LEVEL OF KNOWLEDGE OF HEALTHCARE PROVIDERS IN MBAGATHI COUNTY HOSPITAL AND MAMA LUCY KIBAKI HOSPITAL ON THE ISPAD MANAGEMENT GUIDELINES OF DIABETIC KETOACIDOSIS.

A Dissertation Submitted In Part Fulfillment of the Degree of Master of Medicine (M.Med) in Paediatrics and Child Health

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DECLARATION

I declare that this proposal is my original work and that to the best of my knowledge it has not been presented either wholly or in part to this or any other university for the award of any degree or diploma.

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DEDICATION

I dedicate this dissertation to my parents for their great support, to my loving daughter Suki who has always been my source of inspiration to me without whom this book would not have been possible.

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ABBREVIATIONS

ADH	Antidiuretic Hormone
BG	Blood Glucose
CE	Cerebral Oedema
Cl-	Chloride ions
DKA	Diabetic Ketoacidosis
DM	Diabetes Mellitus
ECF	Extracellular Fluid
GCS	Glasgow Coma Scale
IM	Intramuscular
ISPAD	International Society for Pediatric and Adolescent Diabetes
IV	Intravenous
K+	Potassium ions
KNH	Kenyatta National Hospital
mg/dl	Miligram per deciliter
mls/kg	Mililiters per kilogram
mmol/l	Millimol per litre
Na+	Sodium ions
O2	Oxygen
SC	Subcutaneous
T2DM	Type 2 Diabetes Mellitus
TIDM	Type 1 Diabetes Mellitus
UK	United Kingdom
UON	University of Nairobi
USA	United States of America

ABSTRACT

Background: Diabetic ketoacidosis (DKA) is the leading cause of morbidity and mortality in children with diabetes mellitus. Most healthcare workers especially in sub-Saharan Africa are not able to recognize signs and symptoms of DKA in children at presentation and therefore often misdiagnose it. Standard DKA management guidelines have been developed to guide health care providers as they care for these patients, to ensure optimal patient care. Despite provision of these guidelines, in-patient mortality is still high especially in developing countries. Factors giving rise to this high mortality include poor healthcare systems, patient related issues and healthcare provider problems. Among healthcare provider problems, a lack of adequate knowledge on standard DKA management has been shown to be one of the many causes of poor outcomes among DKA patients.

Study Objectives: Primary objective: To determine the level of knowledge of healthcare providers (HCPs) in Mbagathi County Hospital and Mama Lucy Kibaki Hospital on DKA management using the International Society for Pediatric and Adolescent Diabetes (ISPAD) guidelines.

Secondary Objective: To describe the barriers to recommended DKA management as reported by the healthcare providers.

Methods: We carried out a cross-sectional survey at the two county hospitals to establish HCP knowledge on DKA management. The study targeted nurses, clinical officers and doctors who attend to children aged 0 to 12 years. Mean knowledge level was assessed using questionnaires which were developed based on the ISPAD guidelines. The questionnaires were administered by the principle investigator to HCPs working in the pediatric wards, newborn unit and outpatient departments. Each HCP who consented to take part in the study was given approximately 10-15 minutes to fill out their questionnaire before returning it to the principle investigator. A total of 19 questions were used to assess the level of knowledge. Paediatricians were assessed based on the entire set of questions; however only selected questions were used to assess, medical officers, clinical officers (COs) and nurses in accordance with their level of training. Information obtained from the questionnaires on DKA included: DKA definition, pathophysiology and criteria for diagnosis, fluid and insulin therapy, potassium replacement, bicarbonate replacement, emergency assessment, clinical signs and management of cerebral oedema, management of shock and

severe dehydration, when to refer and frequency of monitoring biochemical changes. Barriers to appropriate DKA management were derived from the responses given by the healthcare providers in the last question, of which, was an open ended question.

Data analysis: Data was obtained and checked daily for errors and entered into a computerized database using SPSS version 22 and later exported to STATA version 17 for further analyses. Descriptive data analysis for continuous variables was done using means and that of categorical variables was done using frequencies and percentages. Multivariate logistic regression and Chi square test of associations was carried out to assess factors associated with level of knowledge on DKA management. All statistical tests were considered significant at 95% confidence interval. Barriers to recommended DKA management among HCPs were analyzed descriptively. They were identified, grouped into categories and reported.

Results: The overall mean level of knowledge of healthcare providers regarding DKA management in two county hospitals was 53.08%. Mean knowledge score of each cadre was: paediatricians 70.18%, medical officers 63.39%, clinical officers 52.20%, and nurses 41.74%. The barriers to appropriate DKA management as reported by HCPs were: lack of medical supplies and equipment, lack of standard operating procedures and continuous medical education, high workload, and inadequate in service training on DKA management.

Conclusions: Mean Knowledge on DKA management among HCPs in two secondary level hospitals in Nairobi was at 53.08% with 35.9% of HCPs scoring below average. The barriers in DKA management as reported by HCPs include: Lack of enough medical supplies and equipment, absence of standard operating procedures (SOPs) and treatment guidelines, lack of continuous medical education and in-service training and increased workload due to understaffing.

Recommendation: 1. Continuous medical education and educational programs on all HCPs on key aspects of DKA management. 2. Availing standard protocols on ISPAD guidelines at the workplace to serve as a reminder on key aspects on DKA management thereby ensuring recommended DKA care. 3. Hospital management teams to look into the various barriers and come up with ways of addressing them. 4. Involve regulatory bodies such as nursing council, medical board, and clinical officers' board to improve knowledge through educational programs. Involve the ministry of Health (MOH) to find ways of addressing the barriers.

CHAPTER 1

1.0 INTRODUCTION

Diabetic Ketoacidosis (DKA) is a major life threatening reversible complication of Type 1 Diabetes Mellitus (TIDM) and rarely Type 2 Diabetes Mellitus (T2DM). The number one cause of mortality and morbidity in children with diabetes is Diabetic ketoacidosis (DKA) (1).

Management of DKA involves use of standard guidelines which have been shown to reduce morbidity and mortality and optimize care. However despite availability of these guidelines morbidity and mortality associated with DKA, especially in developing countries, is still high. Mortality associated with each episode of DKA varies from 0.15-0.31% globally.(1) DKA prevalence in sub-Saharan Africa ranges between 42 and 76 %.(2)(3) and more specific at time of diagnosis ranges between 70 to 80%. (4)(5) In our local set up a study done by Mbugua PK et al in Kenyatta National Hospital (KNH), showed a mortality of 29.8% of the study subjects, who died within 2 days of hospitalization. This study was carried out to determine the precipitating factors, as well as clinical and laboratory features of diabetic ketoacidosis (DKA) (6).

Unlike in adults, mortality in children is mainly due to the development of cerebral oedema which is a consequence of poorly managed DKA. In sub-Saharan Africa most healthcare providers are not able to recognize clinical features of DKA which contributes to high DKA associated mortality.(7) It was found that in three African countries many doctors were afraid of prescribing insulin , and the only training on diabetes they ever had was during their education at the university, stated by a- report by International Insulin Foundation.(4) In addition, inadequate training of healthcare providers (HCPs) and lack of facilities for diagnosis may lead to many children being misdiagnosed.(8) Because HCPs take part in rendering primary care to DKA patients, it is important that they are well knowledgeable.

This study is of value because to date, there are no studies available on assessment of knowledge on DKA management of HCPs in our set up. This study's overall target was to determine the level of knowledge of healthcare providers on the ISPAD management protocol of DKA and to describe barriers to proper management of DKA in secondary-level hospitals. The main goal is to enhance the quality of DKA care in order to lessen the morbidity and mortality rates.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 DEFINITION AND CLASSIFICATION

The biochemical criteria for the diagnosis of DKA are: Hyperglycemia [blood glucose (BG)>11 mmol/L (≈200 mg/dL)], Venous pH<7.3 or bicarbonate<15 mmol/L, ketonemia and ketonuria. (9)

The severity of DKA is based on the degree of acidosis: (10)

Table 1: DKA classification according to severity.(10)

Severity	**Venous PH**	**Plasma bicarbonate(mmol litre^{-1})**
Mild	7.2-7.3	10-15
Moderate	7.1-7.2	5-10
Severe	<7.1	<5

The clinical manifestations of DKA include:

Table 2: Clinical manifestations of DKA.(9)

Clinical Manifestations of DKA
• Tachycardia
• Dehydration
• Nausea, vomiting
• Tachypnea
• Acetone breath; Deep, sighing Kussmaul breathing
• Abdominal pain
• Confusion, drowsiness, reduced level or loss of consciousness.

2.2 ETIOLOGY

Lack of timely diagnosis of diabetes is the most common cause of DKA, especially in young children (particularly infants) as the classic 'adult' triad of polyuria, polydipsia, and weight loss is usually not present. In adolescents, lack of insulin administration is the most common cause.(11)(12) Lack of insulin and limited access to medical services are the main causes of DKA in the developing world.(8,13)

2.3 PATHOPHYSIOLOGY

Insulin regulates the metabolism of carbohydrates, fats and protein by promoting the absorption of glucose from the blood into liver, fat and skeletal muscle cells.(14) The combination of absolute or relative insulin deficiency and high counter-regulatory hormone concentrations in DKA results in an accelerated catabolic state. Increased glucose production by the liver and kidney (via glycogen lysis and gluconeogenesis), and simultaneously impaired peripheral glucose utilization, combine to result in hyperglycemia.

2.4 MORBIDITY AND MORTALITY.

DKA is the most common cause of diabetes-related death in childhood. Without insulin therapy, the mortality rate is 100%.In population studies from the USA, Canada and UK ,the mortality rate from DKA in children is 0.15 – 0.30%.(15–17) Cerebral injury is the major cause of mortality and morbidity (16,18). Cerebral edema accounts for 60 – 90% of all DKA deaths. This is seen in a study done by Edge, in the UK ,where they looked at all cases of cerebral oedema in children in England ,Scotland and Wales between the years 1995 and 1998 (19,20).

2.5 MANAGEMENT OF DKA

Principles of DKA management include: correction of shock, dehydration, hyperglycemia, deficits in electrolytes, acidosis, treatment of infection and other complications of DKA. Management also includes frequent assessment of vital signs, neurological status and biochemical changes.

The International Society for Pediatric and Adolescent Diabetes (ISPAD) is a professional body whose goals are to promote clinical and basic science, research, education and advocacy in adolescents and children with diabetes. ISPAD has published a series of Clinical Practice Consensus Guidelines to be used by health workers for the care of diabetes in adolescents and children. The current version of ISPAD Clinical Practice Consensus Guidelines in use is the 2014 edition. Healthcare providers trained in management of DKA should be available and written guidelines issued (10).

2.6 KNOWLEDGE ON DIABETES AND DKA AMONG HEALTHCARE PROVIDERS

Various reasons for poor management of DKA have been identified, among which a lack of adequate knowledge by healthcare providers play a major role.

A report done by the International Insulin Foundation on diabetes management in three African countries – Mali, Zambia and Mozambique – was looking at management of DKA in sub-Saharan Africa in adolescents and children. The study aim was to promote knowledge on DKA management in sub-Saharan Africa. In the report it was found that many doctors were afraid of prescribing insulin, and the only training they had on diabetes was during their university education. DKA prevalence at time of diagnosis of diabetes in sub-Saharan Africa was found to be 70-80 %. This lack of knowledge by healthcare providers contributed to a delay in referral of patients needing advanced care at low levels of health services. Only 9% of healthcare workers interviewed in Zambia received some form of special education on diabetes and those that felt adequately trained to treat a patient with diabetes were only 33% (21). Therefore, in conclusion, DKA high rates was due to a lack of training of healthcare workers, lack of public knowledge, lack of facilities in most hospitals and a lack of health education to individual patients and families. Furthermore there was erratic insulin supply coupled with infections, bad insulin storage, low parental education, and lack of available areas for blood glucose self-monitoring (22).

Singh et al in the year 2013, conducted a cross-sectional observational study, on final year MBBS students in a peripheral teaching medical college and hospital in Southern India. The study tool used was a self-developed, semi-structured and pre-validated questionnaire on

knowledge of diabetes (DM) and DKA. 73 questionnaires out of 81 were analyzed, with a response rate of 90.12%. 16.4% were aware about the factors leading to DKA. 10.9% were aware about investigations done in DKA. In conclusion only 50% of the students had adequate knowledge on DKA and therefore post teaching evaluation was recommended (23).

In another cross-sectional study done by Ahmed et al, conducted at 5 tertiary care university/teaching hospitals in Karachi, Pakistan assessing diabetes related knowledge among residents in internal medicine (IMR), surgery (SR), family medicine (FMR) and registered nurses (RN). A questionnaire which had 21 open ended questions was used. A total of 381 respondents were assessed. Results were arranged according to participant's specialty. The percentage of questions answered correctly was found to be low with a mean percentage of 50% +/- 21 among all the participants. No statistical difference in knowledge was seen between IMR & FMR residents (64% +/- 14 vs. 60% +/- 16, $p = 0.47$) respectively. SR and RN had low scores of (40% +/- 16 & 31% +/- 15 respectively). Profound deficit in both inpatient and outpatient knowledge of diabetes were found in both SR and RN. However, better scores of IMR was seen from first to second year of their training ($p = 0.03$) with no further improvement thereafter. Most of items related to in-patient management of diabetes had poor response from RNs (Mean score 40% +/- 20). Therefore, sizeable lack of knowledge was seen among trainee residents and nurses with a need of providing further training to improve the delivery of diabetes care (24).

Tofeec et al conducted a service development audit within medical teams in the Central Manchester Foundation Trust to review knowledge on DKA and its management, done in the year 2015. Initially, 66% did not feel confident in prescribing insulin and only 8% felt confident in managing DKA . 28% said they would continue basal insulin while on fixed rate intravenous insulin infusion. No one identified when to take further blood tests or the correct fluid regimen to prescribe or on DKA patients. Education sessions on DKA management were carried out. Post teaching, results improved with 55% feeling confident in prescribing insulin, 70% were able to prescribe basal insulin while on fixed rate intravenous insulin infusion, 30% identified the correct fluid regimen in DKA and 27.5% identified the appropriate time to obtain blood samples for further test in DKA. Thus the need for in service education was noted (25).

A cross-sectional study done by Beliard et al, assessing knowledge and perceptions of health care workers and identifying commonly perceived barriers in provision of optimal care for patients with hyperglycemia, showed that around 50% of questions on best clinical practices had correct responses. The appropriate answers varied across disciplines (mean ± standard deviation [SD]), with physicians scoring (n = 112, 53% ± 26%), pharmacists (n = 20, 64% ± 23%), dietitians (n = 5, 48% ± 30%), patient care assistants (n = 12, 38% ± 34%) and nurses (n = 43, 52% ± 35%). In conclusion it was observed that knowledge regarding management of hyperglycemia was lacking across a sample of health care workers when in comparison to best clinical practices. In addition, care of hyperglycemia should be included within the education programs (26).

Two case studies done in the year 2003 in Mozambique and Zambia by Beran et al showed that in addition to other barriers to DKA management such as problems with availability of syringes and testing equipment and lack of tools and infrastructure for diagnosis there was also low level of healthcare worker knowledge about diabetes. This was due to inadequate health care worker training on this subject. These studies were assessing the barriers to care for patients with diabetes requiring insulin (21).

In another cross-sectional study assessing diabetes knowledge in trained registered general nurses (RGNs) and healthcare assistants (HCAs) by Cardwell et al in 2013, showed a lack of diabetes knowledge needed to deliver high-quality care. The first part of the study had 26 RGNs and 17 HCAs from general medical or surgical wards complete validated questionnaires RGNs had 66 questions and HCAs had 23 questions. RGNs in the medical ward scored a mean of 48.6 out of 66 points (74%) and HCAs 12.3 out of 23 points (54%). In the surgical ward, RGNs scored 48.0 (73%) and HCAs 11.4 (50%). No significant difference in scores was found between the medical and surgical wards. Further tests were undertaken in two neighboring university hospitals where 40 RGNs and 40 HCAs were assessed. RGNs in these hospitals scored a mean of 44.7 (68%) and HCAs 11.35 (49%), with specific knowledge gaps varying slightly from hospital to hospital and all participants were poor in answering questions relevant to the practical management of inpatient diabetes. Regular education and further assessment over a longer period was recommended (27).

Table 3: Summary of studies on diabetes and DKA management.

Author, setting, year of Study	Study design	Study population and sample size	Outcome

Singh et al, , Southern India, 2013	Cross-sectional Study	Final year MBBS students, n=81	Only 50% of students had knowledge on general features and DKA management.
Ahmed et al, University/teaching hospitals, Pakistan, 2010	Cross-sectional multicenter study	Internal medicine, family medicine, surgery residents and registered nurses. n=472	Mean percentage of correct answers was 50%. Standard deviation (SD) 14.
Tofeec et al Entire Central Manchester Foundation Trust audited Manchester, UK, 2015	Audit	Medical team	Only 8% were confident in managing DKA, and 66% were not confident in prescribing insulin.
Beliard et al, USA, 2015	Cross-sectional study	Physicians n=112, nurses n=43,	Physicians scoring (53% ± 26%), nurses (52% ± 35%),
Beran et al, Mozambique, Zambia 2003	Case study	Health workers within Government organizations & health facilities, n=Between 100-200 interviews/discussions per country	In Zambia only 9% had received some form of special training on diabetes and only 33% felt adequately trained
Cardell et al, UK, 2013	Cross-sectional study	First study registered general nurses (RGNs) n=26, Healthcare assistants (HCAs) n=17 , Second study RGNs n = 40, HCAs n = 40	Sub optimal mean knowledge RGNs 73.5% in the initial study and 68% in the second study.

2.7 BARRIERS TO IDEAL DKA MANAGEMENT

Many interconnected obstacles to achieving optimal diabetes care have been identified. These include, patient barriers (behavioral, psychosocial, and socioeconomic), health care provider barriers, and delivery system barriers (structural and technological) (28). Studies have shown that an absence of proper training of health care workers on diabetes and its related complications is a major barrier to ideal DKA management and therefore leads to serious complications (29).

In developing countries, the World Health Organization(WHO) has identified several barriers to adequate diabetes care, these include: minimal staffing, a lack of resources, lack of organizational structure for the care of chronic diseases; inadequate training provided to healthcare workers and poorly organized healthcare information systems (30).

Standardized DKA management guidelines should be availed. A lack of standard operating procedures in the management of DKA has shown to play a major role in poor DKA care. This was demonstrated in a study done by Ildiko H et al on improving management of pediatric DKA where they sought to construct and implement evidence based recommendations for hospital management. The authors hypothesized that creation and utilization of standardized guidelines would lead to improvement in clinical outcomes and reduction in hypokalemia. This study was done in the USA where a team at Seattle Children's Hospital (SCH) developed and implemented evidence-based clinical standards for management of DKA. Pre-intervention, given the lack of standard guidelines, high variability in practice, and numerous safety events there was no consistency in the treatment of children with DKA. The study compared quality of care for 281 patients managed after implementation with that of 172 patients treated prior to implementation. In conclusion there was notable improvement in the post implementation group for various outcomes which included – improvements in insulin infusion, reduced ICU stay and reduced incidence of cerebral oedema (31).

Another barrier to appropriate DKA management is delayed referral. Children presenting with ketosis and hyperglycemia without vomiting or severe dehydration can be managed at home or in an outpatient health care setting (e.g., emergency ward or units with similar facilities), but the quality of care needs to be reevaluated frequently and supervised by an experienced diabetes team. A child with clinical features of severe DKA or who is at risk for cerebral oedema should be referred immediately after stabilization. A Retrospective case note review done by Devalia B, from 1st July 2008 to 13th February 2009 on all adult patients at Kingsmill and Newark District General Hospitals in the UK showed only 46% of patients were referred appropriately i.e of those requiring High Dependency Unit care. 46 episodes of adult DKA were audited for adherence to a new protocol provided. Poor monitoring of biochemical changes was also reported in this study, where it was observed that repeat electrolyte checks at the correct time interval were only done in 38% of patients (32).

Table 4: Summary of barriers to ideal DKA management

Author, setting, year	**Study design**	**Study population and sample size**	**Outcome**
Wallace et al, UK, 1998	Longitudinal	Healthcare workers – nurses and doctors	Imprecise guidelines and treatment targets, limitations in currently available technology, ageist policies, and a lack of resources such as insulin and nursing and medical input contributed to poor glycemic control
Ildiko H et al, Seattle Children Hospital, USA	Cross-sectional	Patient improvement Pre implementation n=281, post implementation n=172	No consistency in treatment before implementation of standardized procedures, after implementation most notable improvement was noted.
Devalia B et al, Kingsmill and Newark District General Hospitals, UK, 2008 - 2009	Retrospective	Adult patients with DKA, n=46	Delayed referrals as only 46% were referred appropriately out of those requiring high dependency support. Poor frequency monitoring of biochemical changes where repeat electrolyte checks at the correct time interval were only done in 38% of patients.

CHAPTER 3

3.1 STUDY JUSTIFICATION AND UTILITY

DKA is the most common cause of death in children with diabetes. Cerebral oedema due to inappropriate DKA management accounts for 60-90% of these deaths. A study done in KNH showed a high mortality of 29.8 % (6). Most complicated patients treated in KNH are usually referrals from primary and secondary level facilities where prior treatment has been initiated. Previous studies done have reported inadequate knowledge among HWs on DKA management.

(23, 24) Adherence by health workers to standard DKA management protocols has been shown to improve patient outcomes (32).

This study was set out to determine the level of knowledge among healthcare workers on DKA management and challenges they face in providing recommended management to children with DKA. Findings from this study will provide a basis for quality improvement interventions

3.2 RESEARCH QUESTION

What is the level of knowledge among healthcare providers in two secondary level hospitals in Nairobi on the ISPAD management guidelines of DKA and what are the barriers to appropriate DKA management?

3.3 STUDY OBJECTIVES

Primary Objective: To determine mean knowledge level among healthcare providers in Mbagathi County Hospital and Mama Lucy Kibaki hospital on the ISPAD management guidelines of DKA.

Secondary Objective: To describe the barriers to implementation of recommended DKA management guidelines as reported by the healthcare providers.

CHAPTER 4

4.0 METHODOLOGY

4.1 STUDY DESIGN

This was a descriptive cross-sectional survey that assessed level of knowledge among healthcare providers in Mbagathi County Hospital and Mama Lucy Kibaki hospital on the management of Diabetic Ketoacidosis.

4.2 STUDY SITE

This study was carried out in Mbagathi County Hospital and Mama Lucy Kibaki Hospital. These are secondary level county hospitals located in Nairobi, Kenya, with a large number of healthcare providers that attend to children. Most patients seen at Kenyatta National Hospital (KNH) with complicated DKA, more so with signs of or impending cerebral oedema, are referrals from secondary level facilities and other peripheral hospitals where initial management has already been initiated.

Mbagathi County Hospital is a County referral hospital located in Nairobi County, under the Ministry of Health. It has a population catchment of about 400,000 and serves as the main County hospital in Nairobi. The hospital serves mainly people of low socio-economic status from a neighboring slum of kibera. It has a pediatric ward with a bed capacity of 45 and has a monthly average admission of 380 children below the age of 13 years. DKA admissions are 2 per month on average. The children are attended to by 4 paediatricians, 2 medical officers, 5 medical officer interns, 5 Clinical officers, 4 Clinical officer Interns and 32 Nurses.

Mama Lucy is a referral hospital found in the eastern part of Nairobi in Embakasi division. It has a bed capacity of 112, 47 of which are for pediatric patients. It serves approximately 2500 adults a day and about 500 children. It is run by the Ministry of Health (MOH) and serves people mainly of the eastern and other urban areas of Nairobi. DKA admissions are 2 per month on average. The children are attended to by 3 paediatricians, 7 medical officers, 6 clinical officers and 29 nurses.

4.3 STUDY POPULATION

Healthcare providers in Mbagathi County Hospital and Mama Lucy Kibaki in the pediatric wards, pediatric outpatient clinics, outpatient department and newborn unit.

4.3.1 Inclusion criteria:

Paeditricians, Medical officers (MOs) and MO interns, Nurses, clinical officers (COs) and CO interns in Mbagathi and Mama Lucy Kibaki county hospitals who attend to children in the

pediatric wards, newborn unit, paediatric outpatient clinics ,general outpatient department or casualty.

4.3.2 Exclusion criteria:

Healthcare providers who decline consent.

4.4 SAMPLE SIZE

Fisher's formula with finite correction population was used to calculate sample size.

$$n = \frac{NZ^2P(1-P)}{d^2(N-1) + Z^2P(1-P)}$$

N = Sample size based on the Fischer's formula without finite population correction, which in this case is total number of healthcare providers required to sample before applying finite population correction factor = 101

P = Proportion of healthcare providers estimated to have adequate knowledge on DKA management which is estimated at 50% from a study done in Pakistan by Singh et al on the assessment of knowledge of healthcare workers on diabetes and DKA.(23)

Z = Normal standard deviate for 95% confidence interval (1.96)

d = Desired precision level set at 5% (0.05)

n = desired sample size with finite population correction factor.

$$\frac{101 \times 3.84 \times 0.5 \times 0.5}{(0.0025 \times 105) + (3.84 \times 0.5)} = \frac{96.96}{1.22} = 80 \text{ (rounded off)}$$

Desired sample size is therefore 80 health workers, 40 in Mbagathi and 40 in Mama Lucy Kibaki. Equal representation of all cadres from each hospital was ensured through stratified sampling. .

4.5 SAMPLING METHOD

Stratified randomized sampling technique was used to achieve the estimated sample size. Healthcare providers were stratified into different cadres before random selection. This was done to avoid bias in the selection process by ensuring participants were well represented from each cadre.

4.6 STUDY TOOL

A questionnaire was developed based on ISPAD guidelines, consisting of 19 multiple choice questions and one open ended question. The 19 questions focused on basic knowledge on DKA and its standard management according to the current ISPAD 2014 guidelines. One question (the last question) which is an open ended question assessed barriers to implementation of the recommended DKA management protocol and responses given for this particular question were not included in evaluating HCPs level of knowledge. The questionnaire included has both theory-based and practice-based questions on DKA.

Each questionnaire used serial numbers for participant identification in place of HCPs names for purposes of maintaining confidentiality. Data was obtained on HCPs', age, sex, cadre, level of qualification, years of experience, prior training in DKA management and department they currently work in.

Each question had only one correct response. Each correct response was awarded one point whereas the other responses including the 'I do not know' response were considered as a wrong answer.

Each cadre was assessed using a different set of questions from the questionnaire depending on their level of training. Paediatricians were assessed based on the entire set of questions based on their postgraduate curriculum; however only selected questions were used to assess, medical officers (MOs), clinical officers (COs) and nurses. Medical officers were assessed on only 14 out of the 19 questions. This was based upon their undergraduate curriculum gotten from the University of Nairobi. They were excluded from questions focusing on insulin and fluid therapy, monitoring of biochemical changes and bicarbonate therapy. Clinical officers were assessed on

13 out of the 19 questions in reference to their latest 2016 clinical medicine undergraduate curriculum gotten from the Kenya Medical and Training College (KMTC).The questions excluded for COs were based on fluid and insulin therapy inclusive of that in shock and in severe dehydration. Other questions excluded were to do with bicarbonate therapy and monitoring of biochemical changes. Nurses were assessed on only 10 questions in accordance to their undergraduate training curriculum from the University of Nairobi. The nurses were exempted from questions addressing emergency assessment, fluid and insulin therapy and management of CE.

Refer *to Appendix 1* for questionnaire.

4.7 STUDY PROCEDURE

Recruitment and Enrollment

Stratified sampling of healthcare providers by their cadre was used to enlist participants for the study. From each stratum, participants were selected using simple random technique until the desired number of participants was reached. Selected participants were approached for recruitment by the principal investigator at their respective work departments after obtaining verbal clearance from the in-charges. They were then briefed on the study prior to commencement. Questionnaires were administered to those who gave informed consent.

4.8 DATA PROTECTION AND MANAGEMENT

Completed questionnaires were collected and stored in a locked cabinet by the investigator during data collection and in a locked cabinet in the statistician's office during data entry. None of the participants' questionnaires had information that could directly identify the participants; instead questionnaires had serial numbers instead of participants' names. The computer used for data entry and analysis was password protected and only the principal investigator and statistician had the password.

All data tools in hard and soft copy are kept in a lockable cabinet only accessible to the principal investigator. Each question had a code. The data was subsequently checked, entered and analyzed into a computerized database using STATA 17.0 statistical software.

Results were reported using frequencies and percentages for categorical variables and means for continuous variables. All unanswered questions were considered a wrong answer with no score awarded, as it was assumed that participants most likely did not know the right response. Each question had one correct answer and all 19 questions answered correctly attained a total score of 19 points which was later translated inform of percentage. However nurses were tested on only 10 of the questions in keeping with their expected knowledge on DKA management.

The total scores of the doctors' questionnaire were acquired and expressed as mean percentages. Pooled means of the various doctor groups (paediatricians and medical officers) are also reported and later presented for each stratum.

To establish whether knowledge levels differ across various demographic information such as age, sex, and experience Chi-Square test of association was used. All factors with p value <0.05 were entered in Binary logistic regression to calculate their odds ratio of influencing knowledge levels. All statistical tests were considered significant at 95% confidence level.

4.9 ETHICAL CONSIDERATIONS AND DATA DISSEMINATION.

Before the research was conducted, approval was sought from the Ethical and Research committee of KNH/UON. Approval to conduct the study was also obtained from the Department of Paediatrics and Child Health as part of the thesis dissertation. Permission was also sought from the Heath Management Teams at the peripheral hospitals – Mbagathi and Mama Lucy Kibaki hospitals, where the study was undertaken.

The study purpose was carefully described to all healthcare providers and written consent obtained prior to enrollment to the study. Strict confidentiality was observed throughout the entire study period. There were no names on the participants' questionnaires; rather they had serial numbers. Participation in the study was voluntary and healthcare providers who declined consent were not included.

No identifiers linking findings to individual study participants will be released to any unauthorized third party without prior written approval of the study institution or the Ethics Research Committee. No experimental investigations or products were used in this study.

The overall study findings will be availed to the paediatricians and staff working at Mbagathi County Hospital and Mama Lucy Kibaki Hospital in hopes of improving any gaps or barriers discovered on the management of DKA. The study findings will also be presented to the University of Nairobi (UON) Department of Pediatrics and Child Health academic staff and students in fulfillment of the requirements of the M.Med Program.

CHAPTER 5

5.0 RESULTS

5.1 Demographic Characteristics

The study targeted a minimum sample of 80 Healthcare providers working in Mbagathi and Mama Lucy Kibaki hospitals. The final sample size was 92 with Mbagathi Hospital having 47 healthcare providers while Mama Lucy hospital had 45 healthcare providers. The response rate was at 100%. The entire sample met predefined eligibility criteria and was added in the analyses.

Results showed most of the respondents 69(75%) were aged <25-34 years, and 23(25%) were aged above 35 years. Gender distribution was fairly comparable with 54(59.5%) being females and 37(40.5%) males. In terms of experience, 54(58.8%) had experience of less than 5 years and 5(5.9%) had more than 15 years of experience. In relation to the various departments 46(50%) were working in paediatric wards, 36(39.7%) were in the outpatient department and 9 (10.3%) in the newborn unit. The summary is tabulated below.

Table 5: Healthcare providers' demographic characteristics

		Mbagathi		Mama Lucy		Overall	
Characteristics		N	%	N	%	N	%
Age (years)	<25-34	41	87.2	28	62.2	69	75
	35-44	5	10.6	14	31.1	19	20.7
	>44	1	2.1	3	6.7	4	4.3
	Total	47	100	45	100	92	100
Sex	Male	22	46.8	16	35.6	38	40.5
	Female	25	53.2	29	64.4	54	59.5
	Total	47	100	45	100	92	100
Professional cadre	Doctors (Paediatricians & Medical officers)	17	36.2	10	22.7	27	29.7
	Clinical officer	18	38.3	24	54.5	42	46.2
	Nurses	12	25.5	10	22.7	22	24.2

	Total	47	100	44	100	91	100
Years of Experience	<5	30	63.8	24	53.3	54	58.8
	5-10	13	27.7	11	24.4	24	25.9
	11-15	3	6.4	6	13.3	9	9.4
	>15	1	2.1	4	8.9	5	5.9
	Total	47	100	45	100	92	100
Department	Outpatient	20	42.6	16	36.4	36	39.7
	Paediatric Ward	25	53.2	21	47.7	46	50.0
	Newborn unit	2	4.2	7	15.9	9	10.3
	Total	47	100	44	100	91	100

5.2 Knowledge of healthcare providers on the management of Diabetic Ketoacidosis

To determine the knowledge leve of healthcare providers on the management of DKA, a questionnaire developed by the principal investigator consisting of 19 multiple choice questions which focused on basic knowledge on DKA and its standard management according to the current ISPAD 2014 guidelines. Expected level of knowledge on DKA for different cadres was determining based on training curricula obtained from the University of Nairobi and Kenya Medical Training College, Nairobi. With this in mind, different sets of questions were analyzed to determine level of knowledge for different cadres. Out of the questions picked for each cadre, the researcher computed scores in percentage form using the formula below.

Formula 1: Percentage score calculation

$$Percentage\ score = \frac{\text{Total number of questions the respondent got right}}{\text{Total number of questions asked}} * 100$$

5.2.1 Paediatricians

The overall percentage score for the paediatricians computed using formula 1 was 70.18%. They were analyzed on all 19 questions on the questionnaire. The study found all paediatricians scored above 50%. The paediatricians had good knowledge of DKA in terms of: signs & symptoms, fluid and insulin therapy, fluid for treating cerebral oedema, definition and biochemical criteria of DKA, monitoring biochemical changes and electrolyte management. In these questions the

paediatricians had a mean average score of 100%. However they had poor knowledge of certain aspects as shown in the table 6 below:

Table 6: Paediatricians poor knowledge of DKA Management

Poor knowledge of:	**Score (%)**
Pathogenesis of hyperglycemia in DKA	0.0
Neurological symptoms of cerebral oedema	0.0
Fluid resuscitation in DKA with shock	0.0
Bicarbonate therapy (not essential)	33.3
Management of cerebral oedema	33.3
Duration of giving deficit fluid replacement plus maintenance fluid	33.3
When to refer a patient with DKA to a specialist	33.3

5.2.2 Medical officers

The overall percentage score for the medical officer computed using formula 1 was 56.39%. The questions used from the questionnaire are 1,2,3,4,5,7,9,10,11,12,13,15,16 and 19.

Medical officers had poor knowledge of: pathogenesis of hyperglycemia, signs & symptoms of cerebral oedema and its management and when to refer a patient with DKA to a specialist. The percentage scores for each were 25%, 33.3%, 25% and 29.2% respectively.

The findings presented in table 7 reveals the areas medical officers had good knowledge of

Table 7: Medical officers' good knowledge of DKA Management

Good knowledge of:-	**Score (%)**
Definition of DKA	100.0
Initial emergency assessment in managing coma in DKA	62.5
Most important electrolyte to monitor	95.8

in DKA treatment	
Insulin infusion drip rate in the DKA management	95.8
Fluid resuscitation in DKA with severe dehydration	91.7
Signs/symptoms of DKA	66.6
Biochemical criteria for the diagnosis of DKA	62.5
Fluid for management of cerebral oedema	91.6
Fluid resuscitation in DKA with shock	54.2
When to initiate dextrose 5%	54.2

5.1.1 Clinical officers

The overall percentage score for the clinical officer computed using formula 1 was 52.2%. The questions used from the questionnaire are 1,2,3,4,5,6,7,9,10,12,13,16,and 19.

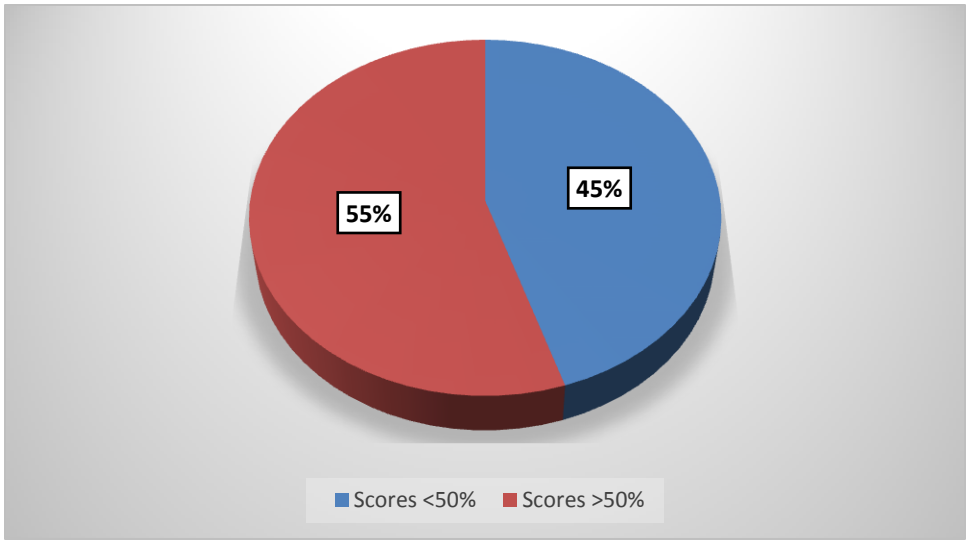

Figure 1: Clinical officers' score.

The findings presented in table 8 revealed clinical officers had good and poor knowledge in the following areas:

Table 8: Clinical officers' knowledge of DKA Management

Good knowledge of:-	**Score (%)**	**Poor knowledge of:-**	**Score (%)**
Definition of DKA	100.0	Pathogenesis of hyperglycemia in DKA	9.5
Fluid for management of cerebral oedema	97.6	Bicarbonate therapy (not essential)	28.6
Most important electrolyte to monitor in DKA treatment	85.7	Neurological symptoms of cerebral oedema	11.9
Insulin infusion drip rate in the DKA management	85.7	Management of cerebral oedema	16.7
Initial emergency assessment in managing coma in DKA	81.0	When to initiate dextrose 5%	23.8
Signs/symptoms of DKA	52.4	Biochemical criteria for the diagnosis of DKA	31.0
When to refer a patient with	54.8		

DKA to a specialist	

5.1.2 Nurses

Only 10 out of 19 of the questions, were used to analyze knowledge level among nurses. The questions used from the questionnaire are 1, 2,3,4,5,6,9,16,18 and 19. The overall percentage score for the nurses computed using formula 1 was 41.74%.

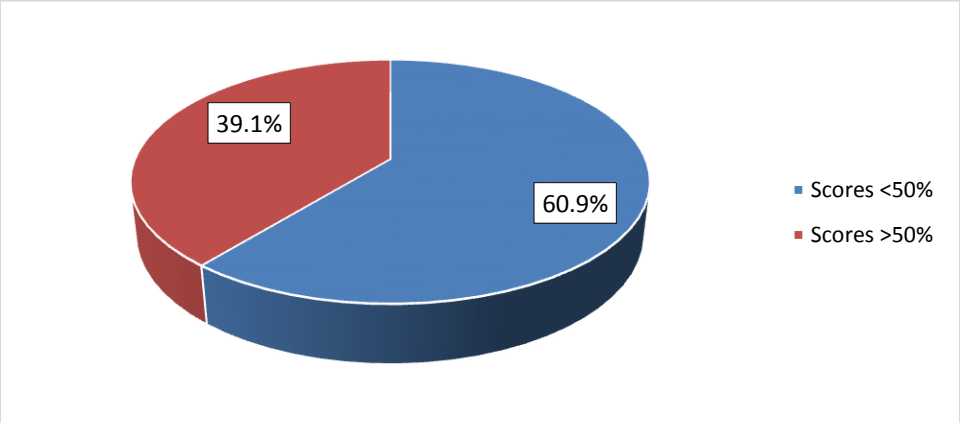

Figure 2: Nurses' scores.

The findings from the study showed that nurses had good knowledge of definition of DKA, most important electrolyte to monitor, and biochemical monitoring with percentages of 91.3%, 87%, and 73.9% respectively. Areas of poor knowledge are tabulated below:

Table 9: Nurses' poor knowledge of DKA Management

Poor knowledge of:-	**Score (%)**
When to initiate dextrose 5%	0.0
Neurological symptoms of cerebral oedema	13.0
Pathogenesis of hyperglycemia in DKA	21.7
Biochemical criteria for the diagnosis of DKA	26.1

Signs/symptoms of DKA	30.4
Bicarbonate therapy (not essential)	34.8
When to refer a patient with DKA to a specialist	39.1

5.1.3 The overall knowledge on the management of Diabetic Ketoacidosis

The overall percentage score for all cadres of healthcare staffs was computed using all applicable questions per cadre. The study found the overall percentage score for all healthcare providers computed using formula 1 was 53.08%. The study found 33 (35.9%) of healthcare providers scored below 50% and 59(64.1%) scored above 50% of the overall score. The summary of percentage scores for all cadres is presented in the figure below.

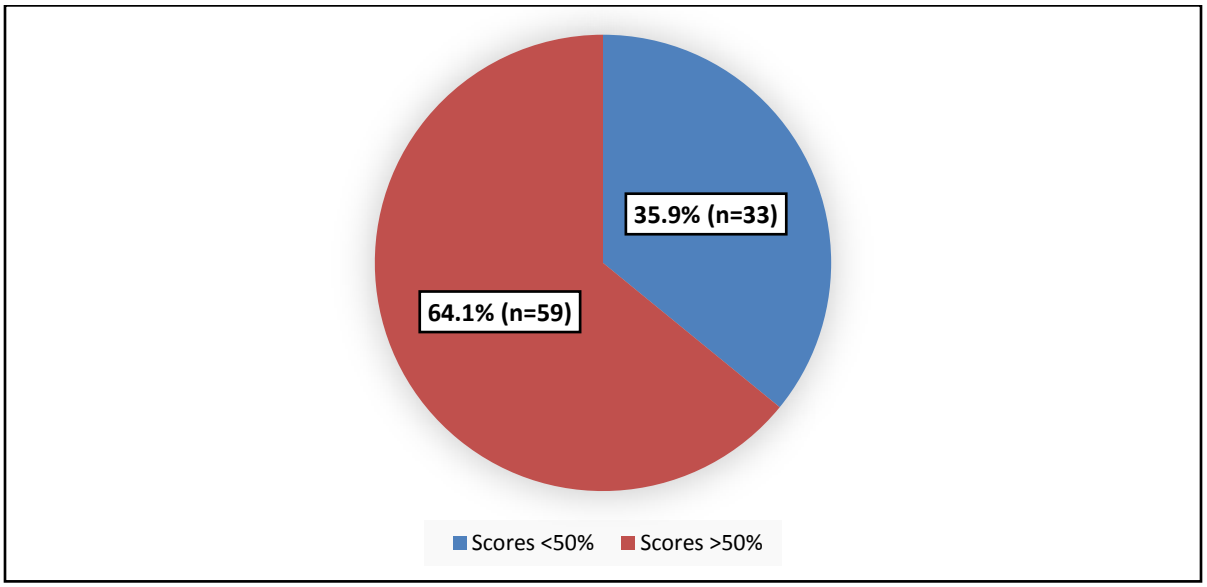

Figure 3: Healthcare providers overall score.

The findings presented in table 10 revealed on average healthcare providers had very good knowledge of:

Table 10: Overall knowledge of DKA Management

Good knowledge of:-	**Poor knowledge of**

➢ Target glucose level drop during insulin therapy (100%) ➢ Definition of DKA (97.8%) ➢ Fluid resuscitation in DKA with severe dehydration (92.6%) ➢ Most important electrolyte to monitor in DKA treatment (89.1%) ➢ Insulin infusion drip rate in the DKA management (89.9%) ➢ Fluid for management of cerebral oedema (89.1%) ➢ Frequency of monitoring biochemical parameters in DKA management (76.9%) ➢ Initial emergency assessment in managing coma in DKA (75.4%) ➢ Signs/symptoms of DKA (52.2%)	➢ Initial management of DKA/whether to start with insulin or IVF (3.3%) ➢ Neurological symptoms of cerebral oedema (17.4%) ➢ Management of cerebral oedema (20.3%) ➢ Pathogenesis of hyperglycemia in DKA (26.3%) ➢ When to initiate dextrose 5% (28.3%) ➢ Bicarbonate therapy (not essential) (30.9%) ➢ Duration of giving deficit fluid replacement plus maintenance fluid (33.3%) ➢ Biochemical criteria for the diagnosis of DKA (40.2%) ➢ When to refer a patient with DKA to a specialist (43.5%) ➢ Fluid resuscitation in DKA with shock (48.1%)

5.2 Association between Knowledge on the management of DKA and participant's demographics

The mean level of knowledge by healthcare provider per cadre was 64.15% for doctors, 52.20% for clinical officers and 41.74% for nurses (Results from ANOVA shows that there was significant association between knowledge level and HCP cadre with ($p<0.05$) with doctors having a higher mean knowledge than clinical officers and nurses. However, mean knowledge did not vary by age, gender, level of experience or department in which they worked.

Knowledge on management of DKA was not statistically different across healthcare provider's age, gender, department of work, or years of experience as summarized in the table below:

Table 11: Association between mean knowledge and healthcare providers' characteristics.

HCPs characteristics		Mean knowledge level (SD)	F statistic	p value
Sex	Male	53.16	0.004	0.948
	Female	53.31		
Appointment	Doctors	64.15		
	Clinical officers	52.2		
	Nurses	41.74	49.77	<0.001
Department	OPD	51.96		
	Paediatric ward	56.68		
	Newborn unit	51.29	0.924	0.402
Years of experience	< 5 years	55.13		
	5-15 years	52.6		
	>15 years	49.47	1.806	0.167
Age	25-34	53.12		
	35-44	52.83		
	>44	53.66	0.011	0.989

5.3 Barriers to standard DKA management

5.3.1 Overall barriers to standard DKA management in the two hospitals

Some challenges staffs face in the management of DKA which were found to lay within three of the six WHO health system building blocks include; health work force, health service delivery, leadership and governance.

Within the health service delivery system challenges faced were mainly unavailability of medicines and commodities such as lack of insulin, intravenous fluids e.g. normal saline, hypertonic saline, mannitol and a lack basic equipment such as glucose sticks, glucometers, insulin pumps. Factors affecting health delivery in terms of the health workforce included: a lack of continuous medical education, absence of standard operating procedures and treatment

guidelines. Finally, challenges in leadership and governance reported were mainly issues to do with understaffing which consequently leads to overworked or overstretched HCPs.

Table 12: Barriers to DKA management per hospital in reference to the health system building blocks.

Building blocks	**Barriers**
Health service delivery	Lack of enough medical supplies and equipment
Health workforce	Absence of standard operating procedures (SOPs), treatment guidelines and lack of continuous medical education
Leadership and Governance	Understaffing/ Workload

Some of the challenges as reported by healthcare providers are quoted below:

[Doctor 1]: "There is lack of ICU facilities, no infusion pumps, poor fluid monitoring, and inadequate lab facilities thus unable to analyses blood gases, occasionally unable to monitor electrolyte levels."
[Nurse Officer 2]: "Infusion pumps lack most of the times, and there are no drugs e.g. mannitol/hypertonic."
[Clinical officer 2]: "There is no consistent availability of Insulin and guidelines are normally not provided."
[Clinical officer 3]: "There are no specialist and some delays in referring a complicated case."
[Clinical officer 4]: "DKA management needs close monitoring and observation and with limited number of personnel and high number of patients thus making it difficult because of the limited number of staffs."

CHAPTER 6

6.0 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

6.1 DISCUSSION

This study found the overall percentage score for all HCPs was 53.08%. 33 (33.9%) of healthcare providers scored below 50% and 59 (64.1%) scored above 50%. This score is higher to that reported by Singh H et al done in Southern India on DKA and diabetes knowledge where only 50% of the students had adequate knowledge on diabetes and DKA. (23) Another cross-sectional study by Beliard et al on pharmacists, dietitians, nurses, physicians and patient care assistants showing similar results with physicians scoring (53% ± 26%), nurses (52% ± 35%), pharmacists (64% ± 23%), dietitians (48% ± 30%), and patient care assistants (38% ± 34%).with an average of 51% and only 50% of questions answered correctly (26).

Most healthcare workers in general have very good knowledge on the definition of DKA, however most of them had poor knowledge on signs and symptoms of cerebral oedema and how to manage it. This poor knowledge may contribute to poor DKA management within the two hospitals leading to increased mortality, as cerebral oedema is the number one cause of mortality and morbidity. This is similar to a review done by Majaliwa et al on DKA management in adolescents and children in sub-Saharan Africa, which showed that most healthcare providers were not able to identify symptoms and signs of DKA, which contributed to high rates of diabetic ketoacidosis at presentation.(33)

Paediatricians' knowledge on the management of cerebral oedema, duration of rehydration, bicarbonate therapy, pathogenesis of hyperglycemia, and when to refer was sub-optimal. However they showed overall good knowledge on DKA management with a mean score of 70.14%. This is similar to a study done by R.Artati et al in Banten and Surabaya from August to September 2009 looking at paediatrician knowledge level on of type 1 diabetes mellitus and DKA management. The study showed good knowledge especially of younger participants with odds ratio (OR) 3, 64 (95% CI 1, 29 to 10, 26) and subject with shorter length of duty with OR 7, 42 (95% CI 2, 13 to 25, 84), therefore showing an association between younger age and shorter

length of duty. However in our study no association between level of knowledge and level of experience or age was seen. (34).

Both medical officers and clinical officers had suboptimal knowledge in pathogenesis of hyperglycemia, signs & symptoms of cerebral oedema and its management. However there overall knowledge level was reasonable with a mean score of 56.39% and 52.2% respectively. Nurses showed a need for improvement in knowledge on when to initiate dextrose 5%, neurological symptoms of cerebral oedema and pathogenesis of hyperglycemia. In overall they had a mean score of 41.74% which classifies them as having poor knowledge. A study done by Cardwell et in two hospitals al in the UK on registered nurses (RGNs) with an aim of assessing diabetes knowledge, showed poor basic knowledge however with a higher mean score of 68% (27).

Some healthcare providers reported a lack of guidelines at the workplace and for those that had guidelines reported a lack standard operating procedure on DKA management. The likely result of this would be variability among HCPs in their management and consequently poor outcome. This is comparable to that study done by Wallace et al, done in the UK assessing poor glycaemic control in type 2 diabetes which showed imprecise guidelines and targets during treatment led to poor glycemic control.(35) Other barriers in this study such as lack of medical equipment and medicines, a high workload due to understaffing have shown to play a huge role in DKA management. Poor health delivery systems have negative consequences on management of DKA. The barriers reported are similar to a review done on DKA in sub-Saharan Africa by Murunga et al which highlighted consequences such as, lack of critical care units, poor healthcare infrastructure, shortage of glucose monitoring equipment, erratic insulin supply and consumables including medication and intravenous fluids cause poor management outcomes (36).

6.1.1 Strengths and limitations

This study is not without limitations. The questionnaire used was not pre validated, however it was structured from the ISPAD guidelines. Since the questionnaires were not issued to all HCPs

at the same time, some HCPs might have gone to read on the ISPAD guidelines beforehand because they were aware of the ongoing study. Paediatricians may not have been well represented as only three were enrolled due to lack of availability. Notwithstanding these limitations, the strength of this study lies in identifying gaps in the recommended DKA management which may form the basis for informed interventions. Targeted continuous medical education which focus on areas of knowledge that need improvement is needed.

6.2 CONCLUSIONS

The mean knowledge level of HCPs in two secondary-level hospitals in Nairobi on the ISPAD management guidelines of DKA was average (53.08%), and varied across cadres. Although HCPs had good knowledge of the definition of DKA, most had poor knowledge on management and clinical signs of CE. Several barriers to recommended DKA management as reported by HCPs include: limited medical supplies and equipment, a high workload, inadequate medical staff and lack of more qualified and specialized staff.

6.3 RECOMMENDATIONS

We therefore recommend, continuous medical education on key aspects of DKA management for all HCPs, provision of standard protocols on ISPAD guidelines at the workplace to serve as a reminder on key aspects on DKA management and involvement of medical training facilities and regulatory bodies like medical boards to improve knowledge through pre-service and in-service educational programs.

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APPENDIX 1: HEALTH WORKERS QUESTIONNAIRE

KNOWLEDGE ON MANAGEMENT OF DKA

The principle investigator: Dr.Lavinia Mayabi

Department of Paediatrics and Child Health UON

Mobile No. 0726451219

Email: laviniamayabi@gmail.com

You are being asked to voluntarily complete this questionnaire for a research project to establish the knowledge of healthcare providers on diabetic ketoacidosis.

If you agree to complete this questionnaire, it should take you 5-10 minutes to fill. Please answer **ALL** the questions. Choose one correct response for each question.

The questionnaire is anonymous and confidential.

PARTICIPANTS DEMOGRAPHIC DETAILS

Date of assessment……

Age (years): 25-34 ☐ 35-44 ☐ >44 ☐

Sex: Male ☐ Female ☐

Appointment: Paediatrician ☐ Nurse: Certificate ☐

Medical officer ☐ Diploma ☐ Medical Office ☐ Intern ☐

BSN ☐ Clinical Officer ☐ MS or Higher ☐ Clinical Officer Intern

Years of clinical experience: <5 ☐ Current department: Outpatient/Casualty ☐

5-10 ☐ Paediatric Ward ☐

11-15 ☐ Newborn Unit ☐

>15 ☐

QUESTIONS

1. Which of the following is the **MOST** accurate definition of diabetic ketoacidosis(DKA)?
    a. A life threatening condition caused by the buildup of ketones in the blood stream from the body breaking down fats,instead of sugars.
    b. Having high blood sugar levels
    c. A digestive system illness resulting in nausea and vomiting
    d. A metabolic disease caused by high glucagon levels
    e. I do not know.
2. The pathogenesis of hyperglycemia in diabetic ketoacidosis includes all the following except:
    a. Increased glycogenolysis in the liver
    b. Increased gluconeogenesis in the kidneys
    c. Increased gluconeogenesis in adipose tissue
    d. Decreased glucose uptake from the muscles
    e. I do not know
3. Which of the following signs/symptoms are clinical features of diabetic ketoacidosis?
    a. Increased urine output and weightloss
    b. Abdominal pain and Vomiting
    c. Dehydration and Confusion
    d. All the above
    e. I do not know

4. The biochemical criteria for the diagnosis of DKA are:
    a. Hyperglycemia >11mmol/l,Venous PH >7.3,Bicarbonate >15,Ketonuria >3+
    b. Hyperglycemia >11mmol/l,Venous PH <7.3,Bicarbonate <15,Ketonuria >2+
    c. Hyperglycemia >7mmol/l,Venous PH >7.3,Bicarbonate >10,Ketonuria >2+
    d. Hyperglycemia >7mmol/l,Venous PH <7.3,Bicarbonate <10,Ketonuria >3+
    e. I do not know
5. The following are neurological symptoms of cerebral oedema except:
    a. Irritable,disoriented,confused
    b. Stuporous,comatose,fixed and dilated pupils
    c. Lethargic,somnolent,abnormal response to pain
    d. Seizures,abnormal movements,pin point pupils.
    e. I do not know
6. Which of the following is not essential in the management of a child with DKA?
    a. Weight of the child
    b. Antibiotic if febrile
    c. Insulin therapy
    d. Bicarbonate therapy
    e. I do not know
7. A 6 year old girl is brought into the emergency room in DKA and has a GCS score of 4/15.Your first approach in her management would be;
    a. Give a bolus of insulin at 10 IU
    b. Asses her airway,breathing and circulation.
    c. Intubate and hyperventilate
    d. Give a bolus of normal saline at 20mls/kg
    e. I do not know
8. Which of the following is true regarding management of DKA:
    a. Give oral antiglycemic drugs
    b. Start with insulin therapy 1-2 hours before fluid therapy
    c. Start with fluid therapy then insulin therapy 1-2 hours later
    d. Start both insulin and fluid therapy together at the same time.
    e. I do not know

9. Which electrolyte is of most importance to monitor when treating a patient with DKA?
    a. Sodium
    b. Phosphate
    c. Chloride
    d. Potassiom
    e. Calcium
10. The most effective fluid for treating cerebral oedema immediately it is suspected is;
    a. Mannitol
    b. Normal Saline
    c. Hartmans Solution
    d. Ringers lactate
    e. I do not know
11. In shock with DKA ,the proper procedure of fluid rescuscitation would be?
    a. Isotonic saline 10mls/kg bolus
    b. Ringers lactate 20mls/kg bolus
    c. Isotonic saline 20mls/kg bolus
    d. Ringers lactate 10mls/kg bolus
    e. I do not know
12. What is the standard IV insulin drip rate in the management of DKA?
    a. 0.2 IU/kg/hour
    b. 0.02 IU/kg/hour
    c. 0.1 IU/kg/hour
    d. 0.01 IU/kg/hour
    e. I do not know
13. A patient with DKA was admitted and started on IV fluids and insulin.After afew hours the patients mentation deteriorated and became comatose.Which of the following is **NOT** part of the management?
    a. Elevate the head to 30^0
    b. Give mannitol 0.5-1g/kg IV over 20 minutes
    c. Give hypertonic saline (3%) 5mls/kg over 30 minutes
    d. 'None of the above

e. I do not know

14. In fluid therapy during DKA ,deficit fluid replacement plus maintenance fluid should be given over a period of how long?
    a. 12 hours
    b. 24 hours
    c. 36 hours
    d. 48 hours
    e. I do not know
15. In severe dehydration in DKA ,the proper fluid management should be?
    a. 0.9% normal saline at 10-20mls/kg over 1-2 hours
    b. 0.45% normal saline at 10-20mls/kg over 1-2 hours
    c. Ringers lactate at 30mls/kg over 2.5 hours
    d. Ringers lactate 30mls/kg over 5 hours
    e. I do not know
16. During ongoing insulin infusion and fluid therapy,a patient undergoing DKA treatment had blood sugar levels of 15mmol/l and PH 7.3.What should be your next step of action?
    a. Stop the insulin infusion
    b. Stop the fluid drip
    c. Add 5% dextrose to the fluid
    d. Add bicarbonate
    e. I do not know
17. During fluid and insulin therapy one should aim for a glucose drop of about?
    a. 5 mmol/L/hour
    b. 10 mmol/L/hour
    c. 15 mmol/L/hour
    d. 20 mmol/L/hour
    e. I do not know
18. Frequent monitoring of biochemical changes in the management of DKA include all of the following **EXCEPT:**
    a. Hourly blood glucose levels
    b. 2 hourly blood gases

c. 6 hourly heart rate
d. 4 hourly electrolytes
e. I do not know

19.Which of the following is False: In a patient with complicated DKA

a. Refer immediately to a specialist/to a facility with advanced care after stabilization
b. Refer to a specialist/to a facility with advanced care after 24 hours after stabilization
c. Refer to a specialist/to a facility with advanced care after 48 hours after stabilization.
d. Do not refer unless status of patient is deteriorating
e. I do not know

20.Name any challenges you mostly face when managing DKA.

APPENDIX 2: HEALTHCARE WORKER CONSENT FORM

Principal Investigator: Dr. Lavinia Mayabi 0726451219

Dear Doctor/Nurse/Clinical Officer: I would like to ask your voluntary participation in this scientific study in the form of survey. A questionnaire is provided for you to answer.

TITLE OF THE STUDY: Assessment of Knowledge on the management of Diabetic Ketoacidosis.

PURPOSE OF THE STUDY: This study aims to assess the knowledge on adherence to DKA management guidelines and assess barriers to standard DKA management. This will help in identifying areas in DKA management that need improvement thus forming the basis for quality interventions.

STUDY PROCEDURE: Each healthcare provider who consents to participation will be given a self-administered questionnaire by the investigator to fill. Each participant will be given a time of 15 to 30 minutes to complete.

RISK OF THE STUDY: There is no risk in participating in the study.

POSSIBLE BENEFITS: By participating in the study, you will aid in increasing information on current DKA management and identify any challenges in providing standard management.

COMPENSATION: There will be no compensation given.

RIGHT TO WITHDRAW: Your participation in this study is completely voluntary. You are free to decline it. You have the right to change your mind anytime without giving explanations.

CONFIDENTIALITY: All answers obtained from you will be considered privileged information. These will be documented and analyzed anonymously. Only researchers have access to personal information which only includes your age, gender, and year of study. Your identity will remain absolutely confidential. The researchers aim to publish this paper for pure academic and scientific purpose. You will be given a copy of consent form

DATA DISSEMINATION: Results of this study will be availed to health managerial team of the hospital where the study will be undertaken and the University of Nairobi (UON) Department of Pediatrics and Child Health Academic Staff and Students in fulfillment of the requirements of the M.Med Program.

If you have any questions regarding the study, feel free to contact me or any of my supervisors or the Chairman of the KNH/UON Ethics and Research committee on Tel: 72630 , Ext: 44102

Dr. Paul Laigong, Department of Paediatrics and Child Health, University of Nairobi

Tel No. 0720386861

Dr. Beatrice Mutai, Department of Paediatrics and Child Health, University of

Nairobi. Tel No. 0708552909

KNH/ERC (Kenyatta National Hospital / Ethics & Review Committee) Tel No.

020-2726300/0722829500/0733606400/EXT 44102. PO BOX 20723, Nairobi.

PART II: CERTIFICATE OF CONSENT

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate in this research.

_____ Signature of participant

_____ Signature of Investigator

_____ Date.

APPENDIX 3: STUDY BUDGET

NAME OF THE ITEM	COST OF EACH ITEM	NUMBER OF ITEMS NEEDED	TOTAL COST
Pens	Kshs 10	5	Kshs 50
Printing questionnaires and consent forms	Kshs 10 per page	50 x 80 20 x 80	Kshs 5,600
Mobile phone	Kshs 10,000	1	Kshs 10,000
Airtime			Kshs 1,000
Statistician			Kshs 15,000
Ethics Committee KNH			Kshs 5,000
Transport costs			Kshs 1,000
Poster presentation			Kshs 1,500
GRAND TOTAL			Kshs 39,150

Source of funds: Personal savings

APPENDIX 4: TIMELINES/GANTT CHART

Time in months (Nov 2017 – Feb 2019)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Proposal writing	■	■	■	■												
Submission to Ethics					■	■										
Data Collection							■	■	■							
Data analysis										■	■	■				
Report writing													■	■	■	
Presentation of Results																■

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Ref: KNH-ERC/A/349

2nd October 2018

Dr. Lavinia Odawa Mayabi
Reg. No. H58/89054/2016
Dept. of Paediatrics and Child Health
School of Medicine
College of Health Sciences
University of Nairobi

Dear Dr. Mayabi

RESEARCH PROPOSAL – LEVEL OF KNOWLEDGE OF HEALTHCARE PROVIDERS IN MBAGATHI COUNTY HOSPITAL AND MAMA LUCY KIBAKI HOSPITAL ON THE INTERNATIONAL SOCIETY FOR PEDIATRIC AND ADOLESCENT DIABETES(ISPAD) DIABETIC KETOACIDOSIS MANAGEMENT GUIDELINES (P313/05/2018)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above research proposal. The approval period is 2nd October 2018 – 1st October 2019.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH-UoN ERC before implementation.
c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e) Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
g) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website **http://www.erc.uonbi.ac.ke**

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