

Improving Nurses' Knowledge on Sepsis Identification and Management at Mulago National Referral Hospital: A Quasi Experimental Study

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Background: Sepsis is a global pandemic and public health concern. There is a paucity of data relating to its management and outcomes in the developing world. The surviving sepsis campaign (SSC) guidelines have been developed to improve outcomes of patients with sepsis. There are no documented in-hospital protocols on sepsis management for nurses in Uganda. This study evaluated the effect of an educational intervention on nurses' knowledge of SSC guidelines in management of patients with sepsis at Mulago National Referral Hospital.

Methods: We used a quasi-experimental design and recruited 40 nurses from neuro-surgical ward and ICU. Pre- and post-intervention assessments were conducted using a validated self-administered questionnaire between October 2020 to February 2021. The intervention was conducted through sessions of presentations, watching videos, and case studies. Data were entered in excel, cleaned, and exported to Stata version 16. Median and interquartile range were used for continuous variables while frequencies and percentages were used for categorical variables. Mean knowledge scores were computed for pre- and post-test evaluation. A paired *t*-test was used to compare the pre- and post-test knowledge scores at $p \leq 0.05$ and 95% confidence interval.

Results: In this study, 57.5% of nurses were from ICU, 67.7% were females and 70% diploma holders. Median age was 32 (IQR= 21.5–35.5) years. In the post test all nurses were able to score above the preset acceptable score of 50% on the current sepsis guidelines. Mean knowledge score was 3.6 (SD = 1.8) pretest and 8.4 (SD = 1.2) posttest. There was a significant difference in pre and post-intervention mean knowledge scores of 4.9 (SD = 1.90, 95% CI: 4.2–4.5; $t(39) = 16.242$, $p < 0.001$).

Conclusion: The educational intervention improved nurses' knowledge on SSC guidelines. Regular continuous professional nursing education on sepsis could improve nurses' knowledge and quality of care for patients with sepsis.

Keywords: nurses, sepsis, knowledge, surviving sepsis campaign guidelines, management

Introduction

Sepsis and septic shock are major healthcare problems associated with significant morbidity and mortality globally.¹ Sepsis affects millions of people globally each year, and kills as many as one in four (and often more) people, and greatly increases expenditure related to medical care.² The worldwide estimates are 288 cases per 100,000 people per year for the last 40 years worldwide.³ Recent estimates suggest 19.4 million yearly cases and 5.3 million deaths from sepsis and septic shock.⁴ Sepsis has been defined as a life-threatening organ dysfunction from dysregulated host response to infection. On the other hand, septic shock is sepsis with circulatory collapse and cellular mediated abnormalities.⁵

The International Surviving Sepsis Campaign (iSSC) published guidelines for management of severe sepsis in 2004, with subsequent overall goal of reducing mortality from sepsis and septic shock.^{2,6} The guidelines have been condensed into a 1-hour bundle with the aim of beginning resuscitation and management immediately.⁷ These can quickly and easily be completed by nurses with expert knowledge on sepsis management and current knowledge on the new developments in the iSSC guidelines.⁸ The aim of the international Surviving Sepsis Campaign Guidelines was to provide guidance for clinicians caring for patients with sepsis, septic shock and other sepsis-associated organ dysfunction. Attempts have been

made globally to ensure that all health care workers get acquainted with all the components of the sepsis bundle to improve patient outcomes.

The iSSC guidelines recommend the following be completed in 1 hour of patient presentation: obtaining serum lactate levels; blood cultures prior to the administration of antibiotics; administration of broad-spectrum antibiotics; and 30 mL/kg crystalloid for hypotension or serum lactate > 4 mmol/l (36 mg/dl); administration of vasopressors if the hypotension is refractory to fluids with a map ≤ 65 mmHg.⁷

Sub-Saharan Africa is reported to account for a significant proportion of the global burden of sepsis which may also go unrecognized.⁹ Yet this geographical region has limited reports on the management and outcomes of sepsis syndrome.

In MNRH, however, nurses still use the systemic inflammatory response syndrome (SIRS) criteria to identify patients with sepsis despite its low predictive value of 0.64 as opposed to 0.74 for Sequential Organ Failure Assessment (SOFA) which is used in the iSSC guidelines. According to the hospital's head nurse, where the nurses had received a number of in-service training sessions regarding use of the SIRS criteria, little attention has been paid to the iSSC guidelines. This may lead to missed diagnosis and improper management of some patients with sepsis. There is a paucity of literature as to whether training nurses in the current sepsis (iSSC) guidelines could improve their knowledge in identification and management of patients with sepsis. Therefore, this study sought to assess the impact of an educational intervention on nurses' knowledge on management of sepsis using the iSSC guidelines.

Materials and Methods

Study Design

A descriptive quasi experimental design was used with a pretest and posttest, on nurses working in the ICU and neuro-surgical ward. Baseline knowledge on the SSC guidelines was assessed through a self-administered questionnaire, after which an educational intervention was conducted and a posttest was conducted to determine effect.

Study Area

The study was conducted at Mulago National Referral Hospital (MNRH). The study site is a public tertiary teaching hospital with a capacity of 1500 beds. The intensive care unit has 16 bed capacity while neurosurgical ward has 24 bed capacity with 24 hour nurse coverage. These units handle critically ill patients who are susceptible to developing sepsis and indeed sepsis is one of the common medical diagnoses in these units. The hospital serves as the national referral hospital for the whole country, receiving patients from all districts of the country for specialized health care. It offers both inpatient and outpatient health services.

Study Population

The study enrolled nurses working in the adult intensive care unit and neurosurgical ward at MNRH. These are not specialized nurses but they have acquired experience on the job with a few nurses having completed some in-house short courses on critical care. There was a total of 48 nurses located in these units. The intensive care unit (ICU) had a total of 30 nurses, and the surgical ward had a total of 18 nurses. With MNRH being at the top of the health system referral of Uganda, most of the critically ill patients may end up being referred there and therefore these nurses are most likely to manage such patients hence their level of knowledge on sepsis management may give insight into the nurses' knowledge on sepsis management nationwide. These two clinical areas were selected because they care for critically ill patients who are most susceptible to infection and are at high risk of developing sepsis.

Sample Size

The intensive care unit (ICU) has a total of 30 nurses, and the surgical ward has a total of 18 nurses, which lead to a total of 48 nurses. For a paired *t*-test analysis, a priori power analysis gave a total sample size of 20 participants per group to detect a large effect (Cohen's $d=0.5$) with $\alpha =0.05$ and $1-\beta=0.95$.¹⁰ The large effect size was used owing to the small population size. To increase the power of the study and allow for an anticipated attrition of ten percent, the researcher aimed to have at least 40 nurse participants in the study.

Sampling Technique

Since the number of nurses working in the general ICU and neurosurgical ward was small, the researchers used a population sampling approach in which all eligible nurses working in the ICU and neurosurgical wards were recruited to the study.

Inclusion: nurses working in the ICU and neurosurgical wards in MNRH at the time of the study with at least 6 months of experience in patient care were eligible to participate in the study. This was done to ensure that there was maximum experience with patient care.

Exclusion: nurses who were away on leave or had other commitments at the time of data collection for baseline knowledge evaluation were not considered eligible to participate.

Data Collection Instrument

A validated self-administered questionnaire was used to assess knowledge on sepsis identification and sepsis management. The questionnaire was adopted with permission from a cross-sectional survey that was performed at the 4th All Africa Anesthesia Conference in Nairobi, Kenya.¹¹ It consisted of 11 fill-in and 18 multiple choice questions related to nurses' knowledge on sepsis management using the SSC guidelines.

The questionnaire was pretested on nurses working at the Naguru-China Friendship Hospital ICU and surgical unit/ward to ensure the questions designed answer the objectives, after which the tool was adjusted accordingly by the researcher. The tool was further reviewed by expert nurses in critical care and senior ICU physician experienced in care of critically ill patients with sepsis with a content validity index of 0.86.

Data Collection Procedure

Ethical approval was obtained from Mbarara University of Science and Technology Research Ethics Committee (MUST-REC) No. 11/07-20. We sought administrative clearance from Mulago National Referral Hospital management. Two research assistants helped in data collection on the objectives of the study in order to avoid misinterpretations. Two nurses with Masters in critical care nursing and with experience in caring for critically ill patients were employed to assist with training of the participants in sepsis management. The researchers contacted the charge nurses of these units/wards and organized meetings with the nursing staff during which the researcher explained the purpose of the study and the relevant details. Written informed consent was obtained from all study participants before they were given a pre-test questionnaire. Data were collected October 2020 to February 2021.

Pre-intervention phase: we assessed participants' baseline knowledge on iSSC guidelines using a validated questionnaire based on the international consensus on sepsis management. Participants were assured of confidentiality of their information.

Intervention phase: we conducted an educational intervention one week after completion of the pre-intervention assessment. The training involved conducting three face to face teaching sessions in groups of 12–14 participants per session for a period of three weeks for the two units/wards selected. The intervention was conducted separately for each ward. The participants were a mix of cadres during the teaching sessions so as to maximize participation levels during working hours. We are cognizant of the effect of level of education on knowledge acquisition but considered the accessible population. The sessions ran for one hour each day in the afternoon to avoid disruption in the unit activities in the morning hours when the staff is usually busy. The researchers used PowerPoint presentation on the new definition of sepsis and septic shock, the iSSC guidelines, qSOFA and SOFA criteria, and video clips to ensure a deeper understanding of the material. In addition, they reviewed multiple case scenarios during the intervention phase. The participating nurses were given handout files with a PowerPoint presentation and video clips illustrating care of patients with sepsis using the iSSC guidelines.

Post-intervention phase: one month after the intervention, a post intervention evaluation was done to assess the effects of the educational intervention on the nurses' knowledge on the use of the iSSC guidelines in the management of patients with sepsis. The period of 4 weeks from the pre to the post intervention assessment was adopted from previous studies.^{12,13}

Data Management and Analysis

The management and analysis were done using Microsoft excel and STATA version 12. Data were sorted, coded and entered into STATA program for analysis. Descriptive statistics (frequencies, means and standard deviations) were reported for normally distributed data and interquartile ranges and median for skewed data. Each item was analyzed separately in addition to the overall evaluation. A paired *t*-test was done to establish association between knowledge and practice improvement and training intervention.

Results

Demographic Characteristics of the Participants

In total, our sample included 40 participants. Majority of our participants (27 [67.5%]) was female, and 13 (32.5%) were male. Majority of the participants (28 [70%]) held a diploma as the highest level of education and majority (23 [57.5%]) were working in ICU. See [Table 1](#).

Baseline Knowledge of Nurses on the iSSC Guidelines

Majority of the participants had never heard about the sepsis guidelines with only 12 (30%) participants reporting having heard about the sepsis guidelines yet did not know the exact guidelines. Majority of the participants (35 [87.5%]) did not know that a lactate measurement of >2mmol/L would warrant a critical value for reporting. About the parameters for assessment of sepsis using the SOFA and qSOFA, only 7 (17.5%) and 11 (27.5%) had knowledge of these parameters respectively and their use. Majority of the participants (25 [62.5%]) reported obtaining blood cultures and administering antibiotics within an hour of diagnosis of sepsis or suspecting sepsis, while only a few participants (8 [20%]) reported correctly on how often patients should be screened for sepsis. Majority of the participants (28 [70%]) did not report correct amount of fluid resuscitation for sepsis and hypotension ([Table 2](#)).

Nurses' Post Intervention Knowledge on iSCC Guidelines

In the post intervention evaluation, majority of the participants (32 [80.0%]) showed knowledge improvement on the fact that a lactate value >2mmol/L would warrant a critical value for reporting in presence of sepsis. There was also improvement in the knowledge on the parameters for the manifestation of septic shock in a patient with sepsis in 19 (47.5%) participants. Majority of the participants (38 [95%]) stated correctly that a blood culture test would be the appropriate test to be performed when you suspect sepsis. About the parameters for assessment of sepsis using the SOFA

Table 1 Demographic Characteristics of the Study Participants (n = 40)

Characteristics	Median	IQR
Age of respondents (Years)	32	28.5 – 35.5
Years of experience	3.5	2–6
		f (%)
Gender		
Male		13(32.5)
Female		27(67.5)
Level of education		
Certificate		5(12.5)
Diploma		28(70)
Bachelor's degree		7(17.5)
Place of work		
ICU		23(57.5)
Neuro-Surgical ward		17(42.5)

Table 2 Baseline Knowledge of Nurses on SSC Guidelines (n=40)

SSC Guideline Items*	Correct	Incorrect
	n (%)	n(%)
What lactate level would warrant a critical value report?	5(12.5)	35(87.5)
What are the manifestations of septic shock (sepsis and a MAP of <70 mmHg)?	12(30)	28(70)
What are the physiological changes that occur in patients with sepsis and septic shock?	13(32.5)	27(67.5)
What is first step in management of suspected sepsis patient?	29(72.5)	11(27.5)
Which are the parameters used in assessment of sepsis patients using the qSOFA?	11(27.5)	29(72.5)
Which organ dysfunctions are looked out for while assessing SOFA?	7(17.5)	33(82.5)
Within how many hours should blood cultures be obtained and first antibiotics administered?	25(62.5)	15(37.5)
How often should a patient be screened for sepsis?	8(20)	32(80)
What is the initial step in management of sepsis?	13(32.5)	27(67.5)
How much fluid is recommended in management of sepsis and hypotension using the SSC guidelines?	12(30)	28(70)
How can you establish whether appropriate fluid resuscitation has been achieved in a patient?	8(20)	32(80)

Note: *SSC items adapted from: Dellinger et al.²⁵

Table 3 Post Intervention Knowledge of Nurses on SSC Guidelines (N=40)

Knowledge of the SSC Guidelines SSC guideline items*	Correct	Incorrect
	n (%)	n (%)
What lactate level would warrant a critical value report?	32(80)	8(20)
What are the manifestations of septic shock (sepsis and a MAP of <70 mmHg)?	19(47.5)	21(52.5)
What are the physiological changes that occur in patients with sepsis and septic shock	38(95)	2(5)
What is first step in management of suspected sepsis patient?	38(95)	2(5)
Which are the parameters used in assessment of sepsis patients using the qSOFA?	23(57.5)	17(42.5)
Which organ dysfunctions should be looked out for while assessing SOFA?	31(77.5)	9(22.5)
Within how many hours should blood cultures be obtained and first antibiotics administered?	35(87.5)	5(12.5)
How often should a patient be screened for sepsis?	27(67.5)	13(32.5)
What is the initial step in management of sepsis?	26(65)	14 (35)
How much fluid is recommended in management of sepsis and hypotension using the SSC guidelines?	31(77.5)	9(22.5)
How can you establish whether appropriate fluid resuscitation has been achieved in a patient?	37(92.5)	3(7.5)

Note: *SSC items adapted from: Dellinger et al.²⁵

and qSOFA, there was improvement in knowledge of the parameters in 23 (57.5%) and 31 (77.5%) participants respectively. Majority of the participants (31 [77.5%]) also reported correct amount of fluid resuscitation for sepsis and hypotension. See [Table 3](#).

A Comparison of Nurses' Baseline Knowledge and Post Intervention Knowledge of Sepsis Management Using the iSSC Guidelines

Prior to the educational intervention, majority of the nurses (34 [85%]) had poor knowledge about the iSSC guidelines, and the total mean sum score of the knowledge was 3.6 ± 1.8 (95% CI: 3.0–4.2) points. However, the knowledge levels increased after intervention with 19 (47.5%) nurses attaining good knowledge and 21 (52.5%) attaining excellent knowledge about the sepsis guidelines, and no one scored below 50% ($p < 0.001$). The post-intervention total mean sum score was 8.4 ± 1.2 (95% CI: 8.0–8.8), giving a statistically significant difference in the mean score of baseline knowledge and post-intervention knowledge of 4.9 ± 1.9 (95% CI: 4.2–4.5; $t(39) = 16.242$, $p < 0.001$). Thus, we reject the null hypothesis and conclude that the intervention had a significant effect of improving the participants' knowledge. See [Table 4](#).

Table 4 Comparison of Baseline Knowledge and Post Intervention Knowledge of Participants About the iSSC Guidelines

	Mean(SD)	95% CI
Total sum score of baseline knowledge	3.6(1.8)	3.0–4.2
Total sum score of post intervention knowledge	8.4(1.2)	8.0–8.8
Difference in Total sum score of knowledge	4.9(1.9)	4.2–5.5
Knowledge levels before intervention	n (%)	p- value
Poor knowledge (score<50%)	34(85)	
Good Knowledge (score between 50–75%)	6(15)	
Excellent knowledge (score > 75%)	–	
Knowledge levels after intervention		
Poor knowledge (score <50%)	–	
Good Knowledge (score between 50–75%)	19(47.5)	
Excellent knowledge (score >75%)	21(52.5)	
		<0.001

Discussion

Baseline knowledge of nurses on sepsis management using the iSSC guidelines was generally low. This could be due to the fact that the participants had never received training on the iSSC guidelines.¹⁴ It could also be attributed to limited scope of practice of the study participants, professional identity, insufficient organizational support in continuing nursing education, and the lack of literature exploring what is taught in undergraduate nursing programs about sepsis. Previous studies assert that training on sepsis at lower levels of tertiary education has been identified as a cause for low knowledge levels for nurses in developed countries like Australia.¹⁵

Knowledge in this study was categorized according to other literature about knowledge of nurses, where a score above 75% was considered high and adequate for the nurse practitioners.¹⁶ Accordingly, 85% of the participants exhibited poor knowledge of iSSC guidelines before the educational intervention. These findings were similar to a study conducted in Egypt where nurses' knowledge regarding sepsis was low prior to training.¹⁷ Egypt is among countries considered to have good healthcare systems in Africa,¹⁸ so this finding indicates that in-service training can also bring about positive change in Uganda's healthcare. Therefore, continuous in-service training for nurses on sepsis recognition and management needs to be encouraged and supported as an integral component of the continuing nursing education for better outcomes of patients with sepsis. Also, there is a need to include clinical nurse specialists in Uganda's health care system to foster continuous mentorship with the lower nursing cadres. This will ultimately improve patient outcomes. This is supported by a study conducted in Italy which found that knowledge can be improved through educational training and that good knowledge of sepsis guidelines is essential for correct management of sepsis and improved patient outcomes.^{19,20} Another study by Robson et al, auditing nurses' knowledge of sepsis also showed an improvement in their knowledge after an educational intervention.²¹ A similar study by Delaney et al, on impact of an educational intervention on nurses' competence, showed an improvement in the knowledge of nurses on sepsis management.²² Similarly, studies done in areas outside sepsis have shown that educational intervention significantly improves participants' knowledge, which can later on be transferred to practice. For example, a study on detection and management of acute kidney injury (AKI) assessed clinicians' knowledge on AKI and found that only 26% of them were knowledgeable about AKI guidelines compared to 64% after the educational intervention.²³ This is evidence that improved knowledge among nurses through educational intervention translates to improved quality of nursing care, which could in turn improve patients' outcomes. The investigators in this study thus believe that regular in-service training of nurses can significantly improve nursing care of patients with sepsis.

Limitations of the Study

This study was conducted in only two units of the entire national referral hospital in consideration of available time for data collection, which may limit generalizability of the findings to the entire hospital and other hospitals in the country. We recommend that further studies be conducted to include a wider population of nurses of various hospital units and other hospitals, which will allow for generalizability of results.

Due to the nature of the study design as applied to this study, there was no control group with which to compare the results and this could have affected the internal validity of the study. Interventional studies generally recommend a period of at least 6 weeks to collect data after intervention.²⁴ However, in this study, we conducted post-intervention data collection after 4 weeks, as adopted from some studies which have deemed a minimum of 4 weeks after intervention as sufficient.^{12,13} The argument is that the participants' memory of the training content could have been still quite fresh, thereby yielding seemingly very good results.

Conclusion and Recommendations

There was generally low level of baseline knowledge among nurses about the iSSC guidelines prior to the educational intervention. The educational intervention, on the other hand, significantly improved the nurses' knowledge on these guidelines. The iSSC guidelines could be incorporated into continuing medical education schedules in the hospital so that information about sepsis can be shared and well-explained to all healthcare providers (nurses) to improve their knowledge on sepsis. A wider scale study, with a larger sample size and selecting participants from more clinical units which are randomly sampled, could also be more informative.

Abbreviations

AKI, acute kidney injury; ICU, Intensive Care Unit; iSSC, International Surviving Sepsis Guidelines; MAP, mean arterial pressure; MNRH, Mulago National Referral Hospital; MUST- REC, Mbarara University of Science and Technology; qSOFA, quick sequential organ failure assessment; SIRS, systemic inflammatory response syndrome; SOFA, sequential organ failure assessment; SSC, Surviving Sepsis Guidelines.

Data Sharing Statement

The datasets generated and analyzed during the study are available from the corresponding author on request.

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Author Contributions

All authors contributed to data analysis, drafting or revising the article, have agreed on the journal to which the article was submitted, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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