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Management of Paediatric Diabetic Ketoacidosis and Occupational Stress in the Emergency Department: A Cross-Sectional Study

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Abstract

Introduction: Diabetic ketoacidosis (DKA) is a serious and potentially life-threatening complication of Type 1 Diabetes Mellitus (T1DM) characterized by hyperglycaemia, ketosis, and metabolic acidosis. Management of DKA in the Emergency Department (ED) requires high knowledge and competencies, and it is challenging due to the unique needs of children.

Purpose: This study aimed to investigate emergency paediatric nurses' (EPNs) knowledge of DKA management in paediatric patients and to evaluate the correlation between this knowledge and occupational stress (OS).

Methods: The study recruited EPNs from Children Hospitals, using an adapted questionnaire to assess knowledge of DKA management, and the Expanded Nursing Stress Scale (ENSS) to evaluate OS. Data were analysed with SPSS v23.0, with significance set at α=0.05.

Results: Eighty-three EPNS participated, revealing a low level of knowledge in DKA management, particularly regarding insulin administration, fluid management, and bicarbonate use. EPNs reported mild OS, with higher stress levels related to patient care and life-threatening situations, and lower stress levels associated with discrimination and colleague issues. An unrevised DKA management protocol was linked to higher stress in situations involving death (p=.049), therapeutic uncertainty (p=.020), and disputes with doctors (p=.012).

Conclusion: Overall, EPNs in Greece exhibit low knowledge in managing DKA and experience mild OS. These findings highlight the need for supportive training programs to enhance EPNs' knowledge and reduce OS, optimizing nursing care in first line clinical settings.

Key words: Type 1 Diabetes Mellitus; Diabetic Ketoacidosis; Paediatric Emergency Department; Nurses; Occupational Stress

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1. Introduction

Nursing practice demands a thorough understanding of disease processes, diagnostic criteria, and diseases' nursing management guidelines to ensure informed decision-making and high-quality care [1]. Nurses are tasked with managing numerous and often complex situations within this, unquestionably, demanding profession, responding to the unique needs of paediatric patients and their families [2].

Diabetic Ketoacidosis (DKA) is one of the primary complications of Type 1 Diabetes Mellitus (T1DM). It occurs due to an absolute insulin deficiency and the overproduction of counter-regulatory hormones, leading to a significant increase in blood glucose levels, dehydration, ketosis, and electrolyte imbalance. Managing DKA is one of the most urgent pediatric clinical situations, requiring advanced nursing skills and knowledge. Effective management necessitates familiarity with treatment protocols, precise calculation of therapeutic doses, and parents' support [3].

Research has indicated that, due to the relatively low frequency of DKA occurrences, Emergency Paediatric Nurses (EPNs) often have limited knowledge regarding its management, despite the high level of vigilance required [4]. Additionally, nursing has been identified as the top stress-inducing profession among 40 examined careers [5]. Nurses experience high levels of stress, which is associated with increased errors, injuries, infections, burnout, and higher resignation rates [6]. Paediatric nurses working in the Emergency Department (EPNs) face significantly higher risks of professional burnout and occupational stress [7]. The management of DKA in the ED further compounds this stress due to the combination of knowledge deficits and the emotional burden of urgent intervention during an extremely critical situation, where nurses, parents, and patients all experience intense anxiety [8]. This study aimed to investigate the knowledge in managing DKA and the relationship between knowledge and occupational stress among EPNs.

2. Methods

2.1. Sample

For this study, a cross-sectional survey was conducted in Paediatric EDs of tertiary hospitals in Greece, which were randomly selected. The study included EPNs who had a good command of the Greek language, volunteered to participate in the study, and employed in Paediatric ED on any shift (rotating shift work).

2.2. Research tools

To evaluate the EPNs' knowledge regarding the management of DKA, the knowledge questionnaire by Barrios et al. titled "Current Variability of Clinical Practice Management of Pediatric Diabetic Ketoacidosis in Illinois Pediatric Emergency Departments'' was used, after author's permission [9]. The questionnaire consists of 15 main items, with subqueries. The questionnaire was utilized following a process of validation and cultural adaptation to the Greek context. The validity coefficient of the questionnaire items ranged from .78 to 1, meeting the minimum required value for inclusion in the final questionnaire [10].

The Expanded Nursing Stress Scale (ENSS) was used to assess the stress experienced by EPNs. The ENSS tool comprises 59 items, with 57 of these grouped into nine categories: death and dying, conflict with physicians, inadequate emotional preparation, conflict with other nurses, conflict with supervisors, workload, uncertainty concerning treatment, patients and their families, and discrimination [11]. Each item is rated on a 5-point Likert scale, with scores ranging from 0 to 4, where higher scores indicate higher levels of stress. The ENSS has been translated and validated in Greek by Moustaka et al [12].

Additionally, all participants completed a demographic data recording form, which included: place of residence and work, age, gender, specialty, total years of work experience, years of work experience in the Pediatric ED, type of shift (rotating or permanent morning), and educational level.

2.3. Statistical Analysis

Means and standard deviations were used to describe numerical data, while absolute frequencies and percentages were employed for categorical variables such as gender and age. For quantitative variables with a normal distribution, the t-test for two independent samples was applied. The normality of quantitative variables was assessed using the Shapiro-Wilk test. Simultaneously, the impact of categorical variables with more than two categories was evaluated using analysis of variance (ANOVA) and the Bonferroni test for multiple comparisons. To examine relationships or differences

between categorical variables, the Pearson Chi-Square test of independence was used, along with Fisher's Exact test in cases where the criteria for the Pearson Chi-Square test were not met.

The analysis was performed using SPSS software version 23.0, with the significance level set at α=.05.

2.4. Ethics

Approval was granted by the Ethics and Deontology Committee of the University of Peloponnese, and approval was given by the respective Scientific Councils as well or relevant Health Region where needed. Administration of the 3rd Health Region of Greece Δ3β/47325, Administration of the 6th Health Region of Greece 44527, General Hospital of Ioannina "G. Hatzikosta" 115/30-07-2020, General Hospital of Messinia 1/13-01-2021, General Panarcadic Hospital of Tripolis 17944/16-11-2020, General University Hospital of Thessaloniki 27/22-10-2020, General Hospital of Thessaloniki "G. Gennimatas-Saint Demetrius" Δ3β/25387, General Hospital of Thessaloniki "Hippokratio" 6/3-12-2020, General Hospital of Volos 13/23-06-2020, General Hospital of Larisa 6/3-07-2020, General, University Hospital of Larisa 20001/11-06-2021, General Hospital of Trikala 20/13-05-2021.

All the participants signed the inform consent form, whilst confidentiality and anonymity of the participants were maintained at all stages of the study. The data collected was accessed and used by the research team solely for the purposes of this study. The legal framework for data protection, as outlined in Personal Data Protection Law 2472/1997 and amended by EU Regulation 2016/679, was adhered to during the research process. After the study's completion, the research records will be kept for three (3) years in a secure, supervised location, with access restricted to the principal investigator of the research team.

3. Results

83 registered EPNs participated from different Greek hospitals. The average work experience was 13.2 (SD=8.2), whilst the average experience in ED was 7 years (SD=6). Table 1 presents EPNs characteristics.

3.1. DKA management knowledge evaluation

84.9% of EPNs confirmed that they had provided care in pediatric patients diagnosed with DKA in the past two years. Additionally, 57.3% stated that their ED follows a Pediatric Diabetic Ketoacidosis Management Protocol, which has been specifically developed for pediatric patients (85.2%). All incorrect and correct answers frequencies are presented in Table 2.

3.2. Occupational Stress Evaluation

Among 9 categories of ENNS, EPNs were more stressed about patients and families (Mean= 22.83, SD=5.71) and death and dying (Mean=19.33, SD=5.22), whilst they were less stressed

Table 1 EPNs' characteristics

Variable	Categories	N	%
Age	20-30	17	20.5
	31-40	31	37.3
	41-50	29	34.9
	51-60	6	7.2
	>60	0	.0
Certification degree	Postgraduate	61	73.5
	MSc	22	26.5
	PhD	0	.0
Specialization in Diabetes Mellitus Management	No	82	98.8
	Yes	1	1.2

About discrimination (Mean=4.21, SD=4.09) and problems with peer support (Mean= 12.11, SD=4.58). Overall OS mean score was found at 141,04 (SD=33,48), indicating mild occupational stress (Table 3).

3.3. DKA management evaluation and OS correlation

Following a Pediatric DKA Management protocol in the ED was found to have no significant effect on the OS. However, it did influence the dimension related to "Conflicts with Colleagues" (p=.032). It was observed that whether the protocol for DKA management had been updated or revised did not significantly impact the overall stress scale. It did affect though, the dimensions related to "Death and Dying" (p=.049), "Uncertainty about Treatment Outcome" (p=.020), and "Conflicts with Physicians" (p=.012). Notably, higher scores were

Table 2 DKA management knowledge evaluation.

Question		N	%
Who usually prepares the insulin for administration in your ED?	Incorrect	0	.0
	Correct	80	100.0
When does insulin administration for the management of DKA start in your ED?	Incorrect	48	78.7
	Correct	13	21.3
What type of insulin is used for managing DKA in your ED?	Incorrect	13	25.5
	Correct	38	74.5
Until when is intravenous insulin administered for DKA management in your ED?	Incorrect	41	68.4
	Correct	19	31.7
When does the intravenous administration of dextrose begin for DKA management in your ED?	Incorrect	26	68.4
	Correct	12	31.6
When is the intravenous insulin administration discontinued?	Incorrect	44	78.6
	Correct	12	21.4
Is sodium bicarbonate used during electrolyte replacement?	Incorrect	25	73.5
	Correct	9	26.5
Do you use the 2-bag system when administering intravenous fluids and dextrose to pediatric patients with DKA?	Incorrect	26	63.4
	Correct	15	36.6
When using the 2-bag system, is it necessary to label the intravenous lines?	Incorrect	12	32.4
	Correct	25	67.6

Table 3 Mean OS for each ENSS category.

ENSS Category	Mean	SD
Death and dying (7 items)	19.33	5.227
Conflict with physicians (5 items)	12.95	3.7
Inadequate emotional preparation (3 items)	6.75	2.31
Problems with peer support (6 items)	12.11	4.58
Problems with supervisor (7 items)	16.56	6.16
Workload (9 items)	21.72	5.73
Uncertainty concerning treatment (9 items)	23.58	7.04
Patients and families (8 items)	22.83	5.7

Discrimination (3 items)	4.21	4.09
Total Score	141,0485	33,48496

recorded for those who confirmed the revision compared to those who didn't. Whether the hospital has a specialized diabetes nurse-educator available to provide training to patients did not influence the overall stress scale but it was found a significant difference in the dimensions related to "Inadequate Preparation for Handling Emotional Needs of Patients and Families" (p=.010), "Discrimination" (p=.049), and "Uncertainty about Treatment Outcome" (p=.040), with the presence of a specialized diabetes nurse-educator resulting in less OS. On the other hand, the availability of a specialized diabetes nurse-educator to provide training to the staff had impact at the "Discrimination" dimension, with significantly lower scores (p=.009) for those who confirmed the presence of a diabetes educator. Caring for paediatric patient with DKA the last two years, protocols specially addressed in paediatric patients, seminars in Advanced Paediatric Life Support (APLS), and Endocrinologist availability 24/7 didn't affect on OS (all p>0.05). Table 4 presents the variations in the stress scale and the dimensions found to be statistically significant in relation to the questions from the DKA management scale.

4. Discussion

Table 4 OS and DKA management knowledge correlation.

ENSS Category	Death and dying	Inadequate emotional preparation	Discrimination	Workload	Uncertainty concerning treatment	Conflict with physicians	Conflicts with colleagues	Problems with supervisor	Patients and families
1. Did you provide care for pediatric patients diagnosed with DKA in the past two years?	0.379	0.814	0.707	0.362	0.695	0.224	0.414	0.177	0.790
2. Do you follow a Pediatric DKA Management Protocol in your ED?	0.653	0.871	0.059	0.739	0.980	0.987	**0.032**	0.518	0.941
3. Does the protocol for managing DKA specifically address pediatric patients?	0.676	0.814	0.154	0.855	0.226	0.218	0.548	0.857	0.500
4. Has the protocol for managing DKA been updated or revised?	**0.049**	0.592	0.406	0.315	**0.020**	**0.012**	0.758	0.094	0.749
5. Does the hospital	0.863	0.149	0.207	0.671	0.482	0.757	0.645	0.069	0.924

provide access to a Pediatric Endocrinologist at all times (24/7)?									
6. Have you attended any seminars on Advanced Life Support for Children and Adolescents?	0.965	0.860	0.548	0.930	0.830	0.442	0.636	0.183	0.328
7. Does the hospital provide a specialized diabetes nurse-educator available to provide training to patients?	0.209	**0.010**	**0.049**	0.570	**0.040**	0.232	0.858	0.247	0.528
8. Does the hospital provide a specialized diabetes nurse-educator available to provide training to the staff?	0.178	0.305	**0.009**	0.821	0.456	0.124	0.858	0.773	0.439

Nursing is a demanding profession, and this is particularly true for paediatric nurses. Studies have shown that the stress nurses experience can lead to significant errors, burnout, and high rates of leaving intention [1]. Additionally, OS is significant high, exacerbated by the complexity of nursing tasks, the unique approach required for paediatric patients, and the anxiety experienced by the parents [6]. Managing Diabetic Ketoacidosis (DKA) in pediatric patients requires a high level of knowledge and skills. This includes calculating insulin and fluid dosages, as well as addressing the anxiety of both the patients and their parents.

The aim of this study was to assess the knowledge of EPNs in managing DKA and the correlation with OS. The main findings indicated that EPNs in Greece have a low level of knowledge regarding DKA management, whilst they experience moderate levels of OS. The correlation between the two variables revealed that EPNs experience higher stress due to insufficient preparation for DKA management.

The research results showed that EPNs had a low level of knowledge. The knowledge percentage in this category is significantly higher in published studies conducted in other countries [13], [14]. The lowest level of knowledge was recorded in the categories related to insulin and the use of bicarbonates. Although insulin is the treatment of choice for managing DKA, it appears that EPNs are not well-versed in its mechanism of action [13]. Various factors explain why nurses lack a high level of knowledge about insulin pharmacology, despite receiving necessary information at the undergraduate level. Researchers attribute this to the complexity of the pathophysiological mechanism and the difficulty nurses have in understanding it [15], as well as the complexity of the underlying knowledge required to calculate the units to be administered based on blood glucose levels [16]. Conversely, understanding and familiarizing nurses with insulin titration and avoiding hypoglycemic events require clinical experience and foundational knowledge in DKA management [17].

Another factor contributing to the reduced level of knowledge among EPNs regarding DKA management is the variety of different insulin formulations. Insulin formulations are classified as rapid, long, and ultra-long-acting, and there are also mixed formulations. Additionally, advancements in this field and the market's enrichment with new formulations and names are ongoing [18]. However, the question concerning the type of insulin used in DKA management in EDs garnered the highest percentage of correct answers (74.5%).

Regarding OS, EPNs reported experiencing mild OS. They felt more stress related to the patients and their families, as well as death, especially in potentially life-threatening situations, and less stress concerning discrimination and peer support issues. This finding is consistent with previous studies [19-22]. However, the results show less stress compared to nurses in other groups [23], but significantly higher when compared to the global average prevalence of stress among healthcare workers [24], [25]. Greek studies on first-line nurses support the findings of this study [26], while primary care nurses reported less stress [27].

The primary stressors for EPNs were managing patients and their families and handling life-threatening situations involving paediatric patients. Studies have shown a significant correlation between job content, a sense of commitment, and stress levels among nurses [28], [29]. The negative emotions associated with the death of a child seem to be particularly stressful for paediatric nurses [30]. Previous studies have also indicated that the anticipation of death, coupled with uncertainty about treatment and the intense emotions of parents, are additional factors contributing to occupational stress [31]. Emergency care, working with children, and dealing with stressed parents add extra burdens to EPNs [32].

The inadequate preparation of EPNs in managing parental anxiety significantly contributes to higher OS levels among them. Previous studies confirm the increased risk of burnout and work-related stress among nurses dealing with DKA in EDs [33]. The need for emotional support for the family and meeting the parents' needs, both in emergency settings and in the chronic nature of a newly diagnosed disease, causes further OS for nurses. This intense emotional interaction affects paediatric nurses, leading to negative thoughts, concentration difficulties, and even sleep disorders, gradually resulting in OS [8].

In our study, the absence of an updated DKA management protocol was associated with increased stress related to dealing with death (p=.049), uncertainty about treatment outcomes (p=.020), and conflicts with physicians (p=.012). These findings highlight the negative consequences of the lack of guidelines in a hospital, especially for acute cases like DKA [34]. The knowledge gap and absence of guidelines are major stress factors for nurses and have significant implications for patient outcomes [35]. Solving this problem requires providing education and establishing specialized interdisciplinary teams in our country's hospitals. The study by Wang et al. showed that organizing and implementing a plan to create a diabetes care interdisciplinary team improved clinical outcomes and reduced overall costs [36].

Moreover, managing DKA requires a comprehensive team approach, involving a paediatrician, an endocrinologist, and a specialized diabetes nurse trained and experienced in DKA management. According to the guidelines, if a healthcare facility does not have staff specialized in Type 1 Diabetes (T1D), it is recommended to consult with a specialized team [37]. The role of the specialized nurse, who possesses advanced knowledge and clinical skills, is now widely recognized. This role has been officially accepted and endorsed by the International Council of Nurses and other regulatory bodies. It has been adopted by most departments and clinical specialties, especially in high-income countries like the United States, the United Kingdom, Australia, New Zealand, and the Netherlands [38]. Specialized nurses contribute significantly to the optimal provision of care and the enhancement of patient satisfaction, leading to improved health system quality indicators [39]. However, in Greece, this role appears to be missing, representing a significant gap in the quality and effectiveness of care provided, a gap reflected in literature [40].

5. Study Limitations

One of the main limitations of this study was the timing of data collection, which coincided during COVID-19 pandemic, a period marked by high levels of uncertainty among healthcare workers. That was also reflected in the number of participants and affected the sample size and its representativeness. Additionally, the tool used to assess OS was a self-reported questionnaire, which may introduce recall bias in the nurses' responses.

5.1. Implications for Emergency Nurses

This study findings highlight a significant gap in EPNs' knowledge about DKA management, coupled with increased levels of occupational stress. For EPNs, this underlies the critical need to enhance both clinical competence and emotional resilience in high-risk paediatric care settings. Standardized clinical guidelines, continuing professional

education, and stress management interventions should be prioritized by nursing leadership. By addressing these gaps, EDs can improve the quality and safety of care provided to paediatric patients with DKA, while supporting the mental well-being and professional performance of EPNs. These implications are particularly crucial for low-resource settings where formal training in paediatric emergencies may be limited or not legislated.

6. Conclusions

Despite these limitations, this study is the first in Greece to explore the relationship between knowledge of DKA management and OS among EPNs. The findings emphasize the need for further research in this area and the development and implementation of sustainable solutions for training nurses in managing acute conditions like DKA. This is crucial for optimizing nursing care and reducing the psychological burden on nurses.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

Approval was granted by the Ethics and Deontology Committee of the Nursing Department at the University of Peloponnese, and approval was given by the respective Scientific Councils as well or relevant Health Region where needed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study

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