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The Knowledge and Confidence in Management of Diabetic Ketoacidosis (DKA) among Bahraini Pediatric Residents: aCross Sectional Survey

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Abstract

Introduction: DKA is one of the leading causes of mortality and morbidity among children with type 1 diabetes mellitus and a very frequently encountered medical emergency. Establishing a high level of knowledge about the appropriate management details of DKA is crucial among training residents.

Objectives: This article aims to assess the level of knowledge and confidence of pediatric residents in the management of patient with DKA.

Methods: an online questionnaire was designed and sent to residents in the four-year pediatric training program in Bahrain.

Results: 45 residents responded to the survey. 86.4% of R4 trainees are aware of the correct diagnostic criteria but unfortunately, they were the second worst among other levels in diagnosing the severity of DKA as only 27% answered correctly compared to 75% and & 71% of R1 and R2s. Otherwise, there was no statistical significance between the knowledge of junior and senior residents. Overall, there is no consistency of when to involve the on-call senior clinician.

Conclusion:A fair level of knowledge is present among residents in the management of DKA, yet various methods can be utilized to improve that.

Keywords: type 1 diabetes mellitus, diabetic ketoacidosis, and pediatric residents

Introduction:

Type 1 diabetes mellitus (DM) is an autoimmune disease affecting the pancreatic beta cells, hindering the ability to produce insulin. [1]It is one of the major non-communicable diseases and a serious public health problem, globally. [2]

415 million people are estimated to have DM according to the International Diabetes Federation in 2015. This number is anticipated to rise to 642 million by 2040. [3] In the United State of America, the prevalence of DM in 2018 was estimated at 26.9 million, out of which 210,000 were children and adolescents younger than 20 years of age including 187,000 with type 1 DM. [4]
Among countries in the middle east and north Africa, Kingdom of Saudi Arabia is considered to have the highest prevalence of DM (17.7%), and the fourth highest prevalence of type 1 DM. [5] Likewise, Bahrain is ranked among the top 10 countries with the highest prevalence of DM in the middle east and north Africa. [6]

Diabetic ketoacidosis is a common complication of type 1 DM and it is a leading cause of mortality. [7]It is not uncommon for the junior members of the team to initiate the management of DKA [8] Hence, assessing the knowledge and awareness of training residents about the appropriate recognition and management of DKA is fundamental in order to minimize medical errors and improve patients' care.

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This study aims to evaluate the level of knowledge and confidence of pediatric residents in Bahrain in the management of Pediatric patients with diabetic ketoacidosis.

MaterialsAnd Methods: an online survey was conducted among Bahraini pediatric residents. A survey link to an online questionnaire consisted of 30 questions was provided and distributed to a total of 78 pediatric residents from year 1 to 4. Survey Monkey, a commercial website was used for the data collection of this cross-sectional study as well as for the statistical analysis [9]. A confidence interval of 95% used, with $p<0.05$ was considered statistically significant. The survey was active between February 29th and March 29th, 2020.

Results: 45 pediatric residents in Bahrain out of 76 had responded to the survey, giving a response rate of 58%. 3 responses were excluded, as 1 response was incomplete and the other two responses came from residents who are living with diabetes, therefore, to avoid bias, their responses were not count in the following analysis.

Half of the responders are in their fourth year of training 22(52%). A comparison of the received responses according to the training level is summarized in table 1.

The experience of trainees in pediatric emergency increases as they progress in their training, each block of training is 3 months. Residents in their fourth year could have completed up to 6 blocks of pediatric emergency placements so far. Thus, it is expected that senior trainees to be more knowledgeable than junior trainees in the recognition and management of DKA in pediatrics as they are more likely have seen more patients presenting with DKA, which was the case, as 18 R4s indicated that each of them had initiated DKA management in more than 10 patients. On self-rating, the knowledge was described to be “very-good” level by 36.4% of R4s compared to 25%,14.3% and 22.2% of R3s, R2s and R1s respectively.

Assessing knowledge of diagnosing DKA

Two clinical scenarios were provided, and the candidates were asked of which they would suspect DKA (Q8 from the questionnaire, appendix1). The second scenario was answered correctly by all however the first scenario was answered wrongly by quarter of R1 and R3 doctors. Surprisingly, the diagnostic criteria for DKA was recognised by only half of R3 trainees, worse than R1 and R2s. However, reassuringly that 86.4% of R4 trainees are aware of the correct diagnostic criteria but unfortunately they were the second worst among other levels in diagnosing the severity of DKA as only 27% answered correctly compared to 75% and & 71% of R1 and R2s.

Management of DKA

Involvement of senior physician

Majority of R1 doctors (62.5%) inform their senior about DKA case immediately, however majority of R4 residents (45%) would consult the seniors only when the case is difficult to manage. 7 residents were not sure when to consult the on-call paediatric endocrinologist, whereas 22 residents would do so while the child is still in the emergency room, or within 2 hours of the patient’s admission. Other 12 residents would consult the endocrinologist if the patient required intensive care unit admission.

Fluid management

31/42 (73.8%) of responders would give fluid bolus for patients presenting with severe DKA, even if they are not in a shock. All of them would use 0.9% sodium chloride for fluid bolus. Majority would start with 10ml/Kg. For patientswith severe DKA and in a shock, the fluid bolus would be delivered fast (over 15-30 minutes) by 57.7% of the residents, whereas the rest opt to give the fluid bolus over 60 minutes. 23 responders (54.7%)chose 0.9% sodium chloride as a maintenance fluid without adding potassium chloride to it. Just below half of responders who would calculate infusing rate of maintenance fluids correctly by adding the deficit and subtracting the boluses and calculate over 48 hours correction.

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The majority of this cohort were aware to add glucose to the running fluid when blood glucose drops below 17mmol/L during acute management of DKA.

Insulin therapy

Only 52.3% (22/42) of residents would start the insulin infusion after 60 minutes from starting the intravenous fluids. Majority of the rest would start it as soon as they confirm the DKA diagnosis.

R1-3s were able to advise correctly when to switch from intravenous to subcutaneous insulin, but only 72% of R4s were able to do that.

Monitoring the progress

Majority of residents at each level of their training do monitor blood glucose on hourly basis in the first 12 hours of DKA management and almost all of them are appropriately selecting the correct parameters needed for monitoring the progress of the patient in response to the treatment plan. Majority would not use sodium bicarbonate routinely to correct acidosis and majority would use cardiac monitors, however 33/45 (73.3%) would check the cardiac monitor physically every 2-4 hours. Saying that, almost all residents are aware that cardiac arrhythmia could result from potassium disorder during the course of DKA, and the majority of them thinking hypokalaemia is the main arrhythmogenic factor, but yet that was not reflecting on their choice of maintenance fluid as it was mentioned earlier.

Dealing with possible complications

In regard to dealing with hypoglycaemia below 4 mmol/L during DKA management, only 36.4% of R4 residents were able to recognise that patient should receive a dextrose fluid bolus, stop the insulin infusion temporarily and increase the infused glucose concentration to prevent further hypoglycaemic episodes. 2 R1s and 1 R2 residents were able to advise for that whereas none of R3 could have answered this question correctly. Majority of residents are aware of signs to detect cerebral oedema.

Overall remarks

60% of residents think there is a need for more DKA teaching sessions as the average confidence score did not pass more than 2 on (0 to 3) scale. Senior residents (R4) had seen and initiated DKA management for more patients compared to junior residents (R1-3), $p<0.001$. Junior residents would seek advice and involve their seniors quite early in the management compared to senior residents who involve their seniors only when it difficult to manage (10.5% vs 45.5%, $p=0.01$). Junior residents were also more capable to recognise the severity of DKA compared to final year residents (63.2% vs 27.3%, $p <0.05$)

Table 1. Comparison between knowledge of paediatric residents on management of DKA according to their training level, (R= Residency year of training)

	R1	**R2**	**R3**	**R4**
n=	9	7	4	22
Gender M:F (%)	5:4 (55.6%, 44.4%)	1:6 (14.3%, 85.7%	2:2 (50%, 50%)	6:16 (27.3%, 72.7%)
Completed blocks of training in paediatric emergency medicine	0-2	0-3	2-4	2-6
Self-rating the knowledge and management of DKA in paediatrics Poor	1, 11.1%	1, 14.3	0	0

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Fair Good Very good	3, 33.3% 3, 33.3% 2, 22.2%	1, 14.3% 4, 57.1% 1, 14.3%	1, 25% 2, 50% 1, 25%	4, 18.1% 10, 45.5% 8, 36.4%
Number of patients that each resident had started the DKA management during the training None Less than 5 5-10 More than 10	 2, 22.2% 1, 11.1% 3, 33.3% 3, 33.3%	 1, 14.3% 2, 28.6% 3, 42.9% 1, 14.3	 0 1, 25% 2, 50% 1, 25%	 0 1, 4.5% 3, 13.6% 18, 81.8%
Percentage of correct answers about scenarios suggestive of DKA Scenario A Scenario B	 77.2% 100%	 100% 100%	 75% 100%	 90.5% 100%
Percentage of correct answers about DKA diagnostic criteria	66.7%	71.4%	50%	86.4%
Percentage of correct answers about diagnosing the severity of DKA	6, 75%	5, 71.4%	1, 25%	6, 27.3%
Response of residents in regard to informing their senior after diagnosing DKA Immediately After giving the 1st fluid bolus After starting the insulin infusion After the second fluid bolus Only when it is difficult to manage	 5, 62.5% 2, 25% 0 0 1, 12.5%	 3, 42.8% 3, 42.8% 1, 14.3% 0 0	 2, 50% 1, 25% 0 0 1, 25%	 5, 22.7% 5, 22.7% 2, 9.1% 0 10, 45.5%
Giving fluid bolus in a patient with severe DKA but not in a shock: 10ml/Kg normal saline 20ml/kg normal saline 10ml/Kg 10% dextrose 20ml/kg 5% dextrose	5, 62% 80% 20%	6, 85.7% 50 % 50%	2, 50% 100%	18, 81.8% 50% 50%
Rate of giving the fluid bolus in a patient with severe DKA and a shock Fast fluid bolus (15-30 min) Slow bolus (over at least 60min)	 5, 62.5% 3, 37.5%	 6, 100% -	 2, 50% 2, 50%	 13, 59.1% 9, 40.9%
Maintenance fluids used for DKA patient with 10% dehydration (not anuric nor hyperkalemic) 0.9% sodium chloride 0.9 % NaCl with 20mmol KCl 0.45% NaCl with 10mmol KCl 0.9% NaCl with 5 % dextrose None of the above	 3, 37.5% 5, 62.5%	 5, 71.4% 2, 28.6%	 4, 100%	 11, 52.4% 7, 33.3% 1, 4.8% 0 2, 9.5%
Fluid's rate calculation (Maintenance rate+deficit) – boluses given at resuscitation, correction over 48 hrs (Maintenance rate+deficit), correction over 48	 3, 37.5% 5, 62.5%	 4, 57.1% 2, 28.6%	 3, 75% 1, 25%	 11, 50% 9, 40.9%

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hrs Correction of fluids over 24 hrs		1, 14.3%	0	2, 9.1%
Timing of starting the insulin infusion After 60min from starting the IV fluids After 60min from the presentation As soon as DKA was diagnosed	 5, 62.5% 0 3, 37.5%	 3, 42.9% 0 4, 57.1%	 3, 75% 1, 25%	 11, 50% 11, 50%
Frequency of glucose monitoring in the first 12 hrs of management Every 30 min Hourly 2 hourly Every 3-4 hrs	 0 6, 75% 2, 25%	 0 6, 85.7% 1, 14.3% 0	 0 3, 75% 1, 25% 0	 1, 4.5% 16, 72.7% 3, 13.6% 2, 9.1%
*Percentage of correct answers about choosing the important parameters to assess the progress of DKA patient (Blood glucose, blood or urinary ketones, electrolytes and kidney function, neurology assessment and blood gas.	100%	100%	100%	95.5%
Percentage of correct answers about using sodium bicarbonate infusion for acidosis correction	7, 87.5%	6, 85.7%	4, 100%	20, 91%
Cardiac monitoring of all DKA patients	7, 87.5%	7, 100%	14, 100%	18, 81.8%
Frequency of checking the cardiac monitor 2-4 hourly 6 hourly Once a day	 7, 100% -	 6, 85.7% 1, 14.3 %	 3, 75% 1, 25%	 17, 89.5% 1, 5.3% 1, 5.3%
*Cardiac monitor use is to detect arrhythmia resulting from Hypokalemia Hyperkalemia Hypophosphatemia Hypernatremia Hypercalcaemia	 7, 87.5% 3, 37.5% 0 0 0	 6, 85.7% 2, 28.6% 0 0 0	 3, 75% 1, 25% 0 0 0	 19, 86.4% 5, 22.7% 1, 4.5% 0 0
First adding of dextrose to the bag of fluids is when blood glucose drops below 9 mmol/L 17 mmol/L 5 mmol/L	 1, 12.5% 7, 87.5% 0	 1, 14.3% 6, 85.7% 0	 4, 100% 	 2, 9.1% 19, 86.4% 1, 4.5%
Percentage of correct answers about recognising cerebral oedema	8, 100%	7, 100%	4, 100%	20, 91%
*Management of hypoglycaemia (<4mmol/L) when ketosis is still evident Giving a dextrose fluid bolus Increasing the infused glucose concentration Stopping the insulin infusion temporarily	 3, 37.5% 2, 25% 1, 12.5%	 2, 28.6% 2, 28.6% 2, 28.6%	 3, 75% 1, 25% 	 2, 9.1% 9, 40.9% 2, 9.1%%

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All of the above None of the above	2, 25% 0	1, 14.3% 0		8, 36.4%% 1, 4.5%
Percentage of correct answers in regards timing to switch from IV to SC insulin	7, 100%	7, 100%	4, 100%	16, 72.7%
Timing to consult the on-call paediatric endocrinologist Whilst the patient is still in emergency room Within 2 hrs of admitting the child Only if the child required PICU admission Not sure	 1, 12.5% 2, 25% 3, 37.5% 2, 25%	 3, 42.9% 0 2, 28.6% 2, 28.6%	 0 1, 25% 2, 50% 1, 25%	 8, 36.4% 7, 31.8% 5, 22.7% 2, 9.1%
Overall confidence in treating DKA in children Very confident = 3 Confident= 2 Fair = 1 Not confident at all =0 Average score of confidence	 0 5, 62.5% 3, 37.5% 0 1.6	 0 3, 42.9% 2, 28.6% 2, 28.6% 1.1	 1, 25% 2, 50% 1, 25% 0 2	 4, 18.2% 9, 40.9% 8, 36.4% 1, 4.5% 1.72
Desire for extra teaching sessions in DKA management in paediatrics Yes, definitely needed May be (optional) Not at all	 5, 62.5% 3, 37.5% 0	 5, 71.4% 2, 28.6% 0	 3, 75% 1, 25% 0	 14, 63.6% 8, 36.4% 0

Table 2. Comparison between junior residents (R1-3) and final year residents (R4)

	R1-3	**R4**	**p-value**
n=	20	22	
Gender M:F (%)	8:12 (40%, 60%)	6:16 (27.3%, 72.7%)	
Completed blocks of training in emergency medicine	0-4	2-6	
Self rating the knowledge and management of DKA in children Poor Fair Good Very good	 2, 10% 5, 25% 9, 45% 4, 20%	 0 4, 18.1% 10, 45.5% 8, 36.4%	
Number of patients that each resident had started the DKA management during the training None Less than 5 5-10 More than 10	 4, 20% 4, 20% 8, 40% 5, 25%	 0 1, 4.5% 3, 13.6% 18, 81.8%	 **0.0002**
Percentage of correct answers about scenarios suggestive of DKA Scenario A	 85%	 90.5%	

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Scenario B	100%	100%	
Percentage of correct answers about DKA diagnostic criteria	65%	86.4%	0.105
Response of residents in regards to informing their senior after diagnosing DKA Immediately After giving the 1st fluid bolus After starting the insulin infusion After the second fluid bolus Only when it is difficult to manage	 10, 52.6% 6, 31.6% 1, 5.3% 0 2, 10.5%	 5, 22.7% 5, 22.7% 2, 9.1% 0 10, 45.5%	 0.06 **0.01**
Giving fluid bolus in a patient with severe DKA but not in a shock: 10ml/Kg normal saline 20ml/kg normal saline	13, 68.4% 71.4% 28.6%	18, 81.8% 50% 50%	0.21
Rate of giving the fluid bolus in a patient with severe DKA and a shock Fast fluid bolus (15-30 min) Slow bolus (over at least 60min)	 13, 72.2% 5, 27.8%	 13, 59.1% 9, 40.9%	 0.27
Percentage of correct answers about diagnosing the severity of DKA	12, 63.2%	6, 27.3%	**0.03**
Maintenance fluids used for DKA patient with 10% dehydration 0.9% sodium chloride 0.9 % NaCl with 20mmol KCl 0.45% NaCl with 10mmol KCl 0.9% NaCl with 5 % dextrose None of the above	 12, 63.2% 5, 26.3% 0 0 2, 10.5%	 11, 52.4% 7, 33.3% 1, 4.8% 0 2, 9.5%	
Fluid's rate calculation (Maintenance rate+deficit) – boluses given at resuscitation, correction over 48 hrs (Maintenance rate+deficit), correction over 48 hrs Correction of fluids over 24 hrs	 10, 52.6% 8, 42.1% 1, 5.26%	 11, 50% 9, 40.9% 2, 9.1%	
Timing of starting the insulin infusion After 60min from starting the IV fluids After 60min from the presentation As soon as DKA was diagnosed	 11, 57.9% 8, 42.1%	 11, 50% 11, 50%	
Frequency of glucose monitoring in the first 12 hrs of management Every 30 min Hourly 2 hourly	 0 15, 79% 4, 21%	 1, 4.5% 16, 72.7% 3, 13.6%	

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Every 3-4 hrs	0	2, 9.1%	
*Percentage of correct answers in regard to choosing the important parameters to assess the progress of DKA patient (Blood glucose, blood or urinary ketones, electrolytes and kidney function, neurology assessment and blood gas.	100%	95.5%	
Percentage of correct answers in regard to using sodium bicarbonate infusion for acidosis correction	17, 89.5%	20, 91%	
Cardiac monitoring of all DKA patients	18, 94.8%	18, 81.8%	
Frequency of checking the cardiac monitor 2-4 hourly 6 hourly Once a day	 16, 88.9% 2, 11.1%	 17, 89.5% 1, 5.3% 1, 5.3%	
*Cardiac monitor use is to detect arrhythmia resulting from Hypokalemia Hyperkalemia Hypophosphatemia Hypernatremia Hypercalcaemia	 16, 84.2% 6, 31.6% 0 0 0	 19, 86.4% 5, 22.7% 1, 4.5% 0 0	
First adding of dextrose to the bag of fluids is when blood glucose drops below 9 mmol/L 17 mmol/L 5 mmol/L	 2, 10.5% 17, 89.5% 0	 2, 9.1% 19, 86.4% 1, 4.5%	
Percentage of correct answers in regard to recognising cerebral oedema	19, 100%	20, 91%	
*Management of hypoglycaemia (<4mmol/L) when ketosis is still evident Giving a dextrose fluid bolus Increasing the infused glucose concentration Stopping the insulin infusion temporarily All of the above None of the above	 8, 42.1% 5, 26.3% 3, 15.8% 3, 15.8%	 2, 9.1% 9, 40.9% 2, 9.1%% 8, 36.4%% 1, 4.5%	 0.11
Percentage of correct answers in regards timing to switch from IV to SC insulin	18, 100%	16, 72.7%	
Timing to consult the on-call paediatric endocrinologist Whilst the patient is still in emergency room Within 2 hrs of admitting the child Only if the child required PICU admission Not sure	 4, 21.1% 3, 15.8% 7, 36.8% 5, 26.3%	 8, 36.4% 7, 31.8% 5, 22.7% 2, 9.1%	 0.14

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Overall confidence in treating DKA in children			
Very confident	1, 5.3%	4, 18.2%	
Confident	10, 52.6%	9, 40.9%	
Fair	6, 31.6%	8, 36.4%	
Not confident at all	2, 10.5%	1, 4.5%	
Desire for extra teaching sessions in DKA management in paediatrics			
Yes, definitely needed	13, 68.4%	14, 63.6%	
May be (optional)	6, 31.6%	8, 36.4%	
Not at all	0	0	

Discussion:

DKA is a preeminent cause of mortality and morbidity among children with type 1 diabetes mellitus and, although to a lesser extent, type 2. It is considered to be the most common cause of hospitalization, and frequently the most common first presentation of type 1 DM. [8]

This study evaluated the magnitude of knowledge and confidence towards managing a patient with DKA, among pediatric residents in Bahrain.

Participants included a total of 42 residents enrolled in the 4-year pediatric residency program in Bahrain. The study first assessed the residents' general knowledge about DKA and it's diagnosis. Four areas in the management of DKA were then evaluated: 1) fluid management, 2) insulin therapy, 3) treatment monitoring and 4) involvement of a senior physician.

The majority of residents showed adequate knowledge about the initiation of insulin therapy and the criteria to switch from intravenous to subcutaneous dosing of insulin.

Contrarily, results related to knowledge about fluid management were not as satisfactory. Only less than half of the participants were aware about appropriate fluid calculation. Participants' knowledge was also lacking in respect to giving fluid boluses and choosing the appropriate type of fluid.

The overall confidence of residents in management of DKA was directly proportional to their year of residency. This was partially reflected on their responses to involvement of a senior resident in the management. While the majority of first-year residents would inform their seniors immediately, others were more confident in initiating the management by themselves. Similarly, the results of the scale rating the confidence level, ranging from poor to very good, demonstrated that the majority of residents across all training years rated themselves as "good". Conversely, more of the year-one residents rated themselves as "Very good" compared to year-two residents surprisingly. This may reflect on the over confidence of year 1 resident which sometimes can be dangerous as it is previously described that confidence can be associated with poor competence at beginning of training that can be inverted during the training, less confidence with better competence and lately when the training advances and experience gained both confidence and performance improved [10]. Therefore, this issue matters in terms of supervising and supporting the junior on-call team when initiating the management of DKA patient. 45.5% of final year residents would involve their seniors only when the case becomes difficult to manage. Now this could perhaps reflect on the maturity of the trainee and his or her confidence in management of DKA. But, the British Society of Paediatric Endocrine and Diabetes had a different view, as it recommended always to consult a more senior doctor on-call as soon as a case of DKA is suspected despite the feeling of confidence in self-management as patients can deteriorate quickly. [11]

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Nalla et al., a similar study conducted in UK to evaluate medical and surgical junior residents' knowledge about DKA and its management. The majority of medical residents were able to correctly diagnose DKA (85%), which is similar to our study results (65% ad 86.4% among R1-R3 residents and R4 residents, respectively).Nevertheless, our study showed that only less than half of year 4 residents were able to correctly classify the severity of DKA cases which may adversely affect their management. However, more participants in our survey showed adequate knowledge about appropriate monitoring during the management of DKA.

Concerning the ability to recognize the signs and symptoms of DKA, results of our study were comparable to Madkhly et al., a similar recent study conducted in Saudi Arabia that assessed final-year medical students' awareness of DKA. For instance, participants of the index study demonstrated higher level of knowledge about fluid management of DKA compared to participants in Madkhly et al. study. However, as the participants were pre-graduates, other detailed aspects of DKA management could not be compared. [5]The new NICE guideline 2020 (National Institute of Clinical Excellence – UK) for management of DKA in children recommended giving fluid bolus of 10ml/Kg 0.9% sodium chloride over 30 minutes to all DKA, clinically dehydrated patients, even not in a shock [14]. However, the second 10ml/Kg bolus has to be discussed with the senior responsible pediatrician. We had 13/42 responses (30.9%) would give 20ml/Kg fluid bolus to start with for patients not in a shock, and majority of them were R4 doctors (9 doctors). This goes against the recommended conservative way of fluid management, hence training will be provided as to reduce the risk of complications. Of note, a minority of participants in Nalla et al. study were able to identify the need to add dextrose to the intravenous fluid (5% of medical residents) compared to participants in our study in which the majority correctly added dextrose with the fall in blood glucose (89.5% ad 86.4% among R1-R3 residents and R4 residents, respectively). [13] Furthermore, However, more participants in our survey showed adequate knowledge about appropriate monitoring during the management of DKA. There was striking weakness in management of hypoglycaemia when the DKA patient is still on intravenous fluids and infusion and ketosis is still evident. Only 36% of year-4 residents answered correctly.

Calling the on-call pediatric endocrinologist/diabetologist was variable among the respondents and there was no obvious pattern of who calls or not. It seems that it is up to the person's personal decision and it does not follow the seniority or confidence. This may need to be studies separately, and residents to be provided with clear criteria of when to involve the subspecialties. Involving responsible seniors was highly recommended by different guidelines and that is not necessary to be the endocrinologist as senior pediatric emergency medicine physicians and general pediatricians are capable of managing DKA in the out of hours. Local agreements need to take place, but residents to have a clear guide.Noteworthy, one of the measures that helped improve the knowledge and confidence of residents in our hospital was having a structured clinical pathway for the management of DKA, readily available for all residents.

The benefit of implementing constructed pathways of management in reducing medical errors and variations of practice was well exhibited in a number of researches. A study published in the local region, in the United Arab Emirates, showed improvement in the overall patient care after the application of a DKA management pathway. [15]

Nevertheless, more comprehensive teaching is required to be directed towards pediatric residents in Bahrain. As our study demonstrated satisfactory background knowledge about DKA and its diagnosis, workshops and teaching sessions should be conducted to increase the awareness of residents about the practical aspects of DKA management including fluid management and monitoring and self-limitation awareness with the need to involve seniors.

One mean to improve the knowledge of residents in the management of DKA would be developing simulation sessions with scripted scenarios of DKA cases. The effectiveness of this was demonstrated in several studies

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including one done recently in 2016. A significant improvement was noted when comparing the residents' knowledge before and after simulation courses. [16]

Conclusion:

Pediatric residents in Bahrain demonstrated fair knowledge about DKA management. Yet, improvements in their knowledge and overall confidence in managing a patient with DKA are still desired. Updating the local protocol using evidence-based medicine helps in broadening the knowledge and unifying the management.

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