

Nurses' Knowledge of Diabetic Ketoacidosis Management: A Cross-Sectional Study in Omdurman Teaching Hospital, Sudan

Huda Hassabelrasool Abdelwahed Yousef

Department of Nursing, College of Nursing and Health Sciences, Jazan University, Saudi Arabia.

(Received: 21st February 2026; Accepted: 11th April 2026)

Abstract

Diabetic ketoacidosis (DKA) is a life-threatening diabetic complication requiring prompt, evidence-based management. Nurses play a key role in detection and care; however, knowledge in Sudan remains limited. This study assessed nurses' knowledge and associated factors at Omdurman Teaching Hospital.

Methods: A cross-sectional study (May–June 2024) included 192 nurses from medical, surgical, emergency, ICU, and endocrinology units. A structured, pretested 20-item questionnaire based on ADA recommendations assessed DKA knowledge. Scores (0–20) were classified as poor, moderate, and good. Data were analyzed using descriptive statistics, t-tests, ANOVA, Pearson correlation, and multiple linear regression.

Results: The mean knowledge score was 13.4 ± 3.6 , indicating a moderate level. Overall, 40.6% had good knowledge, 39.6% moderate, and 19.8% poor. Trained nurses scored higher than untrained (15.0 ± 3.0 vs. 12.3 ± 3.5 , $p < 0.001$). Knowledge correlated with experience ($r = 0.36$) and DKA exposure ($r = 0.42$) ($p < 0.001$). Training, education, and experience were predictors (adjusted $R^2 = 0.33$).

Conclusion: Nurses showed a moderate level of knowledge, with gaps among less experienced and untrained staff. Training and standardized protocols are recommended to improve competence and patient safety.

Keywords: Diabetic ketoacidosis; Nurses; Knowledge; Training; Clinical competence; Sudan

1658-7022© JNBAS. (1447 H/2026). Published by Northern Border University (NBU). All Rights Reserved.



DOI: 10.12816/0062549

(*) Corresponding Author:

Huda Hassabelrasool Abdelwahed Yousef ^{1*}, Ashraf Abdelrhman Elbashir Elmdni¹, Aida Ahmed Fadlala Ahmed², Suaad Ahmed Suliman Omer³, Ghada Siddig Osman Eshag¹, Sittelbanat Osman Ahmed¹, Amani Mukhtar Abdelrahman¹, Amani Awad Taha ¹, Soad Mohamed Abdalla Alnassry¹, SALWA ALI MOUSA¹, Hawa Ibrahim Abdalla Hamid¹, Nasredeen Mohamed Ahmed¹, Asia Mohamed Ahmed¹, Nora Ghalib AlOtaibi⁴, Sara Awadelkareem Elhassan⁵, Lujain Adel Sallam⁶, Meaad Elbashir⁷, Sara Ali⁷, Tahani Babiker Mohamed⁸, Hamza Hosean Ahmed Balola⁹.

1 Department of Nursing, College of Nursing and Health Sciences, Jazan University, Saudi Arabia.

2 Assistant professor of Obstetrics and Gynecological Nursing, Nursing Department, AlNahda College of Pharmacy and Medical Sciences, Riyadh, Kingdom of Saudi Arabia

3 Faculty of Nursing, AL-Baha University, Assistance professor, PhD in Pediatrics Nursing.

4 Department of Community Nursing, College of Nursing, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia

5 Hamad Medical Corporation, Staff education, Nursing Educator, Doha city, Qatar.

6 Department of Medical Surgical Nursing, Faculty of Nursing, King Abdulaziz University, Jeddah, Saudi Arabia.

7 Department of Diagnostic Radiography Technology, College of Nursing and Health Sciences, Jazan University, Jazan ,Saudi Arabia.

8 Assistant professor, Department of Public Health, College of Nursing and Health Science, Jazan University, kingdom of Saudi Arabia.

9 Assistant professor, Department of Community health Nursing. Batterjee Medical College for Sciences and Technology: Khamis mushait, Abha Province, KSA.

E-mail: Huda.hassabo@hotmail.com, <https://orcid.org/0000-0002-1731-0326>

1. Introduction

Diabetic ketoacidosis (DKA) is a severe, potentially life-threatening acute metabolic complication of diabetes mellitus, characterized by hyperglycemia, ketosis, and metabolic acidosis (Mohajan & Mohajan, 2023). It primarily affects patients with type 1 diabetes but can also occur in type 2 diabetes under conditions of physiological stress, infection, or inadequate insulin therapy. Globally, DKA remains a leading cause of hospital admission, morbidity, and mortality among diabetic patients, particularly in low- and middle-income countries where healthcare resources and trained staff may be limited (Mohan & Lee, 2025). Delayed recognition and improper management of DKA are major contributors to preventable deaths, highlighting the need for competent healthcare professionals (Kajembula et al., 2024).

Nurses are central to patient care and play a crucial role in the early detection, stabilization, monitoring, and education of DKA patients (Shaker et al., 2025).

Their clinical knowledge and skills directly influence the timeliness of interventions, adherence to evidence-based practices, and prevention of life-threatening complications such as hypokalemia, cerebral edema, and circulatory shock (Adewale, 2023). Nursing care is particularly vital in emergency, intensive care, and medical wards, where rapid decision-making and accurate monitoring critically affect patient outcomes (Gholipour et al., 2025).

Despite their central role, limited research exists on nurses' knowledge of DKA management in Sudan (Ahmed et al., 2025). Studies from other low-resource settings show significant gaps in knowledge regarding fluid resuscitation, insulin therapy, electrolyte replacement, monitoring of vital signs and laboratory parameters, and patient education. Such gaps can compromise patient safety and quality of care (Alsabri et al., 2025).

This study aims to evaluate the knowledge of nurses regarding DKA management at Omdurman Teaching Hospital, identify demographic and professional factors associated with higher knowledge levels, and provide evidence-based recommendations for in-service training, continuing education, and standardized clinical protocols to enhance nursing competence and patient safety.

2. Methodology

2.1 Study design

A hospital-based cross-sectional descriptive study was conducted at Omdurman Teaching Hospital, Khartoum State, Sudan, from May 1 to June 30, 2024. This design was appropriate for assessing the distribution and characteristics of study variables at a single point in time, allowing estimation of prevalence and patterns of nurses' knowledge regarding DKA.

2.2 Study population

The study population comprised registered nurses working in the medical, surgical, emergency, intensive care, and endocrinology units of Omdurman Teaching Hospital. These nurses were selected due to their direct patient contact and critical role in clinical management. Eligible participants had at least six months of clinical experience and direct patient care exposure. Nurses on long-term leave (>1 month) or who declined participation were excluded.

2.3 Sampling technique

A stratified convenience sampling technique was used to recruit participants from the target population. Nurses were proportionally selected from medical, surgical, emergency, intensive care, and endocrinology units based on the number of nurses in each department. Within each unit, eligible nurses were recruited based on availability during the data collection period. All nurses who met the inclusion criteria and consented to participate were included until the required sample size was achieved.

2.4 Sample size determination

The sample size was calculated using Cochran's formula for cross-sectional studies:

$$n = \frac{(p-1) \times p \times Z^2}{d^2}$$

Where

$Z = 1.96$ (95% confidence)

$p = 0.5$ (assumed prevalence of adequate knowledge)

$d = 0.06$ (margin of error)

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.06)^2} = 267$$

Since the total nurse population was approximately 500, finite population correction was applied:

$$f^*n = \frac{267}{(267/500 + 1)} = 174$$

After adding 10% to compensate for non-response:

$$174 \times 1.1 = 192$$

Thus, the final sample size was 192 nurses.

2.5 Data collection

Data were collected using a structured, self-administered questionnaire based on American Diabetes Association (ADA) recommendations and relevant literature. The questionnaire comprised:

- Demographic and professional data:** age, gender, academic qualification, years of experience, exposure to DKA cases, and prior DKA training.
- Knowledge assessment:** 20 multiple-choice questions covering DKA pathophysiology, clinical presentation, monitoring, fluid and

insulin therapy, electrolyte management, complications, and patient education.

Each correct answer was scored 1 point, with total scores ranging from 0–20, categorized as:

- Poor (0–9)
 - Moderate (10–14)
 - Good (15–20)
3. **Psychometric properties:** Pretested on 15 nurses ;content validity confirmed by three endocrinology and critical care experts; internal consistency acceptable (Cronbach's $\alpha = 0.82$).

2.6 Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of Omdurman Teaching Hospital (Approval No. OTH/IRB/2024/09014, dated 10 April 2024). Written informed consent was obtained from all participants, anonymity was ensured, and data confidentiality was strictly maintained.

2.7 Statistical Analysis

Data were analyzed using SPSS version 25. Descriptive statistics (mean $\pm$ SD, frequencies, and percentages) summarize variables. The dependent

variable was the total knowledge score. Inferential analyses included:

1. Independent t-tests and one-way ANOVA for group comparisons
2. Pearson correlation for continuous variables
3. Chi-square tests for categorical associations
4. Multivariate linear regression to identify independent predictors of knowledge

All statistical tests were two-tailed, with $p < 0.05$ considered significant. Regression diagnostics, including residual analysis and multicollinearity checks, were performed to ensure model validity.

3. Result

3.1 Demographic and Professional Characteristics

A total of 192 nurses participated in the study. Most were female (%65.1), with a mean age of 32.1 ± 7.0 years and mean clinical experience of 8.2 ± 6.3 years. Regarding educational level, %52.6 held a bachelor's degree, %37.5 had a diploma, and %9.9 a master's degree. Only %38.5 reported prior formal training in DKA management (Table 1).

Table 1. Demographic and Professional Characteristics of Nurses (n = 192)

Category	Parameter	n	%
Gender	Female	125	65.1
	Male	67	34.9
Educational level	Diploma	72	37.5
	Bachelor	101	52.6
	Master	19	9.9
DKA Training	Yes	74	38.5
	No	118	61.5
Age ≥ 30 years	Yes	106	55.2
	No	86	44.8
Experience ≥ 5 years	Yes	118	61.5
	No	74	38.5

3.2 Overall, Knowledge Level

The mean knowledge score was 13.4 ± 3.6 , classified as moderate based on cut-offs: poor (0–9), moderate

(10–14), good (15–20). Overall, 40.6% of nurses demonstrated good knowledge, 39.6% moderate, and 19.8% poor (Figure 1).

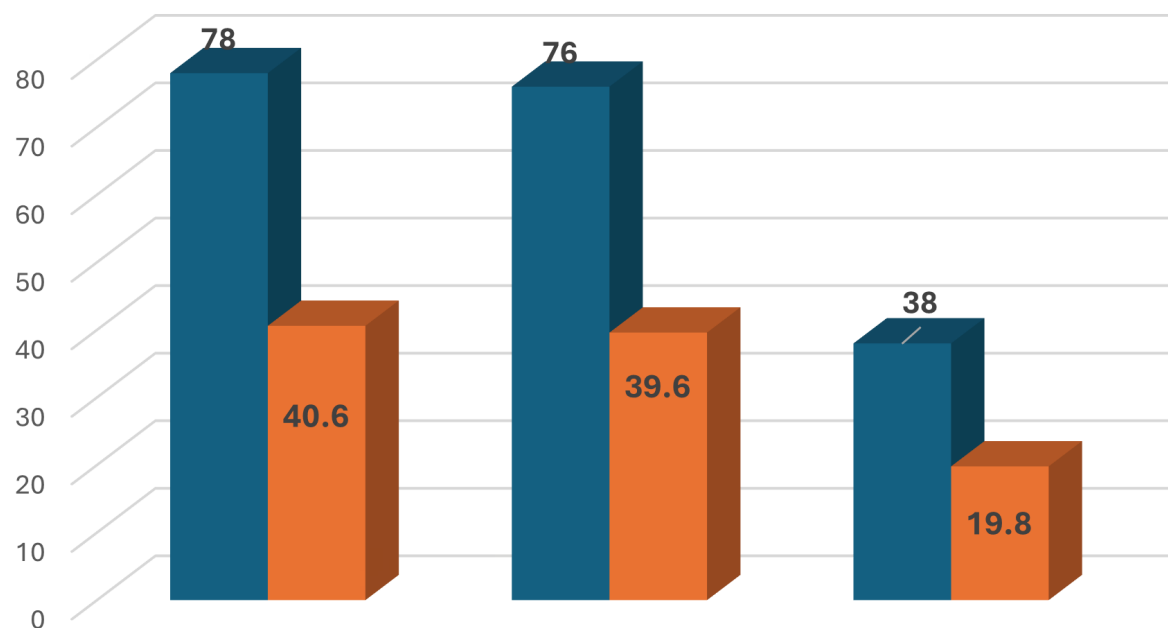


Figure 1. Knowledge Levels of Nurses Regarding DKA Management (n = 192)

3.3 Knowledge According to Academic Qualification

Knowledge scores increased with higher academic levels ($p < 0.001$). Nurses with a master's degree scored the highest (16.1 ± 2.7), followed by bachelor's degree holders (13.6 ± 3.3) and diploma nurses (11.3 ± 3.4) (Table 2).

Table 2. Mean Knowledge Scores by Academic Qualification

Qualification	Mean $\pm$ SD	p-value
Diploma	11.3 $\pm$ 3.4	<0.001
Bachelor	13.6 $\pm$ 3.3	
Master	16.1 $\pm$ 2.7	

3.4 Knowledge According to DKA Training

Nurses who had received prior DKA training achieved higher scores (15.0 ± 3.0) than those without training (12.3 ± 3.5); this difference was statistically significant ($p < 0.001$) (Table 3).

Table 3. Knowledge Scores According to Prior DKA Training

Training	Mean $\pm$ SD	p-value
Yes	15.0 $\pm$ 3.0	<0.001
No	12.3 $\pm$ 3.5	

3.5 Correlation with Demographic and Clinical Factors

Pearson correlation analysis indicated positive associations between knowledge scores and:

- Age: $r = 0.21$, $p = 0.004$
- Clinical experience: $r = 0.36$, $p < 0.001$
- Monthly exposure to DKA cases: $r = 0.42$, $p < 0.001$ (Table 4)

Table 4. Correlation Between Knowledge Scores and Demographic/Clinical Factors

Variable	R	p
Age	0.21	0.004
Experience	0.36	<0.001
DKA cases/month	0.42	<0.001

3.6 Multivariable Predictors of Knowledge

Multivariable linear regression identified the following independent predictors of higher knowledge:

- Prior DKA training: $\beta = 0.38$, $p < 0.001$
- Clinical experience: $\beta = 0.22$, $p = 0.002$
- Master's level education: $\beta = 0.25$, $p = 0.001$

The model explained 33% of the variance in knowledge scores (adjusted $R^2 = 0.33$) (Table 5).

Table 5. Multivariable Linear Regression Predictors of Nurses' Knowledge Scores

Predictor	B	p
Prior DKA training	0.38	<0.001
Clinical experience	0.22	0.002
Master's degree	0.25	0.001

4. Discussion

This study assessed nurses' knowledge regarding diabetic ketoacidosis (DKA) management at Omdurman Teaching Hospital and found an overall moderate level of knowledge, with %40.6 demonstrating good knowledge and %19.8 having poor knowledge. These findings align with research from other low- and middle-income countries, where nursing knowledge in DKA management is often moderate, particularly in critical areas such as fluid resuscitation, insulin therapy, and electrolyte monitoring (Abdulkarim et al., 2024; Matthews et al., 2023). Furthermore, similar gaps in nurses' knowledge and clinical competence have been reported in Egypt, Nigeria, and Ethiopia, highlighting persistent challenges in DKA management across resource-limited settings (Fina Lubaki et al., 2022; Kajembula et al., 2024; Kibret Abebe et al., 2025; Shaker et al., 2025).

A major finding of this study is the strong positive effect of prior DKA training on nurses' knowledge. Nurses who received formal training scored significantly higher than their untrained colleagues, and training was the strongest independent predictor in multivariate analysis. This supports evidence that structured in-service education and continuous professional development improve understanding of DKA complications, insulin administration, fluid and electrolyte management, and patient education, ultimately enhancing patient safety (Ali & Saad, 2022; Xie et al., 2025).

Higher academic qualifications were also associated with better knowledge. Nurses holding master's degrees achieved the highest scores, followed by bachelor's and diploma nurses.

This finding aligns with research from Saudi Arabia and Jordan, which shows that higher levels of education and formal training in evidence-based practice are associated with better adherence to evidence-based guidelines and improved clinical decisionmaking among nurses (Abuadas, 2021; Al-Ghabeesh et al., 2024; Alqahtani et al., 2022).

Clinical experience and exposure to DKA cases were positively correlated with knowledge scores, confirming that experiential learning contributes to competence. However, unlike some studies that report experience as

the main determinant (Karume et al., 2025), this study found that experience alone is insufficient without formal training. This may reflect variability in access to standardized protocols, mentorship, and structured clinical guidance in the hospital setting (Bolado et al., 2024).

Despite the generally moderate knowledge, gaps remained in potassium replacement, recognition of cerebral edema, and follow-up of DKA complications. These gaps are clinically significant, as errors in these areas can lead to serious iatrogenic complications and increased mortality. The persistence of these weaknesses highlights the need for protocol-based management and periodic evaluation of nursing competence.

- **Limitations** of this study include its cross-sectional design, use of a self-administered questionnaire, and single-center setting, which may limit the generalizability of the findings.
- **Implications for practice and policy:** The findings emphasize the importance of targeted in-service training, advanced nursing education, and exposure to clinical cases to enhance knowledge and patient safety. Implementing standardized clinical protocols and continuous monitoring of competence can address persistent knowledge gaps and improve the quality of DKA care.

5. Conclusion

Nurses demonstrated a moderate level of knowledge regarding diabetic ketoacidosis (DKA) management, with notable variability among individuals. While 40.6% showed good knowledge, approximately 19.8% had poor knowledge. These findings highlight the need for targeted in-service training, particularly for less experienced and untrained nurses, as well as the implementation of standardized clinical protocols to improve competence and enhance patient safety.

6. Recommendations

According to the research findings, all nurses should be provided with regular in-service training programs on diabetic ketoacidosis management, which will increase the clinical competence levels and adherence to the evidence-based guidelines. Establishing standardized DKA management guidelines to be used in emergency units and intensive care units are highly suggested and should be visibly placed to assist in the timely and uniform clinical decision-making. In addition, structured DKA modules can be integrated into continuing nursing education programs and staff orientation sessions that can contribute to strengthening the key knowledge and skills. Knowledge and practice of nurses should be managed by arranging periodical reviews and clinical audits to determine any gaps and drive further quality

improvement efforts. Promoting critical thinking and evidence-based practice should also focus on encouraging advanced nursing education and professional growth. Lastly, multicenter studies are suggested to allow a wider range of information about national training needs and implement interventions on a policy-level basis.

7. References

- Abdulkarim, D. N., Alqurashi, H. A., Aldossri, E. A., Almubrook, A. S., Alamri, A. S., Alanzi, A. A. A., Alhafi, M. A., Alanazi, A. H. S., Al Fawaz, F. A., & Alanazi, A. S. F. (2024). *The Role of Nursing in Diabetes Management: The Impact of Biochemical Markers on Diagnosis, Complications, and Patient Outcomes through Comprehensive Care and Support*. *Egyptian Journal of Chemistry*, 67(13), 1235-1249. <https://doi.org/10.21608/ejchem.2024.334932.10769>
- Abuadas, M. H. (2021). *Correlates of evidence-based nursing practice among nurses in Saudi Arabia: a structural equation model*. *Belitung Nursing Journal*, 7(6), 457. <https://doi.org/10.33546/bnj.1803>
- Adewale, G. O. (2023). *Educating Nurses on Failure to Rescue due to Treatment Delay*. Walden University.
- Ahmed, A. A. O., Mounfali, M. A. A., Yassin, T., Ibrahim, H., Ahmed, R. A. O., Ahmed, R. A. O., Ahmed, N., Ahmed, O. A. O., Elbashir, R. M. A., & Mohamed, K. H. (2025). *Prevalence and patterns of diabetic ketoacidosis (DKA) among diabetic patients presenting to hospitals in northern state, Sudan: a cross-sectional study during the 2025 humanitarian crisis*. *BMC Endocrine Disorders*, 25(1), 292. <https://doi.org/10.1186/s12902-025-0292-x>
- Al-Ghabeesh, S., Khalifeh, A. H., & Rayan, A. (2024). *Evidence-based practice knowledge, attitude, practice and barriers as predictors of stay intent among Jordanian registered nurses: a cross-sectional study*. *BMJ open*, 14(7), e082173. <https://doi.org/10.1136/bmjopen-2023-082173>
- Ali, S. A., & Saad, N. S.-E. (2022). *Effectiveness of in-service training program on nurses' performance regarding patient safety practice standards in Intensive Care Units*. *Egyptian Journal of Nursing and Health Sciences*, 3(1), 68-95. <https://doi.org/10.21608/ejnhs.2022.251411>
- Alqahtani, J. M., Carsula, R. P., Alharbi, H. A., Alyousef, S. M., Baker, O. G., & Tumala, R. B. (2022). *Barriers to implementing evidence-based practice among primary healthcare nurses in Saudi Arabia: a cross-sectional study*. *Nursing Reports*, 12(2), 313-323. <https://doi.org/10.3390/nursrep12020031>
- Alsabri, M., Oboli, V. N., Rath, S., Tsoi, V., Del Castillo Miranda, J. C., Alagarswamy, K., & Shehada, W. (2025). *Bridging the gap: Lessons from low-resource pediatric emergency medicine for high-resource settings*. *Current emergency and hospital medicine reports*, 13(1), 10. <https://doi.org/10.1007/s40138-025-00315-z>
- Bolado, G. N., Ataro, B. A., Gadabo, C. K., Ayana, A. S., Kebamo, T. E., & Minuta, W. M. (2024). *Stress level and associated factors among nurses working in the critical care unit and emergency rooms at comprehensive specialized hospitals in Southern Ethiopia, 2023: explanatory sequential mixed-method study*. *BMC nursing*, 23(1), 341. <https://doi.org/10.1186/s12912-024-02004-w>
- Fina Lubaki, J.-P., Omole, O. B., & Francis, J. M. (2022). *Protocol: Developing a framework to improve glycaemic control among patients with type 2 diabetes mellitus in Kinshasa, Democratic Republic of the Congo*. *PLoS One*, 17(9), e0268177. <https://doi.org/10.1371/journal.pone.0268177>
- Gholipour, M., Dadashzadeh, A., Jabarzadeh, F., & Sarbakhsh, P. (2025). *Challenges of clinical decision-making in emergency nursing: an integrative review*. *The Open Nursing Journal*, 19(1). <https://doi.org/10.2174/0118744346378311250320070725>
- Kajembula, I. M., Mattheo, K. I., Simchimba, P. D., Masasi, E. H., Chikwala, V., & Ambikile, J. S. (2024). *Understanding the factors influencing nurses in managing patients with diabetic ketoacidosis in the emergency departments of referral hospitals in Dar es Salaam, Tanzania: A descriptive qualitative study*. *PLoS One*, 19(11), e0310414. <https://doi.org/10.1371/journal.pone.0310414>
- Karume, A. K., Sugut, J., Sankei, P., Kimathi, P. M., Guleid, A., Kimonge, D., Ebert, E., Wanjiku, G., Myers, J. G., & Beck, A. (2025). *Improvement in clinician confidence in and knowledge of Diabetic Ketoacidosis management following a case-based curriculum in Kenya*. *BMC Medical Education*, 25(1), 352. <https://doi.org/10.1186/s12909-025-0352-x>
- Kibret Abebe, G., Bishaw Aynalem, Z., Meseret, F., Dagne Abate, M., & Nuru Muhamed, A. (2025). *Mortality and its predictors in Adult Diabetic ketoacidosis patients in East Africa: A 2025 Systematic review and meta-analysis*. *F1000Research*, 14, 864. <https://doi.org/10.12688/f1000research.141864.1>
- Matthews, S., Coates, M. M., Bukhman, A., Trujillo, C., Ferrari, G., Dagnaw, W. W., Fénelon, D. L.,

- Getachew, T., Karmacharya, B., & Larco, N. C. (2023). Health system capacity to manage diabetic ketoacidosis in nine low-income and lower-middle income countries: A cross-sectional analysis of nationally representative survey data. *EClinicalMedicine*, 55. <https://doi.org/10.1016/j.eclinm.2022.101728>
- Mohajan, D., & Mohajan, H. K. (2023). Diabetic ketoacidosis (DKA): a severe diabetes mellitus disorder. Unpublished Manuscript.
- Mohan, V., & Lee, K. (2025). Global Burden of Diabetic Ketoacidosis. *Diabetes Technology & Therapeutics*, 27(4_suppl), S6-S13. <https://doi.org/10.1089/dia.2025.27.S6>.
- Shaker, M. S., Faltas, S. F. M., & Abdelhady, M. S. (2025). Studying the Role of Nurses in the Diabetic Ketoacidosis Management. *Journal of Integrative Nursing and Palliative Care*, 6(1-2025), 18-23. <https://doi.org/10.51847/AZep6FvIIV>
- Xie, H., Dai, X., Xie, J., Lei, S., Zeng, J., Yang, J., & Zhou, Y. (2025). Artificial Intelligence Adoption in Surgery: Cognition, Usage Patterns and Implementation Barriers of DeepSeek Among Healthcare Professionals in China's Tertiary Hospitals. *Journal of Multidisciplinary Healthcare*, 7719-7737. <https://doi.org/10.2147/JMDH.S538723>