Nurses' Role Regarding Care of Patients with Diabetic Ketoacidosis

Amal Mohamed Ahmed Elshahat [(1)], Nadia Mohamed Taha [(2)], Elham Hamad Mohamed Hamad [(3)], Amira Sabry Mohammed Mohammed [(4)] and Mona Mohamed Fathi Rizk [(5)]

[(1)] *B.Sc. Nursing, Zagazig University, Egypt.* [(2)] *Professor of Medical Surgical Nursing, Faculty of Nursing, Zagazig University, Egypt.* [(3)] *Assistant Professor of Medical Surgical Nursing, Faculty of Nursing, Zagazig University, Egypt.* [(4)] *Lecturer of Medical Surgical Nursing, Faculty of Nursing, Zagazig University, Egypt.* [(5)] *Lecturer of Medical Surgical Nursing, Faculty of Nursing, Zagazig University, Egypt.*

ABSTRACT

Backgrounds: Diabetic ketoacidosis is a critical condition affecting diabetic patients that requires prompt diagnosis and treatment, with nurses playing a crucial role in delivering safe patient care. **Aim of the study**: This study aimed to evaluate nurses' role regarding care of patients with diabetic ketoacidosis. **Subjects and methods: Study design:** descriptive, exploratory design was used. **Setting:** Data were collected from Paid ICU and general ICU of internal medicine hospital at Zagazig University Hospitals, Egypt. **Subjects:** The study has been carried on 50 ICU nurses from the same hospital setting. **Tools of data collections:** Two tools were employed for data gathering. First: An interview questionnaire to gather demographics data about the study subjects and questioning to assess nurses' knowledge level regarding diabetic ketoacidosis. The Second tool was an observation checklist for assessing nurses' practical skills regarding care of DKA patients. **Results:** this study indicated that 62.0% of studied subjects were over 25 years old, female and technical nursing institute graduates. Over half were single, had more than 3 years of ICU experience and had attended training courses regarding DKA, 80.0% of study subjects had unsatisfactory scores of overall knowledge, and 72.0% had unsatisfactory practice level. **Conclusion:** most nurses under study showed unsatisfactory level of all knowledge score and nearly to three quarters represented unsatisfactory levels in whole practical skills regarding care of DKA patients. Additionally, there's a positively significant relation between knowledge and practice scores. **Recommendation:** This study recommended to implement regular refresher training and educating programs for improving nurses' knowledge and practices regarding diabetic ketoacidosis.

Keywords: Diabetic ketoacidosis, Nurses' role, Patients.

Introduction

Diabetic ketoacidosis (DKA) is a critical and potentially fatal condition most linked to type-one diabetes, though its occurrence with type-two diabetes is possible. This complication develops when there is not enough insulin to convert glucose into energy for cells (**Adhikari and Touray, 2024**). DKA is often triggered by insufficient insulin during stressful situations, infections, skipped insulin doses, injuries, and certain

medications such as beta-blocking agents, calcium antagonists, pentamidine (Pentam), corticosteroids, and thiazide diuretic. Other contributing factors include alcohol misuse (due to altered mental state affecting insulin management), low potassium levels, heart attacks, surgical procedures, pregnancy, inflammation of the pancreas, kidney failure, and strokes **(Marshall, 2023)**.

Initial manifestations of DKA are loss of appetite, headache, and tiredness. As the condition proceed, the typical features of extreme feeling of thirst, urination and hunger develop. Without treatment, the patient may experience dehydration, weakness, lethargy, abdominal discomfort, nausea, vomiting, a fruity odor on the breath due to ketone production, faster breathing, rapid heartbeat, blurred vision, and low body temperature. Later signs are air hunger (characterized by Kussmaul respirations, which are rapid and deep), coma, and shock. Without timely medical intervention, the condition can be fatal **(Linton and Matteson, 2022).**

It can induce disturbances in electrolytes and fluids, causing complications like brain oedema, acute kidney-injury and evenually kidney failure with serious conditions **(Fan et al., 2023).** Common complications of DKA treatment include hypokalemia, hypoglycemia, and hyperchloremic metabolic acidosis **(Vincent et al., 2024).**The diagnostic criteria for DKA involve blood glucose levels exceeding 250 mg/dL, arterial pH of 7.30 or lower, bicarbonate levels at or below 18 mEq/L, and an albumin-adjusted anion gap greater than 10 to 12. Consequently, the initial laboratory assessment should encompass a comprehensive metabolic panel and arterial blood gases. **(Kellerman, Rakel and Heidelbaugh, 2023)**.

Critical management for DKA involves ensuring airway, breathing, and circulation, with rapid sequence intubation possibly required for airway protection in patients who are obtunded or severely hypoxic. This includes aggressive fluid replacement, insulin therapy, replenishment of potassium and other electrolytes, addressing the underlying cause (such as infection, acute myocardial infraction, or stroke), and considering sodium bicarbonate for pH levels below 7.0 **(Shah et al., 2024)**. The intensive care nurse is accountable for administering the required fluids, insulin and electrolytes, monitoring patient response, maintaining control of complications and educating patients. Sustained hourly monitoring of blood sugar, potassium levels, and often blood gases are essential. Accurate measurements of intake and output are crucial to monitor reversion of dehydration. Ongoing assessment of the vital signs; heart rate, blood pressure and hemodynamic measures, is required; neurological assessments are conducted hourly or as indicated during the acute phase **(Urden, Stacy and Lough, 2022)**.

Significance of the study

Diabetic ketoacidosis is considered a potentially fatal state, and if it goes undetected and untreated, it may induce serious problems and even loss of life. DKA can progress rapidly (occurring in a matter of hour to 24 hours), with even more rapid development in those utilizing insulins with short action period like Lispro, alongside metabolic sequences possibly happening from one and a half to two hours earlier **(Liu et al., 2024).** Egypt is listed as the 9th among the top 10 countries with diabetes and a mortality rate ranging from 2% to 10% is linked to DKA **(Abouzid et al., 2022).**

Nurses are crucial in enhancing patient's safety during DKA and preventing adverse events related to hospitalization. They work around the clock in acute healthcare settings, providing primary health surveillance and patient counseling, planning for caring process, delivering professional experience with preventing and caring, detecting mistakes, and evaluating caring consequences. The nurse has an essential role within the caring process to safeguard the patient **(Alanazi et al., 2023).** So, the current study carried out to evaluate nurses' role regarding care of patients with diabetic ketoacidosis.

Aim of the study

This study aimed to evaluate nurses' role regarding care of patients with diabetic ketoacidosis.

Research questions

- What are the nurses' levels of knowledge regarding care of patients with diabetic ketoacidosis?
- What are the nurses' levels of practice regarding care of patients with diabetic ketoacidosis?

Subjects and methods
Study design

A descriptive, exploratory study design has been employed.

Setting

This study has been executed within two intensive caring units (Paid ICUs and general ICU of internal medicine hospital) from Zagazig university Hospital, Sharkia governate, Egypt.

Subjects

A convenient sampling was used, including all accessible nurses (50) who work in the above-described setting (30 nurses in Paid ICU and 20 nurses in general ICU of internal medicine hospital) Zagazig university, Egypt.

Tools of data collection

The researcher gathered the data of this study by utilizing two tools as the following:

Tool I: An interview questionnaire:

It has been arranged in simple, clear Arabic to prevent misunderstandings. It was constructed by the researcher after reviewing relevant academic references and recommendations of experts for its validity, it consists of 55 questions and is divided into two parts as the following:

Part I: Demographic characteristics of the study subjects: it covered the personal data of the subjects under study which consisting of seven close-ended questions including (age, gender, marital status, qualificatins, experience years in ICU, attendance of previously training courses and presence of written instructions regarding DKA care in ICU) **(Kassew et al., 2020).**

Part II: Nurses' knowledge assessment: it was utilized to assess knowledge of nurses regarding diabetic ketoacidosis and nursing care required for those patients: This is composed of 48 questioning of MCQ format, and arranged into three main sections:

Section A: It included 11 questions about nurses' knowledge regarding diabetic ketoacidosis such as definition, precipitating factors, etiology, clinical manifestations, diagnosing, management and complications **(Marshall, 2023) and (Linton and Matteson, 2022)**

Section B: It composed of 25 questions about nurses' knowledge regarding nursing care for DKA patients such as fluid therapy, insulin infusion, potassium administration, intake and output measurements, fluid balance chart, skin care, subcutaneous insulin injection, ABG result normal ranges, CVP,

Glasgow coma scale **(Curtis et al., 2023; Harding et al., 2023).**

Section C: It involved 12 questions about nurses' knowledge regarding post-discharge instructions that should be provided to DKA patients such as blood glucose measuring, diet, exercise, insulin (administration time, site, storage), DKA prevention, warning signs and first aid before arrival to the hospital **(Hinkle, et al., 2022)**

The scoring system regarding the previous parts of knowledge

The Scoring system was 48 points (100%), evaluated based on the components in the questionnaire. The researcher prepared a key answer model to evaluate the respondents' (nurses') answers. Each correct response received one point, and incorrect response received zero. With all parts of knowledge, the items grades were added together and the division of the sum by the items number, providing an average score to the part. The scores were then translated to percentage. Total nurses' knowledge was deemed satisfactory if their percentage score was ≥ 80% and unsatisfactory if < 80% based upon statistics.

Tool II: Observational checklist:
Observational checklists included practical skills to evaluate nurses' practices regarding care of patients with diabetic ketoacidosis which included 167 steps into seven procedures**:** initial care upon admittance (44 items) **(Peate and Dutton, 2021; Urden et al., 2022)**, blood sugar testing by using test strips (17 items) **(Berman et al., 2022)**, urine ketone testing(12 items) **(Lippincott Nursing Procedures, 2022)**, IV fluids infusions therapy (27 items) **(Taylor et al., 2023)**, IV insulin infusions using volume-controlled administering sets (22 items) **(Perry et al., 2020)**, arterial blood gas sampling(30 items) **(Lister et al., 2020)** and

routines of caring with DKA patients (15 items) **(Burns and Delgado, 2019)**.

The Scoring system regarding practice:

For observational checklists, a score of one has been perceived for every done correctly step and given zero for steps not done correctly. The total scores were summed and division of the sum by the items number to calculate an average score regarding each part. Nurses were considered to have a satisfactory practicing levels if their entire total percentage score was 80% or higher, and unsatisfactory level if less than 80% according to statistical analyzing.

Content validity and reliability

Content validity was carried out to ensure that the tools content adequately cover the study aim. It was be used to modify the tools. It was ascertained by a committee involving five expertise from Nursing Faculty at Zagazig University (three of them professors and two assistant professors of nursing), who reviewed the tool for clearance, relevancy, coverage, simplicity and applicability. All suggested changes were implemented. Cronbach's Alpha has been employed to measure the entire consistency (reliability) concerning the tools, yielding a score of 0.0.816 for knowledge, 0.799 for nurses' practice.

Table test of reliability of study tools by Cronbach's Alpha

Tool	Cronbach's Alpha	No. of Items
Nurses' knowledge	0.816	48
Observational Checklist for nurses' practice	0.799	167

Filed work

The fieldwork of the current study was conducted over sixteen months from October 2023 to January 2025, as the following three months for preparing the literature review, three months for tool preparation, three months for sample collection, two months for statistical analysis, and five months for writing tables, discussions, and recommendations.

Before sample collection, meetings head units to clarify the study objectives. Nurses' schedules and assignment sheets were obtained to plan data collection. All participating nurses received the same instructions, with the researcher personally meeting each nurse to explain the study purpose and their role with completing the questionnaire, which was then distributed for them to fill out.

The questionnaire has been distributed daily at the end of the morning shift for those who work in the mornings and before starting of the afternoon (evening) shift for those working later. Each nurse was given the questionnaire individually, with completion time ranging from 30 to 45 minutes. Observations were maintained continuously within the mornings and afternoons shifts before the questionnaire was filled out.

Pilot study

The pilot study has been executed on five (10%) nurses for testing the clearness, comprehensiveness and the time spent to complete the questionnaire. These participants were not excluded from the sample in the study as no tool modifications were necessary.

Administration and ethical consideration

First, the study proposal was accepted by the Zagazig University Faculty of Nursing's Post Graduate Committee and Research Ethics Committee (REC) with the code of (M.D.ZU.NUR/199/8/10/2023).

An official permission to gather data at Zagazig University Hospital had been received from the hospital administration supervisors through submitting of an official document from the Dean of the Nursing College.

The researcher conducted meetings with the responsible nursing administration staff (head nurse of hospital and the head nurse of ICU) to explain the research aim and its importance, aiming to enhance the cooperation and facilitations during the implementation phase, also verbal consent from nurses were obtained prior to starting data gathering.

Approval for the study was accomplished by the ethics panel of nursing faculty prior to the study starting. Also, the investigator explained the study objective to the participant subjects in this study, ensuring the privacy and secrecy of their inputs. Furthermore, nurses were notified about their right for deciding whether participating and their ability for withdrawal during the study anytime.

Statistical analysis

The overall data were gathered, organized and analyzed statistically using SPSS 20.0 for windows**.** The quantitative findings were presented as the mean $\pm$ SD and median (range), and the qualitative type were shown as a fixed frequency (numbers) and a proportional frequency (percentages). Chi-square or Fisher's exact test were used for comparison of the percentage of categorical variables whenever necessary. Each test was two-sided. Pearson's correlation coefficient was implemented for assessing the relation among the different research variables, with (+) indicating a positive correlation and (-)

indicating a reversed correlation; value close to 1 reflects strong correlations and value close to 0 reflects weak correlations. It was considered that p- value less than 0.05 has a statistical significance, and there was no statistical significance if p-value ≥ 0.05.

Results

Table 1: Clarifies that around two-thirds (62.0%) of the study subjects were above 25 years old, female and technical nursing institute graduates. Over half of the subjects were single, had more than 3 years of ICU experience and had attended training courses regarding DKA (56.0%, 54.0%, 58.0%) respectively. While more than one third (36.0%) reported that presence of guidelines regarding DKA.

Table 2: Shows that the nurses under study had unsatisfactory levels of knowledge regarding diabetic ketoacidosis disease, nursing care for patients with diabetic ketoacidosis and instructions that must be given to patients with diabetic ketoacidosis to be followed after their discharge (82.0%, 72.0%, 56.0%) respectively and 80.0% of studied nurses had unsatisfactory level of total knowledge score.

Table 3: reflects that there is a significant relationship between participants' knowledge levels and attained training courses regarding diabetic ketoacidosis p=0.031, and available instruction guide regarding diabetic ketoacidosis management in intensive care unit p=0.002.

Table 4: Clarifies that 70.0% of nurses had satisfactory level in nursing practice during intravenous fluid infusion therapy. Otherwise, 84.0% of studied nurses had an unsatisfactory level in practice during taking arterial blood gases (ABG) sample, Also, 78.0% of nurses had unsatisfactory

level in practice regarding emergency care for patient on admission, blood glucose test by using test strip level. While 72.0% of the studied nurses had unsatisfactory level of total practice score.

Table 5: portrayed that there is a significant relationship between participants' practice levels and available instruction guide concerning diabetic ketoacidosis management in ICU, p=0.009.

Table 6: reveals that there is a significant relation between nurses' practices level and nurses' knowledge regard nursing care p= 0.0001, instructions that must be given to patients at discharge p= 0.0001, all over nurses' knowledge toward caring of patients with diabetic ketoacidosis p=0.0001.

Discussion

The present study demonstrated that approximately two-thirds of the nurses studied were over 25 years old, female, and technical nursing institute graduates, with over half being single. In my opinion this outcome might be attributed to the reality that a larger proportion of nursing in Egypt are women, and nursing at Egyptian universities were exclusively for females until a few years ago. Additionally, most bedside nurses are technical institute graduates, while those with bachelor's degrees often serve as head nurses or supervisors. These results align with **(Mekky et al., 2023)** who studied "Effect of an Educational Program on the Nurses' Performance and Patients' Health Outcomes regarding Diabetic Ketoacidosis" found that about two-fifths from the studied nurses aged over 25 years, not married and over half were female and graduated from a technical institute.

Regarding experience years, this study indicated that over half of the subjects had ICU experiences more than three years, this

finding agreed with **McCue (2021)** who studied the nurses' perceptions of caring for diabetic patients, stated that three-quarters of the studied nurses had over three years of experience.

Concerning training courses about diabetic ketoacidosis, more than half of studied nurses reported attending relevant courses, the findings were almost matching with those expressed by **(Uğur et al., 2015)** who reported that more than two-thirds of studied nurses had attended post-graduation educational sessions on diabetes.

As regard to the presence of DKA guidelines in ICUs, this study showed that only one-third of the nurses reported having such guidelines, this findings in accordance with **(Allotey et al., 2024)** who studied the DKA management amongst nurses at the New Tafo Government Hospital, stated that less than half of nurses within the study reported having a DKA management protocol in their unit.

This study highlighted that the study nurses represented unsatisfactory levels of knowledge concerning diabetic ketoacidosis disease, nursing care of DKA patients and post-discharge instructions. These results in accordance with **(Ali et al., 2017)** who reported that over two-thirds of nurses showed insufficient knowledge levels concerning diabetic ketoacidosis disease, the majority exhibited unsatisfactory levels of knowledge as regards nursing care, although nearby two-thirds of participants had a satisfactory knowledge regarding post-discharge instructions. From the researcher's opinion, this lack of knowledge might be due to the majority being technical institute graduates, lack of training programs, and the near absence of DKA management protocols or guidelines.

Additionally, these findings have been supported with **(Allawi and Ahmed,** **2023)** who represented that more than half of nurses lacked adequate knowledge about DKA in Mosul City/Iraq. Also, in the same line with **Mayabi (2019)** who illustrated that over half of the study nurses had inadequate knowledge regarding DKA management in two county hospitals.

Conversely, this outcome contradicts with **(Korany et al., 2022) and (Allotey et al., 2024)** who found that more than half of studied nurses possessed knowledge about all aspects of DKA at a satisfactory level. Also, this finding was controversy with **(Lahouaoui and El-Fakir, 2024)** who assessed the knowledge concerning DKA among nurses in Laâyoune City, Morocco, declared that most of them demonstrated good knowledge in managing DKA.

This study revealed that nearly to three quarters of the study samples represented unsatisfactory levels in overall practice regarding caring of DKA patients. This result was consistent with **Mehany (2015)** who declared that the studied nurses had poor practice in managing diabetic crises in the emergency medical unit at Assiut University Hospital. Also, these findings was supported with (**Ali et al., 2017**) who found that the majority of studied nurse had unsatisfactory levels regarding total practices toward caring of patients with DKA and this finding was on the same line with **(Shaker et al., 2020)** who reported that majority from nurses under study had unsatisfactory levels of overall practice regarding DKA patients' care. From the researcher's perspective, this inadequate practice might stem from a lack of knowledge, training, qualifications, motivation, years of experience, insufficient equipment, an unsuitable environment, and workload, along with the absence of protocols, guidelines, nursing care standards, or close supervision.

According to total emergency care practice level, the present study clarified that more than three quarters of the studied nurses had unsatisfactory practice level regarding emergency care on admission, these findings were in harmony with **Ahmed and Kandeel (2017)** who studied "Evaluating Emergency Nurses' Performance of Cardiopulmonary Resuscitation: An Investigation from Egypt" revealed that the majority of the studied nurses had incompetent practice level regarding emergency patient's ABCDE approach.

Regarding nurses' practice during blood glucose test, the current study represented that about three-quarters of studied nurses had unsatisfactory level of practice during blood glucose test by using test strip level, this finding was contradicted to study conducted by **Onianwa et al., (2020)** who studied "Outcome of an educational training programme on blood glucose monitoring among nurses in the management of hypoglycaemia and hyperglycemia" reported that more than two thirds of the studied nurses had good performance during blood glucose monitoring.

The present study clarified that more than three fifths of the studied nurses had unsatisfactory level of practice during urine ketone test strip, this result was contrary with **Ali et al., (2017)** who found that almost nurses under study had satisfactory level of practice during urine ketone test strip.

The current study demonstrated that more than two-thirds of the studied nurses had satisfactory level of practice during intravenous fluid infusion therapy, this result was on the same context with **Musa and Mahmood (2022)** who studied "Assessment of nurses knowledge and skill about intravenous fluid administration" illustrated that three fifths of the studied nurses had satisfactory skills level during intravenous fluid infusion therapy.

Relating to nurses' practice during intravenous insulin infusion via volume control administration set in the current study, more than half of the studied nurses had satisfactory practice level, this finding differed from **El-sayed et al., (2019)** who studied "Nurses' Performance Regarding Infusion Pumps' Medication Administration among Critically Ill Patients" represented that about two thirds of the studied nurses had an unsatisfactory level of total practice regarding infusion pumps' medication administration among critically ill patients.

Concerning nurses' practice during taking arterial blood gases sample, the present study revealed that the majority of studied nurses had unsatisfactory practice level, these findings was consistent with **Abd Elkader et al., (2020)** who studied "Effect of applying program based learning on nurse's performance and self-efficacy regarding arterial blood puncture" stated that more than two thirds of nurses under study had inadequate level of practice regarding arterial blood puncture in preprogram phase.

The current study found that more than two fifths of the studied nurses had satisfactory level of practice regarding routine care for DKA patients. Unlike, **Ali et al., 2017** who stated that many studied nurses had unsatisfactory practice levels regarding care of DKA patients after the stabilization.

It is clear from the results of the present study that there was no significant correlations between nurses' knowledge and their personal characteristics including ages, gender, married status, qualification and their experience years, while there is a significant relationship between nurses' knowledge and attendance training courses and presence of guidelines. On the same hand **Kaya and Karaca, 2018** reported that no statistical

correlations have been appeared between nurse's knowledge and their sex, married status, experience period, while a statistical relationship was between the state of nurse's training and total knowledge.

The current study declared that no statistical relations between nurses' practices and their personal traits involving age, gender, married status, qualifications, experience years and previous training courses, while there was a highly significant relation between nurses' practice and presence of guidelines. These results were consistent with **Kidane et al., 2024** who stated that nurses' age, sex, work experience, education levels and training concerning physical restraint had no significant difference across practicing scores.

Additionally, the results of that research implied a highly significant relation between overall nurses' knowledge and total nurses' practices regarding care of patients with diabetic ketoacidosis. These findings were gone on the same line with (**Shaker et al., 2020**) who demonstrated that there was a highly statistical correlations between total knowledge score and practices score. While (**Ali et al., 2017**) reported that no statistically significant relations have been approved between total nurses' knowledge and practice.

Conclusion

According to the results and discussion of the present study, it concluded that most nurses under study had unsatisfactory level of overall knowledge score and nearly to three quarters of participants had unsatisfactory level in total practices regarding care of DKA patients. Moreover, there is a statistically significant positive correlation between knowledge score and practices score.

Recommendations
Based upon the results of this study, the following recommendations are proposed:
- Regular refresher training and educational programs implementation is essential to improve nurses' knowledge and practices regarding DKA.
- A specific procedure book and information resources about DKA should be available in Arabic
- Ongoing evaluations of nurses' knowledge and practices is crucial for identifying what they need.
- Nurses should be encouraged to participate in workshops, training sessions, and conferences to enhance their knowledge and skills.

Table 1: Frequency and Percentage Distribution of the Studied nurses According to demographic characteristics (n = 50)

Items	No.	%
Age		
<25 years	19	38.0
≥25 years	31	62.0
Mean ± SD	26.26±3.56	
Median (Range)	25(22-37)	
Gender		
Male	19	38.0
Female	31	62.0
Social status		
Single	28	56.0
Married	22	44.0
Qualifications		
Diploma	6	12.0
Technical institute	31	62.0
Bachelor	13	26.0
Experience years in ICU		
<3 years	23	46.0
≥ 3 years	27	54.0
Mean ± SD	4.45±4.86	
Median (Range)	3(six months-21)	
Training courses regarding DKA		
Yes	29	58.0
No	21	42.0
Presence guidelines regarding DKA in ICU		
Yes	18	36.0
No	32	64.0

Table 2: Satisfactory nurses' knowledge level regarding care of patients with diabetic ketoacidosis score

Nurses' knowledge dimensions	Satisfactory (≥80.0%)		Unsatisfactory (<80.0%)	
	No.	%	No.	%
Diabetic ketoacidosis disease	9	18.0	41	82.0
Nursing care knowledge	14	28.0	36	72.0
Instructions before discharge	22	44.0	28	56.0
Total nurses' knowledge	10	20.0	40	80.0

Table 3: Relation between Nurses' Knowledge Regarding Care of Patients with Diabetic Ketoacidosis and their demographic characteristics (n = 50)

Items	Nurses' knowledge				p-value
	Satisfactory n=10		Unsatisfactory n=40		
	No.	%	No.	%	
Age					
<25 years	2	10.5	17	89.5	0.282
≥25 years	8	25.8	23	74.2	
Gender					
Male	5	26.3	14	73.7	0.474
Female	5	16.1	26	83.9	
Marital Status					
Single	4	14.3	24	85.7	0.302
Married	6	27.3	16	72.7	
Qualifications					
Diploma	1	16.7	5	83.3	0.38
Technical institute	8	25.8	23	74.2	
Bachelor	1	7.7	12	92.3	
Experience years in ICU					
<3 years	3	13.0	20	87.0	0.308
≥ 3 years	7	25.9	20	74.1	
Training courses regarding DKA					
Yes	9	31.0	20	69.0	0.031*
No	1	4.8	20	95.2	
Prescence guidelines regarding DKA in ICU					
Yes	8	44.4	10	55.6	0.002*
No	2	6.3	30	93.8	

non-significant p>0.05   ** p<0.05: significant*

Table 4: Frequency Distribution of Nurses' Practice Level regarding Care of Patients with Diabetic Ketoacidosis Score

Nurses' practice procedures	Satisfactory ≥80.0%		Unsatisfactory <80.0%	
	No.	%	No.	%
Initial care upon admittance	11	22.0	39	78.0
Blood sugar testing by using test strips	11	22.0	39	78.0
Urine ketone testing	18	36.0	32	64.0
Intravenous fluid infusion	35	70.0	15	30.0

Insulin infusions	26	52.0	24	48.0
Arterial blood gases sampling	8	16.0	42	84.0
Routine caring	31	62.0	19	38.0
Total nurses' practice	14	28.0	36	72.0

Table 5: Relation between Nurses' practice Regarding Care of Patients with Diabetic Ketoacidosis and their Demographic Characteristics (n = 50)

Items	Nurses' practice level				χ^2	p-value
	Satisfactory n=14		Unsatisfactory n=36			
	No.	%	No.	%		
Age						
<25 years	4	21.1	15	78.9	0.734	0.392
≥25 years	10	32.3	21	67.7		
Gender						
Male	6	31.6	13	68.4	0.195	0.66
Female	8	25.8	23	74.2		
Marital status						
Single	6	21.4	22	78.6	1.363	0.24
Married	8	36.4	14	63.6		
Qualifications						
Diploma	3	50.0	3	50.0	2.483	0.289
Technical institute	9	29.0	22	71.0		
Bachelor	2	15.4	11	84.6		
Experience years in ICU						
<3 years	4	17.4	19	82.6	2.378	0.123
≥ 3 years	10	37.0	17	63.0		
Training courses regarding DKA						
Yes	9	31.0	20	69.0	0.315	0.574
No	5	23.8	16	76.2		
Presence guidelines regarding DKA in ICU						
Yes	9	50.0	9	50.0	6.752	0.009*
No	5	15.6	27	84.4		

*χ 2 Chi square test   non-significant p>0.05   * p<0.05: significant*

Table 6: Relation between nurses' practice and their knowledge regarding care of patients with diabetic ketoacidosis:

Total knowledge dimensions	Total nurses' practice level				p-value
	Satisfactory n=14		Unsatisfactory n=36		
	No.	%	No.	%	
Diabetic Ketoacidosis disease knowledge					
Satisfactory	5	35.7	4	11.1	0.094
Unsatisfactory	9	64.3	32	88.9	
Nursing care knowledge					
Satisfactory	10	71.4	4	11.1	0.0001*
Unsatisfactory	4	28.6	32	88.9	
Discharge instructions					
Satisfactory	13	92.9	9	25.0	0.0001*
Unsatisfactory	1	7.1	27	75.0	
Total nurses' knowledge level					
Satisfactory	8	57.1	2	5.6	0.0001*
Unsatisfactory	6	42.9	34	94.4	

non-significant p>0.05   ** p<0.05: significant*

References

ABD ELKADER, H. M., SHAHIN, E. S. & EL-ATA, A. B. A. 2020. Effect of applying program-based learning on nurse's performance and self-efficacy regarding arterial blood puncture. American *Journal of Nursing Research*, 8(2), 192-198. https://www.researchgate.net/publication/343582635_Effect_of_Applying_Program_Based_Learning_on_Nurse's_Performance_and_Self-efficacy_Regarding_Arterial_Blood_Puncture

ABOUZID, M. R., ALI, K., ELKHAWAS, I. & ELSHAFEI, S. M. 2022. An overview of diabetes mellitus in Egypt and the significance of integrating preventive cardiology in diabetes management. *Cureus*, 14(7): 1-6.

https://pubmed.ncbi.nlm.nih.gov/36000101/

ADHIKARI, S. & TOURAY, L. Y. 2024. Nursing care of diabetes ketoacidosis as an acute complication of diabetes mellitus: A video guide for the Lapland UAS International nursing students. Available at: https://www.theseus.fi/handle/10024/859155

AHMED, H. H. & KANDEEL, N. A. 2017. Evaluating Emergency Nurses' Performance of Cardiopulmonary Resuscitation: An Investigation from Egypt. *International Journal of Life Sciences*; 6(2), 74-83. https://www.researchgate.net/publication/340066659_Evaluating_Emergency_Nurses%27_Performance_of_Cardiopulmonar

y_Resuscitation_An_Investigation_from_Egypt

ALANAZI, F. K., LAPKIN, S., MOLLOY, L. & SIM, J. 2023. Safety culture, quality of care, missed care, nurse staffing and their impact on pressure injuries: A cross-sectional multi-source study. *International journal of nursing studies advances*, 5(7), 1-11. https://pubmed.ncbi.nlm.nih.gov/38746552/

ALI, A.S.I., HASSAN, M.S.H. & ALI, A.A. 2017. Nurses' Performance Regarding Caring of Patient with Diabetic Ketoacidosis. *Egyptian Journal of Health Care,* 8(3), 276-290. https://ejhc.journals.ekb.eg/article_47312.html

ALLAWI, R. H. & AHMED, M. M. 2023. Assessment of Nurse's Knowledge Towards Diabetic Ketoacidosis among children in Mosul City/Iraq. *Rawal Medical Journal*, 48(2), 448-451. https://www.rmj.org.pk/?mno=144489

ALLOTEY, A.N.A., YARNEY, D., KPIINFAAR, T. & YEBOAH, F.A. 2024. Management of Diabetic Ketoacidosis among Nurses: An Interventional Study at the New Tafo Government Hospital. *IJFMR*, 6(4), 1-61. https://www.ijfmr.com/research-paper.php?id=26761

BERMAN, A., SNYDER, S.& FRANDSEN, G. 2022. Kozier & Erb's Fundamentals of Nursing: Concepts, Process and Practice, (11th ED.), United Kingdom: Pearson Education, 825. https://libgen.is/book/index.php?md5=FE7827BA92F692B17C5DB5C2EA3F0573

BURNS, S. M.&DELGADO, S. A. 2019. A ACN Essentials of Critical Care Nursing, 4th ed., United States: McGraw Hill LLC,

421-428. https://libgen.is/book/index.php?md5=283083140F8E9534486A30A3FDD16222

CURTIS, K., RAMSDEN, C., SHABAN, R. Z., FRY, M. & LORD, B. 2023. Emergency and trauma care for nurses and paramedics. 4th Ed., Australia. Elsevier Health Sciences, 665- 670. https://www.google.com.eg/books/edition/Emergency_and_Trauma_Care_for_Nurses_and_/YjTZEAAAQBAJ?hl=en&gbpv=1&dq=DKA+diabetes.&pg=PA665&printsec=frontcover

EL-SAYED, S.S., ABDEL-SATTAR, M.I. & MOHAMED, Y. M. 2019. Nurses' Performance Regarding Infusion Pumps' Medication Administration among Critically Ill Patients. *Egyptian Journal of Health Care*, 10(2): 277-293. https://ejhc.journals.ekb.eg/article_46258.html

FAN, T., WANG, J., LI, L., KANG, J., WANG, W. & ZHANG, C. 2023. Predicting the risk factors of diabetic ketoacidosis-associated acute kidney injury: A machine learning approach using XGBoost. Frontiers in Public Health, 11,1-9. https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2023.1087297/full

HARDING, M. M., KWONG, J., HAGLER, D. & REINISCH, C. 2023. Lewis's Medical-Surgical Nursing: Assessment and Management of Clinical Problems, Single Volume.12th Ed., United States: Elsevier Health Sciences,1290-1311. https://libgen.is/book/index.php?md5=163E0972EDB5BC28FC610B65B876DC7B

HINKLE, J. L., CHEEVER, K. H.& OVE RBAUGH, K. 2022. Brunner and Suddarth's Textbook of Medical-Surgical Nursing. 15th Ed., United States: Lippincott Williams & Wilkins, 4025-4040. https://libgen.is/book/index.php?md5=05 E397CB6495FCC05BF140396DAC5641

KASSEW, T., DEJEN, A.T. & LIYEW, B. 2020. Nurses' Knowledge, Attitude, and Influencing Factors regarding Physical Restraint Use in the Intensive Care Unit: A Multicenter Cross-Sectional Study. *Critical care research and practice*, 1(2):1-10. https://pubmed.ncbi.nlm.nih.gov/3256628 8/

KAYA, Z. & KARACA, A. 2018. Evaluation of nurses' knowledge levels of diabetic foot care management. *Nursing research and practice*, 2(1),1-12. https://pubmed.ncbi.nlm.nih.gov/3005781 0/

KELLERMAN, R. D., RAKEL, D. P. & HEIDELBAUGH, J. J. 2023. Conn's Current Therapy 2024. (76th ED.), Philadelphia: Elsevier Health Sciences, 331. https://0810f4ac1-1103-y-https-www-clinicalkey-com.mplbci.ekb.eg/#!/content/book/3-s2.0-B9780443121517000670

KIDANE, H., HABTEMARIAM, M., TEWELDE, R., MAHMUD, S. & HABTE, E. 2024. Assessment of Knowledge, Attitude and Practice of Nurses' Towards Physical Restraints for Critical Ill Patients in Orotta National Referral Hospital. *World Journal of Medical Case Reports*, 5(1), 1-12. https://www.researchgate.net/publication/ 383315899_Assessment_of_Knowledge_ Attitude_and_Practice_of_Nurses'_Towar ds_Physical_Restraints_for_Critical_Ill_P

atients_in_Orotta_National_Referral_Hos pital

KORANY, R.M., ABDALLA, K.F., ABDELSALAM, S.N. & SHAKER, M.S. 2022. Factors Affecting the Patients Safety with Diabetic Ketoacidosis in Intensive Care Unit. Egyptian Journal of Health Care, 13(4), pp. 399-414. https://ejhc.journals.ekb.eg/article_26132 4.html

LAHOUAOUI, H. & EL-FAKIR, M. B. 2024. Assessment of Nurse's Knowledge Regarding Diabetic Ketoacidosis in Laâyoune City, Morocco. *South Asian Res J Med Sci*, 6(3), 69-73. https://sarpublication.com/media/articles/ SARJMS_63_69-73.pdf

LINTON, A. D. & MATTESON, M. A. 2022. Medical-Surgical Nursing. 8th ED., United States: Elsevier Health Sciences, 1005-1008. https://www.google.com.eg/books/edition /Medical_Surgical_Nursing_E_Book/d61 tEAAAQBAJ?hl=en&gbpv=1&dq=%22 DKA+diabetes%22&pg=PA1005&prints ec=frontcover

LINTON, A. D. & MATTESON, M. A. 2022. Medical-Surgical Nursing. 8th ED., Unites States: Elsevier Health Sciences, 1005-1023. https://www.google.com.eg/books/edition /Medical_Surgical_Nursing_E_Book/d61 tEAAAQBAJ?hl=en&gbpv=1&dq=medic al+surgical+nursing+8th+edition&pg=PA 1005&printsec=frontcover

LIPPINCOTT WILLIAMS & WILKINS. 2022. Lippincott Nursing Procedures, 9th ED., United States: Wolters Kluwer Health, 880. https://libgen.is/book/bibtex.php?md5=38 09E64B1FD3843B3DF5A9314204ED4B

LISTER, S., HOFLAND, J. & GRAFTON, H. 2020. The Royal Marsden manual of clinical nursing procedures: professional edition. (10th ED.), United Kingdom: John Wiley & Sons, 674-679. https://www.google.com.eg/books/edition/The_Royal_Marsden_Manual_of_Clinical_Nur/mgfYDwAAQBAJ?hl=en&gbpv=1&dq=The+Royal+Marsden+manual+of+clinical+nursing+procedures:+professional+edition.&pg=PA674&printsec=frontcover

LIU, Y., MO, W., WANG, H., SHAO, Z., ZENG, Y. & BI, J. 2024. Feature selection and risk prediction for diabetic patients with ketoacidosis based on MIMIC-IV. Frontiers in Endocrinology; 15, 1-14. https://www.frontiersin.org/journals/endocrinology/articles/10.3389/fendo.2024.1344277/full

MARSHALL, C. 2023. Goodman and Fuller's Pathology: Implications for the Physical Therapist. 3rd Ed., Netherlands: Elsevier Health Sciences, 242-244. https://www.google.com.eg/books/edition/Goodman_and_Fuller_s_Pathology_for_the_P/i_m8EAAAQBAJ?hl=en&gbpv=1&dq=%22diabetes+DKA%22&pg=PA242&printsec=frontcover

MARSHALl, C. 2023. Goodman and Fuller's Pathology: Implications for the Physical Therapist. (3rd ED.), United States: Elsevier Health Sciences, 243. https://www.google.com.eg/books/edition/Goodman_and_Fuller_s_Pathology_for_the_P/i_m8EAAAQBAJ?hl=en&gbpv=1&dq=intitle:Goodman+and+Fuller%E2%80%99s+Pathology:+Implications+for+the+Physical+Therapist.%E2%80%AC%E2%80%AC%E2%80%AC%E2%80%AC%E2%80%AC%E2%80%AC%E2%80%AC%E2%80%AC&pg=PA243&printsec=frontcover

MAYABI, L. O. 2019. Level of Knowledge of Healthcare Providers In Mbagathi County Hospital And Mama Lucy Kibaki Hospital On The Ispad Management Guidelines Of Diabetic Ketoacidosis (Doctoral dissertation, University of Nairobi). https://erepository.uonbi.ac.ke/handle/11295/109432

MCCUE, V. Y. 2021. Self-Efficacy: Nurses' Perceptions of Caring for Patients Living with Diabetes. Nursing & Health Sciences Research Journal; 4(1): 26-45. https://www.semanticscholar.org/paper/98d4bf2dca8ca221e617c621b4f33fbbc69d0ccf

MEHANY, M. M. 2015. Effect of an Educational Program on Nurses' Knowledge and Practice Regarding management of Diabetic Crisis in the Emergency Medical Unit at Assiut University Hospital. *Assiut Scientific Nursing Journal*, 3(5), 138-146. https://asnj.journals.ekb.eg/article_182452.html

MEKKY, E.A., HASSAN, H.A.M. & IBRAHIM, R.A. 2023. Effect of an Educational Program on the Nurses' Performance and Patients' Health Outcomes regarding Diabetic Ketoacidosis. *Journal of Nursing Science Benha University*, 4(1), 488-504. https://jnsbu.journals.ekb.eg/article_277736.html

MUSA, M. H. & MAHMOOD, M. H. 2022. Assessment of nurses knowledge and skill about intravenous fluid administration. *Journal of Duhok University*, 25(2), 531-536. https://www.researchgate.net/publication/366827729_Assessment_of_Nurses_Knowledge_And_Skill_about_Intravenous_Fluid_Administration

ONIANWA, P. O., AYORINDE, M. O., AKANBI, F. O. M., ARE, O. O., NKOM, A. T., AKINTOLA, G. O., OJEMOLA, O. E. ET AL. 2020. Outcome of an educational training programme on blood glucose monitoring among nurses in the management of hypoglycaemia and hyperglycemia. *Journal of Pre-Clinical and Clinical Research*, 15(1): 20-25. https://www.jpccr.eu/Outcome-of-an-educational-training-programme-on-blood-glucose-monitoring-among-nurses,132398,0,2.html

PEATE, L. & DUTTON, H. 2021. Acute Nursing Care: Recognising and Responding to Medical Emergencies, (2nd ED.), United Kingdom: Taylor & Francis, 471-487. https://books.ms/main/7723CA289DE7FD64E2F626334263005A

PERRY, A. G., POTTER, P. A. & OSTENDORF, W. R. 2020. Nursing Interventions & Clinical Skills E-Book, (7th ED.), United States: Mosby, 638-643. https://libgen.is/book/index.php?md5=D6D5C35D63374F9067232AF4CD8ED8B8

SHAH, K., LEE, J., OWYANG, C. G. & RENNE, B. C. 2024. Practical Emergency Resuscitation and Critical Care. (2nd ED.), United Kingdom: Cambridge University Press, 413-423. https://www.google.com.eg/books/edition/Practical_Emergency_Resuscitation_and_Cr/faDhEAAAQBAJ?hl=en&gbpv=1&dq=intitle:Practical+Emergency+Resuscitation+and+Critical+Care&pg=PA413&printsec=frontcover

SHAKER, M. S., ABDELHADY, M. S. & FALTAS, S. F. M. 2020. Effect of Training Program on Nurses' Performance and Health Outcomes for Patients with Diabetic Ketoacidosis. Egyptian Journal of Health Care, 11(2), pp.358-377. https://ejhc.journals.ekb.eg/article_126416_244401468313ff13a642fb208f057856.pdf

TAYLOR, C. R., LYNN, P. B.& BARTLETT, J. L. 2023. Fundamentals of Nursing: The Art and Science of Person-Centered Care, (10th Ed.), United States: Wolters Kluwer Health, 2504-2508. https://libgen.is/book/index.php?md5=BE4B1954B569973C96FD860D8B3B6369

UĞUR, E., DEMIR, H. & AKBAL, E. 2015. Postgraduate education needs of Nurses' who are caregivers for patients with diabetes. *Pakistan journal of medical sciences*, 31(3), 637–642. https://pmc.ncbi.nlm.nih.gov/articles/PMC4485286/

URDEN, L. D., STACY, K. M. & LOUGH, M. E. 2022. Critical Care Nursing, Diagnosis and Management. (9th ED.), Netherlands: Elsevier Health Sciences, 427-436. https://libgen.is/book/index.php?md5=786B9AE35362A45DF3C6FDEA006FCED8

VINCENT, J. L., MOORE, F. A., BELLOMO, R. & MARINI, J. J. 2024. Textbook of Critical Care. (8th ED.), Netherlands: Elsevier Health Sciences, 112-119. https://libgen.is/book/index.php?md5=83F943CEAD81023B284962D9FC6D45B6