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WOLKITE UNIVERSITY COLLEGE OF MEDICINE

AND

HEALTH SCIENCES SCHOOL OF MEDICINE

TREATMENT OUTCOME OF DIABETIC KETOACIDOSIS AND ITS DETERMINANTES AMONG CHILDREN ADMITTED TO WOLKITE UNIVERSITY SPECIALIZED AND TEACHING HOSPITAL, WOLKITE, GURAGE ZONE, CENTRAL ETHIOPIA REGIONAL STATE, ETHIOPIA: RETROSPECTIVE STUDY.

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Table of Contents

ABBREVIATION

AOR-Adjusted Odds Ratio

AKF - Acute Kidney Failure

COR-Crude Odds Ratio

DW - Dextrose in water

DKA - Diabetic Ketoacidosis

DM - Diabetes Mellitus

WUSTH- Wolkite University Specialized and Teaching Hospital

IDF- International Diabetes Federation

ISPAD - International Society of Pediatrics and Adolescent Diabetics

NACL - Sodium chloride

UK - United Kingdom

USA-United States of America

ADA-American Diabetic Association

BGM- Blood Glucose Monitoring

BMI-Body Mass Index

FBS- Fasting Blood Glucose

RBS_random blood sugar

IVF-Intravenous Fluid

UTI- urinary tract infection

RTI- respiratory tract infection

AGE- acute gastro-enteritis

Cr_creatinine

HIV_Human immunovirus

List of tables

List of figures

Abstract

Introduction: Diabetic ketoacidosis (DKA) is a serious acute complication of diabetes mellitus that carries a significant risk of mortality with delayed treatment in low resource countries. This study aimed to determine the treatment outcome of DKA and its determinant in children under 15 years in WUSTH who managed with a modified DKA treatment protocol

Objective: To assess the treatment outcome of diabetic ketoacidosis and its determinants among children admitted to Wolkite University Specialized and Teaching hospital from, 2019-2024 G.C

Methods: An institutional based cross-sectional study design with retrospective data collection was conducted among children younger than 15 years of age admitted from, 2019-2024.Data collection was done by using pretested checklist prepared in English. Completeness and consistency were checked for each data. After the necessary data was collected, it was entered, categorized, coded and summarized and then, it was exported to SPSS version 27.0.1 for further analysis. Descriptive statics was done using percentages and frequency for categorical variables. After binary logistic regression a p-value ≤0.25 was used as a cut of point to entered variables in to multivariate logistic regression. Variables which have P<0.05 was considered as statistically significant. The strength of statistical association was measured by odds ratio and 95% of confidence intervals. In addition, Fisher exact test was used to evaluate associations degree between categorical determinants and treatment outcome. The result of the study was presented in table, graph and charts and charts

Result: Majority of the client's 82(95.3%) of them recovered and 4(4.7%) died in hospital. Factors that associated with treatment outcome were loss of consciousness(phi=0.35), shock(phi=0.889), renal failure (0.5), cerebellar edema(phi=0.49), sepsis(phi=0.52), serum creatinine level(phi=0.654), amount of regular insulin(phi=0.338), and serum potassium level(phi=0.389). Around 39(45%) percent of patient had prolonged hospital stay (>=7 days) that mainly associated with respiratory tract infection (AOR 4.8(1.08-10.87), clinical severity, mild (AOR 2(1.04-6.85) moderate AOR=3.82(1.23-7.43), severe AOR=4.2(1.84-9.21)) loss of consciousness AOR= 3.9(1.24-8.904), dehydration AOR 4.9(1.34-15.78), high serum creatinine AOR=4.7(1.4-9.4). The mean hospital stay was 6.13±2.98 days.

Conclusion: This study tried to assess different factors of DKA management such as Socio-demographic characteristics, sign and symptoms and biochemical parameters, comorbidities and complications of diabetic ketoacidosis and management protocols. Around 45% of patients had prolonged hospital stay. Death of children was relatively higher 4(4.7%).

Chapter One

Introduction

1.1 Background

Diabetes mellitus is a metabolic disorder that occurs due to an absolute or relative deficiency of insulin and body resistance to insulin. Type 1 Diabetes Militias (T1DM) is the most common endocrine metabolic disorder among children. Almost one in 300 children develop T1DM. And these finding have been documented in many countries including both developed and developing countries. It has been reported that the incidence of type 1 diabetes is increasing by 3-4% per year globally in light of geographical variation with high correlation of this incidences to socio economic factors. Diabetic keto acidosis (DKA) is a serious, life threatening and expensive acute complication of T1DM that can occur when there is a comparative or complete decrease in circulating insulin levels in relation to an increase in counter governing hormone levels (Onyiriuka & Ifebi, 2021)

In response to this disparity, normal physiologic mechanisms are exaggerated, resulting in hyperglycemia, hyper osmolality, ketosis, and acidosis (1). It can occur under two occasions (i) at the time of T1DM diagnosis (disease first appearance) or(ii) in clients with a previous T1DM diagnosis who do not receive proper interventional follow up or who are suffering from under recurrent infection that has not been sufficiently controlled (2).The magnitude of DKA cases among diabetic children has steadily increased for the past 3 decades (2).DKA and its complications are the most common cause of hospitalization, morbidity and mortality in children with established diagnosis of T1DM (1). Insulin deficiency, dehydration and hormone increment such as cortisol, adrenaline, glucagon and growth hormone are some of the clinical features of children admitted with DKA (1). The biochemical criteria for the diagnosis of DKA are hyperglycemia (blood glucose level>200mg/dl[>11.1mmol/L]), venous pH less than 7.3 or serum bicarbonate level less than 15 mEq/L (<15 mmol).

Patients can dramatically ill, the severity can be graded based on the degree of acidosis ;mild DKA: venous pH from 7.2-7.3or serum bicarbonate<15 mmol/L; moderate DKA: venous pH from 7.1-7.2 or serum bicarbonate<10mmol/L ; sever DKA: venous pH <7.1 or serum bicarbonate<5 mmol/L and as severity increases, the need for pediatric intensive care as well as risk of morbidity and mortality increases (3).But, with aggressive management most patients can recover rapidly.

In spite of numerous advances in the management of type one diabetes mellitus, more than 70% of T1DM patients unable to maintain glycemic control (4). As a result, diabetic keto acidosis (DKA)became the most common sticky situation of T1DM in children with an incidence of 1-10% of diabetic clients per year in developed nations (5).

1.2 Statement of problems

In every year, the number of children and adolescents living with diabetes is increasing in the world. Most of them have presented with type 1 DM. Currently 1.1 million children and adolescents live with diabetes and annually 132,000 new cases of diabetic children are diagnosed around the world. In countries such as Germany, Europe, north America and Australia the average rate of DKA ranges from 30% to 70% child diagnosed with T1DM, whereas, the proportion of DKA in Asian children among the total cohort was 33.6% (6,7). The prevalence of DKA at the time of diagnosis in sub-Saharan Africa was between 70 to 80 % (8). The inclusive proportion of children diagnosed with DKA in Addis Ababa Ethiopia was high (35.8%). Likewise, in Gojjam Ethiopian the overall incidence rate of DKA was 2.27 over 100 children per month of observation.

DKA is the most common cause of acute comorbidity and mortality in children with T1DM with the range of 16.5 to 78% admission rate in hospital. With the average length of recovery time between 24hours-8 days (5). where a low pH and high total leucocyte count (TLC) at admission were observed to be associated with prolonged acidosis. Mortality of DKA has been reported to be 2 to 5% in treatment experienced centers of the Americas, Europe and Asia. In Africa, the mortality of DKA is unacceptably high with a reported death rate of 6 to 29% in studies from Kenya, Tanzania, and Ghana. In Ethiopia, mortality from DKA was found be high. A retrospective study conducted at Shashemene Referral Hospital reported that DKA contributed 12% in-hospital mortality (21). Another study conducted in Hiwot Fana Specialized University Hospital indicated that about 11% of patients with diagnosis of DKA died in hospital (22).

It has been identified that, poor glycemic control, inappropriate insulin storage, comorbidities, younger age and low socio-economic status have been associated with increased risk of developing DKA, but it is unclear if this risk factors influences patient outcome while in pediatrics management centers.

DKA were reported with an increased incidence of cerebral edema, sepsis, shock, cerebral injury, altered level of consciousness, respiratory failure with low hypophosphatemia, renal failure and delayed diagnosis both in developed and developing countries. DKA can be principal source of death, mainly when complicated by cerebral edema/injury with an estimated mortality rate of 20 to 50% and 15-35% of survivors are left with permanent neurologic deficit (6,7). Acute complication of DKA may be accompanied by malnutrition, parasitic and microbial infections with tuberculosis and HIV Over lapping of these condition contribute to the increased rate of morbidity and mortality. In ability of the patients to afford insulin treatment leads to poor glycemic control as a result, patients may seek alternative treatment from traditional healers or use herbal remedies further complicating the management process (9).

DKA management is too challenging as it can be associated with different types complication. Accessing and utilizing endocrine and critical care published guidelines and attempt to set standards in DKA diagnosis and management is required by taking in to consideration that, standard treatment guidelines for DKA at present may not be ideal as they are adapted from those of the developed world (9).

During DKA treatment, administration of insulin inhibits the production of ketoacidosis and facilitates their metabolism, thereby helping in correcting the acidosis.

Effective treatment requires the replacement of insulin, fluid and electrolytes in addition to applying the novel approach of early diagnosis and treatment by multidisciplinary diabetic care team to ensure good outcomes. Length of hospital stay (LHS) and overall in hospital mortality (IHM) among DKA children during management are the foremost primary out comes that should be measured. Because it is highly trusted on the improvement of T1DM and DKA related complication management. However, data associated to LHS the rate of IHM due to DKA remains to be limited in Ethiopia. In addition to this, Nonfiction is much scarce from Ethiopia in relation to factors associated with treatment outcome among children admitted with DKA starting from its initial presentation and the overall management process.

1.3. Significance of the Study

This study will contribute data regarding to management outcome of diabetic ketoacidosis in the study area as well as it will also contribute to increases the knowledge of the patients and health care professionals on the determinant factors of treatment outcomes of diabetic ketoacidosis. The findings from this study will help the health institution administrators and other stakeholders to give great emphasis to the problem of diabetic ketoacidosis, to identify the gaps on the management of diabetic ketoacidosis and measure the effectiveness of inpatient management or treatment of diabetic ketoacidosis and develop best interventional approaches in the future. In addition, it serves as base line data for further study.

Chapter Two

LITERATURE REVIEW

2.1. Introduction

Diabetic ketoacidosis is the most severe complication of diabetes mellitus that occurs when our body produces high level of ketones it is an acute complication of decompensated diabetes characterized by triad of uncontrolled hyperglycemia, metabolic acidosis and increased total body ketones the symptoms of DKA are excessive thirst, frequent urination, nausea and vomiting stomach pain and confusion. It is commonly triggered by illness particularly pneumonia and urinary tract infection and a problem with insulin therapy. Some of the possible treatment complications are hypoglycemia, hypokalemia and cerebral edema.(3)

2.2. Treatment of DKA in children

Severe insulinopenia results in a physiologic cascade of events in three general pathways

1. Excessive glucose production coupled with reduced glucose use raises serum glucose

2. Increased catabolic processes result in cellular losses of sodium, potassium, and phosphate

3. Increased release of free fatty acids from peripheral fat stores supplies substrate for hepatic ketoacid production (3).

Judicious fluid resuscitation is the first step in the medical management of DKA. rapid decline, or a slow decline to a subnormal range, may indicate an excess of free water entering the vascular space and an increasing risk of cerebral edema. The initial intravenous bolus of 10-20 mL/kg of glucose free isotonic sodium salt solution such as Ringer lactate or 0.9% sodium chloride is given over 1 to 2 hours. Subsequent fluid replacement then consists of 0.45% or 0.9% sodium chloride infused at a rate calculated to replace the fluid deficit (after subtracting initial fluid bolus) over 24-48 hours plus maintenance The fluid deficit can be calculated empirically if a recent weight is available, estimated at 5—10% of body weight based upon clinical severity, or by assuming a standard water deficit (85 mL/kg). (3)

Insulin must be given to promote movement of glucose into cells, to subdue hepatic glucose production, and to halt the movement of fatty acids from the periphery to the liver. Insulin infusion is typically begun without an insulin bolus at a rate of 0.05 to 0.1 units/kg/hr after initial fluid resuscitation is complete. Glucose of >100 mg/dL/hr may increase the risk of cerebral edema; therefore, careful monitoring of serum glucose and adjustment of the dextrose concentration of the IV fluids is essential. The dextrose concentration of the IV fluids should be 5% (D5) once serum glucose falls below ∼300 mg/dL and 10% once glucose is below 200 mg/dL Once the blood glucose level decreases below ∼180 mg/dL (3)

Children with DKA have total body potassium deficits on the order of 3 to 6 mmol/kg, the major loss of potassium is from the intracellular pool. The incidence and severity of hypokalemia (potassium < 3.5 mmol/L) may be higher in malnourished children. In spite of total body depletion, serum potassium levels may be normal, increased, or decreased at presentation Potassium replacement is required regardless of the serum potassium concentration, except if renal failure is present (10).

2.3 Treatment outcome of DKA in children

full recovery is Expected with appropriate management of diabetic ketoacidosis. The degree and quality of monitoring are probably the most important factors in determining outcomes. However, even if cerebral edema has not occurred, a risk of long-term intellectual deficit is noted in children who have had an episode of diabetic ketoacidosis Diabetic ketoacidosis is the most common cause of diabetes-related death in childhood. Without insulin therapy, the mortality rate is 100%, but current mortality rates are around 2-5%. (29).

The institutional based retrospective cross-sectional study done in bahirdar city public referral hospital shows 2.5% of children admitted with diabetic ketoacidosis died (11**).** Different studies conducted in Asia showed that the mortality of children diagnosed with DKA differ across its countries. For instance, research conducted in South India Karnataka tertiary hospitals showed that 89.5% improved and discharge and 11.5% died and another research conducted at Delhi in

tertiary level care hospital in India showed that 12.7% of children with diabetic ketoacidosis died and the remaining 87.3% recovered (12,13). Retrospective observational study conducted over a 5-year period (February 2013-February 2018) among Children and Adolescents Admitted with Diabetic Ketoacidosis at Kenyatta National Hospital (KNH), Kenya Out of the 159 children admitted, 11 died giving a mortality rate of 6.9%.(14) A hospital-based retrospective analysis was conducted on 175 pediatric diabetic ketoacidosis children, who were admitted to the emergency units of two hospitals in Addis Ababa from September 2015 to February 2020, Out of the 175 children admitted, 12 passed on, resulting in a mortality rate of 6.9%.(15)

2.4. Determinants of treatment outcome in children with DKA

2.4.1. Socio-demographic factors

Race does not appear to have any influence on the likelihood of developing diabetic ketoacidosis, but immigrant communities may be at a higher risk of problems in established cases. Although no difference in diabetic ketoacidosis rates between the sexes is observed at diagnosis and during early childhood, adolescent girls with diabetes are more likely to develop diabetic ketoacidosis than adolescent boys (16). Infants and children younger than 5 years are at the greatest risk of presenting with diabetic ketoacidosis because the diagnosis of diabetes in younger children is more difficult and is more likely to be delayed. Adolescents are more likely to develop diabetic ketoacidosis after the diagnosis of diabetes

DKA can also develop in children with previously diagnosed T1D; the incidence is 1—10%. The risk is higher in children who omit insulin, who had diarrhea and vomiting during viral infections, and in puberty the retrospective study performed in the PICU, Clinical Hospital Centre Rijeka, in Croatia shows, 17.2% of children admitted to the PICU due to DKA had previously diagnosed T1D (10/58). All were older than 9 years, i.e., in prepubertal, pubertal, and/or post pubertal age (17)

2.4.2. Clinical profile of children with DKA

Clinical profile of children with DKA involves sign and symptoms such as polyphagia, polyuria, polydipsia, abdominal pain, vomiting, diarrhea, dehydration and loss of consciousness and other biochemical parameters that are determined by laboratory like hypo/hypernatremia, hypo/hyperkalemia, and hypo/hyperglycemia, PH, bicarbonate and creatinine level.

A hospital-based retrospective analysis was conducted on 175 pediatric diabetic ketoacidosis children, who were admitted to the emergency units of two hospitals in Addis Ababa from September 2015 to February 2020 Out of the 175 patients, this research found that 90.3% had signs of dehydration while the least clinical presentation was shock which accounted for 8.6%. The most frequent clinical findings were polyuria and polyphagia each accounting for 85.7% of the symptoms. In this study Nocturia and polyphagia were presented as rare manifestations. Almost half of the patients presented with loss of consciousness. 74.3% of the participants had weight loss, and 58.9% of the participants had vomiting. (15)

The prospective study conducted over a period of two years in Kasturba Medical College, Manipal Karnataka, India shows Nausea and vomiting were the most common symptoms (63.33%) of DKA patients in our study, followed by pain abdomen (43.33%). One third (33.33%) of patients were dehydrated. Altered sensorium was seen in 30% of patients. 26.66% of patients were complaining of polyuria and polydipsia. Only 16.66% of patients had kussmaul breathing and 13.33% had hypotension. Symptoms related to precipitating cause were present in 60% of patients. (12,13)

A case control study conducted in Chennai, south India from February 2013 to February 2015, showed that altered sensorium (loss of consciousness) with p-value 0.04 and vomiting (p=0.024) at presentation were the identified sign and symptoms that increase the risk of mortality of children with DKA even if the other symptoms like polyphagia, polydipsia, dyspnea and abdominal pain were the most presented manifestation among DKA children (12).In Africa, Kenya, Congo as well as Nigeria altered level of consciousness (OR 5.2 (95% CI 1.1-25.1)), (p= 0.007) (OR 6.76 (1.29- 160.26) (p=0.024) and (OR 3.2(1.23-67.24) (p=0.45) was respectively a significant factor for death of children with DKA (39) (40), 42).In a retrospective study conducted in South India, PH venous level less than 7.15 (p=0, 04) and serum bicarbonate concentration less than10 mEQ/L (0.006) were the factors which have great contribution for half mortality of children diagnosed with DKA(12). And another study conducted in this place about risk factors of poor outcome of diabetic ketoacidosis also showed that lower pH (p-0.009) and lower bicarbonates (p-0.035) were the factors associated to mortality of children with DKA (13).

A research conducted in South India and two researches in Pakistan showed that random blood sugar (RBS) greater than 700 mg/dl (p=0,032), >300 mg/dL and >500 mg/dl) 2.1(1.0-23.4) (p=0.04) respectively were a significant factor for the death of children with DKA (38), (43),(44). As research done in Pakistan about clinical characteristics, precipitating factors and predictor of DKA revealed that markedly low pH, serum bicarbonate, and high serum potassium at the time of presentation were the identified determinant factors for death patients with diabetic ketoacidosis (18). And also research conducted in Karachi tertiary hospital in Pakistan showed that hyponatremia (<130Meq/l) with odds of 3.1(0.2-13.6) at p-value 0.04, serum Potassium level (< 2.5 mEq/l) (hypokalemia) (OR; 3.7, 95% CI1.4-4.8) with p=0.03 were a significant risk factors for mortality of children with DKA(19). Research done in Nigeria regarding to outcome of DKA in children and adolescent showed that high serum creatinine level and decreased urine output were the associated factors for mortality of children and adolescent (19). In addition research conducted in Kenya showed that high risk of mortality was reported among children who had high serum creatinine (OR 5.8 (95% CI 1.6-21.2)) and decreased urine output (OR 9.0 (95% CI 2.2-37.3))(14). On the other hand research done in Congo showed that dehydration (p = 0.0006), hemodynamic disorders (p= 0.0006), and diarrhea (p= 0.001) were a significant factors for the death of children with DKA (20) Observational study was conducted in China about clinical characteristics and outcome of DKA. According to this report, children with mild DKA were improved two times faster than those children with severe diabetic ketoacidosis(21).

Whereas a cross-sectional study conducted in Hawassa comprehensive specialized hospital about occurrence and associated factor of DKA among children revealed that moderate and severe DKA were associated with for death children with DKA (22).

2.4.3. Comorbidities and complications before or after admission of children with DKA

Reported mortality rates for DKA are consistent in developed countries, ranging from 0.15 to 0.31 percent in national population studies in Canada, the United Kingdom, and the United States. Cerebral injury accounts for the majority of deaths (60 to 90 percent). Mortality is substantially higher in resource-limited settings. Cerebral injury occurs in 0.3 to 0.9 percent of children with DKA and has a high mortality rate of 21 to 24 percent. it generally develops during the first 12 hours of treatment but can also occur before treatment. Throughout the course of treatment for DKA, all children should be carefully monitored for signs and symptoms that suggest cerebral injury, which include changes in mental status, urinary incontinence, and new headache or recurrence of vomiting. (32)

Other complications include; Cognitive impairment, Venous thrombosis, Acute kidney injury, acute pancreatitis cardiac arrhythmias resulting from electrolyte derangements, pulmonary edema, multiple organ dysfunction syndrome, and intestinal necrosis. (32)

2.4.3.1 Precipitating factors of DKA

The most common events are infection (often pneumonia or urinary tract infection) and omission or inadequate use of insulin therapy Poor compliance with the insulin regimen, and New-onset type 1 diabetes. A retrospective Cross Sectional Study done on Type 1 Diabetic Children<15 Years Admitted With DKA in Bahir Dar City Public Referral Hospital, North West, Ethiopia, shows the most common precipitating factor was found to be infection 56.2% (like pneumonia 16%, UTI 14.8%, URTI 10.2%, AGE 10.5% and others 4.7%) (11). Another institution-based cross-sectional design with a retrospective chart review was conducted in two hospitals Tikur Anbessa Specialized Hospital (TASH) and Yekatit 12, both located in Addis Ababa, Ethiopia, shows Infection was the most common precipitating factor in 24.3% (n = 46); the associated infections being pneumonia (n = 18), urinary tract infection (n = 14), acute gastroenteritis (n = 7), upper respiratory tract infection (n = 6) and meningitis (n = 1). Drug discontinuation was the second common precipitating factor 16.3% (n = 31), and no precipitating factor was identified in 52% (n = 99) (15)

Children who have DKA may have different comorbidities or may develop serious complications before and after admission to hospital. These comorbidities such as: sepsis, different types of infections, malnutrition and complications such as cerebral edema, shock, intracranial thrombosis or infarction, acute tubular necrosis with acute renal failure can affect the treatment outcome of children with DKA (3). Research conducted at tertiary care hospital in south India showed that sepsis and peritonitis were the identified cause for mortality of children with DKA (13). A similar study conducted in India also showed that urinary tract infection, skin and soft tissue infection like cellulitis and boils were the most risk factors for mortality of children who have diabetic ketoacidosis (23). While according to study conducted in Pakistan among 88 children with DKA revealed that presence of infections like sepsis as well as respiratory tract infections at (p-0.029) were majorly related factors for the mortality of children with diabetic

ketoacidosis (24). In addition, research done in Bangladesh showed that septicemia and respiratory tract infections like pneumonia accounts for 40% and 20% death of children death with DKA respectively (25). In Ethiopia, retrospective observational study done in Tigray showed that sepsis was a cause for 27.3% of death of children diagnosed with DKA (5)

Limitation Since the data was collected from medical records, the detailed treatment protocol and some of the important laboratory results were not addressed in all most all study done in different hospital in Ethiopia.

2.4.4. Conceptual framework

The following conceptual framework shows association between independent variables with dependent variable which is developed after reviewing many literatures the dependent variable (treatment outcome of DKA) is affected by socio-demographic characteristics; clinical profile; complications and comorbidities of the child which are described below. (26,27)

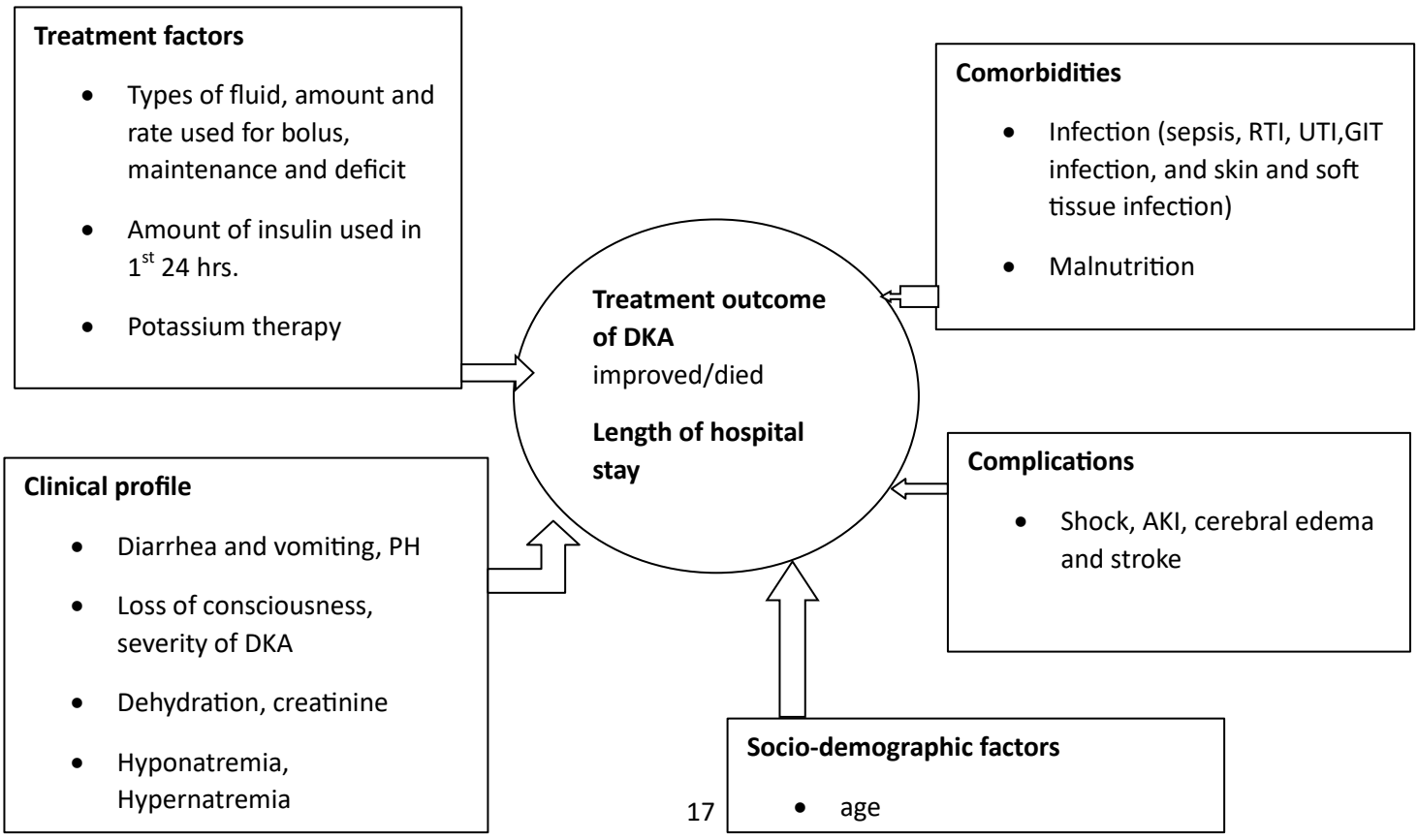

Fig 2.1 conceptual frame work of dka treatment outcomes and its determinants

Chapter Three

Objective

3.1 General objective

To assess the treatment outcome of diabetic ketoacidosis and its determinants among children in Wolkite University Specialized and Teaching hospital in Central Ethiopia region Gurage zone, ETHIOPIA from, 2019- 2024.

3.2 Specific objective

1. To determine the magnitude of bad treatment outcome among children admitted with the diagnosis of diabetic keto-acidosis to wolkite university specialized hospital, Gurage zone, central, Ethiopia, Ethiopia from 2019-2004.
2. to identify determinants of treatment outcome of diabetic ketoacidosis among children in Wolkite University Specialized and Teaching hospital in Central Ethiopia region Gurage zone, Ethiopia from 2019- 2024
3. To identify precipitating factors for DKA among children who is admitted in Wolkite University Specialized and Teaching hospital in Central Ethiopia region Gurage zone, Ethiopia from 2019-2024.
4. To access the determinants of prolonged hospital stay among children admitted with the diagnosis of diabetic keto-acidosis to wolkite university, Gurage zone, central Ethiopia, Ethiopia from 2019-2024.

Chapter Four

4. METHODS AND MATERIALS

4.1 The study area

The study was conducted in Wolkite University Specialized Hospital of Gurage zone in central Ethiopia regional state which is found in wolkite town at Gubrae sub-city. It was established on august 5/2019G.C that is found in south west direction 166km far from Addis Ababa (capital City of Ethiopia). This hospital has provided health care service for population of Gurage zone and its surrounding in Oromia region such as silk amba and keta wayu as their primary catchment areas and it gives a service for more than 4 million of catchment area population.

Wolkite town is a second administrative center of central Ethiopia regional state and gurage zone which has a latitude and longitude of 8 degree17N37degree47E and an elevation between 1910 and 1935 meter above sea level. According to the statistics obtained from Wolkite's Town Municipality, the population was 70,796 out of which 35, 848 were males and 34,948 females.

Wolkite university specialized hospital contains a medical, surgical, pediatric, gynecological and obstetric and psychiatric ward. In addition, it has an ICU, NICU, opd at each respective department. The total number of staff of the hospital is 406 including 11 surgeon, 5 gynaecologist-obstetrician, 9 internist, 8 paediatricians, 59 residents, 23 general practitioners, 10 health officers, 9 anaesthetists, 1 dentist, 2 psychiatrist, 2 ophthalmologist, 2 radiologist, 1 pathologist, 128 nurses, 25 laboratory technologists, and 24 pharmacists.

The total numbers of 9582 pediatric patients were admitted to pediatric emergency in WUSH over the past 5years. Among this 120 were diagnosed as type 1 DM patients from this around 86 were diagnosed as DKA with or without precipitant factor.

4.2. Study period

The study was conducted from November 12, 2024 to December 2, 2024.

4.3. Study design

Five years retrospective institutional based cross-sectional study

4.4. Population

4.4.1. Source population

All children below 15 years who were admitted with DKA diagnosis and treated in Wolkite university specialized and teaching hospital from November 18, 2019 to November 18, 2024.

4.4.2. Study population

All eligible children below 15 years admitted for DKA management and treated in wolkite specialized hospital from November 18, 2019 to November 18, 2024 for who fulfill the inclusion criteria.

4.5. Inclusion and exclusion criteria

4.5.1. Inclusion criteria

The **c**hildren under the age of 15 who were diagnosed as DKA and receive its treatment in Wolkite University specialized hospital from November 18, 2019 to November 18, 2024

4.5.2. Exclusion criteria

The study excludes children under the age of 15 with DKA who do not have complete record, lost cards, leave against medical advice and transferred to other hospitals.

4.6. Sample size determination

In this retrospective study, we aimed to evaluate the treatment outcome of DKA in WUSH in the past 5 years. Due to the limited number of cases available for analysis we planned to take all DKA patient who was admitted and treated in wolkite university specialized hospital. The sample size in this retrospective study was determined by using a single population formula by considering the following statistical assumptions.

P= sample proportion (50%), Z α/2 = the corresponding Z score of 95% CI, d= Margin of error (5%), n= Sample size

$$n= Z (a/2)^2 P (1-P) /d^2=$$

we take p value 13.3%= 0.133 from the institutional based retrospective cross-sectional study done 3 years back on treatment out-come and determinants of diabetic keto-acidosis among children admitted to Debre-Tabor and Gonder Referral Hospitals, Ethiopia with the diagnosis of diabetic keto-acidosis from February 8, 2021 to March 8, 2021.

This makes $n=(1.96)^2(0.133)(0.867)/ (0.05)^2=177.19=178$

Since the total population (86) is less than 10,000, we can use correction formula

Fn = ((n/1+n/N))= 178/1+178/86=57.98=58 Where FN=final sample size n=sample size N=Total number of DKA patient.

After addition of 5% sample for missing and incomplete data, the final sample size is 61 of

under-15 children with DKA.

4.6.1. Sampling technique

The numbers of DKA children who visited wolkite university specialized hospital from November 18, 2019 to November 18, 2024.

Systematic random sampling technique was used to select the charts. **K** value was calculated by dividing the number of DKA patient in WUSH by the number of sample size which is allocated for WUSH.

K=N/Fn=86/61=1(which indicate almost all patient cards or charts should included in study)

4.7. Variables

4.7.1. Dependent variable

Treatment outcome (improved/died)

Length of hospital stay

4.7.2. Independent variable

Socio-demographic variables: (Age, Sex, Residency)

Clinical profiles

- Poly symptoms, fever, Abdominal Pain, Nausea and Vomiting, Loss of consciousness or Altered Mental status, Dehydration, RBS level, K level, Clinical severity of DKA, &DKA recurrence.

Complications

Dehydration, Shock, Electrolyte disturbance, cerebral edema, pulmonary edema, acute kidney injury, increase stroke risk.

Comorbidity

Respiratory tract infection, Urinary tract infection, gastrointestinal infection, Sepsis, cerebral edema and Malnutrition.

Treatment factors

Rate, volume &Type of fluid used for resuscitation, maintenance fluid, dose regular insulin administration, Potassium replacement therapy, precipitating factors, Patient and parent education and follow up care.

4.7.3. Operational definition

Children: - The child whose age is less than 15 years

Treatment outcome: - In hospital mortality or improvement patients from DKA

Improved: Are those children free from urine ketone and random blood sugar < 200mg/dl and discharge well.

Died: those children discharge as death

Prolonged hospital stays if patient stay in hospital for more than 7 days for DKA management

Diabetic ketoacidosis: child random blood sugar > 300mg/dl, PH< 7.3 and urine ketone positive.

Co-morbidities: additional medical conditions presented in children with DKA.

Medication compliance: A patient correctly follows the prescribed medication regimen according to the healthcare provider's instructions

Recurrent DKA: Above one-episode DKA presentation

4.8. Data collection tool

Data collection was done by using checklist prepared in English. The data extraction check list was adopted from different literatures (26,27,22). The checklist contains socio demographic variables, clinical profiles, comorbidities and complications, management protocols {fluid resuscitation, insulin therapy, potassium replacement therapy, complication management} and treatment outcome of DKA.

4.9. Data collection procedure

Records of the eligible children was retrieved from registration book. Then medical registration number (MRN) of all diabetic ketoacidosis pediatric patients was sorted. Then selected randomly one chart out k charts. After this, systematic simple random method was applied to select the study subject. Four medical interns were selected for data collection, and data organization and two Advisors was selected to supervise.

4.10. Data Quality Control

During data collection, regular follow up was be held by two advisors. Completeness and consistency were checked for each data. The collected information was rechecked for its completeness and consistency by the advisors and the principal investigator before transferring into computer software.

4.11. Data processing and analysis

After the necessary data was collected, it was entered, categorized, coded and summarized and then, exported to SPSS version 27.0.1 for further analysis. Descriptive statistics was done using percentages and frequency for categorical variables and mean and stander deviation for continuous variables. After binary logistic regression a p-value ≤0.25 was used as a cut of point to entered variables in to multivariate logistic regression. Variables which have $P<0.05$ was considered as statistically significant. The strength of statistical association was measured by odds ratio and 95% of confidence intervals. In addition, Fisher exact test was used to evaluate associations degree between categorical determinants (loss consciousness, serum potassium level, serum creatinine, cerebral oedema, renal failure, shock, amount of iv bolus fluid used, amount of insulin)) and treatment outcome (death & improvement). Fisher exact test was chosen because contingency table cells contained fewer than 5 observations (death=4). The result of the study was presented in table, graph and charts.

4.12. Ethical Considerations

The ethical clearance was obtained from College of Medicine and Health Science & additional permission was obtained from the Wolkite University and Specialized Hospital administrative and department head. Confidentiality was guaranteed by excluding names or any other personal identifiers from data gathering sheets and reports. The identifier for each eligible subject placed by a code.

4.13. Dissemination of the Study

The result of the study:

✓ Will be submitted and presented to Wolkite university college of medicine and health science, School of medicine

✓ Will also be submitted to WUSH.

CHAPTER FIVE

RESULT

5.1 Socio-demographic characteristics of the study participants

Among 86 DKA children, 45(52.3%) were females and 52(60.5%) were urban residents The age of the DKA children ranges from 1 year up to 15 years with a mean age of 9.11 years and majority of the children were found in the age category of 5-10 years.

Table 1: Distribution of socio-demographic characteristics of children with DKA admitted to wolkite university specialized hospital, Gurage zone, central Ethiopia, Ethiopia, 2019-24 G.C

Characteristics	**Category**	**Frequency(N=86)**	**Percentage (%)**
Age of children	< 5 years	15	17.4
	5-10 years	42	48.8
	>10 years	29	33.7
Sex of child	Male	41	47.7
	Female	45	52.3
Residence of children	Urban	52	60.5
	Rular	34	39.5

5.2 Clinical profile of children with DKA

5.2.1 Clinical feature of children

Among 86 DKA patient, 78(90.7%) of patient presented with poly symptoms, abdominal pain were reported by 68(79.1%) of children with DKA and vomiting was presented in 59(68.6%) children and 24(29.7%) of children had fever. Nearly half of DKA children had sign of dehydration (43.7%) and 14(16.3%) of children was presented with altered mentation.

Table 2: clinical profile of children with DKA admitted to wolkite university specialized hospital, Gurage zone, central Ethiopia, Ethiopia, 2019-24 G.C

Variable	**Category**	**frequency**	**Percentage**

Diarrhea	Yes	15	17.4
	No	71	82.6
Vomiting	Yes	59	68.6
	No	27	31.4
Abdominal pain	Yes	68	79.1
	No	18	20.9
Loss of consciousness	Yes	14	16.3
	No	72	83.7
Dehydration	Yes	38	43.7
	No	48	55.2
Poly symptoms	Yes	78	90.7
	No	8	9.3
Fever	Yes	24	27.9
	No	62	70.9

5.2.2 Biochemical profile of children

Regarding biochemical profile of children, hypokalemia accounts 33(37.9%) And hyponatremia accounts 4(4.7%), random blood glucose level ranges from 300-600 mg/dl in 58(67.4%) of chidren which account for more than half of children. serum creatinine was raised in 12(13.8%) of children and 86(100%) of children had type 1 DM of which newly diagnosed DM accounts for 55(64%). And 16(18.6%) of children had recurrent DKA.

Table 3: biochemical profile of children with DKA admitted to wolkite university specialized hospital, Gurage zone, central Ethiopia, Ethiopia, 2019-24 G.C

Characteristics	Category	frequency	Percentage
Random blood glucose level in mg/dl	<300 mg/dl	1	1.2
	300-600 mg/dl	58	67.4
	>600 mg/dl	27	31.4
Serum concentration of sodium in mmol/l	<136 mmol/l	4	4.7
	136-145 mmol/l	78	90.7
	>145 mmol/l	4	4.7
Serum concentration of potassium in mmol/l	<3.5 mmol/l	33	37.9
	3.5-5.5 mmol/l	50	58.1
	>5.5 mmol/l	3	3.4
Creatinine level in mg/dl	<1.2 mg/dl	74	85.1
	>1.2 mg/dl	12	13.8
Type of DM	Type 1	86	100
	Type 2	0	0
Time of diabetes	New	55	64

diagnosis	Known	31	36
Recurrent DKA	YES	16	18.6
	NO	70	81.4
Compliance to medication	Yes	12	38.7
	No	19	61.3

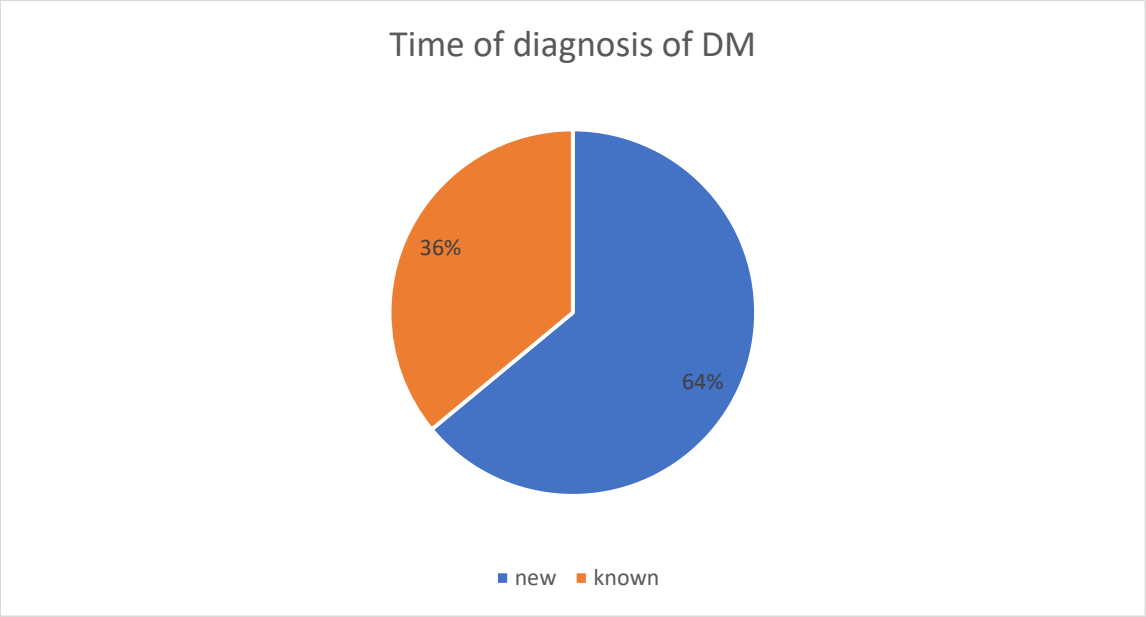

Fig 5.1 proportion of time of diagnosis of diabetic mellitus in children presented with DKA

Urine ketone level and clinical severity of DKA children

Out of 86 children with DKA, about 23 (26.4%) of them had +1 and trace urine ketone level, 27(31%) of them had urine ketone level +2 and the rest approximately 36 (41.4%) of had urine ketone level +3 and +4

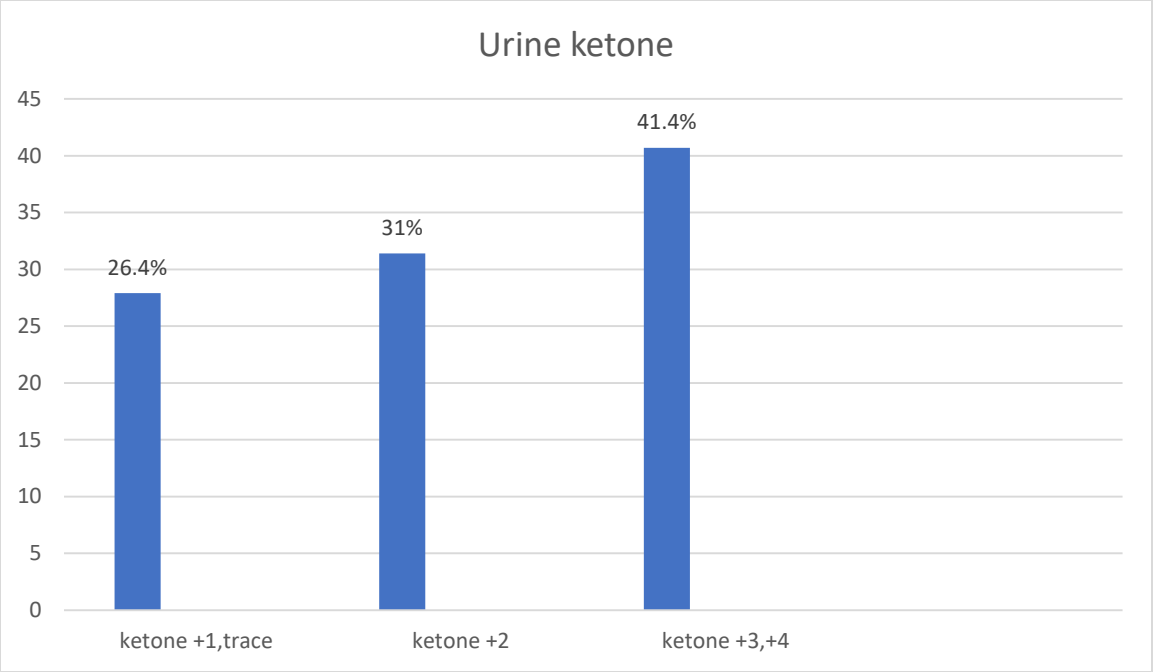

Fig 5.2 urine dipstick ketone level of children with DKA

From a total of 86 DKA children, about 59(67.8%) of them had mild DKA, 22(25.3%) of them had moderate DKA and the rest 5(5.7%) had severe DKA

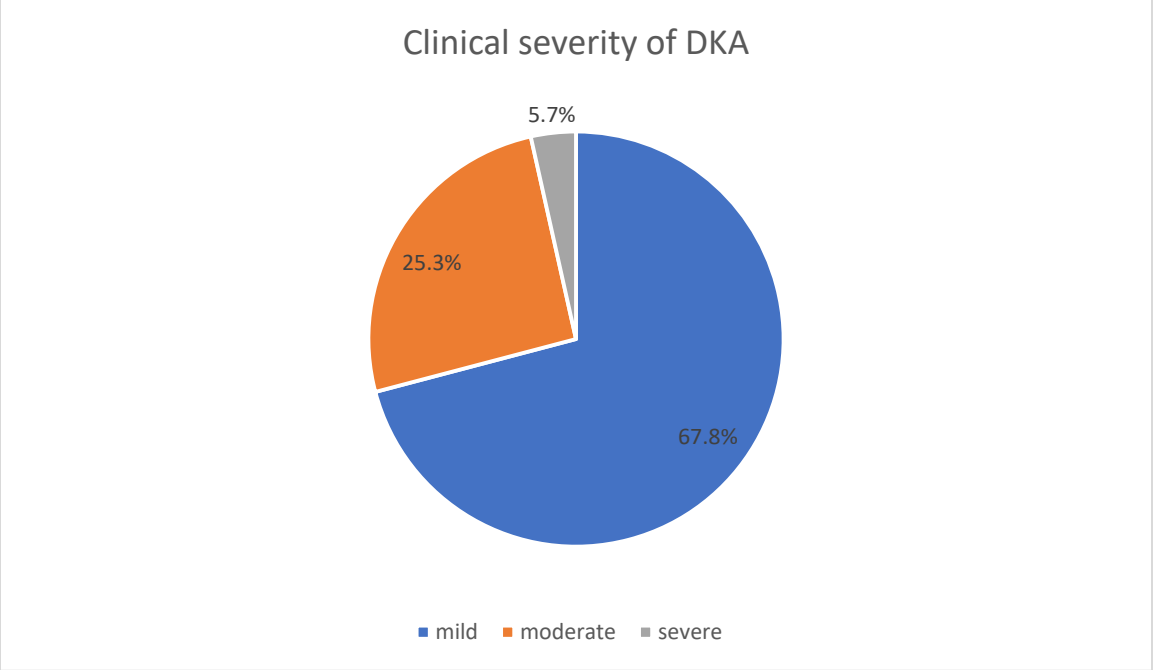

Fig 5.3 clinical severity of children presented with diabetic keto-acidosis

5.3 Comorbidities of children with DKA

Among 86 children with DKA, about 7(8.1%) had respiratory tract infections, urinary tract infections accounts for 8(9.3%) and gastrointestinal infections 7(8.1%). In addition, malnutrition accounts for 4(4.7%). From a total of malnourished children, half 2(50%) of them had non edematous, and 2(50%) had edematous malnutrition.

Table 4: comorbidity of children with DKA admitted to wolkite university specialized hospital, Gurage zone, central Ethiopia, Ethiopia, 2019-24 G.C

Characteristics	Category	frequency	Percentage
Sepsis	Yes	6	7
	No	80	93
Respiratory tract infection	Yes	7	8.1
	No	79	91.9
Gastrointestinal infections	Yes	8	9.3
	No	78	90.7
Skin and soft tissue infection	Yes	2	2.3
	No	84	97.7
Urinary tract infection	Yes	8	9.3
	No	78	90.7
Malnutrition	Yes	4	4.7
	No	82	95.3
Type of malnutrition	Edematous	2	2.3
	Non edematous	2	2.3

5.4 Precipitating factors of DKA

About 74(86%) of DKA patients had known precipitating factor for DKA. The predominant precipitating factor of DKA was new onset T1DM 55(63.4%) followed by poor compliance to antidiabetic treatment (22%) and infections (15.5%), respectively. About 12 (14%) patients had no known precipitating factor. Urinary tract infection was the most common infection 13(30%) that precipitated DKA and respiratory tract infection 9 (20.9%) was the second most common infection that precipitate DKA.

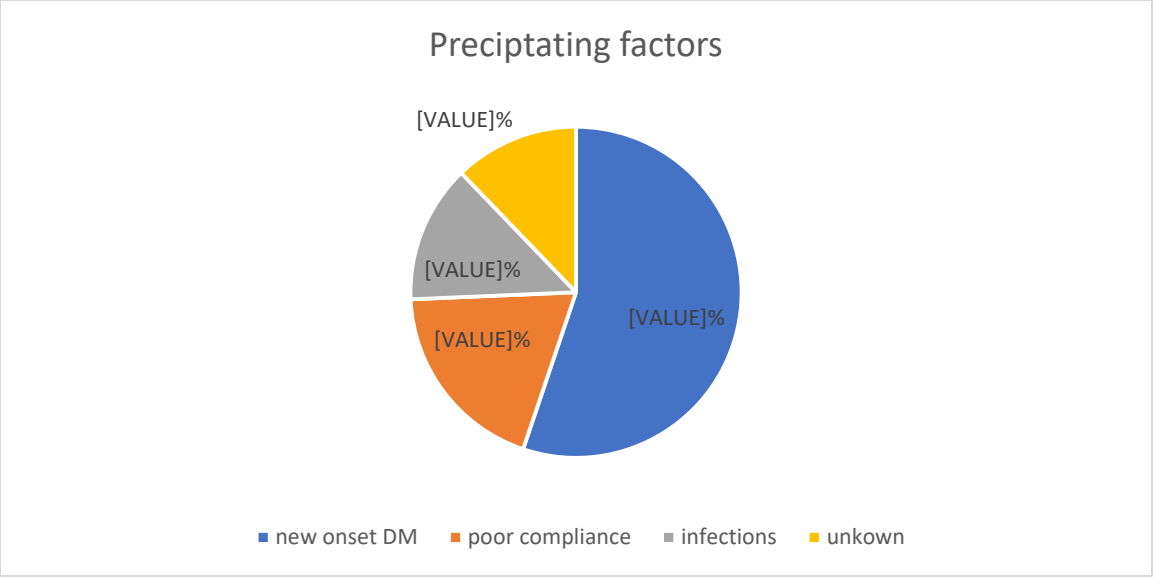

Fig1.4 precipitating factors of children presented with diabetic keto-acidosis

5.5 Complications of children with DKA

Among 86 children with DKA, 8(9.2%) have renal failure, 5(5.8%) had shock, 2(2.3%) had cerebellar edema and 1(1.2%) had hypoglycemia.

Table 5: complication of children with DKA admitted to wolkite university specialized hospital, Gurage zone, central Ethiopia, Ethiopia, 2019-24 G.C

Characteristics	Category	frequency	Percentage
Cerebral edema	Yes	2	2.3
	No	84	97.7
Acute renal failure	Yes	8	9.2
	No	78	89.7
Pulmonary edema	Yes	0	0
	No	86	100
Shock	Yes	5	5.8
	No	81	94.2
Other complications(hypoglycemia)	Yes	1	1.2
	No	85	98.8

5.6 Management protocol of DKA children

Regarding management protocol of DKA children, the most commonly type of fluid used for bolus and maintenance were 0.9% normal saline 72(83.7%), and 1/3rd NS &2/3rd D10 74(86%) respectively. 48(55.8%) of respondents required 1-2 litter of total fluid for maintenance and 50(58.1%) took the maintenance fluid at rate of 50-100 ml/hr. From the total insulin administered in the first 24 hour, 44(51.2%) were take 25-50IU and 19(22.1%) got potassium replacement. Among 86 patient 7(8.1%) of children was stayed in hospital above 6 days. Regarding to outcome of treatment 82(95.3%) was improved and 4(4.7%) was died

Table 6: management protocols of children with DKA admitted to wolkite university specialized hospital, Gurage zone, central Ethiopia, Ethiopia, 2019-24 G.C

Characteristics	Category	Frequency	Percentage
Type of iv fluid bolus	Normal saline	72	83.7
	Ringer lactate	14	16.3
Amount of iv fluid bolus	<1 liter	55	64
	1-2 Liter	29	33.7
	>2 liter	2	2.3
Type of fluid used for maintenance and deficient used in the management	Normal saline	1	1.2
	Ringer lactate	5	5.8
	DNS	6	7
	1/3rd NS & 2/3rd D10	74	86
Rate of fluid use for maintenance and deficient in the management	<50 ml/hr	33	38.4
	50-100 ml/hr	50	58.1
	>100 ml/hr	3	3.5
Amount of fluid used maintenance and deficient in the management	< 1 liter	12	14
	1-2 liter	48	55.8
	>2liter	26	30.2
Amount of regular insulin administered in the first 24 hour	<25 IU	40	46.5
	25-50 IU	44	51.2
	>50 IU	2	2.3
Potassium replacement	Yes	19	22.1
	No	67	77.9
Hospital stays	< 7 days	47	54.7

	>=7 days	39	45.3
Average length of hospital stays		6.13±2.98 days	
Minimum length of hospital stays		2 days	
Maximum length of hospital stays		14 days	
Treatment outcome	Improved	82	95.3
	Died	4	4.7

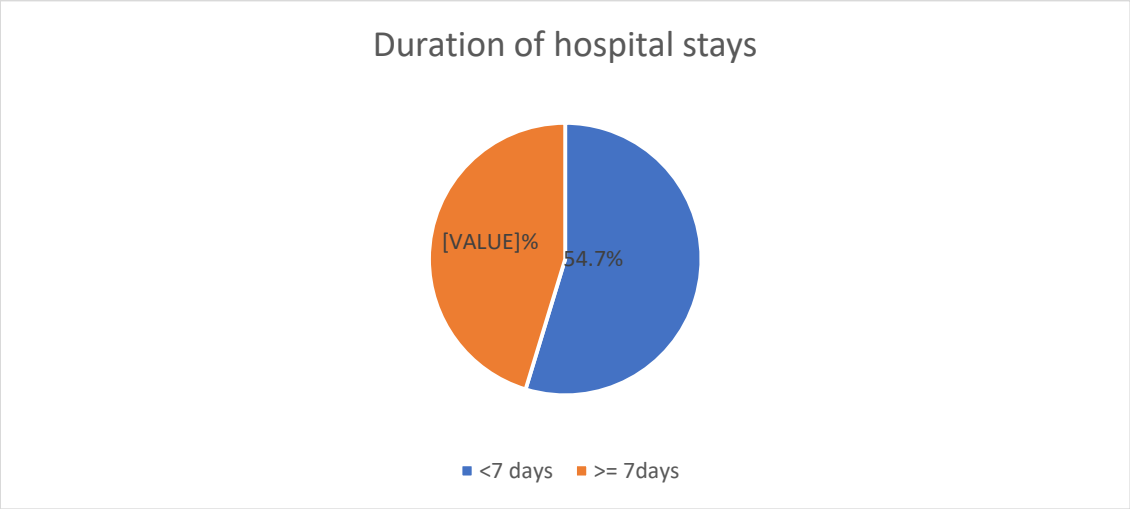

Fig 5.5 duration of hospital stays of children presented with diabetic keto-acidosis

Factors associated with treatment outcome (death) of children with DKA

Seven variables were identified as associated factor for death of children with DKA after chi-square test and fisher exact test analysis was run. We didn't do the multi-viriate logistic regression because the sample size is small and the out-come variable is small (the frequency of death was 4 which is < 10% of respondent) After running chi-square and fisher exact test, acute renal failure, shock, loss of consciousness, cerebellar edema, sepsis, serum creatinine elevation, serum potassium level, and amount of regular insulin given were identified as factors associated with death of children with DKA.

Table 7: Distribution of factors associated with treatment outcome of DKA children admitted to wolkite university specialized hospital, Gurage zone, central Ethiopia, Ethiopia, 2019-24 G.C

Chi-Square Tests ***Loss of consciousness***	***Value***	***df***	***Asymptotic Significance (2-sided)***	***Exact Sig. (2-sided)***	***Exact Sig. (1-sided)***	***Point Probability***

Pearson Chi-Square		10.614	1	0.01	0.13	0.13	
Continuity correction		6.576	1	0.1			
Likelihood Ratio		7.268	1	0.07	0.13	0.13	
Fisher-Freeman-Halton Exact Test					0.13	0.13	
Linear-by-Linear Association		10.49	1	0.01	0.013	0.13	0.012
N of Valid Cases		86					
Symmetric Measures		***Value***	***Approximate Significance***	***Exact Significance***			
Nominal by Nominal	Phi	-0.351	0.001	0.013			
	Cramer's V	0.351	0.001	0.013			

Chi-Square Tests ***Serum k+ level***		***Value***	***Df***	***Asymptotic Significance (2-sided)***	***Exact Sig. (2-sided)***	***Exact Sig. (1-sided)***	***Point Probability***
Pearson Chi-Square		8.236	2	0.016	0.042		
Likelihood Ratio		4.756	2	0.093	0.042		
Fisher-Freeman-Halton Exact Test		7.458			0.042		
Linear-by-Linear Association		0.000	1	1.000	1.000	0.847	0.694
N of Valid Cases		86					
Symmetric Measures		***Value***	***Approximate Significance***	***Exact Significance***			
Nominal by Nominal	Phi	0.309	0.016	0.042			
	Cramer's V	0.309	0.016	0.042			

Chi-Square Tests ***Seum creatinine***		***Value***	***Df***	***Asymptotic Significance (2-sided)***	***Exact Sig. (2-sided)***	***Exact Sig. (1-sided)***	***Point Probability***
Pearson Chi-Square		36.775	2	<0.001	<0.001		
Likelihood Ratio		15.48	2	<0.001	<0.001		
Fisher-Freeman-Halton Exact Test					<0.001		
Linear-by-Linear Association		15.075	1	<0.001	0.001		0.001
N of Valid Cases		86					
Symmetric Measures		***Value***	***Approximate Significance***	***Exact Significance***			
Nominal by Nominal	Phi	0.654	<0.001	0.001			
	Cramer's V	0.654	<0.001	0.001			

Chi-Square Tests ***Cerebellar edema***		***Value***	***Df***	***Asymptotic Significance (2-sided)***	***Exact Sig. (2-sided)***	***Exact Sig. (1-sided)***
Pearson Chi-Square		20.741	1	0.00	<0.001	0.047
Likelihood Ratio		6.398	1	0.03	<0.001	
Continuity correction		4.692	1	0.11	0.047	0.047
Fisher-Freeman-Halton Exact Test					0.047	0.047
Linear-by-Linear Association		20.5	1	<0.001	0.001	
N of Valid Cases		86				
Symmetric Measures		***Value***	***Approximate Significance***	***Exact Significance***		
Nominal by Nominal	Phi	-0.491	0.001	0.047		
	Cramer's V	0.491	0.001	0.046		

Chi-Square Tests ***Renal failure***	***Value***	***Df***	***Asymptotic Significance (2-sided)***	***Exact Sig. (2-sided)***	***Exact Sig. (1-sided)***	***Point Probability***
Pearson Chi-Square	21.46	1	0.001	0.002	0.002	
Likelihood Ratio	11.07	1	0.001	0.002		
Continuity correction	14.072	1	0.001			
Fisher-Freeman-Halton Exact Test				0.002	0.002	

Linear-by-Linear Association		15.075	1	0.0021	0.002	0.002	0.002
N of Valid Cases		86					
Symmetric Measures		***Value***	***Approximate Significance***	***Exact Significance***			
Nominal by Nominal	Phi	-0.5	0.001	0.002			
	Cramer's V	0.5	0.001	0.002			

Chi-Square Tests ***shock***		***Value***	***df***	***Asymptotic Significance (2-sided)***	***Exact Sig. (2-sided)***	***Exact Sig. (1-sided)***	***Point Probability***
Pearson Chi-Square		67.961	1	0.000	0.000	0.000	
Likelihood Ratio		27.35	1	0.000	0.000		
Continuity correction		51.119	1	0.000			
Fisher-Freeman-Halton Exact Test					0.000	0.000	
Linear-by-Linear Association		67.17	1	0.000	0.000	0.000	0.000
N of Valid Cases		86					
Symmetric Measures		***Value***	***Approximate Significance***	***Exact Significance***			
Nominal by Nominal	Phi	-0.889	0.000	0.00			
	Cramer's V	0.889	0.000	0.00			
Chi-Square Tests ***Regular insulin***		***Value***	***df***	***Asymptotic Significance (2-sided)***	***Exact Sig. (2-sided)***	***Exact Sig. (1-sided)***	***Point Probability***
Pearson Chi-Square		9.847	2	0.007	0.05	0.002	
Likelihood Ratio		4.156	2	0.125	0.163		
Fisher-Freeman-Halton Exact Test		5.708			0.05	0.002	
Linear-by-Linear Association		15.075	1	0.471	0.643	0.395	0.282
N of Valid Cases		86					
Symmetric Measures		***Value***	***Approximate Significance***	***Exact Significance***			
Nominal by Nominal	Phi	0.338	0.007	0.056			
	Cramer's V	0.338	0.007	0.056			

associated factors for death of children with DKA

Factors associated with treatment hospital stay (prolonged hospital stays) of children with DKA

Five variables were identified as associated factor for prolonged hospital say among children with DKA after bivariate logistic regression analysis was run. After adjusting in multivariate logistic regression; respiratory tract infection, loss of consciousness, dehydration, degree of clinical severity, and serum creatinine elevation were identified as significant factors affecting length of hospital stays of children with DKA

Table 8: Distribution of factors associated with pronged hospital stay among children admitted to wolkite university specialized hospital, Gurage zone, central Ethiopia, Ethiopia, 2019-24 G.C

Characteristics	Hospital stays		COR (CI95%)	p-value	AOR (CI 95%)
	= >7 days	< 7 days			
Respiratory tract infection	Yes 6	1	8.3(2.03-19.43)	0.05	4.8(1.08-10.87)
	No 33	46			
Loss of consciousness	Yes 10	4	3.7(1.06-12.99)	0.04	3.9(1.24-8.904)
	No 29	43			
Serum CR. Elevation	Yes 9	3	4.4(1.1-17.6)	0.020	4.7(1.4-9.4)
	No 30	44			
Clinical severity	Mild 39	20	1.9(1.028-10.7)	0.021	2.21(1.04-6.85)
	Moderate 7	15	2.14(1.03-9.04)	0.04	3.82(1.23-7.43)
	Severe 4	1	3.53(1.009-8.05)	0.046	4.2(1.84-9.21)
Dehydration	Yes 27	11	7.3(2.8-19.2)	0.01	4.98(1.34-15.78)
	No 12	36			

CHAPTER SIX

DISCUSSION

The aim of this study was to determine treatment outcome and to identify determinant factors of DKA in children and to identify factor associated with prolonged hospital stay.

Regarding hospital stays, In our study the minimum hospital stay was two days and the maximum one was fourteen days with the average hospital stay was 6.13±2.98 days.

Respiratory tract infection, loss of consciousness, high serum creatinine level, degree of clinical severity, and dehydration were significantly associated with long hospital stay.

In this study, precipitating factors of DKA respiratory tract infection was increasing hospital stay 4.8 times higher than a patient who had no RTI. This result was in line with research done India [35]. Child who was dehydrated had 5 times higher risk to stay longer duration in hospital as compared to who had not a dehydration. Children with elevated serum creatinine are 4.7 times more likely to stay in hospital as compared to those children with normal serum creatinine, and those who presented with loss of consciousness stayed four times more as compared to those with no loss of consciousness ,similarly A retrospective Cross Sectional study done on Treatment Outcome and Associated Factors among Type 1 Diabetic Children <15 Years Admitted with DKA in Bahir Dar City Public Referral Hospital, North West, Ethiopia: shows A client with elevated serum creatinine during presentation is 4.28 times more likely to be stayed in the hospital than clients with normal serum creatinine elevation during their presentation (AOR=4.28, 95%CI=1.11 -15.52). (11). In addition, degree of clinical severity also had contribution to longer hospital stay. Mild DKA patient has 2.2 time higher to stay at hospital than DKA free patient but severe DKA patient had 4.2times non severe DKA. Patients with mild DKA had shorter length of stay than patients with severe DKA. A study done at Israel [36] and Libya [37] showed that length of hospital stay was worse in the severe DKA.

Regarding treatment outcome, In our study from a total of 86 children with DKA 82(95.3%) of them recovered and 4(4.7%) died. When compare with studies conducted in different area, percentage of children improved in this study were nearly the same as compared to studies done in two hospitals in Addis Abeba, Tikur anbesa specialized hospital and yikatit 12 (95.3 vs 93.14%). whereas, retrospective study done in tertiary care hospital in south india shows the mortality rate was 11%. which is higher than to our studies. A retrospective Cross Sectional study done on Treatment Outcome and Associated Factors among Type 1 Diabetic Children <15 Years Admitted with DKA in Bahir Dar City Public Referral Hospital, North West, Ethiopia: shows, the magnitude of mortality rate was 2.5% which is lower than the result of our study (11).

In our study Regarding to predictors of treatment outcome of DKA, from all clinical profile of children, altered mental status, and renal failure were among significant factors for death of children with DKA. Loss of consciousness had moderate association with treatment out-come of DKA (phi=0.351). renal failure had also moderate association with DKA treatment out-come(phi=0.5). Research done in Nigeria regarding to outcome of DKA in children and adolescent showed that high serum creatinine level and decreased urine output were the associated factors for mortality of children and adolescent (19). In addition, research conducted in Kenya showed that high risk of mortality was reported among children who had high serum creatinine (14). The scientific explanation for the association might be having renal failure children leads to those children to develop hyperkalemia, anemia and heart disease that increase morbidity and mortality of children

In our study Regarding biochemical profile of children with DKA, children with high serum creatinine had strong association with treatment out-come DKA (phi=0.654). Likewise, research done in Nigeria regarding to outcome of DKA in children and adolescent showed that high serum creatinine level and decreased urine output were the associated factors for mortality of children and adolescent (19). In addition, research conducted in Kenya showed that high risk of mortality was reported among children who had high serum creatinine (OR 5.8 (95% CI 1.6-21.2)) and decreased urine output (OR 9.0 (95% CI 2.2-37.3)) (14).

In our study Regarding to comorbidities of DKA children, renal failure and sepsis were associated factor for death of DKA children. Renal failure had moderate association and sepsis had strong association with DKA treatment out-come with (phi=0.5 & 0.71) respectively. The scientific reason for the association might be infections will result in production of counter regulatory hormones like adrenaline and cortisol that decreases the effect of insulin in glucose regulation (3). As a result of these, the severity of DKA increases with its complication. If it is not treated by adequate medication the children with DKA will die. Similarly, study conducted in Pakistan among 88 children with DKA revealed that presence of infections like sepsis as well as respiratory tract infections at (p-0.029) were majorly related factors for the mortality of children with diabetic ketoacidosis (24). In addition, research done in Bangladesh showed that septicemia and respiratory tract infections like pneumonia accounts for 40% and 20% death of children death with DKA respectively (25). In Ethiopia, retrospective observational study done in Tigray showed that sepsis was a cause for 27.3% of death of children diagnosed with DKA (5).

In our study Regarding to complication of DKA in children, shock, cerebellar edema and acute renal failure were the associated risk factors for the death of children. Related to shock, it had strong association with death of children presented with DKA (phi=0.889). The explanation for this association might be due to shock causes reduced oxygen delivery to vital organs, acidosis, and organ failure. As a result, the children will die. Whereas cerebral edema, had moderate association with DKA treatment out-come of DKA (phi=0.49). The explanation for this association might be due to cerebral edema causes herniation and compression of brain and brain stems that will lead to blocking of oxygenated blood to flow to brain and brain cell death.

In our study Related to management of DKA, potassium as a replacement and amount of regular insulin administered had association DKA treatment out-come. insulin administration had moderate association (phi=0.335). The scientific explanation for this association could be if potassium replacement therapy is not given for those children, hypokalemia that leads to problem in cardiac conduction like cardiac dysthymia will be develop. As a result, the children will die. Therefore, unless the patient exhibits hyperkalemia or anuria, potassium should be added to the intravenous fluids at the beginning of the second hour of therapy (3).

CHAPTER SEVEN

CONCLUSION

This study tried to assess different factors such as Socio-demographic characteristics, sign and symptoms and biochemical parameters, comorbidities and complications of diabetic ketoacidosis and management protocols and determinants of prolonged hospital stay. Around 45% of patients had prolonged hospital stay. Death of children was relatively higher (4.7%). Sepsis, shock, cerebellar edema, renal failure, loss of consciousness, amount of regular insulin and potassium replacement therapy were identified as associated factors for death of children with DKA. Therefore, to reduce complications and comorbidities and death of children, emphasis should be given for improving early detection and immediate management of DKA children.

Strength of the study

The strength of this study includes:-

Using a five years data to increase representativeness

Due to small sample size it requires fewer resource

Limitation of the study

The study was limited to merely on secondary data. So analysis of associated factors for treatment outcome of DKA was based on only information that could be obtained from charts. In addition it didn't include information's related to families' economic status, educational level and occupation. Diagnosis of DKA was based on the diagnosis obtained from the charts that might be misdiagnosed. Since the data were collected from medical records, detail treatment protocol and some of important laboratory results were not addressed. Another limitation is that, this study was conducted in one hospital and has small sample size which may be difficult to generalize the findings to another hospital in the region**.**

RECOMMENDATIONS

Based on the finding of study, the following recommendation could be mentioned:-

For policy makers

Incorporate the need of training for health professionals about prevention and management of complications of diabetic ketoacidosis and develop standard protocol for all facilities to aware health care providers.

For health professionals

The health care professionals should work in improving parents' awareness regarding to early sign and symptoms of complications like shock, hypo/hyperglycemia, electrolyte disturbance &cerebral edema which are the most cause of death of children with DKA. Make a wider scale education to non-communicable disease (DM) And its complication

The health professionals should follow strictly management protocol of diabetic ketoacidosis in order to avoid treatment associated complication like hypo/hypernatremia, cerebral edema and renal failure. They should detect complications as early as possible by following a scientific protocol to monitor a patient condition in DKA.

For respective hospitals

Prepare a schedule for client's education. Adjust job training and refresh knowledge for the health care providers regarding to management of DKA complications according to national protocol to decrease death rate of diabetic ketoacidosis in children.

For future researchers

As this is, a hospital based retrospective secondary data analysis; future researchers should use a prospective cohort study design for better information including other factors not included under this study such as parental socio-demographic and socio-economic characteristics, educational status of child's families and chronic comorbidities of diabetes mellitus.

Work plan

Table 9 work plan for research conducted on treatment out come and its determinants among children admitted with DKA

		Date							
S.NO	ACTIVITIES	12-15/11/24	16-23/11/24	25/11/24	25-28/11/24	28-30/11/24	02/12/24	06/12/24	09/12/24G.C
1	First proposal draft								
2	Final proposal draft								
3	Ethical clearance and letter for a research								
4	Data collection and entry								
5	Analysis and research write up								
6	First draft research submission to advisor								
7	Final research submission								
8	Research defense								

BUDGETBREAK DOWN

Stationary				
Item	**Unit**	**Amount**	**Unit price**	**Total**

	one measurement			
Pen	Each	4	30	120
Flash	Each	1	400	400
Note book	Number	1	80	80
Paper	Number	50	2	100
Sub total				700 ETB

Printing and binding

Items	**Unit**	**Amount**	**Unit price**	**Total**
Printing	Page	50	5	250
Binding		6	50	300
Sub total				550 ETB

Personnel and transport

No	**Reason**	**Unit**	**Duration/Amount**	**Price per unit**	**Sub total**
1	Transport	Per four person	4 days	10x4x2 days (4 day)	320 ETB
2	Internet usage	minute	200birr		200birr
3	Price for collecting each patient card	Per card	86 cards	10	860
Total					1380 ETB

1	Stationary	700ETB
2	Printing and binding	550ETB
3	Personnel &Transport	1380ETB
Total		2630

Table 10 budget break down

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ANNEX I

CHECKLIST

This checklist is prepared for collecting information on treatment outcome of diabetic ketoacidosis and its determinants among children admitted to wolkite university specialized teaching hospital.

1. Data collector name _____

2. Date of data collection _____

part 1: Socio-demographic characteristics

Age	
Sex	Male = A Female =B
Residency	Urban =A Rular = B

Part 2: clinical profile of the children with DKA	
Presence of diarrhea	A. Yes B. No
Presence of vomiting	A. Yes B. No
Presence of abdominal pain	A. Yes B. No
Presence of loss of consciousness	A. Yes B. No
Presence of dehydration	A. Yes B. No
Presence of poly symptoms	A. Yes B. No
Presence of fever	A. Yes B. No
Level of random blood glucose in mg/dl	
Serum concentration of sodium in mmol/l	A. 135-145MEq/L B. >145 MEq/L C.<135 MEqL
Serum concentration of potassium in mmol/l	A. 3.5-5.5MEqL B. >5.5MEq/L C.<3.55MEq/L

Blood creatinine level (mg/dl)	
Urine ketone	

Clinical severity of DKA	A. Mild B. Moderate C. Severe
Time of diabetes diagnosis	A. Newly diagnosis B. Known
Type of Diabetes mellitus	A. Type 1 B. type 2
Recurrence	A. YES B.NO
Compliance to medication	A. YES B. NO

Part 3: Comorbidities before and after admission of children with DKA	
Presence of sepsis	A. Yes B. No
Presence of respiratory tract infection	A. Yes B. No
Presence of gastrointestinal infections	A. Yes B. No
Presence of skin and soft tissue infection	A. Yes B. No
Presence of urinary tract infections	A. Yes B. No
Presence of malnutrition	A. Yes B. No
If yes, Type of malnutrition	A. edematous B. non edematous
Other comorbidities (specify)	

Part 4: Complications before and after admission of children with DKA	
Presence of cerebral edema	A. Yes B. No
Presence of renal failure	A. Yes B. No
Presence of stroke	A. Yes B. No
Presence of pulmonary edema	A. Yes B. No
Presence of shock	A YES B NO
Other complication (specify)	

Part 5: management protocol of DKA children	
Type of iv fluid bolus	Not received iv fluid bolus 0.9% normal saline Ringer lactate
Amount of iv fluid bolus in liter	
Type of fluid for maintenance used in the management	5% dextrose in water 0.9% normal saline Ringer lactate Other fluids
Amount of fluid maintenance used in the management in liter	
Rate of fluid maintenance used in the	

management in ml/hr	
Amount of regular insulin administered in the first 24 hour	
Potassium replacement	A. Yes B. No
Hospital stays	

Part 6: treatment outcome of DKA children	
Outcome	A. Improved B. Died

ANNEX II

Information Sheet

Title of the Research Project: Treatment outcome of DKA and its determinants among children admitted to wolkite university specialized Hospital from (November 18, 2019- November 18, 2024, Gurage zone ,Centeral Ethiopia, Ethiopia, 2024).

Name of the investigators: 1. Abraham Solomon

2. Dawit Ashenafi

3. Haymanot Melesew

4. Natnael Demeke

Name of the Organization: wolkite University College of Medicine and Health Science, School of Medicine, Department of Pediatrics and Child Health

Purpose of the Research Project: To assess treatment outcome of DKA and its determinants among children admitted to Wolkite University specialized Hospital from 2019-2024, Gurage zone centeral Ethiopia, Ethiopia, 2024.