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Original Research Article

Diabetic Ketoacidosis Management in Children and Adolescents with Type 1 Diabetes: A Study on Nurses' Knowledge and Self-Confidence

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Abstract: ***Context*:** Diabetic ketoacidosis (DKA) is a common and severe side effect of type 1 diabetes mellitus (T1DM) in children and adolescents, requiring prompt and accurate treatment. ***Aims*:** The current study aimed to estimate nurses' knowledge and confidence in managing DKA, investigate their relationship with sociodemographic factors, and determine the correlation between nurses' knowledge and self-confidence. ***Settings and Design*:** The current study adopted a cross-sectional approach in four teaching hospitals in Baghdad city. ***Methods and Material*:** This descriptive cross-sectional study included nurses from four Baghdad hospitals. A proportionate stratified random sampling method selected 200 nurses from distinct departments. A standardized, validated questionnaire assessed nurses' sociodemographic features, knowledge, and self-confidence in managing diabetic ketoacidosis. Cronbach's alpha of 0.79 validated the questionnaire's dependability. ***Statistical Analysis*:** In SPSS, the researchers calculated mean scores, Spearman's rank test, and Pearson's analysis. ***Results***: The results proved that the participants' overall knowledge and self-confidence were unacceptable. The study also demonstrated a positive relationship between education level and their knowledge of managing DKA. A statistically significant relationship was also found between the training courses nurses received about DKA and their confidence in managing DKA. The study finds a statistically significant correlation between nurses' self-confidence and their level of knowledge. ***Conclusions*:** Although nurses' general knowledge and confidence in managing diabetic ketoacidosis were moderate, the results indicated room for improvement, particularly in practical aspects. It was also found that the effect of educational level on the variables of knowledge and training among nurses improves confidence.

Keywords: Diabetic Ketoacidosis, Type 1 Diabetes Mellitus, Nurses, Health Knowledge, Self-Confidence.

INTRODUCTION

It is widely known that Diabetes mellitus (DM) poses a major public health challenge and significantly impacts overall human health [1]. It is a serious clinical condition that requires a careful approach [2]. The most common endocrine illness in children is type 1 diabetes mellitus (T1DM) [3]. It also represents a dangerous health problem worldwide, a progressive autoimmune disease, and one of the most significant non-communicable diseases [4, 5]. It affects pancreatic beta cells, impairing their ability to produce insulin [6, 7]. Globally, there is an increase in DM prevalence [2-8]. It is estimated that in 2015, the number of people with DM was 415 million, and it is predicted that by 2040, this figure will increase to 642 million. An estimated 26.9 million people in the US had DM in 2018, including 210 thousand children and adolescents under the age of 20, of whom 187,000 had T1DM [6]. DM is a major public health problem in Arab countries, with an estimated in twenty Arab countries, 20.5 million patients registered in 2011. Compared to other Middle Eastern countries, the prevalence of DM in Iraq is 9.3%, and Bahrain has the highest recurrence rate in the region (25.7%) [9].

Furthermore, in 2021, the projected number of children and adolescents aged 0–19 years with type 1 diabetes T1DM in Morocco was 43,300, with an annual incidence rate increase of approximately 5,100. Also, there is a marked

increase in mortality among adolescents and young adults diagnosed with type 1 diabetes in the first years after diagnosis, primarily due to the acute metabolic complications: DKA and hypoglycaemia [10].

Among children, T1DM is the most prevalent chronic illness, with high rates of morbidity and death [11, 12]. DKA is the most common complication of T1DM [12-14]. It poses a hazard to life, acute complications [1-15], that include hyperglycemia and ketoacidosis, in addition to ketonuria [1-16]. These disturbances emerge from absolute or relative insulin deficiency [13-19], inhibiting glucose from entering cells as an energy source. Consequently, the liver quickly converts fat into ketones to be used as energy, and excessive ketone production occurs, which causes blood acidity due to the accumulation of ketones in the blood and urine [13-15]. Besides dehydration and electrolyte disturbances, the resulting acidosis complicates this condition and needs immediate administration [16]. The classic symptoms of DM, like polyuria, polydipsia, and unintentional weight loss, are similar to early clinical manifestations of DKA [20]. Other symptoms include malaise, general weakness, fatigue, nausea, anorexia, vomiting, and diffuse abdominal pain [15]. Patients also often experience tachycardia, low blood pressure, decreased skin elasticity, severe respiratory distress, and loss of consciousness [20]. Diabetics should be closely monitored for infections, as these are common triggers of DKA [12].

The severe and costly complication of T1DM is DKA [18-20]. DKA poses special difficulties facing healthcare workers, especially in kids, hence, it is a fundamental issue in DM management [16]. People with type 1 diabetes are more likely to develop diabetic ketoacidosis, but those with type 2 diabetes are less likely to develop it [1-15].

DKA has become more common among children with DM over the past three decades [21]. It is especially very common in children and adolescents diagnosed with T1DM, resulting in a rise in hospital admissions, intensive care unit (ICU) entries, recurrences, and death rates. 19.8% of 41,189 children and adolescents newly diagnosed with T1DM experienced DKA during the period from 2000 to 2019. The frequency of severe DKA was reported at 6.1%. Children under 6 years of age exhibited a higher prevalence at 21.7% compared to adolescents aged 12–17 years, who showed a rate of 18.6% [16]. As many as 30% of patients with new-onset T1DM experience DKA, and as many as 6%–8% of cases of children with T1DM experience DKA each year. In Indonesia, in 2017, 71% of paediatric patients experienced DKA as an initial clinical presentation of T1DM [20]. In children with T1DM, the DKA is becoming the most common sticky situation, with an incidence ranging from 1% to 10% per year and a prevalence ranging from 30% to 70% in both high- and middle-income countries [21, 22].

DKA contributes significantly to hospitalization, morbidity, and mortality in paediatric populations, with hospitalization rates ranging from 16.5% to 78% [19]. The combined mortality rate for DKA, by country, varies between 2% and 5% in countries with middle-income and between 6% to 24% in countries with low-income and developing [22-24]. Among children with DKA, rates of mortality are high, due to increased incidences of cerebral oedema, shock, sepsis, brain injury, failure in respiratory function with hypophosphatemia, and renal failure [21]. Individuals with complications of DM often visit the emergency department (ED) and require admission to the ICU and hospitalization [25]. Effective management should begin in the ED to prolong hospital stay and avoid other complications [26]. Given the significant role of nurses in diabetes care, this study significantly integrates two dimensions of nurses' knowledge and self-confidence in the management of DKA in children and adolescents, unlike previous studies that examined each separately. It also examines their interaction and association with sociodemographic characteristics in the paediatric clinical setting, a topic rarely explored in current research, particularly in regional settings.

MATERIALS AND METHODS

Study Design and Setting

The researchers implemented a cross-sectional analytical design to assess nurses' knowledge and self-confidence about DKA management in children and adolescents diagnosed with T1DM and to investigate the correlation between nurses' sociodemographic characteristics and their knowledge and self-confidence in managing DKA.

Study Participants and Sampling

The target population included nurses in paediatric ED, paediatric internal medicine departments, and ICU in the four hospitals (Table 1). These hospitals were selected because they specialize in receiving paediatric cases, including DKA. A total of 392 eligible nurses were recruited. The Cochrane formula was applied to determine the required sample size, assuming a prior knowledge rate of 43%, 95% for a confidence level, and 5% for a margin of error. After adjusting for limited sample size, the final sample was 200 nurses.

A proportional stratified random sampling method was used to select nurses from different hospitals and departments. The process consisted of the following steps:

- Primary Stratification: Hospitals were treated as primary strata. Nurses were proportionally selected based on each hospital's representation in the total number of nurses.

- Secondary Stratification: Within each hospital, departments such as the ED, paediatric internal medicine, and ICU were considered secondary strata. Samples were proportionally distributed across these departments.
- Random Selection: Within each department, nurses were randomly selected to ensure the integrity of the sampling process.
- Proportional Distribution: Finally, each hospital's sample was proportionally distributed across its departments to maintain balance and representativeness.

Table 1: Distribution of participants according to hospital

Hospital	Sample Size (n=200)	
	Frequency	Percent
Child's Central Teaching Hospital	41	20.5
Children Welfare Teaching Hospital	57	28.5
Ibin-AL-Balady pediatric and maternity hospital	58	29.0
Fatima Al-Zahra'a maternity and pediatric teaching hospital	44	22.0
Total Sample Size	**200**	**100.0**

Data Collection Tool and Technique

The study relied on a questionnaire distributed to gather data from participants. The researchers developed the questionnaire after an in-depth review of the previous literature on DKA management in children and adolescents.

The tool was initially designed in English and then translated into Arabic to ensure its clarity and ease of understanding for participants before distribution. It includes three sections: The first covers socio-demographic characteristics (9 items). The second section is a knowledge assessment scale with 28 multiple-choice questions. One point is assigned to each item for a correct answer and zero for an incorrect answer, with a total range between zero and 28. The third section assessed nurses' confidence in DKA management with four Likert questions rated from a five-point Likert scale ranging from not at all confident, scored 1, to very confident, scored 5.

Content and format validity assessments confirmed the validity of the questionnaire. An 18-panel of specialists in paediatric nursing and diabetes management evaluated the questionnaire to ensure its items were clear, accurate, and comprehensive in assessing nurses' knowledge and confidence. The language and vocabulary were evaluated to ensure their suitability for the target population. A pilot study was conducted on a random sample of 10 nurses from the study population to assess its reliability. The internal consistency of the questionnaire was assessed using Cronbach's alpha coefficient, which was 0.79. This demonstrates satisfactory reliability and strong internal consistency of the instrument, confirming that the items consistently assess the desired concepts.

Data collection was conducted during eight weeks, and questionnaires were distributed to participants. Participation was voluntary, and nurses provided informed consent before completing the questionnaire. Completed questionnaires were collected on-site, ensuring no third party influenced the responses.

Statistical Analysis Method

Statistical analysis was carried out by using SPSS, and the researchers also performed descriptive analysis to calculate frequencies, percentages, standard deviation (SD), and mean scores (MS). Also, Spearman's rank test was performed to examine the association between sociodemographic variables of nurses and their knowledge and confidence. To determine the correlation between knowledge and confidence levels among nurses by Pearson's analysis. A probability p-value of 0.05 or less was considered statistically significant.

Ethical Consideration

One of the most important considerations in any research involving participants to ensuring their rights are protected. These rights include procedural integrity, informed consent, confidentiality, and freedom from coercion, harassment, or punishment for refusing to participate. Participants were fully informed of the research objectives and procedures. The researchers took voluntary, written informed consent from all participants. Additionally, all data received from nurses was kept confidential, ensuring participant privacy at all times.

RESULTS

Table 2: Participants' distribution based on socio-demographic characteristics

Variables	Groups	Frequency	Percentage
Age Groups (years)	**21-30**	**139**	**69.5**
	31-40	36	18.0

	41-50	25	12.5
	Total	200	100
	Mean ± SD	29.72 ± 7.303	
Gender	**Male**	**104**	**52.0**
	Female	96	48.0
	Total	200	100
Residence	**Rural**	**178**	**89.0**
	Urban	22	11.0
	Total	200	100
Marital Status	Single	87	43.5
	Married	**113**	**56.5**
	Total	200	100.0
Academic achievement	Secondary	25	12.5
	Diploma	**91**	**45.5**
	Bachelor's Degree	73	36.5
	Master's Degree	9	4.5
	Doctorate	2	1.0
	Total	200	100.0
Experience years in Nursing	**1-5**	**113**	**57.0**
	6-10	41	20.0
	11-15	23	11.5
	16-20	9	4.5
	21-25	10	5.0
	26-30	4	2.0
	Total	200	100.0
	Mean ± SD	7.09 ± 6.806	
Department or unit currently working	ED	**96**	**48.0**
	Medical department	86	43.0
	ICU	18	9.0
	Total	200	100.0
Training on DKA management?	Yes	59	29.5
	No	**141**	**70.5**
	Total	200	100.0
What is your family's income level to cover basic needs?	**Somewhat sufficient**	**129**	**64.5**
	Sufficient	39	19.5
	Not Sufficient	32	16.0
	Total	200	100.0

This table demonstrates that the highest percentage of the study sample, which amounted to 69.5%, was within the age group (21-30) years, 52.0% were males, 89.0% lived in rural areas, and 56.5% were married. Most of the study sample, 45.5%, held a diploma, 57.0% had 1-5 years of experience in nursing, and 48.0% were currently working in the ED. (70.5%) None of the participants received training about DKA. The nurses' families' income was sufficient for somewhat to cover basic needs, representing 64.5%.

Table 3: Nurses' knowledge levels based on the main domains of the questionnaire

Nurses' Knowledge	**No.**	**MS**	**SD**	**Assessment**
Part 1: General Knowledge of DKA (pathophysiology, causes, and risk factors)	200	**.4570**	.249	M
Part 2: Assessment of DKA (laboratory test)	200	**.4230**	.242	M
Part 3: Assessment of DKA (clinical features)	200	**.4937**	.292	M
Part 4: Nursing Interventions for DKA	200	**.4353**	.224	M
Part 5: Complications and Monitoring	200	**.4593**	.260	M
Part 6: Prevention of DKA	200	**.5425**	.346	M
Over all Knowledge	**200**	**.4601**	**.179**	**M**

MS: Mean scores; SD: Standard deviation

Table 3 indicates that the nurses' overall knowledge, as well as their knowledge across specific domains to DKA management, was assessed at a moderate level according to the computed mean scores.

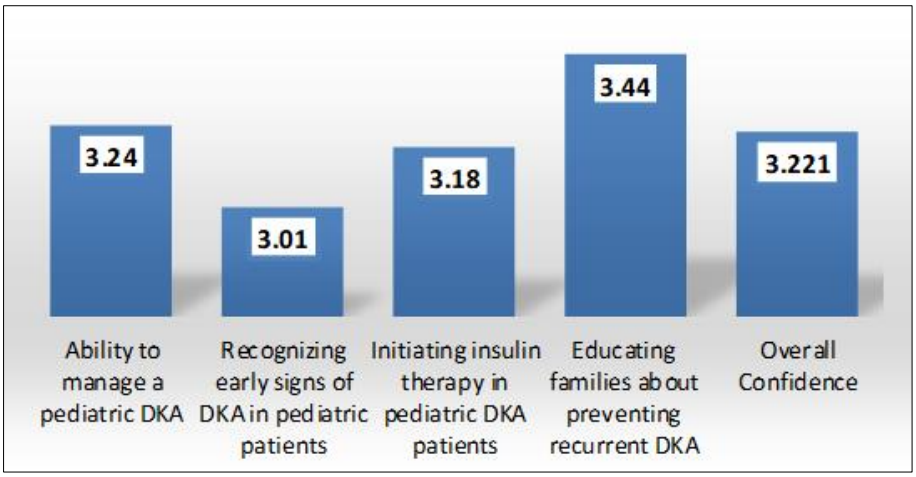

Figure 1: Nurses' levels of self-confidence based on the main areas of the questionnaire and overall scores

Figure 1 shows that nurses' confidence level regarding the management of DKA was moderate, according to the mean score.

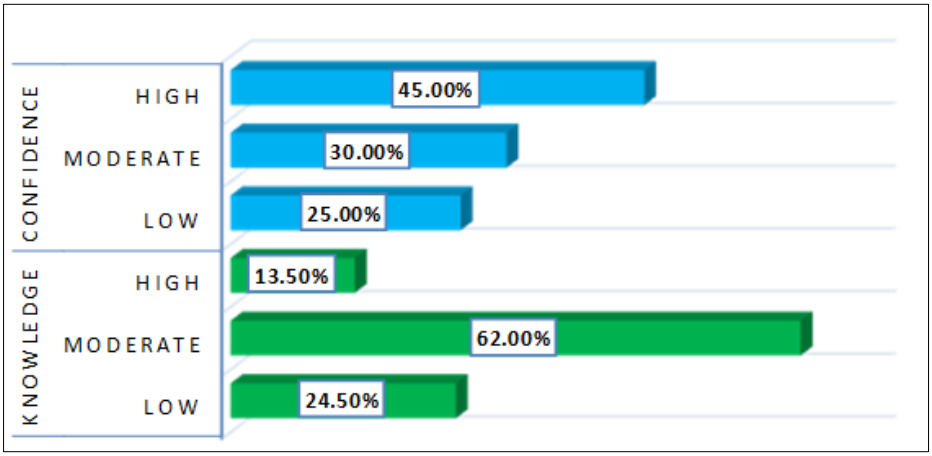

Figure 2: Distribution of nurses according to three levels of knowledge and confidence in DKA management

The figure indicates that most of the study sample represents moderate knowledge and accounted for 124(62.0%), while 90(45.0%) represent high confidence about DKA management.

Table 4: Correlation between knowledge & confidence of nurses and their socio-demographical characteristics variables

Variables	*Spearman's rho*	Knowledge	Confidence
Age years	*Correlation Coefficient*	.018	.126
	Sig.	.796 NS	.075 NS
Gender	*Correlation Coefficient*	-.101	-.073
	Sig.	.155 NS	.304 NS
Resident	*Correlation Coefficient*	-.091	-.025
	Sig.	.201 NS	.724 NS
Marital status	*Correlation Coefficient*	.108	.057
	Sig.	.129 NS	.423 NS
Academic achievement	*Correlation Coefficient*	.262	.076
	Sig.	.000 HS	.282 NS
Experience years in Nursing	*Correlation Coefficient*	.013	.056
	Sig.	.858 NS	.427 NS
Department or unit currently working	*Correlation Coefficient*	-.033	.046
	Sig.	.648 NS	.520 NS
Training on DKA management	*Correlation Coefficient*	.134	.150
	Sig.	.059 NS	.034 S

HS: Highly significant at P≤0.01; S: significant at P≤0.05; NS: Non-significant at P>0.05

This table indicate a strong relationship between nurses' academic performance and their knowledge regarding managing DKA (p= 0.000), as well as a significant correlation between nurses' training about DKA management and their confidence regarding DKA management (p= 0.034).

Table 5: Association between nurses' knowledge & their confidence about DKA management

Correlations			
		Knowledge	**Confidence**
Knowledge	Pearson Correlation	1	**.383****
	Sig.(2-tailed)		**HS .000**
	N	200	200
Confidence	Pearson Correlation	**.383****	1
	Sig.(2-tailed)	**HS .000**	
	N	200	200
***. Correlation is significant at the 0.01 level (2-tailed).*			

HS: Highly significant at P≤0.01; S: significant at P≤0.05; NS: Non-significant at P>0.05

This table displays a statistically highly significant association between the nurses' knowledge and confidence about DKA management (p= 0.000).

DISCUSSION

The present study reported that overall knowledge of nurses regarding DKA management was unacceptable (moderate level) (Table 3). This finding is consistent with a previous study by Allotey *et al*., which revealed that nurses often demonstrate limited understanding of the care of acute diabetic complications, such as DKA, particularly in paediatric settings [27]. Also, this finding agrees with a study by Shaker *et al*., in 2020, which indicated that nurses' knowledge of DKA was limited. This suggests a knowledge gap that requires greater attention from healthcare and educational institutions [28]. Also, similar to a study conducted by Muhiasen & Musihb in 2024, it indicates that most of the health care workers demonstrate poor to moderate levels of knowledge about DKA management [25].

It is worth noting that the highest-ranking knowledge domain in this study was related to the prevention of DKA (M=0.5425). This may reflect the general trend of institutional educational and preventive programmes focusing on increasing awareness of diabetes complications. In contrast, knowledge regarding other vital aspects, such as laboratory and clinical assessments, nursing interventions, and complication monitoring, remained within the moderate range. From the researcher's perspective, this modest level of knowledge falls short of the standards necessary for effective nursing care for DKA, especially given the critical nature of these conditions, which require rapid and precise interventions. A lack of knowledge in these vital areas may negatively impact the quality of care provided. Additionally, the findings indicated that the overall level of nurses' confidence in managing DKA cases was also moderate (Figure 1). Also, 45% of nurses had high confidence (Figure 2). This result was supported by Karume *et al*., in 2025, who reported that 53.6% of the study sample were highly confident before training [9].

Moreover, it was statistically found that nurses' academic achievement affects their knowledge level (p = 0.000) in Table 4. This refers to an expected result, as higher educational attainment is typically associated with enhanced theoretical understanding, demonstrating the importance of a solid academic foundation in nursing. These results align with Muhiasen & Musihb study, which reveals a significant association ($P < 0.05$) between healthcare providers' knowledge of DKA and the educational level variable. Moreover, the observed association is consistent with the findings of Opoku *et al*., in 2023, which indicate that higher academic qualifications are associated with enhanced clinical competence and evidence-based decision-making skills [29].

However, the current findings of the study indicate that some variables, like age, gender, residence, and experience, did not show any statistically significant relationship with knowledge or confidence levels [25]. This result is supported by Kajembula *et al*., in 2024, who noted that clinical knowledge is primarily influenced by academic level and ongoing training rather than personal or experiential factors [26].

The nurses who received training also demonstrate significantly higher confidence ($P \leq 0.05$), underscoring the importance of practical training in developing skills. That is consistent with Karume *et al*., in 2025, who observed that clinical performance confidence is closely linked to practical training and field experience [9]. The results supported this notion, as there was a significant correlation between training on DKA management and confidence level (p=0.034). This highlights the importance of continuous training in improving nurses' competency and confidence in managing such cases. Shaker *et al*., in 2020 also confirmed that training programmes lead to improved nurses' performance and health outcomes for patients with DKA [28].

Furthermore, Piya *et al*., in 2022 demonstrated that targeted training workshops significantly enhanced nurses' confidence in providing emergency diabetic care and insulin therapy [30]. This suggests that continuing professional development, particularly through practical training, simulation-based learning, and case discussions, is critical in enhancing nurses' confidence in managing DKA.

The current research results, in Table 5, showed a significant positive relationship between knowledge and confidence among nurses (r=0.383, p=0.000), supporting the hypothesis that improving scientific knowledge positively impacts professional confidence. The researcher suggests that updating nursing curricula and integrating intensive practical training may help improve both domains. This is consistent with the findings of Kurnia *et al*., in 2020, who noted a similar relationship in the context of palliative care. Their study revealed that nurses with higher cognitive scores demonstrated greater self-confidence in providing complex care in intensive care settings [31]. This reinforces the notion that cognitive preparedness directly influences clinical self-efficacy, a principle that applies to various high-risk care contexts, including the management of DKA in paediatrics.

Moreover, self-efficacy, defined as an individual's belief in their ability to perform necessary actions, is closely related to cognitive competence. Thus, the more knowledge nurses acquire about the pathophysiology, diagnosis, and treatment algorithms of DKA, the more confident they will be in initiating and managing appropriate interventions. This finding reinforces the need for healthcare organizations to invest in knowledge-centered, practice-focused educational strategies that build theoretical understanding and applied skills.

This study's findings reveal inadequate knowledge and confidence among nurses in managing DKA, which is particularly alarming due to health professionals' pivotal role in therapeutic patient education, Therapeutic patient education transcends basic information-sharing; it constitutes a systematic, evidence-based methodology that promotes glycaemic regulation, diminishes hospital admissions, and elevates quality of life. The insufficient training and education of nurses may impede the comprehensive management of T1DM and its acute consequences, underscoring the critical necessity for capacity-building initiatives centred on DKA protocols and family-oriented diabetic care [32].

Limitations, Strengths, and Recommendations

The study was limited to four hospitals in Baghdad, which may affect its generalizability. Self-reported data may also involve response bias. A strength of the study is that it is one of the few studies in Iraq examining nurses' knowledge and confidence in managing DKA in children and adolescents. The use of a proportionately stratified sample and a validated instrument enhanced the study's reliability and applicability.

Future research should use longitudinal designs and include broader geographic areas to better understand changes in nurses' knowledge and confidence in managing DKA. Qualitative researchers are encouraged to examine the factors influencing nurses' confidence in paediatric care.

CONCLUSION

The study revealed suboptimal nurses' knowledge and confidence in managing DKA in children, putting patient safety at risk. These findings underscore the need to integrate competency-based training into national health policy, focusing on paediatric diabetes emergencies. Mandatory continuing education and clinical simulation programs related to DKA will enhance knowledge and confidence. In line with global health policy, health systems should use standardized nursing competency assessment criteria to provide high-quality, evidence-based care for children and adolescents with T1DM.

Acknowledgement

We would like to express our thanks and gratitude to all the nurses who participated in the study and to all the experts who worked on reviewing the questionnaire.

List of Abbreviations:

DKA: Diabetic Ketoacidosis
DM: Diabetes mellitus
ED: Emergency department
ICU: Intensive Care Unit
MS: Mean scores
SD: Standard deviation
SPSS: Statistical Package for the Social Sciences.
T1DM: Type 1 Diabetes

Key Messages: This study demonstrates that nurses' knowledge and confidence in managing DKA in children remain inadequate. Specialized training in DKA management is essential to improve nurses' skills and ensure safe and effective care for children with type 1 diabetes.

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