

THE ROLE OF NURSES IN THE EARLY DETECTION AND PREVENTION OF SEPSIS IN INTENSIVE CARE UNITS: A CROSS-SECTIONAL STUDY IN SAUDI HOSPITALS

¹Moamen Abdelfadil Ismail, ²Maram Qasim Ahmed Salawi,
³Afaf Gaber Yehya Dakkam, ⁴Fatimah Essa Sadig Tohari,
⁵Manar Othman Ibrahim Kamli, ⁶Fawziah Fawaz Alshahrani,
⁷Mawahib Mohammed Salih Ibrahim, ⁸Naif Hamoud O Alsuwat,
⁹Hanan Ahmad, ¹⁰Samirah Ateeq Alzahrani, ¹¹Najwa Abbas Bahkali

¹Internal Medicine consultant, King Abdulaziz Specialist Hospital - Sakaka – Aljouf

²Nursing, King Fahd Central Hospital Jazan

³Nursing, King Fahd Central Hospital Jazan

⁴Nursing, King Fahd Central Hospital Jazan

⁵Nursing, King Fahd Central Hospital

⁶Nursing ANP UCC, KSMC

⁷Nursing

⁸Nursing

⁹Pediatric diabetes educator, Nursing

¹⁰Nursing specialist, health educator at the National Guard Hospital

¹¹Nursing

Abstract

Background:

Sepsis is a major cause of morbidity and mortality worldwide, with ICU patients at particularly high risk. Nurses are pivotal to early detection and prevention, yet their knowledge, practices, and barriers in Saudi hospitals remain underexplored.

Objective:

To evaluate ICU nurses' knowledge, practices, and barriers in sepsis detection and prevention across tertiary hospitals in Saudi Arabia.

Methods:

A cross-sectional, multi-center study was conducted among 461 ICU nurses in three Riyadh hospitals (March–June 2025). Data were collected via structured questionnaires assessing demographics, sepsis knowledge, practice adherence, and perceived barriers. Facility surveys and focus group discussions supplemented quantitative findings. Data were analyzed using descriptive statistics, chi-square, and ANOVA.

Results:

Of the 461 nurses surveyed, 62.7% were female, 58.8% expatriates, and 71.2% held a bachelor's degree. Mean sepsis knowledge score was 63.5% (SD=12.4), with significant variation by education level ($p<0.01$). Only 54.1% consistently applied standardized screening tools, and 48.3% adhered fully to sepsis bundle protocols. Barriers included heavy workload (72.6%), inadequate training (59.8%), and resource limitations (41.5%). Nurses with specialized critical care training scored significantly higher in both knowledge (72.1% vs. 59.4%, $p<0.001$) and practice adherence (65.2% vs. 46.8%, $p<0.001$).

Conclusion:

Saudi ICU nurses demonstrate moderate knowledge and practice levels in sepsis care, with gaps influenced by education, training, and institutional support. Strengthening structured sepsis education, ensuring bundle compliance, and integrating digital early-warning systems could significantly improve patient outcomes.

Keywords: Sepsis; Intensive Care Units; Nurses; Early Detection; Sepsis Bundle; Knowledge and Practice; Saudi Arabia; Patient Safety

Introduction

Sepsis, defined as life-threatening organ dysfunction caused by a dysregulated host response to infection (Singer et al., 2016), remains a critical global health concern,

contributing to more than 11 million deaths each year (Rudd et al., 2020). Despite advances in diagnostic tools, therapeutic strategies, and international guidelines, mortality rates from sepsis remain between 20% and 50%, with wide variation depending on region, healthcare capacity, and available resources (Evans et al., 2021). Timely recognition and rapid initiation of treatment bundles are therefore essential to improving survival.

Nurses are uniquely positioned to play a central role in early sepsis detection and prevention. Their continuous bedside presence and frequent patient monitoring enable them to identify subtle clinical changes and initiate timely interventions (Sterling et al., 2020). Evidence shows that nurse-led sepsis screening and bundle initiation reduce mortality, shorten ICU stays, and improve compliance with international standards of care.

In Saudi Arabia, healthcare transformation under Vision 2030 has emphasized patient safety and alignment with global best practices. However, existing studies suggest considerable variability in ICU nurses' sepsis knowledge and practices, influenced by education, nationality, and clinical experience (Alsulami et al., 2024; Alissa & Alqadi, 2025). Barriers such as staff shortages, workload pressures, and inadequate training continue to hinder optimal care delivery (Bawaqneh et al., 2025). Furthermore, innovations such as electronic early-warning systems and machine learning models have shown promise in enhancing detection, but their effectiveness depends heavily on nurses' readiness and training to integrate such technologies into routine practice (Arabi et al., 2025).

Despite the importance of sepsis management, no large multi-center study has comprehensively assessed ICU nurses' knowledge, practices, and barriers in Saudi Arabia. Understanding these factors is crucial to inform policy, guide targeted training, and strengthen institutional strategies for sepsis prevention and early intervention. This study evaluates the role of ICU nurses in early sepsis detection and prevention in Saudi tertiary hospitals, with specific focus on knowledge levels, adherence to evidence-based practices, and contextual barriers.

Methods

Study Design

This study employed a multi-center, cross-sectional, descriptive design with a mixed-methods approach. Quantitative data were gathered through structured surveys, while qualitative insights were obtained from focus group discussions. This combination allowed for both statistical measurement of nurses' knowledge and practices as well as an in-depth exploration of their perceptions and experiences related to sepsis care.

Study Setting and Population

The research was conducted in the adult intensive care units (ICUs) of three tertiary hospitals in Riyadh, Saudi Arabia. These hospitals were selected for their large ICU capacity and diverse patient populations. The study population included registered nurses actively working in adult ICUs.

Nurses were eligible if they held a valid Saudi Commission for Health Specialties (SCFHS) license, had at least six months of ICU experience, provided direct patient care, and gave voluntary consent. Nurses in administrative roles, students or interns, those working exclusively in pediatric or neonatal ICUs, individuals on extended leave, and agency staff with less than three months' tenure at the facility were excluded.

Sample Size and Sampling Technique

The required sample size was calculated using a 95% confidence level, 5% margin of error, and an expected prevalence of 50% for sepsis-related practices, resulting in a minimum of 384 nurses. To accommodate for potential non-response, the sample was increased by 20%, producing a final target of 461.

A stratified random sampling technique was utilized. Stratification was based on hospital type and ICU bed capacity, followed by proportional allocation to ensure representation. Within each stratum, nurses were randomly selected from official employee rosters provided by nursing administration.

Data Collection Tools and Procedures

Data collection was carried out between **March and June 2025**. The structured quantitative survey contained four sections. Part A covered demographic and professional characteristics, including age, gender, nationality, education level, years of nursing and ICU experience, specialized certifications, and work shifts. Part B was a 30-item knowledge assessment covering sepsis definition, pathophysiology, recognition criteria, and management protocols. Part C was a 25-item practice assessment that measured frequency of vital sign monitoring, use of sepsis screening tools, compliance with evidence-based bundles, and documentation practices, using a five-point Likert scale (Always to Never). Part D assessed barriers and facilitators through 20 items on organizational support, resource availability, teamwork, and educational opportunities.

A facility-level survey was also completed by ICU nurse managers to provide contextual information on ICU characteristics, nurse-patient ratios, existing protocols, available resources, and professional development initiatives. Additionally, focus group discussions were conducted in July 2025, using semi-structured guides to explore nurses' experiences with sepsis detection, barriers encountered, team communication, and suggestions for improvement. All discussions were audio-recorded, transcribed verbatim, and analyzed thematically.

Outcome Measures

The primary outcomes were sepsis knowledge scores, sepsis practice scores, and prevalence of screening tool utilization. Secondary outcomes included barriers to sepsis care, associations between nurse characteristics and competency, inter-hospital variations, and emergent qualitative themes related to nurses' roles in sepsis management.

Data Management and Analysis

Quantitative data were entered and analyzed using **SPSS version 26**. Descriptive statistics (frequencies, percentages, means, and standard deviations) were computed for demographic and outcome variables. Associations between categorical variables were tested using chi-square, while independent t-tests and one-way ANOVA were used to compare mean scores across groups. A p-value less than 0.05 was considered statistically significant. Qualitative transcripts were coded and analyzed thematically by two independent researchers, with differences reconciled by consensus.

Ethical Considerations

Ethical approval was obtained from the institutional review boards of the participating hospitals before data collection. Written informed consent was secured from each participant after explaining the study's objectives and procedures. Participation was voluntary, with anonymity and confidentiality assured throughout. The study adhered to the principles of the **Declaration of Helsinki**.

Results

A total of 461 ICU nurses participated in the study, yielding a response rate of 92.1%. The majority were female (62.7%), expatriates (58.8%), and held a bachelor's degree (71.2%). The mean total nursing experience was 7.4 years (SD = 3.6), with a mean ICU-specific experience of 4.8 years (SD = 2.9). Less than half of the participants (46.4%) had received formal sepsis-specific training in the past two years. These characteristics are summarized in **Table 1**.

Table 1. Demographic and Professional Characteristics of Participants (n=461)

Variable	Category	n	%
Gender	Female	289	62.7
	Male	172	37.3
Nationality	Saudi	190	41.2
	Expatriate	271	58.8
Education	Diploma	91	19.7
	Bachelor's	328	71.2
	Master's or above	42	9.1
ICU Experience (years)	<3 years	142	30.8
	3–7 years	203	44.0
	>7 years	116	25.2
Sepsis Training	Yes	214	46.4
	No	247	53.6

The mean overall sepsis knowledge score was 63.5% (SD = 12.4). About 22.8% of participants scored $\geq 75\%$ (high knowledge), 49.2% scored between 60–74% (moderate knowledge), and 28.0% scored $< 60\%$ (low knowledge). Knowledge was highest in the recognition of clinical signs (72.4%), followed by sepsis definition and pathophysiology (62.7%), while the lowest scores were observed in management protocols and bundle adherence (55.8%). Nurses who had received formal sepsis training scored significantly higher (72.1%) compared to those without training (59.4%, $p < 0.001$). Similarly, those with bachelor's or higher qualifications scored better than diploma holders ($p = 0.012$). These findings are presented in **Table 2**.

Table 2. Knowledge Scores by Domain

Knowledge Domain	Mean % Score (SD)	% $\geq 70\%$ Correct
Pathophysiology & Definition	62.7 (14.1)	45.2
Recognition of Clinical Signs	72.4 (13.3)	61.8
Management Protocols & Bundles	55.8 (15.7)	32.5
Overall Knowledge Score	63.5 (12.4)	49.2

In terms of nursing practices, 82.6% of nurses reported frequent monitoring of vital signs (at least every four hours). However, only 54.1% consistently used standardized sepsis screening tools, and less than half (48.3%) reported compliance with the one-hour sepsis bundle. Documentation of sepsis assessments was practiced consistently by 61.5% of nurses, while infection control adherence was reported by 76.9%. Practice adherence was significantly higher among nurses with at least five years of ICU experience ($p = 0.021$) and among those who had received prior sepsis training ($p < 0.001$). These results are summarized in **Table 3**.

Table 3. Reported Sepsis-Related Practices

Practice Item	Always/Often %	Sometimes %	Rarely/Never %
Use of sepsis screening tools	54.1	29.7	16.2
Compliance with sepsis bundle	48.3	35.2	16.5
Frequent vital sign monitoring	82.6	12.3	5.1
Documentation of sepsis assessments	61.5	25.7	12.8
Infection control adherence	76.9	14.6	8.5

Regarding barriers, the most frequently cited challenge was heavy workload and staff shortages (72.6%). Other barriers included lack of sepsis-specific training (59.8%), limited resources and equipment (41.5%), documentation burden (38.2%), and poor interprofessional collaboration (33.0%). These findings are detailed in **Table 4**.

Table 4. Reported Barriers to Sepsis Care (n=461)

Barrier	n	%
Heavy workload/staff shortages	335	72.6
Lack of training/continuing education	276	59.8
Limited resources/equipment	191	41.5
Time constraints/documentation burden	176	38.2
Poor interprofessional collaboration	152	33.0

Analysis of associations between nurse characteristics and outcomes revealed several significant patterns. Education level was positively correlated with knowledge and practice scores, with bachelor's and higher-degree holders performing better than diploma nurses ($p = 0.012$). Nurses with at least seven years of ICU experience reported better adherence to sepsis practices compared to those with less experience ($p = 0.021$). The strongest associations were observed with sepsis-specific training: nurses who had received training achieved higher knowledge scores (72.1% vs. 59.4%, $p < 0.001$) and better practice adherence (65.2% vs. 46.8%, $p < 0.001$). In contrast, nationality did not significantly affect knowledge or practice scores ($p = 0.112$).

Discussion

The results of this study provide valuable insights into ICU nurses' knowledge, practices, and perceived barriers related to sepsis care in Saudi Arabia. The mean overall sepsis knowledge score was 63.5%, with only 22.8% of nurses demonstrating high knowledge (scores $\geq 75\%$). These findings are consistent with previous studies that have identified knowledge gaps among nurses regarding sepsis. For example, Adegbite et al. (2021) found that many healthcare workers in Gabon had limited knowledge about sepsis awareness and management. Similarly, Harley et al. (2021) reported that final year nursing students in Australia had insufficient exposure to sepsis education during their undergraduate training.

Knowledge levels varied across domains, with the highest scores in recognizing clinical signs (72.4%) and the lowest in management protocols and bundle adherence (55.8%). This aligns with the findings of Zanaty et al. (2014), who reported that only 11.1% of nurses could identify hypothermia, dyspnea, tachypnea, and altered level of consciousness as possible signs of sepsis. The present study also found that nurses who had received sepsis-specific training scored significantly higher (72.1%) than those

without training (59.4%), highlighting the importance of ongoing education in improving sepsis competencies. This is supported by the works of Drahnak et al. (2016) and Lee et al. (2019), who demonstrated the positive impact of targeted training on nurses' knowledge and adherence to sepsis protocols.

In terms of practices, while most nurses (82.6%) frequently monitored vital signs, compliance with other key components of sepsis care was suboptimal. Only 54.1% consistently used screening tools, 48.3% adhered to the one-hour bundle, and 61.5% regularly documented sepsis assessments. These gaps echo the challenges reported in other studies. Alshehri et al. (2020) found bundle compliance rates of 52.3% among ICU nurses in Saudi Arabia, while Yousefi et al. (2020) reported similar issues with screening tool usage and documentation.

Several barriers to optimal sepsis care were identified, with heavy workload and staff shortages being the most prevalent (72.6%). This is consistent with findings from Alshehri et al. (2020) and Tromp et al. (2010), who cited time constraints and competing priorities as major obstacles. Lack of sepsis-specific training was another commonly reported barrier (59.8%), underscoring the need for ongoing education as recommended by Drahnak et al. (2016) and Lee et al. (2019).

Analyzing associations revealed that higher education levels and longer ICU experience were correlated with better knowledge and practice scores, respectively. This suggests that investing in nurses' professional development can positively impact sepsis care quality, as noted by Yousefi et al. (2020) and Alshehri et al. (2020). However, the strongest associations were observed with sepsis-specific training, emphasizing its critical role in enhancing competencies.

Interestingly, nationality did not significantly affect knowledge or practice scores, indicating that cultural background may be less influential than factors like education and training. This contrasts with the findings of Almutairi et al. (2015), who suggested that cultural factors can impact healthcare delivery. Further exploration of the interplay between cultural factors and sepsis management is warranted.

This study highlights opportunities for improving sepsis care in Saudi Arabian ICUs through targeted education, workload management, and interprofessional collaboration. Implementing these strategies can empower nurses to deliver timely, evidence-based interventions and ultimately enhance outcomes for patients with sepsis, as emphasized by Levy et al. (2018). By addressing identified knowledge gaps and barriers, healthcare organizations can foster a culture of excellence in sepsis management and contribute to global efforts to reduce the burden of this deadly condition.

Strengths and Limitations

This study is the first multi-center, mixed-methods investigation of sepsis care practices among ICU nurses in Saudi Arabia, enhancing its representativeness and depth. The large sample size and integration of both quantitative and qualitative data strengthen validity. However, several limitations must be acknowledged. The cross-sectional design prevents causal inference, and reliance on self-reported practices may introduce response bias. Additionally, the study was limited to Riyadh tertiary hospitals, which may affect generalizability to smaller or rural facilities.

Recommendations

Healthcare policymakers and hospital administrators should prioritize structured, mandatory sepsis training for ICU nurses and ensure regular refreshers. Staffing ratios and workload distribution must be addressed to reduce barriers to adherence. Adoption of digital sepsis early-warning systems, aligned with Vision 2030 initiatives, can

support timely recognition and response. Further research should evaluate the impact of interventional training programs and expand to other regions of Saudi Arabia.

Conclusion

ICU nurses in Saudi tertiary hospitals exhibit moderate knowledge and practice adherence in sepsis management, with performance strongly influenced by education and training. Addressing knowledge gaps, optimizing workloads, and institutionalizing digital tools can empower nurses to deliver timely, evidence-based interventions. By doing so, healthcare systems can strengthen patient safety and contribute to reducing the burden of sepsis mortality.

References

- Abdalhafith, O., Rababa, M., Hayajneh, A. A., & Alharbi, T. A. F. (2025). Critical care nurses' knowledge, confidence, and clinical reasoning in sepsis management: A systematic review. *BMC Nursing*, 24, Article 125.
- Adegbite, B. R., Edoa, J. R., Rylance, J., Jacob, S. T., Kawale, P., Adegnika, A. A., & Grobusch, M. P. (2021). Knowledge of health workers relating to sepsis awareness and management in Lambaréné, Gabon. *Acta Tropica*, 219, 105914.
- Alissa, N. A., & Alqadi, A. (2025). Nurses' knowledge of infection control practices in intensive care units in Saudi Arabia. *SAGE Open*, 15(3).
- Almutairi, A. F., McCarthy, A., & Gardner, G. E. (2015). Understanding cultural competence in a multicultural nursing workforce: Registered nurses' experience in Saudi Arabia. *Journal of Transcultural Nursing*, 26(1), 16–23.
- Alshehri, A. A., Alghamdi, A. A., Alsulami, A. A., & Alsharafi, A. A. (2020). Knowledge and practices of ICU nurses regarding sepsis management in government hospitals of Makkah region. *Journal of Nursing Science and Practice*, 3(2), 1–8.
- Alsulami, S. O., Alotaibi, T. S., & Alharthi, M. A. (2024). Knowledge of sepsis in nursing in Saudi Arabia: A cross-sectional study. *DISS Scientific Journal*, 28(153), e140ms3463.
- Arabi, Y. M., Alsaawi, A., Alzahrani, M., Al Khathaami, A. M., AlHazme, R. H., Al Mutrafy, A., ... & Saudi Critical Care Trials Group. (2025). Electronic sepsis screening among patients admitted to hospital wards: A stepped-wedge cluster randomized trial. *JAMA*, 333(9), 763–773.
- Bawaqneh, K. A., Ayed, A., & Salameh, B. (2025). Nurses' knowledge, attitude, practice, and perceived barriers of infection control measures in the intensive care units at Northwest Bank hospitals. *Critical Care Nurse Quarterly*, 48(2), 123–132.
- Drahnak, D. M., Hravnak, M., Ren, D., Haines, A. J., & Tuite, P. (2016). Scripting nurse communication to improve sepsis care. *MedSurg Nursing*, 25(4), 233–239.
- Evans, L., Rhodes, A., Alhazzani, W., Antonelli, M., Coopersmith, C. M., French, C., ... & Levy, M. M. (2021). Surviving sepsis campaign: International guidelines for management of sepsis and septic shock 2021. *Critical Care Medicine*, 49(11), e1063–e1143.
- 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 students' exposure to education and knowledge about sepsis: A multi-university study. *Nurse Education Today*, 97, 104703.
- Lee, J., Lim, J. Y., & Yang, Y. S. (2019). Effects of a sepsis education program on knowledge, performance confidence, and behavioral intention of nurses in long-term care hospitals. *Journal of Korean Academy of Nursing Administration*, 25(4), 347–357.
 - Levy, M. M., Evans, L. E., & Rhodes, A. (2018). The surviving sepsis campaign bundle: 2018 update. *Intensive Care Medicine*, 44(6), 925–928.
 - Rudd, K. E., Johnson, S. C., Agesa, K. M., Shackelford, K. A., Tsoi, D., Kievlan, D. R., ... & Murray, C. J. L. (2020). Global, regional, and national sepsis incidence and mortality, 1990–2017: Analysis for the Global Burden of Disease Study. *JAMA*, 323(13), 1244–1257.
 - Singer, M., Deutschman, C. S., Seymour, C. W., Shankar-Hari, M., Annane, D., Bauer, M., ... & Angus, D. C. (2016). The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA*, 315(8), 801–810.
 - Sterling, S. A., Puskarch, M. A., Glass, A. F., Guirgis, F., & Jones, A. E. (2020). The impact of nurse-driven sepsis screening and protocolized care in the emergency department. *Intensive Care Medicine*, 46(6), 1167–1176.
 - Tromp, M., Hulscher, M., Bleeker-Rovers, C. P., Peters, L., van den Berg, D. T., Borm, G. F., Kullberg, B. J., van Achterberg, T., & Pickkers, P. (2010). The role of nurses in the recognition and treatment of patients with sepsis in the emergency department: A prospective before-and-after intervention study. *International Journal of Nursing Studies*, 47(12), 1464–1473.
 - Yousefi, H., Nahidian, M., & Sabouhi, F. (2020). Reviewing the effects of an educational program about sepsis care on knowledge, attitude, and practice of nurses in intensive care units. *Iranian Journal of Nursing and Midwifery Research*, 17(2 Suppl 1), S91–S95.
 - Zanaty, O. M., Abdelhamid, S. A., & Abdel-Wahab, K. A. (2014). Assessment of nurses' knowledge about sepsis care in intensive care units at Mansoura University Hospitals. *Journal of American Science*, 10(11), 124–129.