7.33$, $p < 0.0001$).

For the second sepsis-specific competency statement, “I feel competent in my ability to care for patients diagnosed with systemic inflammatory response syndrome, sepsis, severe sepsis, and septic shock,” the pre-NCS mean score was 62.48 ($SD = 22.92$) and the post-NCS mean score was 84.14 ($SD = 22.92$).

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### Table 2

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<th>Competence Domain</th>
<th>$M$</th>
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<th>$M$</th>
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<td></td>
<td>$M$</td>
<td>$SD$</td>
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<td>22.54</td>
<td>3.60</td>
<td>24.96</td>
<td>1.31</td>
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</table>

Note. TSEP = Taming Sepsis Educational Program®; $df = 81$.

* NCS scores are based on a visual analog scale of 0-100.

* Significant at $p < 0.05$. 

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Mean score improved to 86.64 (SD = 16.48). The mean difference between these two scores was 24.16 (t = 16.72), which is greater than the critical value of 1.96. Responses to the third competency statement, “I feel competent to mobilize the health care team to begin early goal-directed therapy to patients showing signs and symptoms of sepsis,” also showed improvement. The pre-NCS mean score was 66.36 (SD = 22.33) and the post-NCS mean score was 85.60 (SD = 17.92). The mean difference between these two scores was 19.25 (t = 6.99, p < 0.0001). Additional analysis of the frequency-of-use data for each domain of the NCS was evaluated. Statistically significant differences were found in the helping role and the therapeutic intervention domains. The total frequency-of-use score for all domains also showed statistically significant improvement.

Analysis-Related Research Question 3

A subsample of 54 was used for the correlation of competence with the IHI bundles and staging sepsis posttests; a subsample of 53 was used for the correlation analysis of competence with HLCC and TeamSTEPPS posttests. The mean age of the subsample (n = 54) used was 27.0 years (SD = 6.25), with a range of 21 to 45 years; all had a baccalaureate in nursing (BSN) degree. The majority (n = 35, 64.8%) were new graduates with less than 1 year of nursing experience; 14 (25.9%) had been nurses for 1 to 5 years; and five (9.2%) had been nurses for 6 to 10 years. Most (n = 34, 63%) worked in ICUs; 18 (33.3%) worked in emergency departments; and two (3.7%) worked in the postanesthesia care unit. These characteristics are similar to the characteristics of those of the original study sample.

The NCS overall postcompetence scores for the subsample were slightly lower than the scores for the original sample (M = 61.09 and M = 64.14, respectively); frequency-of-use overall scores were almost identical, and the managing situations domain scores were also similar. All other domain scores were slightly lower. The posttest knowledge scores were equal to the original study sample scores.

A Spearman correlation analysis was used to test for an association between the four modular posttest scores (IHI, staging sepsis, HLCC, TeamSTEPPS) and the post-NCS scores overall and in each of the seven competence domains. No significant relationships were found among the posttest competency scores (total score and domain scores) and the postknowledge scores.

Discussion

Statistically significant improvement in the posttest scores over the pretest scores was found in the IHI bundles, staging sepsis, and TeamSTEPPS modules; these findings indicated that educational modules facilitated knowledge acquisition. The participants’ mean scores for overall self-assessed competence and for competence in each of the seven domains of practice (managing situations, diagnostic functions, work role, helping role, teaching-coaching, ensuring quality, and therapeutic interventions) were all in the very good range and did not demonstrate any significant improvement after the TSEP. However, the three sepsis-specific competence statements (competence in the early identification of patients with sepsis, competence in caring for a patient with sepsis, and competence to mobilize the health care team) showed a significant improvement in the postcompetence scores, advancing from the good range to the very good range. This finding reflects an enhancement in participants’ own sense of competence in dealing with patients with sepsis.

The three highest rated postcompetence domains in this study were the helping role, ensuring quality, and managing situations; all fell into the good range. Only Hengstberger-Sims et al. (2008) and Salonen et al. (2007) studied new graduate (BSN) nurses and new ICU and emergency department nurses, respectively. Similar to the current study, the helping role was rated as good and was also the highest scoring domain in these studies.

The frequency-of-use scores improved significantly in the helping role and therapeutic interventions domain. The helping role was the highest rated of the frequency-of-use competencies, which is similar to previous studies on self-assessed nurse competence (Bahreini et al., 2011, Hengstberger-Sims et al., 2008; Meretoja, Iosah, & Leino-Kilpi, 2004; Meretoja & Leino-Kilpi, 2003; Salonen et al., 2007). Hengstberger-Sims et al. (2008) reported therapeutic interventions as the lowest rated competence domain and the lowest frequency-of-use activity in a sample of new BSN graduates. Some studies also reported therapeutic interventions as the second lowest rated domain (Bahreini et al., 2011; Meretoja, Iosah, & Leino-Kilpi, 2004; Mertoja & Leino-Kilpi, 2003; Mertoja, Leino-Kilpi, & Kaira, 2004). Although no statistically significant improvement in competence was found, the frequency-of-use behaviors improved from moderate to good. This may possibly be attributed to the TSEP, which targeted clinical interventions and incorporated hands-on practice using high-fidelity medical simulation.

In the current study, the quality domain was assessed as good and was positioned as the second highest domain. Previous studies found quality to be good while being one of the lowest rated of the competence domains (Hengstberger-Sims, 2008; Meretoja, Iosah, & Leino-
Kilpi, 2004; Meretoja & Leino-Kilpi, 2003; Meretoja, Leino-Kilpi, & Kaira, 2004; O’Leary, 2012; Salonen et al., 2007). Nurses in the current study may have felt stronger in quality because they were in the middle of a year-long training program for critical care and emergency nursing. Admission into the program is competitive, and the curriculum is grounded in evidence based-practice and integrated with regulatory core measures.

Researchers comparing self-assessed competence among the sample nurse populations must also contem- plate that differences may exist internationally in nursing education, nursing practice, and regulatory health care structures.

LIMITATIONS
Several limitations of the current study were identified. A purposive sample of nurses, who were similar in educational background and experience, was used. The sample evaluated competencies with a self-assessment instrument. Both of these elements limit the generalizability of the results.

IMPLICATIONS FOR NURSING PRACTICE
Competency development and maintenance are vital for professional nurses to care for complex patients in complex clinical environments. Competencies evolve and must be attuned to epidemics, such as sepsis, that face health care professionals. Professional nurses must seek out and take advantage of educational opportunities to improve their own competence and the knowledge and behaviors required for growth and advancement. Nurse educators, health care administrators, and clinicians must collaborate to create, support, and provide innovative educational programs and opportunities that support this mission.

RECOMMENDATIONS FOR FUTURE RESEARCH
In this study, a 4-week interval may have been insufficient for the assimilation of sepsis knowledge and skills to occur and for there to be improvement in overall self-assessed competence scores. Also, it was unknown whether any of the study participants encountered patients with sepsis during this time period. Future longitudinal research to evaluate sustained perceptions of competence over time is suggested. In addition, evaluation of objective-based participant performance in the high-fidelity sepsis medical simulation scenarios is recommended to ascertain the impact of the TSEP on critical thinking through the integration of knowledge with performance.

Quality competence scores in this study were rated as good, similar to most previous studies. Quality self-assessed competence behaviors were also rated lower in overall use in practice. Today’s highly complex and technologically advanced health care systems mandate quality practices to be more than just good. Exploring quality competencies and the frequency-of-use behaviors in nurses, with a variety of experiences and a range of clinical specialty settings, is recommended.

REFERENCES

Sepsis Education

1 Sepsis is an emerging health care issue, and nurses must be knowledgeable and competent in the early identification and care of patients with sepsis.

2 A multimodal sepsis educational program is one endeavor in developing nurses’ self-competence and competency to care for patients with sepsis.

3 Educational programs should be designed specifically for nurses to empower them with the tools to recognize patients in the early stages of sepsis, mobilize the health care team, and implement appropriate interventions to positively influence patient outcomes.

key points


