Effect of Early Sepsis Resuscitation Bundle on Patient's Initial Outcomes at Emergency Department

Mona Mohamed Elhady[1,2], Elham Alnagshabandi[3], Dalia Zaki Rehbeini[4], Aida Faried Abdelwanees[1], Marwa Mehrez Mahmoud Ali[1]

[1]Emergency and Critical Care Nursing Department, Faculty of Nursing, Mansoura University, El-Mansoura, Egypt.

[2]Emergency and Critical Care Nursing Department, Faculty of Nursing, King Abdulaziz University, Jedda, Saudi Arabia.

[3]Medical Surgical Nursing Department, Faculty of Nursing, King Abdulaziz University, Jedda, Saudi Arabia.

[4]Medical education unit, king Abdulaziz university hospital, Jedda, Saudi Arabia

Corresponding author dr_marwammm@mans.edu.eg

Abstract

Background: Sepsis remains one of the leading causes of mortality in emergency care, with delayed recognition and treatment contributing significantly to poor outcomes.Early identification and treatment using standardized protocolscan improve patient outcomes. However, inconsistent adherence to these protocols and limited evidence on their impact in emergency departments highlight the need for further research. **Aim**: The study aims to explore the effectiveness of early sepsis resuscitation bundles amongpatient's initial outcomes at emergency department.**Study Design:** A quasi-experimentalstudy was carried out on 100 adults admitted to the emergency unit atEmergency hospital, El Mansoura, Egypt. Samplewas distributed on two groups; the bundle group and non-bundle group. Sepsis Screening Sheet and Sepsis Management Flow-chartwere used to gather data from research subjects. **Results**: Significant improvement in patient's initial outcomes was discovered ($p \leq 0.05$) among patients in the bundle received group more than control group as reflected by reduction in overall mortality rate(14%vs.28%, P = 0.021), APACHE score(26.969±9.93 versus 43.541±15.63, P=0.044), QSOFA score(1.960 ± 0.63 vs. 2.68 ± 0.71), mechanical ventilation therapy(14% vs. 28%), length of stay in emergency department group (4.842 ± 2.73versus 1.76 ± 0.823, P = 0.029)and admission to ICU(14%vs. 40%).**Conclusion:** Nurses play a key role in the early detection of sepsis and the prompt initiation of necessary care, which are essential in reducing patient decline and improving clinical prognosis. Research indicates that applying the sepsis treatment bundle within three hours of a patient's arrival to the emergency department correlates with more favorable early outcomes in those diagnosed with sepsis. **Recommendation:** Implementing an early sepsis bundle within 3 hours of sepsis recognition at the ED, in addition toperform another researches are forcibly recommended.

Key words: Sepsis, Sepsis bundle, Early sepsis management, and Sepsis outcomes.

Introduction

Sepsis is a severe health threatening condition triggered by a dysregulated immune reaction to infection, often leading to organ dysfunction and carrying a substantial high rate of mortality and morbidity affecting 49 millions globally (**Khowaja et al., 2022**). Sepsis remains a significant healthcare challenge, particularly in emergency departments (EDs), where timely diagnosis and intervention are critical to patient survival **(Rudd, et al., 2020).** Sepsis is often activated by viral, bacterial, or fungal infections, accompanied by highest likelihood of progression to sepsis being associated with abdominal infections, pneumonia, and renal infections. It involves a complex series of inflammatory responses that lead to tissue damage and hemodynamic disturbances, ultimately impairing the adequate perfusion of vital organs **(Sayed, 2020).**

Care bundle is a set of "management" designed around best evidence-based practices, that, when implemented together, give greater benefits in terms of patient outcomes than individual interventions (**Khowaja, et al., 2022**). Sepsis is a time-criticalcondition, and early recognition and intervention by healthcare professionals, including nursing staff and healthcare team, can promote rapid treatment initiation. This reduces patient clinical decline, sepsis-related morbidity and mortality, and decreases hospitalization period **(Fleischmann-Struzek, et al., 2020).** The early identification and continuous sepsis management are important, which is why introduction of evidence-based sepsis bundles is crucial for improving patient prognosis **(Harley et al., 2019)**.

Sepsis continues to be significant global concernfor healthcare team members. To address

this challenge, the Surviving Sepsis Campaign (2015) introduced the Early Sepsis Resuscitation Bundle as a standardized protocol to guide sepsis management. This bundle emphasizes key interventions, including blood culture acquisition, prompt administration of broad-spectrum antibiotics, lactate level monitoring, and fluid resuscitation within the first 3 hours of sepsis recognition **(Levy et al., 2019)**. These measures aim to target the critical "golden hours" of sepsis care, during which timely intervention has the greatest impact on survival **(Marik, et al., 2019; Levy et al., 2019)**.

Previous studies have demonstrated effectiveness of sepsis resuscitation bundles in reducing mortality and improving patient outcomes. **Sayed (2020)** reported a significant reduction in mortality rates with adherence to bundle protocols in critical care settings. Similarly, **Seymour et al. (2017)** found that early administration of antibiotics and fluids within the recommended time frames significantly improved survival, particularly in patients with septic shock. These findings underscore the life-saving potential of early bundle implementation.

Despite its proven benefits, challenges persist in applying sepsis bundles universally. Studies highlight barriers such as limited resources, variations in staff training, and inconsistent adherence to protocol elements **(Evans, Rhodes & Alhazzani 2021; Uffen, et al., 2021)**. Moreover, Rigid adherence to specific bundle components may not always yield superior outcomes compared to individualized care tailored to patient needs **(Acharya, et al., 2024)**.

The role of emergency care nurses in the care of septic patients highlights the critical importance of nurses in early sepsis detection, resuscitation protocols, and facilitating procedures such as blood culture collection and the initiation of primary resuscitation **(Harley, et al., 2019)**. Nurse-led sepsis response teams have demonstrated positive impact of a multi-professional, team-based approach in reducing mortality, ED LOS, and rehospitalization rates **(Kleinpell, et al., 2019)**.

While sepsis bundles are widely endorsed, their impact in resource-limited EDs remains underexplored (**Baghdadi, et al., 2020).** Additionally, the initial outcomes of early intervention, such as length of ER stay, ICU incidence rate and recurrence rates, require further investigation. Addressing these gaps is essential to optimize sepsis care and ensure equitable outcomes across diverse healthcare settings **(Jung, et al., 2019)**.

Current research seeks to explore the effectivness of the Early Sepsis Resuscitation Bundle on the initial outcomes of emergency patients. By assessing its implementation in an ED context, the study aims to explain valuable viewon the real-world effectiveness of sepsis bundles, potentially informing policy and clinical practice improvements.

Significance of the study

Sepsis is still aleading cause of increased mortalityat emergency care, with delayed recognition and treatment contributing significantly poor outcomes. Estimated mortality rates for sepsis range from 10% to 20%, increase to 20% to 50% for severe sepsis, and rise further to 40% to 80% in cases of septic shock **(Evans, et al., 2021; Ko, et al., 2018)**. While Surviving Sepsis Campaign has provided evidence-based guidelines for sepsis management, implementation gaps persist in many healthcare settings. In particular, there is limited research on how adherence to early sepsis bundle affects short-term outcomes as initial stabilization, length of emergency departmentstay and progression to septic shock **(Monti, et al., 2023)**. Furthermore, variability in bundle application across different emergency settings complicates efforts to generalize its efficacy. These challenges necessitate an investigation into practical impact of early sepsis resuscitation bundle on initial patient outcomes **(Murri, et al., 2018; Ryoo, et al., 2019)**.

A critical gap in literatures regarding real-world impacts of early sepsis resuscitation bundle in emergency care. Understanding bundle's effect on initial outcomes can guide healthcare providers in optimizing sepsis management and resource allocation. Additionally, there is a need to understand strategies to improve protocol adherence, enhance early recognition, and mitigate barriers to effective sepsis care **(Buchman, et al., 2020; Schinkel, et al, 2022)**. By highlighting importance of timely interventions, this study required to contribute to global effort to reduce sepsis-related morbidity and mortality, particularly in resource-limited settings. So that the aim of current study is to explore the effect of early sepsis resuscitation bundle on patient's initial outcomes at emergency department.

Aim of the study:
The study aims to explore the effect of early sepsis resuscitation bundle on patient's initial outcomes at emergency department.

Study hypotheses:
To achieve the aim of this investigation, the following study hypothesis was proposed:
H: Patients undergoing early sepsis resuscitation bundle will achieve better initial clinical outcomes compard with patients not receiving bundle**.**

Operational definition:
Early sepsis resuscitation bundle:
Early sepsis resuscitation bundle is a group of management actions including sepsis recognition, lactate level measurement, pre-antibiotic blood culture, broad spectrum antibiotic administration, fluid resuscitation by 30 mL/kg crystalloid if hypotension or lactate ≥4 mmol/L appears, vasopressors administration when persistent hypotension regardless fluid resuscitation aimed to keep mean arterial pressure (MAP) at ≥65 mmHg within 1 to 3 hours of sepsis recognition.

Initial patients' outcomes:
In the scope of this study, the initial outcomes for patients will involved:

- Shorter emergency department length of stay (ERLOS).
- Decrease in the incidence of mortality rate.
- Decrease the incidence of ICU admission rate.
- Decrease the incidence of mechanical ventilation rate.

Methods:
Study design:
A quasi-experimental studywas utilized. It is an empirical study used to investigate the effect of an independent variable on a dependent variable without randomization **(Nestor & Schutt, 2018).**

Study setting:
This study was carried out in the Emergency department (ED) at Mansoura Emergency Hospital. The ED provides emergency care for patients admitted with traumatic (unitrauma or polytrauma) or non-traumatic disorders (including acute neurological, GIT, respiratory, cardiovascular or endocrine disease). The ratio of nurse-patient in ED is nearly 1:3. **Subjects:**
A convenience sample of 100 adult patients of both genders who directly admitted to an ED at Mansoura Emergency hospital and met inclusion criteria was included in this research. The sample was assigned into bundle group (50 patients) and a non-bundle group (50 patients).

Inclusion and exclusion criteria
Adult patients aged 18 years or more with an initial diagnosis of sepsis was involved in the study. Patients with sepsis were excluded from the study if they presented with acute cardiogenic pulmonary edema, acute coronary artery disease, acute stroke, pregnancy, drug poisoning, burn, trauma, required emergentoperation, or had a "do not resuscitate" within sex hours of admission time (**Surviving Sepsis Campaign, 2017).**

Study sample size calculation
The research sample size was calculated through Stephen Thompson formula[CI = 95.0%, power=0.8, confidence limit = 0.05, population= 135].

$$n = \left[\frac{N\,X\,p(1-p)}{[N-1X(d^2 \div z^2)]+p(1-p)}\right]$$

$$\frac{135\ \text{x}\ 0.50(1-0.50)}{135-1\text{x}\left(\frac{0.0025}{3.84}\right)+0.50(1-0.50)} = 100\ \text{patients}$$

Data Collection tools:
Two tools were utilized to gather data for existing research after reviewing the relevant literature **(Schinkel, et al., 2022; Uffen, et al., 2021; Evans, Rhodes, & Alhazzani, 2021; Sayed, 2020; Acharya, et al., 2024).**

Tool One: "Sepsis' Screening Sheet"
The sheet was established by investigators to evaluate the participant's sepsis severity. Cronbach's Alpha coefficient showed good reliability of the tool (0.844). It involved three parts:

Part 1: "Patient's Demographic Characteristics"
This part included emergency patient's demographic data involved age, gender, education level, nationality, and occupation.

Part 2: "Patient's Clinical Data"
It was established by investigators after reviewing related literature**(Alhazzani, 2021; Sayed, 2020; Acharya, et al., 2024).** It aims to assess the health releated data of the emergency patients with sepsis such as admission time, discharge time and type, GCS, APPACHE II score, comorbidities and 1ry disorders.

Part 3:"Sepsis screening criteria Questionnaire"
It was adopted from **Acharya, et al., (2024)** to evaluate severity of sepsis. It included 3 close end questions about a patient's new infection history, infection manifestations and organ dysfunction characteristics to ranking the severity of sepsis (sepsis, severe sepsis & septic shock). Sepsis category included only new

infection history, severe sepsis category included new infection occurrence and infection clinical manifestations and septic shock included patient's new infection history, infection manifestations and organ dysfunction characteristics.

Tool Two: "Sepsis Management Flow-Chart"

It was developed by researchers to evaluate participant's clinical outcomes for sepsis management. It was used hourly until the patient was discharged from ED. It contained vital signs, SpO2, LOC, quick sequential organ failure assessment score (QSOFA), blood test (lactic acid (mmol/L) and culture sample), O^2 therapy, fluid resuscitation, antibiotic and vasopressors administrations, and MV therapy.Cronbach's Alpha coefficientof tool reflect good reliability (0.871).

Pilot Study

It was performed on 10 patients who were not included in study subjects. It was carried out to test the feasibility and clarity of the tools. Required modifications were made accordingly.

Data Collection process

Data was collected for three months.This study was carried out in 3 main phases: preparation, implementation, and evaluation.

I. Preparation phase

In this phase, ethical approval was obtained from Research Ethics Committee, Faculty of Nursing, Mansoura University. Additionally, an official approval to carry out research was secured from selected hospital matron after exploring the study's purpose and nature. A data collection tool was established by researchers after reviewing relevant literature. Experts in the field assessed the tool to ensure its validity and reliability. Furthermore, an informed consent form was prepared to obtain voluntary participation from eligible patients or their legal representatives.

II. Implementation phase

During the implementation phase, the investigators explained research aim and procedures to emergency patients or their legal representatives in cases where the patient was unconscious. After obtaining informed consent, demographic characteristics and clinical data were collected using the first and second sections of the first data collection tool. Additionally, the severity of sepsis was assessed using part III of tool one. The intervention group (sepsis bundle group) received the sepsis resuscitation bundle administered by the researchers, whereas the control group (non-bundle group) received standard sepsis management from the emergency healthcare team.The Sepsis care bundle involved five element that must be achieved within three hrs of patient's ED admission. The bundle elements involve lactate level measurement, pre-antibiotic blood culture, broad spectrum antibiotic administration, fluid resuscitation by 30 mL/kg crystalloid if hypotension or lactate ≥4 mmol/L appears, vasopressors administration when persistent hypotension regardless fluid resuscitation aimed to keep mean arterial pressure (MAP) at ≥65 mmHg.

III. Evaluation phase

In the final evaluation phase,the researchers evaluated patient's initial clinical outcomes for both groups (length of patient's stay within ED & hospital, mortality rate, ICUadmission and mechanical ventilation incidence, APACHE II score, QSOFA, GCS, vital signs (MAP, Temp, HR, RR) and PaSO2) using second evaluation tool to identify the impact of sepsis bundle.

Data Analysis

The study data was analyzed by the statistical package for Social Sciences (SPSS, Version 24). Statistical methods which have been used include mixed ANOVA test, Chi-Square test, independent Samples T test, means, std. deviation, and the percentage of variables.

Ethical Considerations

Ethical approval for the study was obtained from the Research Ethics Committee of the Faculty of Nursing, Mansoura University (Ref. No. 0722). Official permission to conduct the study was also granted by the administrative authority of Mansoura University Emergency Hospital following a thorough explanation of the study's purpose and nature. Written informed consent was obtained from all patients—or from their legal representatives in cases of altered consciousness—after providing detailed information about the study's objectives, procedures, potential benefits, and risks. Participants were assured that their involvement was entirely voluntary and that they had the right to withdraw from the study at any time without any negative consequences.

Results:

3.1. Baseline features of the study participants.

Table (1) reveals that there were not statistically significant differences between the studied groups regarding all baseline features. The patients' mean age of bundle group and control group were 52 ±11.66 and 57 ± 12.15 years, respectively. Regarding gender, more thanhalf participants in the bundle group and control group were Males

(60.0%, 54.0% respectively). Also, most patients in bundle group and control group were Egyptian (82.0%,76.0% respectively). Approximately three quartershave secondary school educational level (68.0%) in bundle group, and in control group (60.0%). The data analysis showed that 56.0% of patients in bundle group, and 48.0% in control group had service & sales occupations.

3.2. Clinical data of the participants.

Table (2) shows nonsignificant differences (p> 0.05) among all clinical variables between bundle and non-bundle groups. In relation to the comorbidities, it was observed that DM was the highest comorbidity followed by hypertension among bundle group (78% & 76% respectively), while hypertension was the highest in control group followed by DM (88%, &82% respectively). Approximately three quarters of both bundlegroup and control group admitted the ER with septic shock (68%, 64% respectively). The mean score of GCS on admission for patients in bundle group was 12.46± 2.89 vs 12.30±3.702 for control group. The mean score of APACHE II on admission was slightly elevated among bundle group rather than control group (29.44 ± 6.464, 28.42 ±5.333 respectively). The most common infection site reported by participants on admission was surgical site or wound infectionin bundle group (50%) andsurgical site or wound infection and respiratory tract infection amongcontrol group (50%, 44% respectively). The mean QSOFA score on admission was2.88±0.52 for bundle group vs 2.90±0.58 for control group.

3.3Patient's initial clinical outcomes of resuscitation sepsis bundles

Table (3) highlighted presence of significant difference ($p \leq 0.05$) between both groups concerning clinical sepsis outcomes, except for GCS, temperature, RR, and SaO_2, where no significant variation was found (P=0.56, 0.629, 0.401, and 0.52, respectively). The APACHE II score on the post bundle performance was notably higher in the control group compared to the bundle group (43.541±15.63 versus 26.969±9.93, P=0.044). Additionally, the QSOFA score exhibited a significant reduction in the bundle group when contrasted with the control group (1.960 ± 0.63 vs. 2.68 ± 0.71

Regarding mean HR, the control group demonstrated a significant elevated mean value than the bundle group (110.41 ± 6.53 vs. 99.46 ± 9.63). Additionally, the mean MAP of the bundle group was significantly higher than control group (81.38±16.90, 68.80±19.25, respectively). Furthermore, the ED-LOS was notably prolonged in the control group in comparison to the bundle group (4.842 ± 2.73 versus 1.76 ± 0.823, P = 0.029). Similarly, the H.LOS was significantly reduced among patients receiving the bundle intervention (8.01± 1.96 vs. 11.99± 4.12, P = 0.031).With respect to ICU admissions, findings indicate that 40% of patients in the control group required ICU admission, whereas this rate was markedly lower in the bundle group (14%). Lastly, mortality rates were significantly elevated among control group patients in contrast to those who received the bundle intervention (28% vs. 14%, P = 0.021).

Table 1: ***Frequency and percentages distributions of patient's baseline features (n=100).***

Variables		Bundle group (n=50)		Control group (n=50)		Chi-Square Value	Sig. P. value
		N	%	N	%		
Age(years)	20 < 35	6	12.0	6	12.0	3.068	0.217
	35<50	21	42.0	13	26.0		
	50– 65	23	46.0	31	62.0		
	M ± SD	52 ± 11.665		57 ± 12.153			
Gender	Female	20	40.0	23	46.0	0.372	0.556
	Male	30	60.0	27	54.0		
Nationality	Non-Egyptian	9	18.0	12	24.0	1.983	0.165
	Egyptian	41	82.0	38	76.0		
Educational level	Illiteracy	5	10.0	3	6.0	8.722	0.070
	1ry school	5	10.0	15	30.0		
	2ry school	34	68.0	30	60.0		
	High school	6	12.0	2	4.0		
Occupational status	Unemployed	6	12.0	12	24.0	6.171	0.178
	Military	4	8	4	8		
	Professional	12	24	10	20		
	Service & sales	28	56.0	24	48.0		

Significant: = $p \leq 0.05$

Table 2: Sample distribution according to the patients' clinical data (n=100)

Variables		Bundle group (n=50)		Nonbundle group (n=50)		Chi-Square Value	Sig. P. value
		N	%	N	%		
Comorbidities							
	Diabetes mellitus	39	78.0	41	82.0	8.889	0.713
	Malnutrition	4	8.0	8	16.0		
	CAD	29	58.0	26	52.0		
	Dementia	3	6.0	2	4.0		
	Cancer	8	16.0	7	14.0		
	CRI	3	6.0	3	6.0		
	COPD	6	12.0	3	6.0		
	Hypertension	38	76.0	44	88.0		
Sepsis categorization	Severe sepsis	16	32.0	18	36.0	5.933	0.167
	Sepsis shock	34	68.0	32	64.0		
Infection site	Surgical site / wound infection	25	50.0	22	44.0	8.060	0.708
	Respiratory tract infection	18	36.0	22	44.0		
	Urinary tract infection	13	26.0	15	30.0		
	Blood stream infection	7	14.0	3	6.0		
	Abdominal infection	9	18.0	6	12.0		
	Cerebral infection	2	4.0	3	6.0		
GCS onadmission M ± SD		12.46± 2.890		12.30± 3.702		1.931	0.391
APACHE II M ± SD		29.44 ± 6.464		28.42 ± 5.333		2.044	0.563
QSOFA (M±SD)		2.88±0.52		2.90±0.58		3.141	0.763

Tables 3: Comparison of initial clinical outcomes between bundle and non-bundle groups(N=100)

Clinical outcomes	**Bundle group (n=50)**	**Control group (n=50)**	**T-Value**	**Sig. P. value**
	Mean ± SD	**Mean ± SD**		
APACHE II score	26.969±9.93	43.541±15.63	3.981	0.044*
QSOFA	1.960±0.63	2.68±0.71	5.37	0.001*
LOS in ED (days)	1.76 ± 0.823	4.842 ± 2.73	5.806	0.029*
Length of hospitalization (days)	8.01± 1.96	11.99± 4.12	4.023	0.031*
GCS	12.44±2.91	12.06±2.97	0.65	0.56
Vital signs				
• Temp	37.08±0.66	36.94±0.55	1.15	0.629
• HR	99.46±9.63	110.41±6.53	6.65	<0.001*
• MAP	81.38±16.90	68.80±19.25	7.16	0.000*
• Resp. Rate	24.14±3.87	25.40±5.26	1.36	0.401
SaO2	95.44±1.85	95.34±2.46	0.23	0.52
	N (%)	**N (%)**	**Chi-Square Value**	**Sig P. value**
Mechanical ventilation therapy	7 (14.0)	14 (28.0)	4.672	0.021*
Discharge type				
• Department	26 (52.0)	10 (20.0)	11.88	0.035*
• Intensive care unit	7 (14.0)	20 (40.0)		
• Home	10 (20.0)	6 (12.0)		
Mortality rate	7 (14.0)	14 (28.0)	4.672	0.021*

Significant: $p \leq 0.05$

Discussion:

Sepsis is an acute disorder which occurs frequently inducing mortality for millions of patients worldwide regardless of advanced technology and progressive health care services used. Patient's clinical outcomes are not affected only by pathogen, patient's responses,correcting tissue hypoperfusionand preventing organs failure.The effeciency of bundle care in sepsis and septic shock mangement is controversial (Marik, et al., 2019; Levy, et al., 2019; Freund, et al., 2019; Murri, et al., 2018).The recent study was applied to explore the effectivness of implementing early sepsis resuscitation bundle on patient's initial outcomes at emergency department by assessing hospitalization period, mortality rate, admission to ICU, mechanical ventilation incidence, QSOFA, LOC, APACHE II, ventilation and oxygenation parameters and vital signs.

4.1. Patients' demographic and clinical data

The study explored that both groups were fairly similar in terms of demographics and clinical presentation at baseline. This suggests that both groups were reasonably comparable before treatment began, helping to ensure that the differences seen later can more confidently be attributed to the intervention.

Regarding the common sources of infection, the findings of the current study revealed that wound infections were the most prevalent among participants in bundle and non-bundle groups. This may be attributed to the high prevalence of diabetes mellitus (DM) as a comorbidity in both groups, which is known to impair immune function and increase susceptibility to infections and sepsis. These findings contrast with those of **Song et al. (2019),** who identified respiratory and genitourinary systems as the most frequent sources of infection. However, the current result aligns with **Roh et al. (2019)**, who stated that diabetes mellitus was the most commonly observed comorbidity among patients.

4.2. Patients' length of stay

Perhaps just as important are the time-based metrics. Both ED length of stay (EDLOS) and hospital length of stay (HLOS) were shorter for those who received the bundle. Faster throughput in the ED means patients get appropriate care sooner and frees up resources in often-overcrowded emergency settings. Similarly, shorter hospital stays help reduce overall system strain and lower the chance of hospital-acquired complications. This finding aligns with the investigation by **Prasad et al. (2017),** which demonstrated that adherence to the sepsis bundle was related to a reduced LOS in the emergency department. Similarly, the results are consistent with those of **Machado et al. (2017),** who found a significant difference between the bundle and non-bundle groups in terms of reduced hospital stay duration. This could be attributed to earlier recognition of sepsis and timely implementation of the sepsis bundle. Supporting this, **Kim et al. (2017)** reported a significantly shorter hospital stay in participants undergo bundle. In the same context, **Sayed (2020)** noticed that nearly half of the participants in the usual care group remained hospitalized for one week, whereas the majority (46%) of those in the bundle care group had hospital stays of less than one week.

4.3. Severity of illness

Implementing a sepsis care bundle grounded in evidence-based practice has proven effective in managing sepsis rates. This success is largely due to the consistent identification and reduction of risk factors. Additionally, acute care nurses have a pivotal rolenot only in promptly recognizing and triaging patients at risk for sepsis but also in initiating the bundle early, which has contributed significantly to lowering mortality rates in the ICU **(Sayed, 2020).**

The majority of patients in both the bundle and non-bundle groups had APACHE II scores ranging between 20 and 29 upon admission to the emergency department. This finding is consistent with **Teles (2017),** who reported that most patients in his study fell within a similar range, corresponding to a median mortality risk associated with this APACHE II score.

After the bundle was implemented, patients in the bundle group showed notable improvements. The reduction in APACHE II scores in the bundle group compared to increased score in those who didn't receive bundlecare to better overall patient stability and a lower burden of illness. Lower scores here generally suggest improved prognosis, and this outcome mirrors what was reported by **Ko, et al (2021)**, who showed that early targeted care led to better survival and faster recovery among patients with sepsis. Furthermore, **Kang et al (2022)** found that APACHE II and SOFA scores were significantly elevated in the non bundle group. While **Wu (2020)** reported that there were no significant differences of APACHE II score between bundle and usual care group.

Another encouraging result was the drop in QSOFA scores in the bundle group. QSOFA is widely used for rapid bedside assessment, and lower scores are linked to reduced risk of sepsis-related deterioration. The fact that the bundle

group had lower scores after care began supports the idea that early, coordinated intervention can help prevent worsening organ dysfunction. These results are in line with sepsis definitions introduced by **Singer et al. (2016),** where prompt detection and early response are seen as central to better outcomes.

4.3. Vital parameters

In terms of assessing level of consciousness (LOC), the Glasgow Coma Scale (GCS) indicated that most patients in both the bundle and non-bundle groups presented with mildly altered LOC upon admission. Following the intervention, GCS scores improved in the bundle group, while they declined in the non-bundle group. This finding may be attributed to early fluid resuscitation—a key component of the sepsis bundle—which helps improve mean arterial pressure (MAP) and cerebral perfusion. These results are in line with the findings of Gyawali et al. (2019), who reported that patients commonly presented to the emergency department with mildGCS scores.On same view **Carvas et al (2016) and Lester et al (2018)** research detected that 30ml/kg crystalloid fluid resuscitationimproved MAP and tissue perfusion and low mortality.

Heart rate was also significantly decreased among bundle group, which is another indication of better cardiovascular stability. Since tachycardia is often a marker of poor perfusion in septic patients, managing it early can help reduce strain on the body. This result was on the same alignment with **Kang et al. (2022)** who observed higher HR among patients in non-bundle group that suggests that patients without structured early intervention may be more prone to hemodynamic instability.

Regarding ventilation therapy initiation, the recent investigation reflected significantly increased ventilation therapy used among patients in non-bundle group than bundle group. Unrecognized sepsis usually led to deterioration in ventilation, oxygenation, and tissue perfusion which finally led to organ failure and death. This finding may be attributed to increased awareness of disease management, which facilitated more timely therapeutic interventions and, in turn, contributed to improved overall survival. As the results of the current study revealed most patients in control group after 3 hours of patients admission to ED have tachypnea, decreased SaO2, decreased LOC, tachycardia and decreased MAP that triggered the initiation of ventilation therapy. The finding agrees with **Evans et al (2021)** study which reported that perform sepsis bundle within 3 h of sepsis onset was associated with reduced ventilation therapy used, decreased in-hospital mortality, fastened resolution of hypotension and decreased length of stay in ICU.

4.4. Mortality incidence

The results also revealed a significant difference in ICU admission rates between the bundle and non-bundle groups. Specifically, only 14% of participants in the bundle group were transferred to the ICU, compared to 40% in the non-bundle group. This finding may be attributed to the timely completion of the sepsis resuscitation bundle, which has been linked to reduced mortality, particularly when the interventions are completed within the first three hours. These results are consistent with the findings of **Le Conte et al. (2017)** and **Jeon et al. (2019),** both of whom reported that adherence to the sepsis bundle was associated with a reduction in ICU admissions.

Most notably, the bundle group had a significantly lower mortality rate than non-bundle group. That difference is perhaps the strongest indicator of the bundle's effectiveness. A 14% mortality rate in the bundle group versus 28% in the control group shows that timely, structured sepsis care can literally be the difference between life and death. More importantly, it can be hypothesized that prompt recognition of sepsis by nurses and other healthcare providers may have positively influenced mortality outcomes by preventing the progression to septic shock and subsequent death.This finding aligns closely with prior research and global guidelines promoting early, protocol-driven interventions **(Rhodes et al., 2017).**This finding is consistent with the study by **Ko et al. (2021)**, which reported that completion of the 3-hour sepsis bundle was associated with significantly lower in-hospital mortality compared to patients who did not receive the full bundle. Similarly, in a large-scale study involving 49,311 patients across 149 hospitals in New York**, Seymour et al. (2017)** found that rapid completion of the 3-hour bundle was linked to a notable reduction in in-hospital mortality. Also, **Sayed (2020)** study revealed that 3h sepsis bundle is effective in reducing sepsis rates and ICU sepsis related mortality due to early identification and management of high risk adding to an important role of acute care nursing staff in triaging and managing patients with sepsis. Additionally, the current findings agree with those of **Levy et al. (2015), Chelkeba (2015), and Damiani et al. (2015),** who all reported that implementation of the 3-hour sepsis bundle was associated with a reduction in mortality rates.

Strengths and limitations

This study is the first of its kind to explore the impact of sepsis bundle implementation on outcomes among critically ill patients in Egypt. Given the limited availability of published research addressing the effect of early sepsis bundle application on initial patient outcomes in emergency departments within the region, this study fills an important gap in the literature. It contributes to improving the knowledge and clinical practice of healthcare providers, including nurses and physicians, in relation to early sepsis management. Moreover, the findings may assist in shaping hospital policies, protocols, and educational programs aimed at fostering early recognition of sepsis and enhancing patient outcomes. However, the use of non-random sampling within a single geographic area restricts the generalizability of the results. Additionally, the exclusion of patients from labor and delivery, gynecology, neonatal, and pediatric units may have influenced the outcomes, as these populations may differ significantly from those included in the study.

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