

EFFECT OF SEPSIS EDUCATION ON KNOWLEDGE AND PRACTICE OF INTENSIVE CARE UNIT NURSES ABOUT THE MANAGEMENT OF SEPSIS

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DOI: <https://doi.org/10.5281/zenodo.16757933>

Keywords

Sepsis, nursing education, structured teaching, critical care, clinical practice, early detection, Pakistan

Article History

Received: 30 April, 2025

Accepted: 20 July, 2025

Published: 07 August, 2025

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Abstract

Background: Sepsis remains a life-threatening condition and a leading cause of mortality globally, particularly in low- and middle-income countries. Despite being preventable with early recognition and intervention, nurses often lack the required knowledge and practical skills to detect and manage sepsis effectively. This gap is especially evident in general wards, where early symptoms are commonly first observed.

Aim: This study aimed to assess the effectiveness of a structured teaching program in improving nurses' knowledge and practices related to the recognition and management of sepsis in a tertiary care hospital.

Methods: A quasi-experimental design was employed with pre- and post-intervention assessments. Forty nurses from ICU and neurosurgical wards at Faisal Masood Teaching Hospital, Sargodha, participated. Data were collected using a sepsis knowledge questionnaire and a nursing practice checklist. The intervention consisted of three structured training sessions delivered over three weeks. Data were analyzed using SPSS version 24, applying paired t-tests to compare pre- and post-intervention scores.

Results: There was a statistically significant improvement in nurses' knowledge and practice scores after the intervention. The mean difference in knowledge was 0.311 ($p < 0.001$), and in practice was 0.327 ($p < 0.001$). Post-intervention, knowledge improved by 32.4% and practice by 34.0%, particularly in areas such as early assessment, timely antibiotic administration, and patient communication.

Conclusion: Structured educational interventions significantly enhance nurses' ability to recognize and manage sepsis. Continued training, simulation, and institutional support are essential for sustaining improvements

INTRODUCTION

Sepsis is defined as suspected or confirmed infection with evidence of systemic inflammation, consisting of two or more of the following: fever or hypothermia, tachycardia, tachypnea, leukocytosis or

leucopenia (Felix, 2023). If left untreated, sepsis progresses to severe sepsis and septic shock, and is ultimately fatal. Sepsis, a life-threatening condition triggered by the body's response to infection, requires

prompt and effective management to reduce mortality rates (Vaughn & Upperman, 2023).

Sepsis is a life-threatening condition caused by suspected or apparent infection. Sepsis is characterized by systemic signs of circulatory collapse such as poor peripheral perfusion, pallor, hypotonia and poor responsiveness (Liang & Yan, 2023). As well as temperature instability, increased oxygen demand, apnea, intercostal retraction, weak pulse, delayed capillary refill, hypotension, tachycardia, irritability, lethargy, hypotonia, abdominal distension and may progress to septic shock and DIC. Hematological indices, a cute phase reactants, protein markers, and cytokines have been extensively examined as adjunctive tests for diagnosis of sepsis (Schertz et al., 2023).

Sepsis is associated with high mortality rate and constitutes one of the main causes of death. At least 19 million cases every year are diagnosed with sepsis and the majority in low- and middle-income countries. Mortality rates from sepsis range between 25% to 30% for severe sepsis and 40% to 70% for septic shock (Hunt, 2024). The annual incidence of sepsis is about 50 million globally, and sepsis-related mortality is 25%-30%. Sepsis has ranked top among the most expensive conditions treated in the United States, and the annual medical cost of sepsis in the is \$24 billion. In Korea, the mortality rate from sepsis has nearly tripled in 10 years and is the 10th leading cause of death for women (Shappell et al., 2023).

The clinical presentation of sepsis is highly variable depending on the etiology. The most common sites of infection are the respiratory, genitourinary, and gastrointestinal systems, as well as the skin and soft tissue. These deaths caused by infectious causes such as neonatal sepsis, meningitis and pneumonia (Tsantes et al., 2023). It is the culmination of complex interactions between the infectious agent and the host immune, inflammatory and coagulation responses. Both the host responses and the characteristics of the infecting organism influence the outcome of sepsis (Tsantes et al., 2023; Xin et al., 2023).

Sepsis is characterized by systemic inflammation and widespread tissue injury caused by infection. The severity of illness is ranging from sepsis, severe sepsis and septic shock. When

infection is absent, the clinical syndrome is termed Systemic Inflammatory Response Syndrome (Mangalesh et al., 2023). Systemic inflammatory response syndrome is a collection of signs where body reacting to a range of injuries or illnesses (Iba et al., 2023). It is inflammatory state affecting the whole body. Frequently it is the result of the body immune response to infectious or non-infectious diseases (Arora et al., 2023).

Sepsis causes multiple organ damages at the molecular and cellular level, such as changes in inflammatory signals and metabolic disorders, as well as organ levels, including microcirculation changes and endothelial changes, and can lead to septic shock and death if left untreated (Cheng et al., 2020; Margraf et al., 2020). However, those unwanted critical conditions can be prevented by early detection. If sepsis is detected within an hour and treated in a timely manner, the prevalence, mortality, and total medical expenses of this critical and costly condition can be reduced. Nevertheless, early recognition is not easy because initial symptoms of sepsis are nonspecific and ambiguous. In addition, health care professions' lack of knowledge of sepsis has been reported (Dolmatova et al., 2021).

Nurses are health care workers who take care of patients at bedside, and spend more time by patients than any other professions. Therefore, it is very critical for nurses to assess sepsis quickly in order to avoid serious consequences (Chua et al., 2023). In order to assess patients accurately and fast, there is need for effective educational intervention. Studies on sepsis knowledge and education programs have been focused more on nurses working at intensive care units. However, the place where initial changes of patients' clinical manifestations take place is in general units rather than intensive care units. A significant number of sepsis patients were treated in general units (Bleakley & Cole, 2020; Rababa, Bani Hamad, et al., 2022).

Critical care nurses are the health care professionals who have the obligation to protect critically ill patients against infection especially that leading to sepsis, in order to promote patients' recovery and prevent deterioration in their health (Sole et al., 2020). Intensive care nurses play a critical role in the prevention, early detection and starting therapeutic interventions in patients with sepsis (Blot et al.,

2022) (16). Nurse should possess the knowledge, current practice of SIRS diagnostic criteria, sepsis guidelines and the importance of SIRS recognition for better quality of nursing care to the patients (Blot et al., 2022).

Early recognition is crucial to improve patient's outcomes. The nursing assessment can note the subtle changes in a patient condition that signal early sepsis so, early treatment will improve patient outcomes (Rababa, Bani-Hamad, et al., 2022). Aims of initial management to secure the airway and correct hypoxemia. Intubation and mechanical ventilation may be required to stabilize patient's respiratory status (Gustad et al., 2024; Lasater et al., 2021). Steps in sepsis management were early triage and identification with rapid and appropriate fluid resuscitation in addition to blood cultures, antibiotic administration, and source control of infection finally close clinical and biomarker (lactate) monitoring. Much debate continues on what elements or interventions should be used to care for persons with sepsis (Gustad et al., 2024).

Unfortunately, it is reported that nurses working at different wards have poor knowledge of sepsis recognition and initial intervention (Luo et al., 2024). ICU nurses, often on the frontline of patient care, must possess up-to-date knowledge and skills to identify, treat, and manage sepsis efficiently. Education initiatives are essential to ensure that nurses are well-equipped with the latest guidelines and protocols, which can lead to improved clinical practices and patient outcomes. Thus, education programs targeting them are compelling. Although there is a significant relationship between education and knowledge, knowledge and performance are not always related. Therefore, an educational approach helpful for a transition from knowledge to practice should be adopted to improve both knowledge and practice.

Methodology

This study employed a descriptive quasi-experimental design with a pre-test and post-test approach. The aim was to evaluate the effectiveness of a structured teaching program on nurses' knowledge and practices regarding the management of sepsis. The design allowed for assessing changes in outcomes following an educational intervention.

The study was conducted at Faisal Masood Teaching Hospital in Sargodha, Punjab, Pakistan. Nurses working in the ICU and neurosurgical wards participated in the study. These units were selected because of their high-risk patient populations prone to sepsis. All registered nurses aged 23–45 years with at least six months of experience in critical care and not having received sepsis-specific training in the past six months were eligible. A population sampling approach was used due to the limited number of available nurses. A total sample of 40 nurses was determined appropriate using a priori power analysis for a paired t-test. A 10% dropout rate was considered to ensure sufficient statistical power.

Data Collection Procedure

Data collection occurred in four phases:

1. Pre-Intervention Phase

Participants completed a demographic questionnaire, a knowledge test on sepsis, and a nursing practice checklist. Each assessment took 20–30 minutes for knowledge and 5–10 minutes for observation.

2. Planning Phase

The researchers developed a training module based on existing literature and pre-test findings. It consisted of seven educational units covering sepsis knowledge, early detection, management, and nursing interventions.

3. Intervention Phase

Three face-to-face teaching sessions were conducted over three weeks. Each session included lectures, discussions, PowerPoint presentations, videos, and case scenarios. Participants received printed handouts and were grouped to ensure active participation.

4. Post-Intervention Phase

One month after the intervention, the same tools were used to reassess knowledge and practices.

Data Analysis Procedure

Data were analyzed using SPSS Version 24. Categorical data were analyzed using chi-square tests. Descriptive statistics (frequencies, percentages, mean, and standard deviation) were computed for all variables. A paired sample t-test was applied to

compare pre- and post-intervention scores, with

statistical significance set at $p < 0.05$.

Results and Analysis

Demographic Variable	Category	Frequency	Percentage
Gender	Male	7	14.0
	Female	43	86.0
Job Type	Permanent	50	100.0
Marital Status	Married	16	32.0
	Single	34	68.0
Age Group	23-34 Years	17	34.0
	35-45 Years	33	66.0
Qualification	Nursing Diploma	29	58.0
	Specialty	11	22.0
	Masters	10	20.0
Job Position	Charge Nurse	50	100.0
DHQ Location	FMTH Sargodha	50	100.0
Department	ICU	34	68.0
	Neurosurgical ward	16	32.0
Experience	1-3 Years	13	26.0
	4-6 Years	11	22.0
	7-10 Years	13	26.0
	Above 10 Years	13	26.0

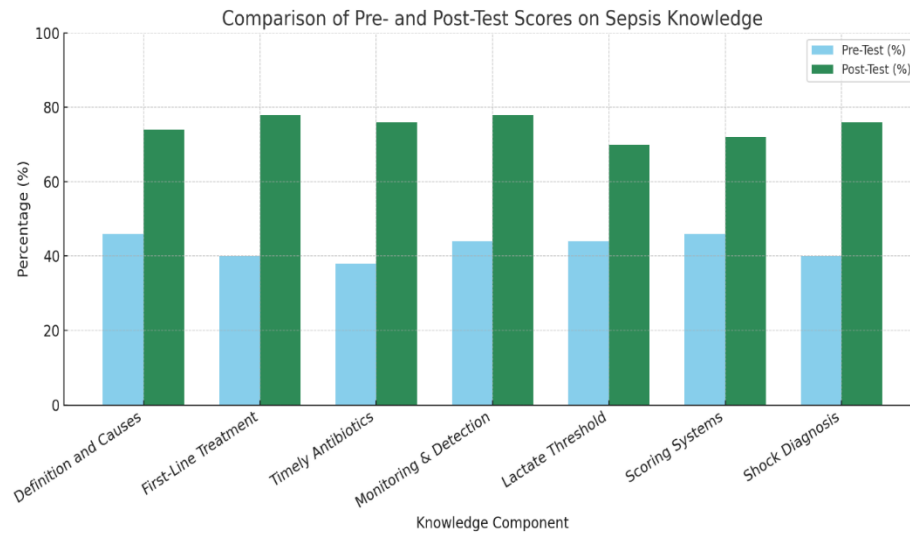


Figure 1: Pre- and Post-Intervention Knowledge Scores of Nurses

Figure 1 illustrates a clear improvement in nurses' knowledge across all components of sepsis management after the educational intervention. Notably, post-test scores rose significantly, especially in areas like first-line treatment and timely antibiotic administration.

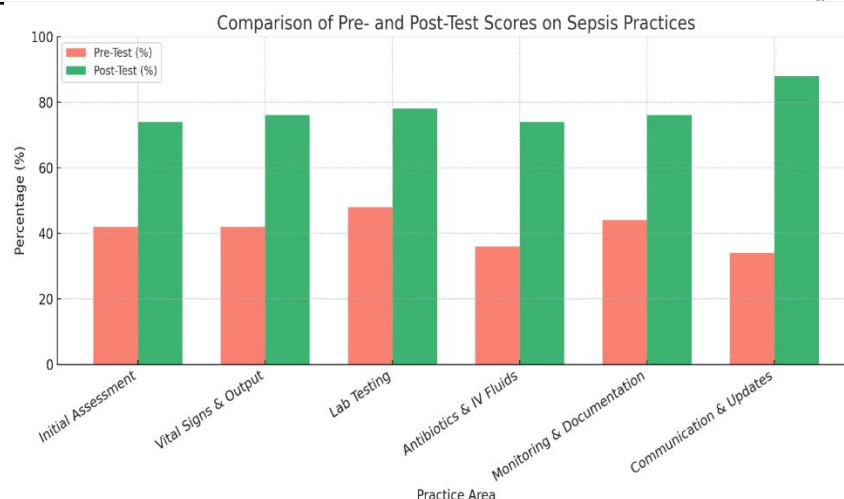


Figure 2: Pre- and Post-Intervention Practice Scores of Nurses

Figure 2 highlights substantial improvements in nurses' practical skills after the intervention, with the most notable gains in team communication and timely treatment delivery. All practice areas showed marked progress, reinforcing the effectiveness of the training.

The paired t-test results indicate a statistically significant improvement in both knowledge and practice scores after the educational intervention. The mean difference for knowledge was 0.311 ($t = 15.460$), and for practice was 0.327 ($t = 11.658$), with both p-values < 0.001 . This confirms the intervention had a strong positive effect on nurses' competencies in sepsis management (Table 2).

Table 2: Paired Sample T-Test for Knowledge and Practice Scores

Parameter	Mean Difference	SD	t-value	p-value
Knowledge (Pre vs. Post)	0.311	0.142	15.460	<0.001
Practice (Pre vs. Post)	0.327	0.198	11.658	<0.001

The table shows notable gains after the intervention, with overall knowledge improving by 32.4% and practice by 34.0%. These results reflect the

effectiveness of the structured training in enhancing both theoretical understanding and clinical performance in sepsis management (Table 3).

Table 3: Percentage Improvement in Knowledge and Practice Scores

Component	Pre (%)	Post (%)	Improvement (%)
Overall Knowledge	43.0	75.4	+32.4%
Overall Practice	41.3	75.3	+34.0%

Discussion

Sepsis, a serious and usually fatal infection-related condition, can quickly lead to organ failure and death if not managed. It affects millions of people each year, particularly in low- and middle-income countries such as Pakistan, where early detection and treatment are more difficult owing to financing

restrictions. Sepsis signs, such as fever, rapid pulse, disorientation, and dyspnea, can be confusing and difficult to identify; hence, early identification is critical. Nurses, particularly those working in critical care units, are on the front lines of patient care since they are the first to notice slight changes in a patient's health. Nonetheless, studies show that many

nurses are not properly prepared to diagnose and treat sepsis in a timely manner.

Patients may have inferior outcomes and treatment delays as a result of this information gap. Spending money on focused education and training for critical care unit nurses might have a significant impact. With the right knowledge and skills, nurses may detect sepsis early, intervene promptly, and perhaps save lives. Thus, current study aims to investigate how an educational program might enhance nurses' practical knowledge and abilities in efficiently managing sepsis.

The pre-intervention data indicated that many nurses had severe knowledge gaps when it came to sepsis something that's regrettably not unique to this environment. Studies conducted worldwide have demonstrated that frontline healthcare personnel frequently get inadequate sepsis education (Tate, Dussaux, & Mandelbrot, 2023). Less than half of the nurses in this study were able to describe sepsis accurately, and even fewer knew that bacterial infections are a prevalent cause. Just 40% were aware that the first line of therapy should be broad-spectrum antibiotics. As Damschroder, Reardon, Opra Widerquist, and Lowery (2022) pointed out in their study on clinical knowledge gaps, they are more than simply numbers; they are lost chances for prompt intervention.

Particularly concerning is the fact that just 38% of nurses were aware that antibiotics must be administered within the first hour of a sepsis diagnosis. This window is crucial since waiting too long might be lethal. However, several nurses went against the most recent recommendations from the Surviving Sepsis Campaign, believing that they should wait for test findings before beginning medication (Evans et al., 2021). The difficulty of striking a balance between taking immediate action and waiting for confirmation is evident, and Kumar et al. (2018) address this issue as well.

In terms of patient education, fewer than half of the nurses provided accurate answers, indicating a more widespread problem. Despite other research showing that focused education and awareness initiatives may have a significant impact, many people continued to hold misunderstandings (Levy, Evans, & Rhodes, 2018).

The limitations persisted in terms of clinical tool use and monitoring. According to Liu et al. (2019), who discovered that testing delays frequently resulted in worse outcomes, less than half of the nurses were aware that lactate levels should be tested within 30 minutes or that a level of 4 mmol/L is a warning sign. In order to identify early indicators of deterioration, vital signs must be checked every 30 minutes, but just 46% of people were doing so. In line with the findings of Bentley, Sparks, and High (2023), many nurses are simply not utilizing scoring tools like qSOFA or MEWS in their everyday practice, maybe as a result of a lack of support or training. This underutilization of these tools is equally troubling.

Additionally, there was misunderstanding regarding septic shock. Just 40% of respondents knew that persistently low blood pressure following fluids is a crucial indicator of shock. The introduction of life-saving vasopressors may be delayed as a result. Similar to this, several nurses were unaware that starting antibiotics immediately after obtaining cultures rather than later could affect the results (Rhodes, Janssen, Bredin, Warburton, & Bauman, 2017).

There was also a lack of capacity to identify early sepsis symptoms. For example, just 38% of respondents recognized changed mental state as an early warning sign, even though it's frequently one of the first signs that something is amiss (Perner et al., 2017). According to Singer et al. (2016), almost 50% of the nurses identified aberrant white blood cell counts or unexpectedly elevated blood sugar in non-diabetic patients as warning indicators; nonetheless, many were still unclear of fundamental diagnostic markers.

It is evident from all of this that nurses are having a difficult time recognizing and responding to sepsis. However, there is hope. According to other research, online learning and hands-on, scenario-based training may greatly increase knowledge and confidence in these areas (Chalwin, Giles, Salter, Kapitola, & Karnon, 2020). Enhancing exam results is only one goal; another is to give nurses the skills and intuition they need to save lives.

The post-interventional analysis makes it clear that most nurses had a good grasp of key sepsis concepts. Many could correctly define sepsis as a life-

threatening condition caused by a dysregulated response to infection, and they knew that bacteria were the most common culprits. They also understood the urgency of treatment—particularly the importance of starting broad-spectrum antibiotics quickly, which reflects current guidelines from the Surviving Sepsis Campaign (Evans et al., 2021). About three-quarters of the nurses answered knowledge-based questions correctly overall, suggesting that the training made a meaningful difference.

The degree of nurses' comprehension of the early indicators of sepsis was one positive outcome. The majority acknowledged the need of continuously monitoring vital signs, checking lactate levels, and taking prompt action if a patient's condition started to worsen. Additionally, they were aware of early warning sign detection techniques such as SIRS and qSOFA. The findings are consistent with previous research (Makam et al., 2023) that highlights the increasing role of frontline nurses in the early diagnosis of sepsis. The fact that not all nurses were regularly utilizing these screening techniques in practice, despite their knowledge of them, is probably due to practical issues such time constraints or resource scarcity, which have also been mentioned in previous research (Rhee et al., 2022).

The majority of nurses were aware of the proper course of action when it came to therapy, particularly when it came to identifying when a patient was approaching septic shock and required immediate attention. Numerous people accurately recognized the necessity of early antibiotics and fluid resuscitation. However, other questions remained, such as whether blood cultures should be obtained before to administering antibiotics or the appropriate timing and administration of drugs like corticosteroids, which are still debatable (Briel, Eldridge, Stanway, Stevance, & Chrimes, 2022).

It was more challenging for nurses to understand test findings, such as aberrant white blood cell counts, even when they could identify common warning signs like dizziness, low oxygen levels, or sudden spikes in blood sugar. According to a recent study (Vu et al., 2023), nurses need continual support and training to feel comfortable analyzing more complex data, even if they are typically aware of what to look for.

In practice, however, the largest disparity was seen. Although nurses were aware of their responsibilities, they did not always carry them out at the patient's bedside. Sometimes, simple yet important procedures were neglected, such as doing comprehensive physical examinations or monitoring urine output. That's not uncommon; recent research (Twigg, Fedenko, Hurst, Stanley, & Hughes, 2024) demonstrates that strict adherence to procedures is frequently hampered by hectic shifts, heavy patient loads, and staffing shortages.

Important follow-up actions, including recording changes, keeping doctors informed, and reevaluating the patient, were frequently overlooked, even in cases where medications like fluids and antibiotics were administered promptly. Knowing isn't necessarily the same as acting, which is a prevalent problem in the healthcare industry. Furthermore, nurses frequently operate under extreme pressure, so it's not a lack of effort. According to Daniels and Pahuja (2023), the answer is to create mechanisms that encourage best practices, such frequent training, collaboration, and instruments that facilitate prompt action.

Specifically, training was effective, since nurses obviously gained a lot of knowledge. However, converting such information into consistent, real-time action is still difficult. We must do more than one-time schooling to narrow that gap. Nurses need ongoing guidance, opportunities for hands-on practice, and environments that enable them to respond to sepsis with confidence and speed. In this approach, we turn information into therapy that can save lives.

This study unequivocally demonstrates how the head nurses were impacted by the educational intervention. Their practical abilities and knowledge both significantly increased, with average improvements of around 0.31 and 0.33. The data show that these changes were undoubtedly not coincidental.

Conclusion

This study unequivocally demonstrates that focused instruction greatly enhances nurses' understanding and proficiency in managing sepsis. Prior to the intervention, there were significant gaps, especially in early detection and prompt treatment results that are in line with international studies. Following training,

nurses showed a deeper comprehension of important ideas, including early warning indicators and the need to start antibiotics as soon as possible, in accordance with current recommendations.

Despite advances in understanding, consistent implementation in practice remained difficult, most likely because of systemic obstacles including workload and resource constraints, which have been mentioned in recent articles. This emphasizes how important continuing education, encouraging surroundings, and real-world reinforcement are. Essentially, nurses who possess the necessary skills and information are better able to respond quickly, which can improve patient outcomes and even save lives.

Recommendations

1. Implement Regular Sepsis Training Programs

Healthcare institutions should integrate structured, evidence-based sepsis education into routine nursing training schedules to ensure continuous knowledge and skill enhancement.

2. Establish Sepsis Protocols and Checklists

Standardized clinical protocols and checklists should be made available in all critical care areas to guide nurses in early detection, prompt treatment, and effective monitoring of sepsis cases.

3. Promote Simulation-Based Learning

Practical training sessions using real-life case simulations should be conducted regularly to reinforce critical decision-making skills and confidence in managing sepsis emergencies.

4. Monitor and Audit Clinical Practice

Regular audits of nursing documentation and sepsis management practices should be conducted to identify performance gaps and provide timely feedback for improvement.

5. Strengthen Multidisciplinary Communication

Encourage clear and consistent communication among nurses, physicians, and families to ensure collaborative care, timely interventions, and patient-centered decision-making in sepsis management.

REFERENCES

- Almarhabi, M., Cornish, J., & Lee, G. (2021). The effectiveness of educational interventions on trauma intensive care unit nurses' competence: A systematic review and meta-analysis. *Intensive and Critical Care Nursing*, 64, 102931.
- Arora, J., Mendelson, A. A., & Fox-Robichaud, A. (2023). Sepsis: network pathophysiology and implications for early diagnosis. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 324(5), R613-R624.
- Bassetti, M., De Waele, J. J., Eggimann, P., Garnacho-Montero, J., Kahlmeter, G., Menichetti, F., Nicolau, D. P., Paiva, J. A., Tumbarello, M., & Welte, T. (2015). Preventive and therapeutic strategies in critically ill patients with highly resistant bacteria. *Intensive care medicine*, 41, 776-795.
- Bentley, B. H., Sparks, E. C., & High, K. P. (2023). Polymicrobial Bacteremia Due to SARS-CoV-2-Related Superior Mesenteric Vein Thrombosis. *Annals of Internal Medicine: Clinical Cases*, 2(12), e230902.
- Bladon, S., Ashiru-Oredope, D., Cunningham, N., Pate, A., Martin, G. P., Zhong, X., Gilham, E. L., Brown, C. S., Mirfenderesky, M., & Palin, V. (2024). Rapid systematic review on risks and outcomes of sepsis: the influence of risk factors associated with health inequalities. *International Journal for Equity in Health*, 23(1), 34.
- Bleakley, G., & Cole, M. (2020). Recognition and management of sepsis: the nurse's role. *British Journal of nursing*, 29(21), 1248-1251.
- Blot, S., Ruppé, E., Harbarth, S., Asehnoune, K., Poulakou, G., Luyt, C.-E., Rello, J., Klompas, M., Depuydt, P., & Eckmann, C. (2022). Healthcare-associated infections in adult intensive care unit patients: Changes in epidemiology, diagnosis, prevention and contributions of new technologies. *Intensive and Critical Care Nursing*, 70, 103227.

- Borguezam, C. B., Sanches, C. T., Albaneser, S. P. R., Moraes, U. R. d. O., Grion, C. M. C., & Kerbauy, G. (2021). Managed clinical protocol: impact of implementation on sepsis treatment quality indicators. *Revista Brasileira de Enfermagem*, 74, e20200282.
- Briel, M. M., Eldridge, J., Stanway, E. R., Stevance, H., & Chrimes, A. (2022). Estimating transient rates from cosmological simulations and BPASS. *Monthly Notices of the Royal Astronomical Society*, 514(1), 1315-1334.
- Chalwin, R., Giles, L., Salter, A., Kapitola, K., & Karnon, J. (2020). Re-designing a rapid response system: effect on staff experiences and perceptions of rapid response team calls. *BMC Health Services Research*, 20, 1-9.
- Cheng, Z., Abrams, S. T., Toh, J., Wang, S. S., Wang, Z., Yu, Q., Yu, W., Toh, C.-H., & Wang, G. (2020). The critical roles and mechanisms of immune cell death in sepsis. *Frontiers in Immunology*, 11, 1918.
- Choy, C., Liaw, S., Goh, E., See, K., & Chua, W. (2022). Impact of sepsis education for healthcare professionals and students on learning and patient outcomes: A systematic review. *Journal of Hospital Infection*, 122, 84-95.
- Chua, W. L., Ooi, S. L., Chan, G. W. H., Lau, T. C., & Liaw, S. Y. (2022). The effect of a sepsis interprofessional education using virtual patient telesimulation on sepsis team care in clinical practice: mixed methods study. *Journal of Medical Internet Research*, 24(4), e35058.
- Chua, W. L., Teh, C. S., Basri, M. A. B. A., Ong, S. T., Phang, N. Q. Q., & Goh, E. L. (2023). Nurses' knowledge and confidence in recognizing and managing patients with sepsis: A multi-site cross-sectional study. *Journal of advanced nursing*, 79(2), 616-629.
- Coiner, S. E., & Wingo, N. P. (2021). Addressing gaps in nurses' knowledge of sepsis: A literature review. *The Journal of Continuing Education in Nursing*, 52(1), 43-46.
- Daniels, P., & Pahuja, M. (2023). Looking at Sepsis in Patients with Terminal Illnesses. *Current Treatment Options in Infectious Diseases*, 15(3), 53-60.
- Damschroder, L. J., Reardon, C. M., Opra Widerquist, M. A., & Lowery, J. (2022). Conceptualizing outcomes for use with the Consolidated Framework for Implementation Research (CFIR): the CFIR Outcomes Addendum. *Implementation science*, 17(1), 7.
- Doherty, P., Barksby, J., & McCorkindale, M. (2024). Signs and symptoms of sepsis: raising awareness in the learning disability community. *Learning Disability Practice*, 27(1).
- Dolmatova, E. V., Wang, K., Mandavilli, R., & Griendling, K. K. (2021). The effects of sepsis on endothelium and clinical implications. *Cardiovascular research*, 117(1), 60-73.
- Edwards, E., & Jones, L. (2021). Sepsis knowledge, skills and attitudes among ward-based nurses. *British Journal of nursing*, 30(15), 920-927.
- Evans, L., Rhodes, A., Alhazzani, W., Antonelli, M., Coopersmith, C. M., French, C., . . . Prescott, H. C. (2021). Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021. *Critical care medicine*, 49(11), e1063-e1143.
- Felis, S. (2023). Sepsis. *American Journal of Medical and Clinical Research & Reviews*, 2(12), 1-22.
- Gauer, R., Forbes, D., & Boyer, N. (2020). Sepsis: diagnosis and management. *American family physician*, 101(7), 409-418.
- Gustad, L. T., Bangstad, I.-L., Torsvik, M., & Rise, M. B. (2024). Nurses' and Physicians' Experiences After Implementation of a Quality Improvement Project to Improve Sepsis Awareness in Hospitals. *Journal of Multidisciplinary Healthcare*, 29-41.
- Harley, A., Massey, D., Ullman, A. J., Reid-Searl, K., Schlapbach, L. J., Takashima, M., Venkatesh, B., Datta, R., & Johnston, A. N. (2021). Final year nursing student's exposure to education and knowledge about sepsis: a multi-university study. *Nurse education today*, 97, 104703.
- Hunt, A. (2024). Sepsis: an overview of the signs, symptoms, diagnosis, treatment and pathophysiology. *Emergency Nurse*, 32(1).

- Iba, T., Helms, J., Connors, J. M., & Levy, J. H. (2023). The pathophysiology, diagnosis, and management of sepsis-associated disseminated intravascular coagulation. *Journal of Intensive Care*, 11(1), 24.
- Kim, B., & Jeong, Y. (2020). Effects of a case-based sepsis education program for general ward nurses on knowledge, accuracy of sepsis assessment, and self-efficacy. *Journal of Korean Biological Nursing Science*, 22(4), 260-270.
- Kule, A., Stassen, W., Flores, G. E., Djarv, T., & Singletary, E. (2024). Recognition and Awareness of Sepsis by First-Aid Providers in Adults With Suspected Infection: A Scoping Review. *Cureus*, 16(6).
- Kumar, S., Gupta, E., Kaushik, S., Kumar Srivastava, V., Mehta, S., & Jyoti, A. (2018). Evaluation of oxidative stress and antioxidant status: Correlation with the severity of sepsis. *Scandinavian Journal of Immunology*, 87(4), e12653.
- Lasater, K. B., Sloane, D. M., McHugh, M. D., Cimiotti, J. P., Riman, K. A., Martin, B., Alexander, M., & Aiken, L. H. (2021). Evaluation of hospital nurse-to-patient staffing ratios and sepsis bundles on patient outcomes. *American Journal of Infection Control*, 49(7), 868-873.
- Levy, M. M., Evans, L. E., & Rhodes, A. (2018). The surviving sepsis campaign bundle: 2018 update. *Intensive care medicine*, 44(6), 925-928.
- Liu, Z., Meng, Z., Li, Y., Zhao, J., Wu, S., Gou, S., & Wu, H. (2019). Prognostic accuracy of the serum lactate level, the SOFA score and the qSOFA score for mortality among adults with Sepsis. *Scandinavian journal of trauma, resuscitation and emergency medicine*, 27, 1-10.
- Makam, S. N., Setamou, M., Alabi, O. J., Day, W., Cromey, D., & Nwugo, C. (2023). Mitigation of Huanglongbing: Implications of a Biologically Enhanced Nutritional Program on Yield, Pathogen Localization, and Host Gene Expression Profiles. *Plant Disease*, 107(12), 3996-4009.
- Perner, A., Rhodes, A., Venkatesh, B., Angus, D. C., Martin-Loeches, I., Preiser, J.-C., . . . Joannidis, M. (2017). Sepsis: frontiers in supportive care, organisation and research. *Intensive care medicine*, 43, 496-508.
- Rhee, T. G., Shim, S. R., Forester, B. P., Nierenberg, A. A., McIntyre, R. S., Papakostas, G. I., . . . Wilkinson, S. T. (2022). Efficacy and safety of ketamine vs electroconvulsive therapy among patients with major depressive episode: a systematic review and meta-analysis. *JAMA psychiatry*, 79(12), 1162-1172.
- Rhodes, R. E., Janssen, I., Bredin, S. S., Warburton, D. E., & Bauman, A. (2017). Physical activity: Health impact, prevalence, correlates and interventions. *Psychology & health*, 32(8), 942-975.
- Singer, M., Deutschman, C. S., Seymour, C. W., Shankar-Hari, M., Annane, D., Bauer, M., . . . Coopersmith, C. M. (2016). The third international consensus definitions for sepsis and septic shock (Sepsis-3). *Jama*, 315(8), 801-810.
- Tate, B., Dussaux, C., & Mandellbrot, L. (2023). Impact of extending criteria for home care management in Preterm Prelabor Rupture of Membranes. *Journal of Gynecology Obstetrics and Human Reproduction*, 52(8), 102638.
- Twigg, G., Fedenko, J., Hurst, G., Stanley, M. S., & Hughes, A. D. (2024). A review of the current potential of European brown seaweed for the production of biofuels. *Energy, Sustainability and Society*, 14(1), 21.
- Vu, D. M., Krystosik, A. R., Ndenga, B. A., Mutuku, F. M., Ripp, K., Liu, E., . . . Maina, P. W. (2023). Detection of acute dengue virus infection, with and without concurrent malaria infection, in a cohort of febrile children in Kenya, 2014–2019, by clinicians or machine learning algorithms. *PLOS Global Public Health*, 3(7), e0001950