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RESEARCH ARTICLE

Nurses' Experiences in Caring Diabetic Ketoacidosis Patients in the Emergency Departments: A Qualitative Study

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Abstract

Background: Diabetic ketoacidosis (DKA) is a critical complication of diabetes mellitus requiring prompt and effective management to prevent adverse outcomes. Despite the increasing burden of diabetes in Africa, limited research focuses on nurses' experiences with DKA management within this context, particularly in Tanzania. This qualitative case study aims to explore nurses' experiences and challenges, on DKA management within the emergency department (ED) of a Regional Referral Hospital (RRHs) in Dar es Salaam Tanzania.

Methodology: A descriptive qualitative study was conducted to understand nurses' experiences in managing patients with diabetic ketoacidosis in the emergency department. A total of 12 purposively selected nurses participated in in-depth interviews. The interview guide written in Kiswahili was used to collect data. All interviews were audio recorded and transcribed verbatim, and transcripts analyzed using deductive content analysis highlighted by Graneheim and Lundman.

Results: Two main themes emerged from the study including variability in nursing interventions for DKA management and clinical challenges in DKA management. Variability in nursing interventions included three categories variability in correction of dehydrations, correction of hyperglycemia and correction of electrolyte. On other hand clinical challenges identified includes ineffective monitoring and assessment, nurses' roles clarity, patients' culture and religious believes.

Conclusion: These findings underscore the urgent need for standardized training, design strategies to improved adherence to DKA management protocols, and the integration of point-of-care testing (POCT) to enhance timely and effective DKA management.

Keywords

Nursing care diabetes mellitus, Diabetic ketoacidosis, Emergency nursing, Management guidelines

Abbreviations

EMD: Emergency Medical Department; DKA: Diabetic Ketoacidosis; DM: Diabetes Mellitus; ICU: Intensive Care Unit; RRH(s): Regional Referral Hospital(s); RBG: Random Blood Glucose

Introduction

Globally, Diabetes mellitus remains a significant and potentially burden noncommunicable disease as it contributes life-threatening complications including diabetic ketoacidosis (DKA), hyperosmolar hyperglycemic syndrome (HHS) and micro vascular complications [1,2]. Despite, advancement in healthcare, diabetes mellitus and its related complications continue to pose challenges for healthcare systems worldwide, placing a substantial burden on both patients and

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healthcare providers. In many regions, including Africa, the prevalence of diabetes mellitus is on the rise, exacerbating the incidence of DKA and necessitating a deeper understanding of its management within local healthcare contexts [2].

In Africa, the burden of NCDs is escalating, driven by various factors including rapid demographic with growing and aging population, sociocultural factors include lifestyle changes and eating habits [1]. Lancet diabetes and endocrinology commission reported in Sub Saharan Africa (SSA) the burden of diabetes mellitus and its applications is still unknown with health systems that are unable to cope with diabetes mellitus and its complications [3]. Meanwhile, type 2 diabetes (T2D) accounts for 90% of diabetes cases in SSA with variation in prevalence between urban and rural population where higher prevalence observed in urban population [4].

Data from medical facilities indicate that DKA patients should be managed in the intensive care unit (ICU) [5]; yet, effective management must begin at the emergency department (EMD) using the approved DKA management guidelines to prevent further complications and prolong length of hospital stay. Therefore, more often nurses get involved in management of acute critical ill patients including DKA patients both in the ICU and EMD. The existing literature on DKA management predominantly stems from developed countries, overlooking the realities faced by healthcare providers in resource-limited settings, such as Tanzania [6-9]. Consequently, there is a notable research gap regarding nurses' experiences with DKA management within the Tanzanian healthcare context.

Studies conducted in high-income countries have identified various factors influencing DKA management, including nursing workload, education, training, and interdisciplinary collaboration. For example, Uğur [10] underscored the importance of nursing education and training in enhancing nurses' confidence and competency in managing diabetes and its related complications. However, the applicability of these findings to the Tanzanian healthcare context remains uncertain due to differences in healthcare infrastructure, resources, and patient demographics.

By exploring nurses' experiences, challenges, and perspectives on DKA management, this research seeks to provide valuable insights into the contextual factors influencing care delivery and patient outcomes. Furthermore, the study aims to identify areas for improvement and inform the development of tailored interventions and training programs to enhance nursing competency and optimize DKA care within the Tanzanian healthcare system.

Material and Methods

Study design

We conducted an exploratory descriptive qualitative study, to look into the nurses' experiences of caring of DKA patients in the emergency department [11]. The design was considered relevant as it provides a broad insight and description of the phenomena under investigation in a naturalistic, realistic, and comprehensive view [12,13].

Study setting

The study was conducted between August 2023 and November 2023 in two selected Regional Referral Hospitals (RRHs) located in Dar es Salaam, namely, Mwananyamala RRH and Temeke RRH. Both are public hospitals with Emergency department which not only receive DM patients with DKA complications but also other emergency patients and provide initial management before admitting them to either medical wards or ICU. According to Demographic and Population Census of 2022, Temeke Municipal Council and Kinondoni Municipal Council had a population of 1,346,674 and 982,328 respectively [14].

Study population

The study involved licensed nurses working in the Emergency Medical Department. The study's inclusion criteria were nurses working in an emergency medical department, having a nursing diploma as a minimum level of education, having at least six months of work experience, and giving consent to participate. Nonetheless, nurses who were on annual leave, sick or attending other official duties during data collection were excluded.

Sampling method

Purposive sampling method was employed to recruit study participants, allowing researchers to select participants with needed information regarding nurses' perspectives on the factors influencing care of DKA patient at the emergency department [15]. Sample size was determined by the saturation of information, where Monique Hennink and Bonnie N. Kaiser described that 9-17 interviews can provide saturation of information in face-to-face interviews [16]. Also, we employed the code meaning approach, in which researchers first examined interviews and identified codes, and then they determined whether any new codes were identified in the interviews that followed until no new codes were found.

Data collection

Data were collected between august 2023 and November 2023 by authors and one experienced research assistant in qualitative data collection. Before beginning an interview, all participants were asked to provide written informed consent, which was obtained after they were informed about the study's objectives, information gathering procedures, participants' right to withdraw from the study, participant information confidentiality, participation in audio recording, and participant information publication.

A semi-structured interview guide was developed after the literature was carefully reviewed and used for conducting interviews. To elicit the nurses' viewpoints, experiences, and factors impacting the effective management of DKA patient at the emergency department, a series of initial and follow-up questions were constructed.

Twelve (12) face to face in-depth interviews were conducted in a quiet room that provided participants' privacy and comfort at the respective hospital buildings [17]. The interviews were conducted at a convenient time decided by participants. All interviews were digitally audio-recorded to capture participant responses, each lasting for 40 to 60 minutes. During the interviews, the research assistant took notes regarding participant's non-verbal cues, followed by a review of the filed notes to improve the following interviews and to note the emerging findings.

Data analysis

Management and analysis of data was an iterative process. All the recorded interviews (N = 12) were first transcribed verbatim in Swahili and then translated into English and retranslated back to Swahili. The transcripts were manually analyzed using qualitative content analysis as highlighted by Graneheim and Lundman [18]. Authors first read and re-read all transcripts to become familiarized with the data and context. Condensed meaning units were then developed related to nurses' experiences regarding caring patients with DKA. This was followed by manual coding in the margins and synthesizing and grouping of data in relatively exhaustive categories through memos. All authors participated in the data analysis process. In instances of discrepancies in forming codes, categories, discussions were conducted to reach a consensus.

Methodological considerations

The utilization of approaches such as credibility, transferability, dependability, and conformability guarantee trustworthiness in qualitative studies [19]. To maintain the credibility in the current study all authors discussed together and the concept with the greatest potential for expressing their point of views were picked [20]. To ensure uniformity, the interview guide was used, and two researchers (IMK and KIM), with a third checker (JSA) experienced in qualitative study designs, read and analyzed all transcripts [20]. The study's conformability was established by using quotes from participants and accomplishing methods of credibility, transferability, and dependability [11].

Ethical considerations

This study was approved by the Research Ethics Board of Muhimbili University of Health and Allied Sciences with Ref. no DA 282/298/01.C/1741. Permission to conduct the study was granted by Temeke RRH with Ref. No TRRH/RSC/9/9/02/8 and Mwananyamala RRH with Ref. no MA. 239/240/01/102. Written informed consent was obtained from all participants prior to recruitment into this study and the beginning of each interview.

Findings

Participant demographic characteristics

A total of 12 nurses participated in this study, with eight of them being males. Most of them (eight) had one year working experience at Emergency Medical Department; nine were holders of diploma (assistant nursing officers). Table 1 summarizes participants' demographic characteristics.

Two major themes emerged from the interview, namely, (1) Variability in nursing interventions for DKA management (2) Clinical Challenges in DKA management. Themes were organized to sub-theme as follows correction of dehydration, correction of hyperglycemia corresponding to variability in nursing intervention for DKA management while ineffective monitoring and assessment, nurses' roles clarity, patients' culture and

Table 1: Demographic characteristics of study participants (N = 12).

Participant No.	Sex	Age	Nursing Category	Level of Education	Experiences working at EMD
1	Male	26	Nursing Officer	Bachelor of Science in Nursing	1 year and 2 months
2	Female	32	Assistant Nursing Officer	Diploma in Nursing	1 year and 6 months
3	Male	36	Assistant Nursing Officer	Diploma in Nursing	1 Year
4	Male	29	Nursing Officer	Bachelor of Science in Nursing	2 years and 6 months
5	Female	36	Assistant Nursing officer	Diploma in Nursing	1 Year
6	Male	26	Assistant Nursing Officer	Diploma in Nursing	2 years
7	Male	24	Assistant Nursing Officer	Diploma in Nursing	1 year and 4 months
8	Male	33	Assistant Nursing Officer	Diploma in Nursing	1 year
9	Female	28	Nursing Officer	Bachelor of Science in Nursing	9 months
10	Male	23	Assistant Nursing Officer	Diploma in Nursing	1 year
11	Male	23	Assistant Nursing Officer	Diploma in Nursing	1 year and two months
12	Female	35	Assistant Nursing Officer	Diploma in Nursing	3 years and 4 months

religious beliefs corresponding to Clinical Challenges in DKA management.

Variability in Nursing interventions for DKA management

While many nurses successfully managed DKA by adhering to established guidelines, some faced challenges due to gaps in their comprehensive knowledge of DKA management. Therefore, this theme describes nurses' experiences when managing DKA where theme three sub-themes were identified: Correction of Dehydration, Correction of hyperglycemia and Correction of Electrolyte imbalance.

Correction of dehydration: The majority of nurses who participated in this study discussed mixed of responses regarding the amount of fluid to be used, type of fluid and time interval of fluid administration when managing patient with DKA at Emergency department, as reported by male and female nurses;

"….. We start with 2 liters of normal saline within the first 30 minutes, continue with 3 liters over the next 3 hours, and then administer 1.5 liters of normal saline every 3 hours until the blood sugar decreases…" (Participants No. 04)

"What we administer is 2 liters of fluids within the first hour once we've identified that the patient has DKA. After that, in the following hours, we give 500 mls per hour." (Participant No.09)

Surprisingly, some participants responded that the measured level of RBG determined the amount of fluid that DKA patient to be administered contrary to the available management protocol as reported by Male assistant nursing officer;

"…. It depends on the patient level of RBG, because the volume of fluid depends on RBG value….., at least 30 mmol/L and above, you cannot administer small volume of fluids, you have to administer almost three liters and above… three to four liters." (Participants No. 11)

Furthermore, participants had a mixed of general responses concerning the amount of fluid and time interval of fluid therapy required to the patient with DKA as reported by male assistant officer and female nursing officer;

"Ah, in the guideline that we follow, during the first hour after the patient arrives, I must administer two liters of normal saline. Then, after one hour, once you've checked RBG and observed it is above 15 mmol/L I will add more fluids...." (Participant No.03)

"What we administer is 2 liters of fluids within the first hour once we've identified that the patient has DKA. After that, in the following hours, we give 500 mls per hour." (Participant No.9)

Correction of hyperglycemia: Nurses discussed on the importance of administering insulin when caring DKA patient at EMD. Where, most nurses in the study demonstrated a clear understanding of when to administer the first dose insulin, as illustrated by the response from a male assistant medical officer;

"After the first hour of fluid therapy, we proceed to monitor patient RBG, if you see it's still above 15 mmol/L, you must administer insulin, but for those below 15 mmol/L, you should not give them [patients] insulin because it would cause further RBG lowering." (Participant No.3)

Also, one participant emphasized the importance of thorough assessment before initiating insulin and during insulin therapy in DKA management, stating;

"Absolutely, before initiating insulin, it's crucial to assess the current blood sugar level and overall vital signs, with a specific focus on checking blood sugar levels before insulin administration. While it progresses, we also keep a close watch on vital signs, including RBG, and if it reaches 14 mmol/L we discontinue the insulin, we switch to DNS and then we continue with the other aspects of management" (Participant No. 09)

However, some of nurses provided uncertainty responses when they were discussing about the required type of insulin, insulin dose preparation, route and Rate of insulin administration to the patient with DKA at EMD as reported by Male Nursing officer and male assistant officer;

".....With insulin, we use a specific calculation of 0.1 IU per KG, often employing a one-to-one ratio. For example, if the patient weights fifty kilograms, we would use 0.1 per KG, resulting in 5 IU of insulin…." (Participant No.04)

"Insulin is often administered through an infusion pump, its dosage is one international unit per kilogram, (1 IU/Kg) per hour I think" (participants No.07)

Additionally, few participants highlighted the need to monitor potassium levels during insulin administration, stating;

"Since we know that insulin administration can lower potassium levels, we need to monitor that it's necessary to draw blood for testing because it's challenging to determine the patient's condition just by observation." (Participant no 2)

Correction of electrolyte imbalance: Regarding the management of electrolyte imbalances, some nurses discussed potassium replacement, while others expressed uncertainty about the preparation of dosages, despite it being quite an uncommon practice. As reported by Male nursing officer;

We usually administer potassium through IV, but not very frequently..., in fact, it's quite rare. When it happens, we typically mix it with normal saline. I think

it's about 100 ml of normal saline that you mix with the potassium and it depends on the patient's body weight and how the doctor calculates the dosage, such as giving a certain number of milligrams. (Participant No 03)

Clinical challenges in DKA management

Ineffective monitoring and assessment: Sometimes, due to unavailability of point of test devices lab results are delayed making it hard to adjust treatments in real-time. Therefore, the decision to initiate insulin can be delayed as reported by a male nursing officer;

"In our emergency department, it's a bit challenging because all matters related to patient testing are usually handled by the main hospital lab, and we don't have those point-of-care testing machines here. So, we must collect the samples and send them to the lab for testing, at times, the laboratory can get congested and getting results on time is a challenge." (Participant no. 4)

Additionally, regarding when to collect sample for electrolytes investigation, participants had a uncertain responses as reported by a female nursing officer and emphasized by male assistant nursing officer;

"…… I'm not sure whether it's correct or not, during cannulation procedure, we take a blood sample for lab investigation…., and those results are then used before administering insulin to the patient and not electrolyte results after the first hour of fluid resuscitation." (Participant no 09)

"….. while continuing with other management, we wait for at least two hours to get the initial results that come while the patient is still in emergency department. Other results, which tend to take longer time, reach the patient in the ward." (Participant no 10)

Sometimes, the patients' ability to pay for investigations influenced the DKA management approach leads to prolonged periods of imbalance and delayed recovery as reported by male nursing Officer and emphasized by female assistant nursing officer;

"Ah, one of the challenges, is not so much about the patient; it's about the relatives of the patients especially when it comes to purchasing medications. We struggle a lot with exemptions office…..," (Participant no 05)

Nurses' roles clarity: Some participants thoughtful concern regards the clarity of roles highlighting a potential issue of overlap in responsibilities between doctors and nurses, prompting them to question the specific duties assigned to nursing staff within available comprehensive DKA protocol, as reported by a female assistant nursing officer;

"I think the protocol appears to be quite comprehensive, where it might seem like it leaves no distinction between doctors and nurses regarding the management steps, when it comes to a DKA management protocol, what does a nurse do?" (Participant no. 2)

Additionally, concerns regarding clarity of roles impacted nurses' ability to make informed decisions when caring for patients with DKA as participants emphasized the need to rely on doctors for crucial decisions, which can delay timely interventions. Participant no. 11 illustrated this frustration by stating

"You want to do something, but you can't just do it; you must wait for the doctor to come and say … administer this amount of insulin…. give this amount of fluid." (Participant no. 11)

Similarly, Participant no. 3 shared an example of their routine, highlighting the dependency on doctors for decision-making in patient care;

"So, when I have measured patient RBG, I will inform the doctor, 'doctor. patient RGB is still high what do we do?' and the doctor is the one who will make decision to either increase the fluid or start insulin therapy." (Participant no. 3).

Patients' culture and religious beliefs: The interaction between healthcare providers and patients can be influenced by various cultural and religious beliefs. This is particularly evident in the management diabetic ketoacidosis (DKA) at the emergency department, where timely intervention is critical. A male Assistant Nursing Officer highlights this challenge;

"There are others [patients] who come here with strong religious beliefs and cannot have anything done without the consent of someone specific, either a pastor or another religious leader. So, for anything you do, they [patients] tell you to wait first until that person gives consent, even when you see that it is something emergent. They tell you, 'No, no, don't do that yet, wait until so-and-so gives consent.'...." (Participant no. 06)

Discussion

This study explored the DKA patients' management experiences among nurses working in the emergency medical department from regional referral hospitals. Variability in nursing interventions for DKA management and clinical challenges were major themes emerged. Therefore, in this section we further discuss these findings and provide insights into areas for improvement and the future need for the implementation study.

Firstly, this study identified variability in nursing interventions for DKA management reflecting difference in knowledge, adherence to established DKA management guidelines, and practices among nurses working in the emergency departments. This variability was evident in three sub-themes: Correction of Dehydration, Correction of Hyperglycemia, and Correction of Electrolyte Imbalance. Despite the available DKA management guidelines, nurses exhibited mixed responses regarding the amount, type, and timing of fluid administration for DKA patients that are contrary with the available guidelines [21,22]. Similar,

to the studies done Iraq assessed nurses' knowledge and skills revealing a significant need for educational interventions to improve proficiency in Intravenous fluid administration [23,24]. Additionally, the study done in Iran found that the most frequency fluid administration errors (30%) being the administration rate of fluids similarly to our study where participants had mixed of response on the amount and time of fluid administration to DKA patient [25].

Furthermore, fluid therapy follows medication administration safety, therefore, any incorrectness of fluid administration results to fluid administration errors as unreported fluid therapy errors highlighted in the present study findings, similarly with the study done in Saud Arabia found the prevalence of medication error was 72.1%, with only 41.2% of the total were reported [26]. Such discrepancies in the presence study highlighting inconsistencies in fluid management practices among nurses and underscore the need for standardized training and adherence to protocols to ensure consistent and effective DKA management.

The administration of insulin was another area nurses experiences a diverse practice response reflecting knowledge gape, where, despite of nurses' working experiences and the level of professional education the responses regarding the time of initiation of insulin, type of insulin, dosage calculation and administration route varied among nurses participated in this study. Similar to study done in Ireland found deficits in nurses' knowledge and practices relating to insulin dosage, injection site technique and rotation, hypoglycemic or hyperglycemic management [27]. Also, finding from elsewhere, reported similar finding that nurses had limited understanding about insulin pumps in diabetes in diabetes management [28]. While, others studies in Greece [29], China [30,31], Nepal [32], Gambia [33], and mid-west [34] reported that nurses had insufficient knowledge regarding insulin therapy and diabetes management principles. This finding reflects gaps in knowledge and practice, which can affect the timely and effective correction of hyperglycaemia in DKA patients.

With the available DKA management protocols its recommended that infusion rate of 0.1 units/kg/hr. intravenous infusion with a concentration of one ratio one for both adults and children until resolution of acidosis [22,35]. But in this study, most of nurses had vague of uncertainty and variable responses regarding with the dosage preparation of insulin infusion rate. While very few nurses were able to correctly respond on the infusion rate as per recommended guidelines. Others, mentioned that sometimes unavailability of insulin syringes affected their ability to prepare insulin infusion dosage as nurses used regular syringes to prepare the dosage contrary with the ISPAD Clinical Practice Consensus Guidelines of 2018 [35]. Similarly, with the Matthews, et al., a study on health system capacity of managing DKA found a shockingly limited availability of critical items needed for DKA management such as insulin and glucometers [36].

In addition to variability in nursing interventions, several clinical challenges were identified that hinder effective DKA management include ineffective monitoring and assessment, unclear nursing roles, and patients' cultural and religious beliefs.

The major issue was the delayed in obtaining lab results due to the unavailability of point-of-care testing (POCT) devices at the emergency department. This delay making ineffective monitoring and assessment of patient with DKA during the management as initiation of insulin therapy depends on lab electrolytes investigations especially potassium electrolyte. Since point of care testing provide on time results and ultimately improve patient outcome by contributing to shorter stays and reduced management waiting time [37], the situation is different with the context of the present study where delayed investigation results was reported by nurses when relaying on hospital main laboratory. Study done by McIntosh, et al., found that bedside POC testing by clinical nurses was as reliable and accurate as core laboratory testing by trained technicians suggesting that clinicians to be confident when using the POC results when making clinical decisions [38]. Also, Jain, et al., emphasize that critical decisions can be made by trusting the potassium electrolyte values obtained from the arterial blood gas (ABG) analysis as there were no significant difference between the potassium electrolyte values measured by the POC blood gas machine and the auto-analyser [39]. To ensure results are reliable, nurses must be competent [40], as in the present study nurses had uncertainty responses regarding the timing of sample collection for electrolyte investigations. Therefore, POCT decrease the time of stay in EDs, facilitating early diagnosis, management, treatment, and deposition and hence improve patient satisfaction with care [41].

Despite of the unavailability of POC, patients' financial constraints influenced the approach to diabetes emergencies management comparable with the study done at Sweden children from household with relative poverty had 41% increased risk of developing DKA [42]. Other studies from Taiwan [43] poverty was associated with inequality of diabetes care while, in South Africa diabetic patients who lost income had compromised diabetes management and adherence to treatment as they get inadequate spousal support [42] and in Tanzania lack of health insurance was associated with poor glycemic control among diabetic patients [44].

Furthermore, the present study identified a concern among nurses regarding the clarity of their roles within the comprehensive DKA management protocol. The Unclear roles hamper nurses' ability to make informed

decisions and often force them to wait for doctors' directives, delaying critical care. Similar with the study in Iran where nurses experienced role ambiguity when caring post resuscitated patients while physicians had inappropriate attitudes towards nurses' roles [45]. Another study from Iraq nurses experienced role conflict challenge in delivering care to patients with CVAs in neurological wards [46].

Lastly, the interaction between nurses and patients influenced by cultural and religious beliefs when caring diabetic patients with DKA in emergency departments, necessity for external consent associated with delayed urgent care, even in life-threatening situations where timely intervention is needed. Contrary, with the study done in Indonesia among Javanese diabetic patients where they managed diabetic stress by submitting to God believed that for them to be diabetic it's a Gods will [47]. Therefore, Ly, et al., suggested the need for intervention efforts that address both cultural and psychological factors in order to improve diabetes self-care behaviors and associated disease outcomes among diabetic patients [48].

The following limitations of our study are important to highlight. Participants might have overstated their knowledge or give responses they think are more acceptable rather than accurately representing their actual practices resulting to response biases. The study focused solely on nurses, limiting perspectives from other healthcare professionals involved in DKA management. Nurses may not have accurately recalled specific details about their practices or experiences when responding to interview questions, which could to recall bias.

Conclusion

This study offers new insights into emergency nurses' experiences when managing diabetic patients with DKA. It has revealed variability in nursing interventions and clinical challenges when caring patient with DKA in the emergency department at RRHs. The results show the differences in practices responses to established guidelines were evident in areas such as fluid administration, insulin therapy, and electrolyte management, pointing to a gap in knowledge and practice. Additionally, clinical challenges like ineffective monitoring, delayed lab results due to the lack of point-of-care testing devices, unclear nursing roles, and the influence of patients' cultural and religious beliefs further hinder effective DKA management. These findings underscore the urgent need for standardized training, improved adherence to protocols, and the integration of point-of-care testing to enhance timely and effective DKA management. The Future implementation studies should focus on these areas to develop targeted interventions that can bridge the knowledge gaps and mitigate the identified challenges.

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Declaration of Interests

The authors have declared that no competing interests exist.

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