Effect of Evidence Based Sepsis Care Bundle on Patient Outcome in Medical Intensive Care Unit

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Abstract

Background: In intensive care unit (ICU), sepsis is a main cause of death for the survival of patient with this condition, early identification and management is necessary. ***Aim of this study*** was to investigate the effect of evidence based sepsis care bundle on patient outcome in medical intensive care unit. ***Method:*** Quasi-experimental research strategy was used in this study the sample was included 100 adult critically ill patients taken from medical intensive care in Aswan University Hospital. Tool (I): Patient assessment sheet was used for collecting data, which included two parts: bio-demographic data and medical data, Tool (II): evidence based sepsis care bundle, to control mortality frequency and diminished length of stay within medical ICU. ***Results:*** ICU stay, the half of the usual care group stayed one week and majority (46%) of the bundle care group stayed less than one week. As regarding mortality rate was lowered than the control group with a substantial variation (P = 0.021). **Conclusion:** implementation of the evidence-based sepsis care bundle to all critically ill sepsis patients can promote optimal patient outcome. ***Recommendation:*** must be reduplication this study in a large probability sample in the different critical care setting area.

Keywords: Evidence based practice, Sepsis care bundle, medical ICU, and patient outcome.

Introduction:

Sepsis is a survival-threatening system disorders' due to deregulated host reaction to infection. Most of late, the expressions systemic inflammatory response syndrome SIRS and acute sepsis were removed, and sepsis is currently recognized as "fatal organ dysfunction caused by a deregulated patient reaction to illness **(Seymour et al., 2016)**

Sepsis is a wide spread illness entity that is accompanied by increased rate of mortality and morbidity especially within critical care settings. Globally, it is appraised that more than 30 million people are admitted hospitals for sepsis every year, and sepsis may lead to every year more than 5.3 million deaths (**Fleischmann., 2016)**

Sepsis is recurrently triggered by viral, bacterial, or fungal infections, with the infections greatest to be predictable progress into sepsis being abdominal pneumonia, and renal infections. Sepsis includes a complex collection of inflammatory response that effects in tissue integrity and hemodynamic disorder that fails to adequately tissue perfuse of vital organs **(Perez et al., 2016).**

Bundles of care are a collection of "therapies" created round the greatest evidence-based strategies, which, when applied collectively, provide more advantage in terms of outcome than the separate therapeutic interventions (**Gyawali et al., 2019**)

Sepsis is a time sensitive condition, so early identification and response by nurse and health team member can encourages rapid treatment progression, reducing patient deterioration, sepsis morbidity, fatality rates, and decrease ICU length of stay which rely on the early recognition and ongoing management of sepsis, and death, so that evidence-based sepsis bundle is introduced to improve patient outcomes **(Harley et al., 2019).**

Sepsis remains a major challenge facing health care providers internationally. One of the central nursing intervention is the use of innovation nursing care protocols (Sepsis care bundles), which comprise categorization resuscitation care which include intravenous fluids, oxygen supply,

antibiotics, low dose steroid, insulin and blood glucose monitoring, collection of specific tests (cultures, Lactate) and vasopressors **(Teles et al., 2017).**

The role of the ICU nurses in septic patients care highlight the important role that nurses plays a critical role in monitoring for primary detection of sepsis, resuscitation of sepsis protocols to facilitate attaining blood cultures and beginning primary resuscitation procedures, and nurse-led sepsis response groups have revealed the influence of nurse-led multi-professional team-based management in diminishing death, ICU length of stay, and readmission of ICU rates. **(Maclay, 2017)**

Hence, the crucial object of current study was to investigate the effect of evidence-based sepsis care bundle on the patient outcome in medical intensive care unit.

Significance of the study:

Nursing care in ICU and a long recovery time for patients with sepsis come at a high cost, and the mortality rate for patients with severe sepsis and septic shock remains high at 30–40% and 40–50%, respectively **(Angus et al., 2001 and Dellinger et al., 2008).** Sepsis is a time-sensitive illness, so early identification and fast response by nurses at the initial points of care can improve the patient outcome, reducing the patient deterioration **(Macdonald, 2017 and RhodesA, 2015).** The appropriateness and speed of sepsis care bundle protocol directed in the initial times after onset of sepsis are expected to influence the patient outcome **(Khan & Divatia, 2010).**

Aims of the study:

Aims of the study is to investigate the Effect of Evidence Based Sepsis Care Bundle on Patient Outcome in Medical Intensive Care Unit.

Research hypothesis:

Evidence Based Sepsis Care Bundle will be effective in improving Patient Outcome & decrease length of stay in Medical Intensive Care Unit.

Subjects and Methods:

Research design:

Quasi-experimental research design was carried out to evaluate the effect of evidence-based sepsis care bundle on the patient outcome and in MICU.

Setting:

This study was conducted at the medical intensive care unit of Aswan University hospital during the period from February 2019 until October 2019.

Subjects

A purposive sample included 100 adults critically cases that were diagnosed with sepsis in MICU. The total sample was selected randomly and divided equally into 2 groups each group 50 patients by using simple random number table (the first case was selected for implementing evidence-based sepsis care bundle (study group) and the second case was selected for control group which taken only the routine care of intensive care and so on).

Inclusion criteria:

- Aged more than 18 years, both sexes.
- Patients who had a diagnosis of sepsis or disseminated infection.
- Following criteria of systemic inflammatory response syndrome: **(Sakr et al., 2007)** that include:
  - ❖ Body temperature >38ºC or <36ºC.
  - ❖ Pulse rate > 90 beats/min.
  - ❖ Breathing rate >20 breaths/min or PaCO2 <32mmHg.
  - ❖ White blood cell count > 12,000/µL or <4000/µL

Exclusion criteria:

- Patients who were under 18 years and over 80 years.
- Patients transferred in or out hospital.
- Patient who receives immunosuppressive therapy.

Tool for data collection:

Two tools were applied to assemble the data of this study. They are established by the researchers after widespread and relevant review of literature. The validity & reliability of these tools were revised by a panel of

medical disease staff and critical care nursing experts, and then pilot study was done.

First Tool: Patient assessment sheet (English form) was used to collect the data of this study (developed by the researchers), which included two parts as follows:

Part 1: Bio-demographic data of sepsis cases including gender, age, sepsis source, length of ICU stays and the decease rate.

Part 2: An assessment sheet used to collect the medical data, laboratory investigations according to the sepsis care bundle, Acute Physiology and Chronic Health Evaluation (APACHE II) score by **Sadaka ,et al., (2017).**The APACHE II score is used to prediction of mortality in patients during critical therapy and care starting with the date of ICU admission.

Second Tool: Evidence Based Sepsis Care Bundle, to assess the application of evidence-based sepsis care bundle on a sepsis critically ill adult patient's outcome, this tool was implemented by researchers with assistance the critical care nurses in MICU. To be completed within 6 hours, for early identification and management of sepsis by using the recent guideline and supportive nursing interventions for sepsis **(Rhodes et al, 2016) and (Kleinpell, 2019**, **National Institutes of Health, 2017**, and **Mikkelsen, 2016)**.

The Based Sepsis Care Bundle involves six steps:

- ✓ Monitor lactate level.
- ✓ Yield blood cultures prior to antibiotics administration.
- ✓ Quickly administer 30 mL/kg crystalloid fluid for hypotension or lactate ≥ 4 mmol/L.
- ✓ Apply vasopressors to maintain MAP ≥ 65 mm Hg.
- ✓ Low dose steroid, insulin if hyperglycemia is evident.
- ✓ Volume status tissue perfusion, and re-measure lactate if the original lactate elevated.

Supportive nursing interventions:

It consisted of four main nursing intervention including:

A- First nursing intervention: Close monitoring of the patient for early recognition of sepsis:

- ✓ Monitor vital signs.
- ✓ Obtain a baseline measurement.
- ✓ Arterial blood gases analysis
- ✓ Applying sepsis screening as a measure of routine nursing care for patient assessments especially WBC count and body temperature.

B- Second nursing intervention: Supportive nursing care for initiatives sepsis bundle to improving sepsis care:

- ✓ Time to implement blood culture specimen.
- ✓ Time to start antimicrobial treatment.
- ✓ Time to give standard of fluid resuscitation.
- ✓ Time to complete blood lactate monitoring.
- ✓ Position the patient in the semi-recumbent position with the head elevated at 45 degrees and provide oxygen supply.

Third nursing intervention: Manage altered tissue perfusion and shock

- ✓ Offer fluid resuscitation according to the guidelines of sepsis care bundle (30 mL/kg). IV fluid within the first 3 hours.
- ✓ Administer medication, antibiotics as prescribed, direct role of nurses give antibiotics as measure of sepsis management; start give of antibiotics is a cornerstone of nursing care.
- ✓ Monitor and document alter tissue perfusion it includes:
  - Declining urine output,
  - Altered tissue perfusion,
  - Change mental condition,
  - recording intake and output

- ✓ Monitor lactate levels
- ✓ Ensure infection prevention trials are applied for sepsis patients within ICU.

Fourth nursing intervention: Continuity of Care:

- ✓ Evaluate and report reaction to sepsis care managements.
- ✓ Saturation did not improve in spite of modifications in ventilator parameters.
- ✓ RBCs transfusions after the hematocrit was less than 30 g/dL.
- ✓ Nutrition plan initiated within 48 hours of admission.
- ✓ Oral feeds be held in the situation of hemodynamic instability.
- ✓ Parenteral nutrition when patients have protein-calorie malnourishment. The albumin level 3.8 g/dL.
- ✓ Promote patient and family awareness of sepsis care protocol.
- ✓ Contagion or infection control**,** all invasive procedures must be carried out with aseptic technique**.**
- ✓ Identify the site and source of sepsis (obtain culture from suspected site).
- ✓ Continuing monitor and management of fever.
- ✓ Assess physiologic status and hemodynamic status.

Outcome measures

1. Frequency rate death from sepsis among the whole study population**.**
2. Length of ICU stays between both groups.

Methods for data collection:

Ethical considerations

- Administrative approval was obtained from the responsible persons (directors of Aswan University Hospital and the head of the medical intensive care unit).
- Written consent was obtained from patients who accepted to participate in the study. For unconscious patients, an informed consent was obtained from next of kin after presenting myself to them and explaining the aim of the study.
- Patients was assured that all information collected would be kept confidential.

Content validity

- The validity of the tool was tested by measuring its contents validity index by 5 experts in critical care nursing and medical disease it equaled 91% .
- *Reliability:* The reliability of the tool was calculated statistically by alpha cronbach test (r=0.82).

Study maneuver:

The study was applied through assessment, planning, implementation, and evaluation phases. The researchers were available three days weekly.

Assessment phase:

Upon finalization of the study tools and getting official permissions, the researchers started to recruit the samples.

- At the medical intensive care unit, the researchers introduced themselves and informed the nurses about the nature of the study.
- In 9 months duration, we enrolled 100 patients was recruited according to inclusion and exclusion criteria, divided into 50 patients (control group) for usual care and 50 patients (study group) for evidence based sepsis care bundle.
- After obtaining studied patients consent to participate, the patient's bio-demographic data were collected from the patient record.
- The assessment was done for all patients at admission to detect and monitoring sepsis condition by using tool two.
- (APACHE II) score used to prediction of mortality in patients during critical therapy and care sepsis bundle was started at the identification sepsis state tool I.
- Data of This phase lasted from February 2019 until April 2019.

Intervention phase:

This phase lasted for three months from May to June 2019.

- The study began by reviewing the charts of ICU patients with sepsis in study setting.
- The assessment sheet requires about 10-15 minutes filling; about 1-2 critically ill patients were collected per week.
- **The researchers obtain the patients consent for voluntary participation in the study.**
- Researchers **enrolled 100 patients, divided into 50 patients** (control group) **for usual care that include:**
  - Fluid therapy with Ringer acetate
  - Nor-epinephrine infusion or Dopamine infusion.
  - Obtaining of septic workup (Blood, Urine and sputum cultures). Intravenous administration of broad-spectrum antimicrobials.
- 50 patients (study group) for application of the evidence based sepsis care bundle for critically ill patient with sepsis.
- The assessment was done for all patients at admission to detect and monitoring sepsis by using tool one.
- During this phase, once recognizing the patient with sepsis, the responsible nurse immediately obtaining blood for culture and chemistry tests, urine or culture are given from other site of the body suspected reason or origen of infection and. Additionally, the application of the care bundle, Lactate levels early measured, Plasma lactate >4mmol/L indicates hypotissue perfusion and a fluid resuscitation (with 20ml/kg of Ringer Acetate) given and repeated if needed until SBP ≥90mmHg Finally, the nurses played an vital role in timely obtaining the doctor's prescription for antibiotic treatment.
- Early administration of antimicrobial: Intravenous antibiotic given within 1 hour of the identification of sepsis and after proper cultures had been withdrawn.
- Fluid therapy, (SBP,90 mmHg MAP , or 65 mmHg) fluid resuscitation of 20ml/kg of Ringer Acetate had been given over 30 minutes
- Close monitoring, CVP >8mmHg (>12mmHg if ventilated);
- O2 saturation.
- MAP <65mmHg or SBP < 90mmHg
- Urine output < 0.5ml/kg/hour
- Vasopressors/inotrope therapy and monitoring patient response through SBP, CVP and output.
- Maintain adequate oxygen saturation and measure every 2 hours.
- Blood glucose control, insulin infusion was started when the blood glucose level exceeded 80mg/dl and adjusted to maintain it between 80 and 140 mg/dl.
- Random blood sugar has been measured every 2 hour and treated accordingly with regular insulin infusion (units/min), with frequent glucose monitoring by finger stick.
- Mechanical ventilation strategies, Inspiratory plateau pressures maintained below 30cm H_2O.
- Adequate supplemental oxygen was provided to maintain a pulse oximetric saturation of >90%.
- Use of steroids: Low-dose intravenous corticosteroid.
- Data was collected as follows: - Demographic data including the patients' age, gender, weight and height were recorded. - The patients' temperature, heart rate, SpaO2, urine output, blood pressure, and central venous pressure have been measured continuously and recorded every hour.
- Arterial blood gases were recorded every 6 hour in the first 24 hours.

Evaluation phase:

This phase was emphasized on evaluation clinical outcome in medical ICU for all studied patients through tool I, and

evaluation length of stay and mortality rate in ICU at discharge or transferred to ward.

Statistical analysis:

Date entry and data analysis were done using SPSS version 19 (Statistical Package for Social Science). Data was presented as mean and standard deviation. Chi-square and Fisher Exact tests were used to compare qualitative variables. Mann-Whitney test was used to compare quantitative variables in case of non-parametric data. P-value was considered statistically significant at $P < 0.05$.

Results:

Table (1): showed that there was no statistically significant difference between the study and control groups regarding all items of demographic characteristics. The more than half (56%) at control group was female but half of them in study group was female and the other half was male. As regard reasons of sepsis there were (20 %, 36%) respectively in the control group were surgical site infection and abdominal infection vs. (46%) in study group the respiratory tract infection was main cause of sepsis. Also, illustrated that the acute physiology and chronic health evaluation score (APACHI) in study group was lowered than the control group with a substantial variation ($P = 0.040$).

Table (2) showed that there was a statistically significant difference between the studies groups regarding hemodynamic Parameters was improved after the evidence based sepsis care bundle application.

Table (3) showed that there was a statistically significant difference between the study and control groups regarding laboratory investigations after the evidence based care bundle application except regarding Total protein and albumin.

Table (4), shows regarding ICU stay half of the control patients stayed one week and majority (46%) of the study group patients stayed less than one week. As regarding mortality rate was lowered than the control group with a substantial variation ($P = 0.021$).

Table (1): Distribution of demographic and medical data of the studied groups

Demographic characters	Control (n= 50)		Study (n= 50)		P-value
	No.	%	No.	%	
Age group					
40- <50 years	12	24.0	15	30.0	0.499
50-60 years	38	76.0	35	70.0	
Sex					
Male	22	44	25	50.0	0.548
Female	28	56	25	50.0	
Causes of sepsis					
Surgical site infection/ wound infection	10	20.0	2	4.0	0.014*
Respiratory tract infection	13	26.0	23	46.0	0.037*
Urinary tract infection	38	76.0	33	66.0	0.271
Blood stream infection	12	24.0	18	36.0	0.190
Abdominal infection	18	36.0	5	10.0	0.002*
APACHE II score:	13.57 ± 2.75		12.10 ± 4.01		0.040*

Table (2): Hemodynamic parameters monitoring among the studied groups

	Control (n= 50) Mean ± SD	Study (n= 50) Mean ± SD	P-value
Body temperature:	38.13 ± 0.35	38.20 ± 0.32	0.307
Heart rate:	121.24 ± 17.26	128.93 ± 15.33	0.024*
SBB: Systolic blood presuure	99.47 ± 9.64	110.42 ± 6.53	<0.001*
DBB: Diastolic blood pressure	68.61 ± 8.05	74.73 ± 4.98	<0.001*
Respiratory rate:	24.97 ± 7.01	19.13 ± 6.21	<0.001*
Pulse oximetry:	90.76 ± 2.58	94.23 ± 1.45	<0.001*

Table (3): Comparison between the studied groups according to laboratory investigations

	Control group (n= 50) Mean ± SD	Study group (n= 50) Mean ± SD	P-value
CBC			
WBCs: White blood cells	17.59 ± 4.31	12.63 ± 6.46	<0.001*
RBCs: Red blood celld	3.99 ± 0.93	4.75 ± 0.74	<0.001*
Hemoglobin:	9.96 ± 1.93	12.35 ± 1.32	<0.001*
Creatinine:	52.96 ± 23.03	114.11 ± 30.67	<0.001*
Liver function tests:			
Total Bilirubin:	2.37 ± 1.47	5.12 ± 1.15	<0.001*
Total protein:	16.55 ± 3.41	14.91 ± 5.14	0.069
Albumin:	10.14 ± 4.52	9.39 ± 3.56	0.366
Blood sugar:	124.17 ± 19.52	155.39 ± 42.56	<0.001*

Table (4): Comparison of the studied groups regarding patients' outcome

Patient outcome	Control (n= 50)		Study (n= 50)		P-value
	No.	%	No.	%	
Length of ICU stay:					
< week	11	22.0	23	46.0	0.028*
One week	25	50.0	20	40.0	
> week	14	28.0	7	14.0	
ICU Mortality	38	76.0	27	54.0	0.021*

Discussion:

Sepsis could be a critical and frequently deadly illness influencing millions of persons across the nation and over the world, and in spite of the progresses in technology plus health care services, the poor outcomes are sepsis consequence. Patient outcomes not depend only on the pathogen, nevertheless on controlling the host's reaction and minimizing hypo perfusion of organ and tissue damage **(Singer et al., (2016).**

In current the study the evidence based sepsis care bundle emphasis to evaluate the effect of the evidence based sepsis care bundle on patients' health outcomes, ICU mortality rate and length of stay for the septic patient in the medical ICU setting,

The current study revealed a variance in reasons or cradle of infection among the before and after of considered groups, this did not impact the application of evidence based sepsis care bundle by critical care nurses. *From researcher insight,* the cause of infection is one a threat factor of sepsis besides during the close monitoring patients may not be marked and the emphasis of stimulating and initiating of applying the sepsis care bundle. Therefore, regardless of the variance in reasons or origin cause of infection, it is improbable that the initiation time to application of care bundle in the results was not influenced by these factors.

This supported with **Romero et al 2017,** the results demonstrated a dissimilarity in diagnosis and cause of infection among the study and control groups, this did not effect the carrying out of sepsis guidelines by triage nurses. Cause of infection effect care bundle decision-making when applying.

With regard to the leading sources of sepsis in the current study were identified as pneumonia the main source of sepsis. This result correlates with a study done by **Levy et al**., **2010,** who shown that pneumonia as the source of sepsis and predicted hospital mortality over other infections.

The ICU mortality frequency was decreased more than half in the evidence based care bundle group. This is illustrated by the next ways.

Several studies have revealed similar results, **Rivers et al., 2001.** Revealed diminished in mortality rate in study group after application of sepsis care bundle more than the usual care group. **Castellanos-Ortega, 2010.** Showed that 34.55% decrease in mortality from 57.3% in the before group to 37.5% in the after group.

This study statement that reaching of blood sugar control is linked by enhanced consequences is not essentially reinforced by lately printed data, while blood sugar control (150 mg/dL) is still used as a curative goal. Currently, major differences were observed between usual care and bundle care-application blood sugar control (180.5 vs. 124.1 mg/dL); however, this did not clarify to any mortality benefit.

This study showed the mean length of ICU stay among critically ill sepsis group; it was observed that, the length of ICU stay has been significantly decreased than the rotuine care group. This was coordinated with several studies **(Delaney et al., 2013; Mouncey et al., 2015; Yealy et al., 2014)** the new guidelines was made mandatory, significantly decreased reduced LOS and mortality were reflected in the post-intervention group as compared to the pre-intervention group.

Furthermore the current finding was agreement with **Castellanos-Ortega et al., 2010.** There was illustrated a reduction of 2.6 days in ICU length of stay from 11 to 8.4 days after application of sepsis care bundle.

In the contrast, **Memon et al., 2012.** Found that the mean ICU period time of stay was not significantly different among both study groups.

While the study by **Nguyen et al., 2007**. Observed the outcome implications of implementing a sepsis bundle in the emergency units, the study by did not show a significant difference regarding LOS in the emergency.

From point view of the researcher, Implementation of sepsis care bundle for sepsis patients involves a collaborative effort to rapidly identify patients who potentially have sepsis, perform critical evaluations, and deliver timely interventions that improve patient outcomes.

From the researchers' point of view, evidence based sepsis care bundle intervention is effective in controlling sepsis rates because of regular detection and elimination of the risk factors and on other hand the critical care nurses played a vital role in triaging and identifying patients who potentially had sepsis, initiating the application care bundle, and decreasing the rate of mortality in ICU.

In conclusion, the findings in this study supported previous studies showing that implementation and practice of care of a septic patients with sepsis care bundles significantly reduced the length of ICU stay and might eventually reduce mortality rate.

Study Limitations

There were several limitations to this study. First, the study sample size was relatively small. Second, this was a one-medical ICU study.

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Recommendation:

The start of the implementation of the sepsis bundle among ICU nursing staff could have meant a period of a compliance to both the sepsis care bundle and the nursing staff implementing the bundle within the specified time protocol and further research is needed to support our results. Replication of the study on large samples in different intensive care units, Egypt.

Conclusions

Sepsis care bundles have an important role for septic infection nursing care and as a consequence, any effort undertaken for declining the length of stay and fatality rate within ICU due to sepsis should focus on increasing and encouraging application these evidence-based interventions in these cases. By instituting measures that are based on the sepsis care bundle, critical care nurses can improve care for patients with sepsis and help to ensure that critically ill patients with sepsis receive qualified nursing care to promote optimal outcomes.

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