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Management of Diabetic Ketoacidosis among Nurses: An Interventional Study at the New Tafo Government Hospital

Annabella Naa Adoley Allotey[1], David Yanney[2], Titus Kpiinfaar[3], Francis Asare Yeboah[4]

[1]Nurse specialist, Emergency Nursing, Ghana College of Nurses and Midwives
[2]Anaesthetist, New Tafo Government Hospital
[3]Lecturer, Anglican University College of of Technology
[4]Health Research Officer, Eastern Regional Health Directorate

ABSTRACT

Diabetic ketoacidosis (DKA) is a very serious medical emergency that typically affects diabetics. The study aim was to evaluate Nurses' knowledge on the management of diabetic ketoacidosis and was carried out among Nurses working in the New Tafo Government Hospital in the Eastern Region of Ghana in the Abuakwa North District. A Quasi-experimental (Pre-Test-Post-Test) study design and a stratified random sampling method was used. Structured pre and posttest questionnaires was used to gather data. Data analysis was done using Statistical Package for Social Sciences (SPSS) version 29. Descriptive analysis of data done and differences in the pre and post-test results analyzed using inferential statistics. Chi-square test was done to find relationship between respondent's knowledge level and their demographic characteristics at 95% confidence interval, and significant level of 5% ($p \leq 0.05$). A total of 116 nurses were studied, and pre-test and post-test assessment of knowledge of nurses on DKA management indicate (57.7%) had high knowledge score on the management of DKA, while 42.3% of the nurses had low knowledge score. Associated socio-demographic characteristics with nurses' pre-post-test knowledge were, ever nursed a patient with condition of DM or DKA ($p=0.05$), ever had training in DKA management ($p=0.001$), and years of clinical experience ($p=0.01$). During the pre-test and post-test assessments, it was revealed that (74.1% versus 73.3%) respondents had never received any training on how to manage DKA. Only 13.8% and 2.6% of respondents claimed to have received training in the last three months, according to the pre-post-test assessment. About 69.8% and 80.2% disclosed not always having enough medical supplies and equipment for managing DKA during both pre-test and post-test evaluation. In conclusion, there was an average level of nurses' knowledge on management of DKA and a statistically significant correlation between nurses' level of knowledge of managing DKA and their years of clinical experience, whether they had received training in managing DKA or not, and whether they had ever cared for patients with DM or DKA.

CHAPTER ONE
INTRODUCTION

1.0 Introduction

In the New Tafo Government Hospital, this study assesses the level of nurses' knowledge on the management of diabetic ketoacidosis (DKA). A severe consequence of diabetes mellitus called diabetic ketoacidosis occurs when the body produces too many blood acids (ketones). When the body is unable to create enough insulin, the condition arises. Sugar metabolism, a primary source of energy for muscles and other tissues, is mostly regulated by insulin. It may be brought on by an infection or another disease. The ability of nurses to manage diabetic ketoacidosis is crucial because it enables them to ensure that DKA patients take their medications as prescribed, follow up with clinicians, and adopt healthy lifestyle choices. An adequate understanding of DKA by nurses enables them to explain to patients how to check their blood sugar at home and the value of vigilant blood sugar monitoring during infections, stress, or trauma. This serves as the foundation for the current study topic.

1.1 Background

Diabetic ketoacidosis (DKA) is an acute significant life-threatening medical emergency complication of diabetes mellitus characterized by hyperglycemia, ketonemia or ketonuria, and ketoacidosis and is linked to high morbidity and mortality. This reversible life-threatening emergency complication occurs in both type 1and type 2 Diabetes but more in type 1 Diabetes. (Nyenwe & Kitabchi as cited in Benoit et al. 2018). When the body is unable to create enough insulin, which aids in the uptake of glucose in the blood, or when the body's cells are unable to respond to insulin effectively, diabetes develops. This leads to high levels of glucose in the body (hyperglycemia) which can result in serious damage to vessels and body organ systems (Association Ad as cited in Amon & Aikins 2017). There are various forms of diabetes mellitus. Type one diabetes, sometimes referred to as insulin dependent diabetes, develops when the pancreas cells cannot produce enough insulin to allow the body to utilize the serum glucose. Dysfunction is due to autoimmune abnormalities. The second is Type two diabetes, commonly known as insulin resistance diabetes, occurs due to inability of the body cells to respond to insulin effectively. Again, there is another type called gestational diabetes which occurs in pregnancy and increases the woman's risk during pregnancy and delivery (Centre for Disease Control (CDC) 2022). There was a global estimation of 382 million people who had diabetes mellitus in 2013 and this is expected to double by 2035 especially in low- and middle-income countries (Guariguata et al., cited in Lotter et al. 2021). Relatively High Prevalence of diabetes is expected between 2021 and 2045, comparing high-income (12.2%) and low-income (11.9%) countries, middle-income countries had a higher rate of unemployment (21.1%). The cost of treating diabetes-related illnesses worldwide was anticipated to be 966 billion USD in 2021 and is expected to rise to 1,054 billion USD by 2045 (Sun et al. 2021). This expected relative increase in diabetes globally may be an indication of increase in diabetic ketoacidosis cases as well.

In Africa a lot of children and adults commonly present with diabetic ketoacidosis at initial presentation (Reddy et al. as cited in Ameyaw & Agyei 2017). Diabetic ketoacidosis emergencies constitute 48.7% of all diabetic emergencies in Cape Town (Guariguata et al. cited in Lotter et al. 2021). Even though mortality from diabetic ketoacidosis is less than 1% in developed countries, more than 40% is recorded in low and middle income countries (Dhatariya, as cited in Dhatariya 2022). In Ghana misdiagnosis and mismanagement are worrying causes of morbidity and mortality of diabetic ketoacidosis among diabetic patients (Ameyaw & Agyei, 2017).

1.2 Statement of the Problem

Developed nations including Canada, the United States, Australia, Italy and France have prevalence of DKA in children and adolescents varying from 18.6% to 43.9% although the general mortality rate ranges from 0.15% to 0.35% in these same countries (Malik et al. 2016; Taye, Bacha, Taye, Bule, & Tefera 2021). However, poor nations such as India, Bangladesh and Pakistan have a comparatively high mortality rate for kids and teenagers with DKA, which varies from 3.4% to 13.4% (Taye et al. 2021). Similar to how mortality rates differ between developed and developing nations, cerebral edema is a common cause in developed nations while sepsis, shock, cerebral edema and renal failure are the leading reasons for high frequencies of mortality in underdeveloped nations (Malik et al. 2016).

In Ghana, 106 study respondents that were retrospectively studied in the Pediatric Endocrinology Unit of the Public Health Unit of the Komfo Anokye Teaching Hospital between the year February 2012 to August 2016 showed that 90 (84%) were Type 1 diabetic patients and 16 (15.9%) were Type 2 diabetic patients of which 90 (84.9%) presented with DKA and three died as a result of DKA (Ameyaw, Asafo-Agyei, Thavapalan, Middleburg & Ogle 2017). There is little or no published data on the clinical characteristics of young Ghanaians with diabetes. The lack of public health sector support as well as awareness among health professionals and the public is a major problem (Ameyaw, et al. 2017). Other contributing factors that result in increase in DKA mortalities are lack of resources like IV infusions, glucometers, ketone check meters and delay in getting laboratory results, inadequate knowledge on identifying signs and symptoms of DKA and lack of treatment guidelines (Paragas & Trajano-Acampado 2020).

Many factors are implicated to result in the increase in mortalities of patients diagnosed with diabetic ketoacidosis. Patient-related variables, a subpar healthcare system, and issues with healthcare providers are all present. One of the main causes of the rise in mortality rates among healthcare providers is a lack of basic understanding regarding routine DKA management (Taye, et al. 2021). The number of patients visiting the facility's diabetic clinic on an annual basis in the study's current setting, New Tafo Government Hospital, was observed to be 269 in the year 2020, 380 in the year 2021, and 130 in the year 2022, representing both old and new cases, respectively (District Health Information Management System Two (Dhims 2). Most diabetic patients who seek health care services have poor knowledge of the signs and symptoms of diabetic ketoacidosis (Thakare, & Anka 2021). But then, when services are provided by professional nurses and midwives who have in-depth knowledge on the management of DKA, the condition will be identified early and appropriate interventions as well as evidenced based education on preventive measures will be given (Thakare, & Anka 2021). This will also help maintain DKA free state, reduce DKA reoccurrence or facilitate early reporting for health care at the earliest appearance of any sign or symptom of diabetic ketoacidosis (Thakare, & Anka, 2021). Though there are divergent views on the management guidelines, management of diabetic ketoacidosis as a complication of diabetes mellitus is complex and nurses whose roles are very crucial in the care of patients need to have better understanding of this life-threatening condition and rational for management((Crabtree, et al. 2022). Hence, this study seeks to investigate the knowledge level of management of DKA among nurses.

1.3 Research questions

1. What is the knowledge of Nurses on the management of Diabetic ketoacidosis in the New Tafo Government Hospital?
2. What is the relationship between Nurses' knowledge levels of DKA management with their demographic characteristics in the New Tafo Government Hospital?

3. What training program are available for nurses on the management of diabetic ketoacidosis in the New Tafo Government Hospital.
4. What are the barriers nurses encounter with the management of diabetic ketoacidosis in the New Tafo government Hospital?

1.4 Purpose of the study

The purpose of the study is to evaluate the level of nurse's knowledge on the management of diabetic ketoacidosis in the New Tafo Government Hospital. The study also determines the relationship between nurses' level of knowledge on diabetic ketoacidosis management and their demographic characteristics, available training programs for nurses in the management of DKA, and barriers nurses encounter with the management of diabetic ketoacidosis in the New Tafo Government Hospital.

1.5 Research objectives

1.5.1 Main objective

The study's primary goal was to measure the level of nurses' expertise in managing diabetic ketoacidosis at the New Tafo Government Hospital.

1.5.2 Specific objectives

The study specific objectives are to:

1. Examine the knowledge level of Nurses on the management of Diabetic ketoacidosis in the New Tafo Government Hospital
2. Determine relationship between nurses' level of knowledge on diabetic ketoacidosis management and their demographic characteristics in the New Tafo Government Hospital
3. Explore which training programs are available for nurses on the management of diabetic ketoacidosis in the New Tafo Government Hospital.
4. Identify the barriers nurses encounter with the management of diabetic ketoacidosis in the New Tafo Government Hospital.

1.6 Significance of The Study

Usually signs and symptoms of DKA like abdominal pains, nausea and vomiting resembles other conditions like acute abdomen so by the end of the study nurses would appreciate how to distinguish DKA from other conditions and would provide evidenced based professional support to the few medical officers they work with to provide quality care to improve patients' outcomes. No research of this sort has been done in the New Tafo Government Hospital so findings of the study when published would help as a source of literature for future reference.

The findings of this study may also bring out the realities of the challenges nurses face whiles rendering care to DKA patients. Also, findings of this study may serve as an empirical evidence to be used by hospital authorities to seek for support from other stake holders to support Hospital Management on in-service trainings and emergency drills on DKA management for nurses and provision of resources to help with evidenced based care to diabetic patients in the NTGH. Literature provided can informed decision making at Nurses Training Institutions as to making DKA management as a curricular activity where enough simulation activities will be used to build confidence in early identification and management of DKA of nursing students.

1.7 Operational Definition of Terms

Nurses: In this study, the term "nurse" refers to a male or female (person) who has successfully finished a basic, generalized nursing education program and has been given permission by the relevant regulatory body, such as the NMC and government, to practice nursing in Ghana.

Knowledge of nurses: Knowledge of nurses of DKA refer to the facts, information, and skills nurses acquired through experience or education; the theoretical or practical understanding of DKA.

Diabetes: Diabetes is a chronic condition brought on by either insufficient insulin production by the pancreas or inefficient insulin utilization by the body.

Diabetic Ketoacidosis: This study uses the term DKA to describe a significant complication of diabetes in which the body creates too many blood acids (ketones). When the body is unable to create enough insulin, the condition arises.

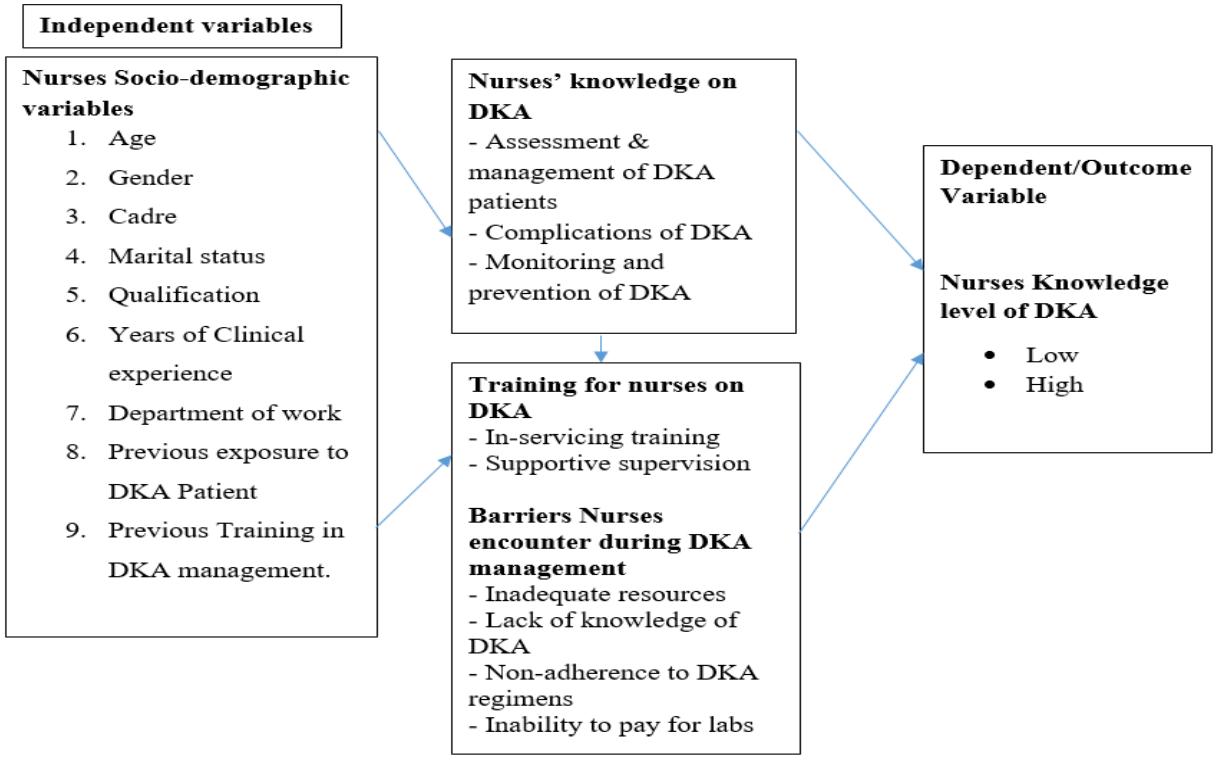
Management of diabetic ketoacidosis: In this study, immediate IV fluid induction, insulin therapy, electrolyte replacement, and identification and treatment of precipitating factors are used to manage diabetic ketoacidosis. Utilizing management guidelines and routine clinical and laboratory data to closely monitor patients' conditions will help to assure better results.

1.8 Conceptual Framework

The conceptual framework for the study was author's own construct which is on interrelationship between nurses socio-demographic characteristics, knowledge on management of diabetes ketoacidosis, available training programs for nurses in the management of diabetes ketoacidosis, and barriers nurses encounter with the management of diabetic ketoacidosis in the New Tafo Government Hospital. Age, marital status, and educational attainment are sociodemographic factors that may have an impact on a nurse's knowledge of diabetic ketoacidosis care. Due to the possibility that senior nurses may have more expertise managing diabetic ketoacidosis than younger nurses.

Also, those who had higher education like degree holders, masters and above could have increased exposure in term of knowledge level relating to the management of diabetes ketoacidosis as compared to those who are certificate holders and diploma holders which could influence the healthcare they provide, and the management outcome of diabetic ketoacidosis patients at the New Tafo Government Hospital. Again, nurses' knowledge level on the assessment and management procedures of diabetic patients as well as their knowledge on the complications of DKA could influence the healthcare provided to DKA patients to enhance positive health outcome among DKA patients.

Nurse's knowledge level on DKA which could either be high or low could be influenced by their educational level, and the in-service training they received on the job, and that could influence the healthcare they provide to patients at the health facility. Barriers nurses encounter with the management of diabetic ketoacidosis in the New Tafo Government Hospital such as inadequate resources, patient inability to pay for laboratory services could also influence the healthcare they provide in relation to the management of DKA at the health facility. The relationships between the various variables are shown in Figure 1.1 with arrows to show how the socio-demographic characteristics of the nurses, their level of knowledge regarding the management of diabetic ketoacidosis, and the obstacles they encountered while providing health services interrelate and affect their overall knowledge regarding the management of diabetic ketoacidosis at the New Tafo Government Hospital.



Source: Authors construct, 2023

Figure 1.1: Conceptual framework on characteristics that determine nurses' knowledge of treating diabetic ketoacidosis (DKA) at the Tafo Government Hospital.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

In order to assess the level of nurses' knowledge on the treatment of diabetic ketoacidosis at the New Tafo Government Hospital, this chapter reviews pertinent literature. The literature review has been arranged to include an overview of diabetic ketoacidosis, nurses' knowledge of the condition's management, a relationship between nurses' demographic traits and their level of expertise in managing it, training programs for nurses that can help them manage diabetic ketoacidosis, and challenges they face in doing so. The data were collected from studies that had already been published using a variety of sources, including Medline, Hinari, PubMed, Abstracts, Journals, Government documents, Dissertations, the internet, records from the New Tafo Government hospital, and the Joint British Diabetes Societies of Inpatient Care (JBDS-IP) DKA management guidelines.

2.1 Definition and Overview of Diabetic Ketoacidosis

A venous pH less than 7.3, a blood bicarbonate concentration less than 15 mmol/L, a serum glucose level larger than 200 mg/dL (11 mmol/L), and either ketonemia less than or equal to 3.0 or ketonuria greater than or equal to 2+ are considered biochemical indicators of diabetic ketoacidosis (Umpierrez & Korytowaski, 2016).

Euglycaemic ketoacidosis, often known as DKA, can happen when there is pregnancy or partial therapy and circulating glucose levels are normal (Dhatariya &JBDS-IP, 2022; Umpierrez & Korytowaski, 2016).

Diabetes mellitus causes acute emergency complications such as diabetic ketoacidosis and hyperglycemic hyperosmolar state (HHS). Both have comparable signs and symptoms, such as polyuria, polydipsia, excessive appetite, physical weakness, dehydration, and mental state disturbances, but they differ in pathogenesis (Ameyaw & Agyei, 2017). Hyperglycemia, ketonemia or ketonuria, and ketoacidosis are the signs that distinguish diabetic ketoacidosis from HHS. Diabetes type 1 and type 2 are characterized by absolute and relative insulin production by the pancreatic cells, or islets of Langerhans, which causes diabetic ketoacidosis. The degree of acidity determines how serious DKA is:

- Severe: venous pH < 7.1, bicarbonate < 5 mmol/L
- Moderate: venous pH > 7.1, and < 7.2, bicarbonate < 10 mmol/L
- Mild: venous pH > 7.1, and < 7.3, bicarbonate < 15 mmol/L

When triggering events such as infections, particularly respiratory and urinary tract infections, and the release of hormones that regulate hormone balance, such as cortisol, are present, the disease worsens, adrenaline and catecholamine's which leads to increase glycogenolysis, gluconeogenesis and lipolysis with resultant hyperglycemia, ketonemia and acidosis (Savage et al., as cited in Taye et al. 2021). Signs and symptoms of nausea, vomiting and abdominal pains are usually experienced by patient suffering from diabetic ketoacidosis due to ketonemia (Hamed, Gawaly, Abbas & EL Ahwal 2017). This signs and symptoms may resemble symptoms of other conditions and can lead to misdiagnosis and mismanagement when the health service provider has inadequate knowledge to identify diabetic ketoacidosis and therefore follow treatment guidelines to manage diabetic ketoacidosis (Ameyaw & Agyei, 2017).

Also, hyperglycemia and ketoacidosis subsequently result in dehydration and metabolic acidosis which can respectively end up in hypovolemic shock, cardiac arrest, acute kidney injury and electrolyte imbalances (Kamleshun & Jyotsnav, 2020). However, it is very critical for experienced staff to promptly identify diabetic ketoacidosis, initiate intensive treatment protocol to achieve efficient management of diabetic ketoacidosis (Alotaibi et al., 2020). Correcting fluid and electrolyte imbalance, using weight-based fixed rate intravenous insulin infusion (FRIII), closely monitoring capillary ketones, glucose, electrolyte, and venous pH, and detecting and treating precipitating factors are the main ways that diabetic ketoacidosis is controlled (Hamed et al., 2017; Evans, 2019; Gosmanov et al., as cited in Paragas et al., 2020).

Professional awareness is very critical in the management of diabetic ketoacidosis as the mortalities are simply due to complications from diabetic ketoacidosis (Ameyaw & Agyei, 2017). The demise of a thirteen (13) year old girl, a known diabetic client who was diagnosed with diabetic ketoacidosis and referred to a tertiary hospital in Ghana was an unfortunate example of death resulting from complications of diabetic ketoacidosis (Ameyaw & Agyei, 2017). Correcting the underlying pathophysiologic abnormalities, addressing fluid and electrolyte imbalance, bringing blood sugar levels back to normal, addressing acid-base disruption, and treating precipitating factors are all of utmost importance in managing diabetic ketoacidosis (Evans, 2019).

2.1.1 Pathophysiology of Diabetics Ketoacidosis

DKA is caused by a severe relative or absolute insulin deficiency, which causes insulin-dependent tissues (such as muscle, liver, and adipose) to starve intracellularly. This triggers the release of the counter-regulatory hormones glucagon, catecholamines, cortisol, and growth hormone (Fayfman, Pasquel and Umpierrez,2017:Rosenbloom, 2016). The pathophysiology of DKA is based on insulin deficiency, elevated insulin counter-regulatory hormones (cortisol, glucagon, growth hormone, and catecholamines), and peripheral insulin resistance. These factors cause hyperglycemia, dehydration, ketosis, and electrolyte

imbalance. Abundant free fatty acids are converted to the ketone molecules acetoacetate and beta-hydroxybutyrate (β-OHB) and hydroxybutyrate (β -OHB) as a result of greater lipolysis and decreased lipogenesis. If oral fluid intake is insufficient, hyperosmolarity, electrolyte loss, and hyperglycemia-induced osmotic diuresis result in dehydration, hyperosmolarity, and a reduction in glomerular filtration rate (Fayfman, Pasquel and Umpierrez,2017: Gosmanov et al., 2014).

Glycosuria decreases when renal function deteriorates, and hyperglycemia gets worse. Potassium absorption by skeletal muscle is significantly reduced by decreased insulin action and hyperosmolar hyperglycemia; moreover, hyperosmolarity can result in outflow of potassium from cells (Grinslade and Buck, 2019). This causes intracellular potassium depletion, followed by potassium loss through osmotic diuresis, which lowers total body potassium by an average of 3-5 mmol/kg of body weight. However, a wide range of serum potassium values might be found in DKA patients (Grinslade and Buck, 2019). A "normal" plasma potassium concentration still shows that the body's overall potassium reserves are significantly depleted, and the implementation of insulin therapy and the treatment of hyperglycemia will lead to hypokalemia. Patients with DKA typically exhibit the following water and critical deficits (Eledrisi & Elzouki, 2020).

In insulin-sensitive tissues, absolute or relative insulin deficit reduces glucose uptake and increases lipolysis. Energy deficit in these tissues is a stress that activates hormones that counteract it, including as cortisol, growth hormone, catecholamines, and glucagon, as well as pro-inflammatory cytokines (Fayfman, Pasquel and Umpierrez,2017: Rosenbloom, 2016). In turn, the counter-regulatory hormones boost lipolysis and proteolysis, supplying a substrate for hepatic ketogenesis and hepatic and renal gluconeogenesis. This leads to ketoacidosis, osmotic diuresis, dehydration, and tissue hypo-perfusion, and adds lactic acidosis to the metabolic acidosis from accumulated ketones and loss of base in the urine.

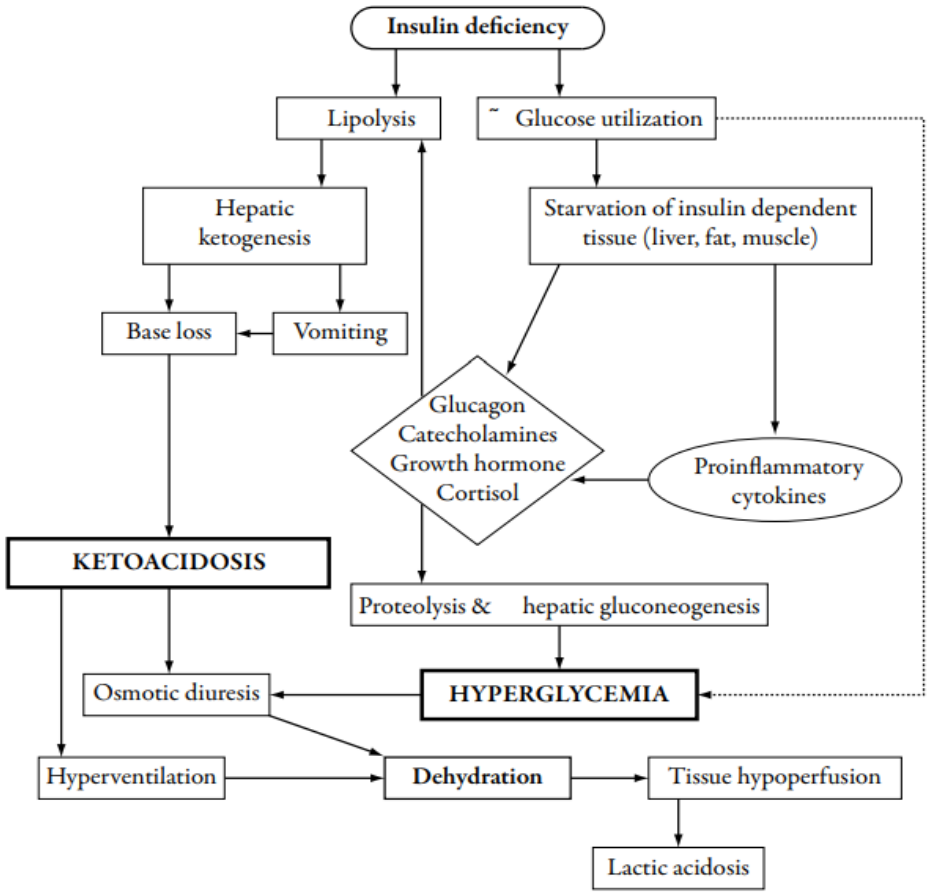


Figure 2.1. Pathophysiology of diabetic ketoacidosis.

Table 2.1: The difference features between diabetic ketoacidosis and Hyperosmolar state.

Indicators	Diabetic ketoacidosis	Hyperosmolar, and hyperglycaemic state
Blood sugar	More than 200 mg /dl	More than 600 mg /dl
pH	Less than 7.3	More than 7.3
Bicarbonate level	Less than 15 mEq/ l	More than 15 mEq/ l
Serum/ urinary ketone	Positive	Negative or trace
Serum osmolality	Variable	More than 320mOsm/kg
Anion gap	More than or equal to 13	Less than 12
Mental confusion	Depends on severity	Stupor or coma is common

2.1.2 Risk Factors and Causes of DKA with New-onset Diabetes

The probability of new-onset diabetes manifesting as DKA varies significantly by geographic region and correlates negatively with the regional incidence, according to research findings by Rosenbloom (2016). According to Jackman et al. (2015), this frequency ranges from 11% to 67% throughout Europe.

According to Flores et al. (2020), the frequency in Australia between 2018 and 2021 was 26%, while in New Zealand it varied between 63% in 2008 and 42% in 2015 (Jackman et al., 2015). Children under the age of five and people with socio economic circumstances that prevent easy access to medical treatment are more likely to have DKA at diagnosis (Dhatariya, Ketan, & Umpierrez, 2017).

DKA was detected at the outset in 28.4% of Colorado patients; the odds ratio between uninsured and insured patients was 6.2, with the severity being considerably higher in the uninsured group (Mills and Stamper, 2014). Following extensive education of the medical and lay communities, there have been reports of long-term decreases in the prevalence of DKA at onset. According to estimates by Mills & Stamper (2014), up to 25% of children with type 2 diabetes had DKA at the time of diagnosis. Prior to becoming dangerously ill, previously undiagnosed individuals in DKA are frequently visited in doctors' offices or emergency rooms without a complete medical history or laboratory results that could have made the diagnosis (Mills & Stamper, 2014).

In Colorado, there were 1243 patients; eight episodes of recurrent DKA occurred for every 100 patient years, with 20% of the patients representing 80% of the incidences. Recurrent DKA was associated with factors such as poor metabolic control or prior episodes of DKA, female gender (peripubertal or adolescent), psychiatric disorders, such as eating disorders, difficult or unstable family circumstances, limited access to medical services, and insulin pump therapy

were risk factors for recurrent DKA (Castellanos, Tuffaha, Koren & Levitsky, 2020). Pumps only use rapid- or short-acting insulin, thus any cessation of insulin administration for whatever cause quickly results in an insulin shortage. The establishment of treatment teams with intensive family education on managing sick days and 24-hour availability between 2017 and 2020, according to the findings, demonstrated a significant decrease in recurrent DKA, which is almost always caused by the purposeful omission of insulin administration (Castellanos et al., 2020). Again other important factors precipitating the cause of DKA are; drugs e. g corticosteroids, Sodium-Glucose Cotransporter 2 (SGLT-2) Inhibitors e.g. (Gliflozins), stress e.g. stroke, trauma, surgery and also pregnancy due to insulin antagonistic state, accelerated starvation especially in 2nd and 3rd trimester and effects of emesis (Barski et al., as cited in Shahid et al.,2020; Bryant, Herrera, Nelson & Cunningham, 2017).

2.1.3 Diagnosis and Initial Evaluation of DKA

Ketone elevation and high anion gap metabolic acidosis greater than twelve are key diagnostic criteria for ketonemia in DKA diagnosis. Ketones can be checked using nitroprusside reaction in urine or serum. Nitroprusside test provides semi-quantitative acetoacetate and acetone levels, but underestimates ketoacidosis severity making direct measurement of serum β-hydroxybutyrate(β-OHB) the best choice (Sheikh-Ali et al as cited in Fayfman, Pasquel and Umpierrez,2017).

2.1.4 Laboratory Investigations

The following are other laboratory investigations which are very important in the diagnosis and management of the patient diagnosed with DKA ((Dhatariya & JBDS-IP, 2022).

- Capillary glucose will help to determine blood glucose levels.
- Complete blood count is important to pick up any leukocytosis or infection that may be precipitating DKA.
- Serum electrolytes to determine any imbalances especially in potassium levels to provide guidance to, as and when insulin therapy and potassium replacement therapy should be initiated.
- Blood urea and Serum Creatinine levels very necessary for early detection of acute kidney injuries as dehydration in DKA due to hyperosmolality can result in acute kidney injury.

- Arterial or venous blood gases helps to establish the diagnosis of DKA as it gives clues to blood acidity levels.
- Electrocardiogram also helps to pick up other issues e.g. myocardiac infarctions that might have precipitated the DKA event in a diabetic patient.
- Cultures of urine, blood and throat, if clinically indicated will all help to pick up other organisms causing infection and Chest X ray- if respiratory infection is under suspicion.
- HbA1c (glycosylated hemoglobin) provides information about the degree of metabolic control and guide patient health education on the need to maintain good glycaemic controls. (Dhatariya & JBDS-IP, 2022).

2.1.5 Differential Diagnosis

- Starvation ketosis and Alcoholic ketosis can be mistaken as DKA but then it must be noted that starvation ketosis arises due to reduced intake of carbohydrates. This results in decrease secretion of insulin leading to lipolysis and ketosis (ChaHill as cited in Dhatariya & JBD-IP, 2022). Low levels of glucose and ketosis of course in a known Alcoholic should warrant the diagnosis Alcoholic Ketosis than DKA (Umpierrez cited in Dhatariya & JBD-IP, 2022).
- Drugs producing metabolic acidosis e.g. three most common ones to consider are methanol, ethylene glycol and salicylates (Pham, Xu & Moe, 2015).

2.1.6 Treatment of Diabetic Ketoacidosis

Optimization of volume status, hyperglycemia and ketoacidosis, electrolyte abnormalities, and probable precipitating factors are the therapeutic goals of DKA treatment and management (Jackman et al., 2015). The vast majority of DKA patients visit the emergency room. Therefore, while a physical examination is being conducted, fundamental metabolic parameters are being gathered, and a definitive diagnosis is being made, emergency nurses and doctors should begin the therapy and management of hyperglycaemic crises (Jackman et al., 2015). Early DKA management should include a number of crucial steps, including: collection of blood for a metabolic profile before starting intravenous fluid one litre of 0.9% sodium chloride over an hour, make sure your potassium level is above 3.3 mEq/L before starting insulin therapy, add potassium intravenously if necessary and start insulin therapy only after the earlier mentioned points have been completed. It must be underlined that for a treatment to be effective, clinical and metabolic parameters that promote DKA resolution must be regularly monitored (Mills & Stamper, 2014). The treatment and management protocol of DKA should involve the following;

2.1.7 Fluid and Insulin Replacement

Treatment with fluid and insulin aims to:

- Restore perfusion, which will boost glomerular filtration, enhance glucose uptake in the periphery, and stop the progression of acidosis.
- Stop ketogenesis with insulin injection, which inhibits glucose absorption and utilization while reversing proteolysis and lipolysis and stabilizing blood glucose levels.
- Replace any lost electrolytes.
- Act quickly to address problems, including cerebral edema.

2.1.8 Fluid Therapy

According to Grinslade & Buck's (2019) study, fluid loss in DKA ranges from 6 to 9 L on average. Fluid therapy in DKA aims to replenish the entire volume loss within 24–36 hours, with the first 8–12 hours seeing the administration of 50% of the resuscitation fluid (Grinslade & Buck, 2019).

The initial fluid of preference is a crystalloid fluid (Grinslade & Buck, 2019). According to current guidelines, volume loss should be started being restored using intravenous boluses of isotonic saline (0.9% NaCl), depending on the patient's hemodynamic condition (Fayfman, Pasquel and Umpierrez,2017; Rosenbloom, 2016). After that, an intravenous infusion of 0.45% NaCl solution will further reduce plasma osmolality and aid water movement into the intracellular compartment based on corrected serum sodium concentration (Dai, Chen, Huang, & Yang, 2022). In a prospective randomized controlled study, patients were treated with either 500 mL/hour (h) or 1 L/ of isotonic fluid, and the appropriate rate of starting fluid administration was examined (Flores et al., 2020). There were no changes in the mortality, comorbidities, or DKA resolution rates. According to most protocols, an initial bolus of isotonic crystalloid solution (0.9% saline) should be administered at a rate of 15-20 mL/kg/h (1-1.5 L/h) for the first hour. Fluids can be given at a reduced rate of 4–14 mL/kg/h after the first hydration (Papanastasiou, Glycofridi, Gravvanis, Skarakis, & Papadimitriou, 2021).

The tonicity of the succeeding solution depends on the body's electrolyte balance, hydration level, and urine production. Cerebral edema may be more likely to develop if blood sodium and, consequently, serum osmolality are corrected quickly with hypotonic fluids (Papanastasiou et al., 2021). On the other side, it was discovered that patients receiving continuous isotonic fluid therapy had an increased risk of developing a non-anion gap hyperchloremic acidosis, which could lengthen hospital admissions due to erroneous diagnoses of persistent ketoacidosis. As a result, providing an initial bolus of isotonic saline at a rate of 15-20 mL/kg/h followed by hypotonic saline solution (0.45% saline) at a rate of 4-14 mL/kg/as long as the patient is hemodynamically stable and corrected serum sodium is normal to high is considered a safe practice for fluid resuscitation in DKA patients (Papanastasiou et al.,2021)

According to corrected serum sodium levels, it is advised to start giving a patient 0.9% saline at a rate of 150–250 mL/h until eunatremia is reached if they become hyponatremic (Jie, Jia, Ng, & Yeoh, 2020). Since pediatric patient populations have not been examined, replacing the water deficit with high intravenous fluid rates cannot be advised for the management of pediatric DKA (Jie et al., 2020). If renal function is not severely impaired, intravascular and extravascular volume resuscitation will reduce hyperglycemia by promoting osmotic diuresis and improve peripheral insulin action (insulin effects on glucose transport are decreased by hyperglycemia and hyperosmolarity) (Flores et al., 2020).

In order to prevent hypoglycemia when blood sugar levels drop below 200–250 mg/dL, intravenous fluids should be changed to a dextrose-containing 0.45% NaCl solution, or the rate of insulin infusion should be reduced (Jie et al., 2020). Patients with chronic renal disease and congestive heart failure should be given special consideration. Because these patients have a propensity to retain fluids, care should be used when volume resuscitating these patient groups. Monitoring urine output in patients experiencing hyperglycemic crises is crucial (Jie et al., 2020).

2.1.9 Insulin Therapy

The infusion of insulin is crucial in the therapy of DKA because it increases peripheral tissues' ability to utilize glucose, reduces gluconeogenesis and glycogenolysis, and inhibits ketogenesis. Fixed rate insulin infusion (FRII) in individuals with DKA, is the preferred method of delivering insulin (Dhatariya & JBDS-IP, 2022). It is not recommended to provide insulin without first administering volume resuscitation because this could make the dehydration worse. Low doses of insulin in the range of 5–10 U/hour have replaced high doses of up to 100 U/hour via various modes of administration in the treatment of diabetes (Flores et al., 2020).

According to Mills and Stamper's (2014) research, a 0.1 U/kg bolus of normal insulin followed by a conti-

nuous insulin infusion is advised. 0.1 U/kg of insulin can be administered once more while maintaining insulin infusion if plasma glucose does not decrease by at least 10% in the first hour of insulin infusion rate (Mills and Stamper, 2014). The concept of hyperglycemia-induced insulin resistance has therapeutic implications; with glycaemia reduction, there may be a nonlinear decrease in insulin needs. The insulin rate can be reduced by 50% or to 0.02-0.05 U/kg/h when plasma glucose exceeds 200-250 mg/dL (Dhatariya & Umpierrez, 2017).

A study in individuals with HHS provided the evidence for use of a priming bolus of insulin by suggesting that an initial bolus could help reduce the relative insulin resistance of DKA (Dhatariya & Umpierrez, 2017). However the use of insulin boluses was only emphasized in exceptional situations when starting FRII therapy takes longer than expected(Dhatariya & Joint British Diabetes Societies of In-Patients Care(JBDS-IP) DKA guideline 2022), Additionally, it is recommended that all newly diagnosed patients be started on long acting basal insulin at a dose of 0.25units subcutaneously once daily in addition to the fixed rate insulin infusion (FRII) during the management of patients with diabetic ketoacidosis rather than stopping those who are already taking it (Dhatariya & JBDS-IP, 2022).

2.1.10 Electrolyte Therapy

A severe whole body deficit of serum electrolytes, notably sodium, chloride, and potassium, is linked to DKA. Electrolyte deficits in individuals with DKA typically range from 7 to 10 mEq/kg for sodium, 3 to 5 mEq/kg for potassium, and 3 to 5 mmol/kg for chloride. The principles outlined above will be followed when replacing salt and chloride (Fayfman, Pasquel and Umpierrez,2017;Mills and Stamper, 2014).

2.1.11 Potassium, Bicarbonate, and Phosphate Therapy

The importance of potassium, bicarbonate, and phosphate therapy in the treatment and management of DKA patients is shown by numerous research. When treating DKA, serum potassium should be regularly watched. Hypokalemia, which can come from the delivery of insulin and the treatment of hyperosmolality and academia, drives potassium intracellularly and increases the risk of arrhythmias and cardiac arrest (Dhatariya & JBDS-IP, 2022). Because significant quantities of blood potassium must be supplied before beginning insulin therapy, insulin should not be begun if serum potassium is determined to be less than or equal to 3.3 mEq/L prior to DKA treatment (Dhatariya & JBDS-IP, 2022).

When serum potassium levels are between 3.5 and 5.5 mmol/L, small doses (20–40 mEq/L) of potassium are frequently administered to intravenous fluids. When potassium levels are greater than 5.5 mmol/L, no replenishment is required. Because metabolic acidosis will be resolved by insulin therapy in mild and moderate forms of DKA, bicarbonate therapy is not recommended (Dhatariya & JBDS-IP, 2022 ; Fayfman, Pasquel and Umpierrez,2017).

Bicarbonate treatment may actually cause peripheral hypoxemia, hypokalemia, paradoxical central nervous system acidosis, cerebral edema in children and young adults, and intracellular acidosis. Bicarbonate therapy may be recommended if the blood pH is 6.9 or less since severe acidosis is linked to worse clinical outcomes, can damage the sensorium, and can worsen cardiac contractility (Dhatariya & JBDS-IP, 2022;Fayfman, Pasquel and Umpierrez,2017).Therefore, until the results of upcoming randomized controlled trials are known, the infusion of 50-100 mmol of bicarbonate in 400 mL of sterile water combined with 20 mEq potassium chloride over a period of two hours and repeating the infusion until the pH is greater than 7.0 could be advised (Dhatariya & JBDS-IP, 2022: Fayfman, Pasquel and Umpierrez,2017).

Randomized prospective studies have not been able to demonstrate any positive impact of phosphate supplementation on the clinical outcomes in DKA. However, cautious phosphate replacement is advised in patients with a serum phosphate concentration less than 1.0 mg/dL or in patients with a serum phosphate level between 1.0 and 2.0 mg/dL and cardiac dysfunction, anemia, or respiratory depression (Dhatariya & JBDS-IP, 2022). Phosphate replacement has actually been linked to the development of a state of severe hypocalcemia.

2.1.12 Diabetic Ketoacidosis Management Protocols in Clinical Care

Several academics have produced technical evaluations and DKA guidelines based on their research, however it is necessary to effectively disseminate the most recent information on these guidelines (Dai, Chen, Huang, & Yang, 2022). The creation of inpatient standardized procedures for DKA management is one strategy for implementing best clinical practices (Balmier et al., 2019). Studies have demonstrated the effectiveness and safety of protocol-directed care for patients with hyperglycemic crises, as evidenced by considerable reductions in length of stay without an increase in the frequency of iatrogenic consequences (Dai et al., 2022).

Key DKA management points

- Before beginning insulin therapy, the patient must be urinating and the potassium level must be > 3.3 mEq/L (potassium supplementation may be administered intravenously if necessary).
- Start a 0.1 U/kg/hour continuous fixed rate insulin infusion. Every hour, check the blood sugar at the bedside to alter the insulin infusion rate.
- Reduce the pace of the insulin infusion until the DKA has been treated in order to prevent hypoglycemia while the insulin is being administered.

2.1.13 The Role of the Nurse in Diabetic Ketoacidosis Management

The nurse in collaboration with other professional health care team members ensures quality care is provided to the patient diagnosed with DKA by adhering to DKA treatment guidelines. The following points elaborates on the DKA treatment guideline that guides the nurse to play quality role in the early detection and management of DKA (Dhatariya & Joint British Diabetes Societies for Inpatients (JBDS-IP), 2022).

2.1.13.1 Assessment and Management of Client Using the ABCDE Parameters

- **AIRWAY**: Assess the patient airway by ensuring it is clear and patent. Employ the use of manoeuvers e.g. chin lift –head tilt and jaw lift accordingly, advance air way or definitive airways if the need be and suction any secretions (Dhatariya & JBDS-IP, 2022).
- **BREATHING**: Assess breathing by checking the respiration, spo2 levels if, signs of hyperventilation present give oxygen, high flow oxygen 15l/min non rebreathe mask or via reservoir mask and attach pulse oximetry and titrate to maintain spo2 of 94-98% or 88 -92% ,if patient is known to have chronic obstructive pulmonary disease (COPD) (Dhatariya & JBDS-IP, 2022).
- **CIRCULATION**: Attach patient to three lead cardiac monitor Assess circulation by checking patient vital sign, blood pressure level, and pulse, assess for capillary refill, signs of dehydration as to whether patient is in shock and manage by ensuring IV bore cannula insitu, take blood sample for complete blood count, blood electrolytes, arterial blood gases or venous pH, blood culture, capillary glucose and ketones and Renal function test (RFT). If client in SHOCK administer

500mls N/S 10 to 15 minutes. Repeat until Blood Pressure (B/P) is greater than 90mmhg (Dhatariya & JBDS-IP, 2022).

- **DISABILITY**: Assess for diagnostic criterion for diabetic blood glucose >11mmol/l or history of diabetes mellitus, glucose will be less than 11mmo/l in Euglycemia ketoacidosis, blood ketones >3mmol/l or urine ketones ≥2+ and pH <than 7.3 or bicarbonate <than 15mmol/l. Check Glasgow coma scale (GCS) (Dhatariya & JBDS-IP, 2022).

- **EXPOSURE**: Check temperature and expose patient and examine back looking out for anything that can be a source of infection e.g. wound (Dhatariya & JBDS-IP, 2022).

2.1.13.2 Consider Referral After Initial Resuscitation If the Following Are Present;

1. Patient is young 18-25 years or elderly or pregnant.
2. Heart or kidney failure.
3. Presence of severe diabetic ketoacidosis judged by; blood ketones greater than 6mmol/l, or bicarbonate less than 15mmol/l or pH less than 7.1 or potassium less than 3.5 mmol/l or GCS less than 12 or persistent hypoxia or persistent Bradycardia or tachycardia or anion gap greater than 16 (Dhatariya & JBDS-IP, 2022).

2.1.13.3 Resuscitation Fluid still continues as followings:

- 1 litre Normal Saline(N/S) in 1 hour
- 1 litre iv N/S in 2hours
- 1litre iv N/S in 2hours
- 1litre iv N/S in 4 hours
- 1litre iv N/S in 4 hours
- 1litre iv N/S in 6 hours

(Dhatariya & JBDS-IP, 2022).

2.1.13.4 Insulin Therapy

- Start fixed rate insulin infusion (FRII) at 0.1 unites/kg/hour when serum potassium is not less than 3.5mmol/l. Fifty (50) unites of regular insulin, e.g. actrapid in 50mls of 0.9% N/S (1 unit /ml) is to run. For a patient with 70kg weight, 7units of regular insulin will run per hour whiles you continue clients long acting insulin.
- Start 500mils of 10% dextrose at 125mls per hour and reduce insulin infusion rate by 50% that is 0.05mls/kg/ hour when glucose level is less than or equal to 14mmol/l per litre.
- If blood glucose is ≤ 4mmol/l follow hypoglycemic guidelines and ensure fixed rate insulin infusion is running at 0.05 units/kg/hour (Dhatariya & JBDS-IP, 2022).

2.1.13.5 Potassium replacement

- Even though potassium levels may be high on arrival, it will rapidly fall once the FRII commences and therefore

  Potassium chloride (Kcl) should be added to the resuscitation fluid above as follows:
- 20-40mmol/l when serum potassium is 3.5-5.5 mmol/l
- Serum potassium less than 3.5mmol/l requires supplementation with KCL 6o-80mmol/l under senior review in a high dependency unit (HDU) care
- Serum potassium greater than 5.5mmol/l needs no KCL supplementation to the resuscitation fluid (Dhatariya & JBDS-IP, 2022).

2.1.14 Monitoring of DKA Patients

The implementation of diabetic ketoacidosis recommendations requires the cooperation of healthcare

workers in order to ensure regular audit and continuous quality improvement (Grinslade & Buck, 2019). Without the assistance of nurses and other professional staff, the practice of admitting, treating, and releasing patients with diabetic ketoacidosis is risky and likely to jeopardize the safety of patient care (Papanastasiou et al., 2021). In order to promote independence and improve diabetes self-management, the nurse is essential. As a result, nurses are in a position where they regularly and directly interact with the diabetic. They can help DKA patients manage their physical and psychological morbidity and alleviate the physical and psychological issues that come with a chronic disease by applying their specialized knowledge and abilities (Mills & Stamper, 2014).

As a component of the multidisciplinary team, they can assist in coordinating complex treatment and provide referrals to other experts, especially inside the hospital facility. They can offer competent, engaging, knowledgeable, and accessible support to persons with diabetes so they can heal quickly (Mills & Stamper, 2014). According to Dhatariya & Joint British Diabetes Societies for In-Patient Care DKA guideline, (2022), some responsibilities for monitoring DKA patients include:

- Hourly glucose and hourly ketones checks, and monitoring vital signs often
- Check venous pH, bicarbonate, and potassium at one hour, two hours, and then every two hours after diagnosis.
- Monitoring urine output and ensuring minimum urine output is not less than 50 mls per hour. can pass urethral catheter in order to maintain and monitor an accurate fluid balance chart, If the patient is incontinent or anuric (i.e., has not passed urine by 60 minutes).
- Regular observations and, when necessary, Early Warning Score (TEWS) charting.
- The Glasgow Coma Scale score should be regularly monitored; if it falls, immediate brain imaging should be considered.
- Ongoing cardiac surveillance for people with severe ketoacidosis.
- Check for treatment-related problems, such as fluid overload or cerebral edema.
- Precipitating factors should still be dealt with as appropriate.
- If severity criteria are satisfied despite adequate therapy, if there is a decline in clinical condition, or if facilities for intensive monitoring are not available, consider referral to a Level 2 High Dependency Unit (HDU) environment (Dhatariya & JBDS-IP, 2022).
- Monitor for DKA resolution (Dhatariya & JBDS-IP, 2022).

2.1.15 Management After Resolution of Diabetic Ketoacidosis

Diabetic ketoacidosis resolution is indicated when the following occurs; ketone<0.6mmol/l and pH >7.3 or bicarbonate>15mmol/l. if present switch to variable rate insulin infusion and seek specialist or senior review for further management (Dhatariya & JBDS-IP, 2022). It is also advised to keep the IV fluids and insulin infusion going if the patient is unable to eat (Dhatariya & JBDS-IP, 2022). Monitoring the patient's state is essential, following the resolution of DKA, and signs like blood pressure, pulse, hydration, fluid intake, urine output, and mental status should be regularly checked. In addition to measuring serum electrolytes, blood urea nitrogen, and creatinine every 2-4 hours, depending on the severity of the disease and the clinical response, follow-up laboratory investigations should also include measuring blood glucose and serum ketones initially every hour until the patient's condition is stable (Eledrisi & Elzouki, 2020).

2.1.16 Prevention of Diabetic Ketoacidosis

The management of DKA includes many different aspects, but one of the most crucial is the prevention of further episodes and admissions. Understanding the precipitating cause is a crucial step in developing a plan to prevent DKA. Hospital admissions for DKA were found to be significantly caused by poor

adherence to insulin therapy. A lack of patient knowledge, restricted access to medical care, financial constraints, underlying psychological illnesses, and eating disorders have all been linked to insulin omission (Eledrisi & Elzouki, 2020).

According to Balmier et al., (2019), social and psychiatric factors like depression, low socioeconomic status, and sexual or physical abuse have also been linked to the occurrence of recurrent admissions for DKA. Substance abuse, particularly cocaine usage, is another factor connected to repeated hospital hospitalizations for DKA. In order to avoid additional hospital admissions due to DKA, patient education is essential (Balmier et al., 2019). Guidelines for managing diabetes while ill (sick day management) should be included in educational programs.

These programs ought to provide clear information on the following topics: the significance of continuing insulin, early detection of DKA symptoms, more frequent home blood glucose and ketone (urine or blood) monitoring, adjusting insulin doses and the use of supplemental insulin, as necessary, and circumstances necessitating contact with the healthcare provider. When compared to urine ketone testing, self-monitoring of blood ketones enables earlier diagnosis and treatment of ketosis and can reduce emergency room visits and hospitalizations due to diabetes. Structured patient education, behavioral interventions, support for patients and families, better patient access to healthcare providers, availability of extended access to telephone services, and telemedicine are all ways to lower the frequency of DKA recurrence (Eledrisi, & Elzouki, 2020).

Additionally, a documented care plan ought to be given to the patient and/or caregiver since this improves comprehension and highlights the value of managing diabetes on one's own (Eledrisi, & Elzouki, 2020). It has also been demonstrated that at-home usage of ketone meters that detect blood B-OHB can help with early detection and management of ketosis, potentially reducing the need for specialized care. When B-OHB levels of 1.1-3.0 mmol/L are found, extra short-acting insulin can be given with fluids early on to prevent DKA since B-OHB typically does not reach levels > 1.0 mmol/L outside of metabolic instability (Castellanos, Tuffaha, Koren, & Levitsky, 2020).

Nurses must inform patients about the significance and seriousness of the disease, the importance of adhering to treatment and dietary guidelines, the importance of self-blood sugar monitoring twice daily, and the routine monitoring of serum ketones for earlier detection of diabetic ketoacidosis, which aids in the prevention of DKA (Dhatariya and JBDS-IP 2022; Macarthur, 2015).

2.1.17 Complications of Diabetic Ketoacidosis

Complications from diabetic ketoacidosis are numerous. According to Eledrisi & Elzouki's study from 2020, hypoglycemia is the most common consequence of DKA and can be avoided by early insulin dose adjustments and regular blood glucose monitoring. Any blood glucose level below 70 mg/dL is referred to as hypoglycemia. Reduce the rate of insulin infusion and/or add 5% or 10% dextrose to the existing IV fluids if DKA is still present and blood glucose levels are below 200-250 mg/dL (Eledrisi & Elzouki, 2020).

Hypokalemia is also another common complication during DKA treatment. To prevent hypokalemia, IV potassium replacement is indicated when concentration is below 5.2 mEq/l. Insulin therapy should be held until serum potassium is 3.3 mEq/l (Dhatariya & JBDS-IP, 2022 ; Fayfman, Pasquel and Umpierrez,2017).

Although cerebral edema is rare, but is a lethal complication of DKA. Often occurring in 1% of children (Glaser et al.,as cited in Fayfman, Pasquel and Umpierrez,2022). It usually appears 4–12 hours after treatment, however it can also happen 24–48 hours afterwards. Clinically manifesting as headaches, vomiting, irritability, loss of consciousness, abnormal postures, nerve palsies, and abnormal breathing

patterns. Mannitol 0.5-1g/kg iv over 20 minutes is used as a treatment, and if there is no improvement after the first dose, the process is repeated after 30 minutes. As an alternative to mannitol, hypertonic saline 3%,5-10ml/kg over 30 minutes can be utilized (Dhatariya & JBDS-IP, 2022 ; Fayfman, Pasquel and Umpierrez,2017).

2.2 Knowledge of Nurses on Management of DKA

A questionnaire with 19 questions was used to gather opinions from 92 respondents from a variety of professional cadres, including pediatricians, medical officers, clinical officers, and nurses. The survey was conducted as part of a descriptive cross-sectional study by Mayabi (2019) to evaluate knowledge among healthcare professionals in Mbagathi Country Hospital and Mama Lucy Kibaki Hospital on the management of DKA. Pediatricians scored 70.18%, Medical Officers 56.39%, Clinical Officers 52.2%, and Nurses 41.74% in terms of overall percentage scores for each cadre, which were calculated by dividing the number of questions each cadre correctly answered by the total number of questions each cadre answered and multiplying that result by 100 (Mayabi, 2019).

The nurses in one of the four cadres had little expertise in managing DKA. Only 10 of the 19 questions were assessed for the nurses, and while their overall knowledge was low, they did well on the following items: the definition of DKA (91.3%), the most crucial electrolyte to monitor (87%) and biochemical monitoring (73.9%). According to Shaker, Faltas, and Abdelhady (2020), nurses' knowledge gaps included when to start 5% dextrose (0.0), biochemical criteria for the diagnosis of DKA (26.1%), signs and symptoms of DKA (30.4%), and when to refer a patient with DKA to a specialist (39.1%).

One of the main causes of diabetic coma is diabetic ketoacidosis. 35 nurses from the emergency care unit were conveniently recruited for a descriptive research study at Assuit University Hospital that evaluated nurses' knowledge and procedures related patients with diabetic comas. Results showed that (94.3%) practices related to the management of patients with diabetic coma were poor, while (68.6%) nurses had unsatisfactory knowledge regarding patients with diabetic coma (Abdelrahma, Mohammed, Abdelaziz & Ahmed, 2020).

The American Diabetes Association (2018) states that a fundamental component of DKA care and management is the requirement for nurses with sufficient knowledge of DKA to make changes in patients' lifestyles and behaviors relating to physical activity, nutrition, medication intake, psychosocial issues, problem-solving, monitoring blood glucose levels, and risk reduction among patients (Beck et al., 2017). The primary educators of diabetic patients are generally believed to be nurses, dietitians, and physicians. In order to help patients, reach maximum health, one of their primary responsibilities is to inform patients with diabetes and DKA problems about the dietary management of the illness. Thus, the key sources of information for patients with diabetes and complications of DKA on how to effectively manage their disease and have an improved quality of life are nurses, physicians, and dietitians (Parry Strong, Lyon, Stern, Vavasour, & Milne, 2014)

The type of management that health professionals provide to patients may be influenced by their level of knowledge, which was observed to be 56% among health professionals, particularly nurses, on the management of DKA among patients living with the condition (Carney, Stein, & Quinlan, 2013). This is due to the fact that patient behaviors and management outcomes are positively correlated with nurses' degree of knowledge about the management of DKA (Rustad & Smith, 2013).

In order to effectively manage DKA, nurses must be knowledgeable about clinical care procedures as well as nutritional management, which includes understanding where to get carbohydrates from, what to eat,

how much to consume, and how food affects blood sugar levels (Beck et al., 2017).

Three hospitals in the Midwest used 137 volunteer registered nurses to measure their level of expertise. In collaboration with a group of knowledgeable nurse diabetes educators, the original author (S.D.S.) created a 34-item multiple choice Diabetes Knowledge Test (DKT). 34 nurses (or 25%) had scores of 80% or higher on the test, 62 (or 45%) received scores between 70% and 79%, and 41 (30%) received scores of less than 70%. Nurses with higher scores performed well on questions requiring the use of exchange lists, however they missed.

According to Ali, Nasir, and Mohi (2018), nurses with exam scores below 60% frequently omitted questions about the usage of exchange lists, the impact of regular exercise and illness on blood glucose, and the signs and triggers of hypoglycemia and hyperglycemia. An evaluation of the nurses' caregiving skills for patients with diabetic ketoacidosis was conducted in Egypt. Nurses' knowledge regarding treating patients with diabetic ketoacidosis was evaluated using a self-administered questionnaire, and nurses' practice observational checklists were utilized to evaluate nurses' practice for treating patients with diabetic ketoacidosis(Shaaban et al., 2017).

2.3 Nurses Knowledge of DKA Management in Relation to Demographic Characteristics

In a quasi-experimental study carried out by Shaker et al., (2020) on the topic “effect of training program on Nurses Performance and Health Outcomes for Patients with Diabetic Ketoacidosis” where 40 nurses were conveniently sampled with 25 patients, the following findings were reported after a self-administered questionnaire was given to the nurses. Majority of the nurses were under 30 years old, with a mean age of (26.4 ± 3.8) years, a mean duration of work experience of (3.1 ± 1.2) years, more than half of them being female (55%), the majority being single (69%), with technical nursing level education (81.4%), ninety-seven percent (97%) had less than 5 years’ experience and none of the respondents had previous training in DKA management.

However, findings revealed no statistically significant association between total level of knowledge of nurses before and after the intervention in regards to demographic characteristic such as age of nurses with p-value reported as ($p = 0.06$) and ($p = 0.09$) respectively, which were all greater than the significant level of $p = 0.05$, and hence do not showed any statistically significant association with the outcome variable of nurses’ level of knowledge on the management of diabetic ketoacidosis (Shaker et al., 2020).

There was also no significant association between nurse’s knowledge level and demographic characteristic of gender, as nurses’ total level of knowledge before training was with p-value of ($p = 0.8$) and after training intervention was (0.4). In addition, there was no significant association between nurses’ level of knowledge and their previous training experience as none of the respondents had previous exposure to training on DKA management (Mayabi, 2019). The research study also shows increase in statistical significance between nurses’ level of knowledge and level of qualification as p values for total knowledge level was (0.03) and for level of qualification post training intervention was 0.4. Shaker, et al (2020) proposed that respondents level of qualification and years of experience might have positively impacted on their level of knowledge. In a study done by Mayabi, (2019) in her study to “assess knowledge among health care providers in Mbagathi Country Hospital and Mama Lucy Kibaki hospital on the management of DKA” found out that there was no relationship between healthcare workers’ level of knowledge and demographic characteristics.

This study was conducted in Tripoli, Libya, with the ultimate goal of improving the standard of care for diabetics who were brought to hospitals for other medical conditions. It sought to identify areas of hospital

nurses' expertise that were lacking in relation to the management of diabetes. Using a 66-item questionnaire, 116 nurses' knowledge of diabetes was evaluated; the mean overall score was (48.5±15.1.). When compared to nurses working in other specialty wards, pediatric nurses had the highest levels of knowledge (62.0 ± 5.5; P < 0.05), while nurses working in medicine units had mean knowledge scores that were significantly higher (53.0 ± 12.8). than those working in surgery (43.6 ± 16.2; P < 0.01) and dermatology (38.3 ± 15.2; P < 0.01) units. However, it was discovered that the nursing staff lacked a general understanding of diabetes.

According to Burns, Farrell, Myszka, and Park (2016), the mean total knowledge score for nurses with less than 10 years of experience was 46.5 ± 14.5 and for those with more than 10 years of experience was 57.2 ± 11.7 (P < 0.001) . When it came to questions about exercise (P = 0.005), diet (P = 0.001), chronic complications (P = 0.05), and diabetic ketoacidosis (P = 0.005), nurses with more years of work experience had significantly greater levels of knowledge. Compared to the 8.3% of Libyan nurses, more over three-quarters of non-Libyan nurses (78.1%) had job experience lasting longer than 10 years (Abduelkarem & El-shareif, 2013; Parwar, 2018).

The mean total knowledge score for nurses with a positive family history of diabetes was 49.1 ± 13.9; for those with a negative family history of diabetes the mean total knowledge score was 49.4 ± 15.8 (P > 0.05). The mean total knowledge score for male nurses was 47.6 ±14.4 and for female nurses was 48.6 ± 15.2 (P > 0.05). There was found to be no significant effect of gender or family history of diabetes on total knowledge score or level of knowledge in the subscale questions (P > 0.05). The mean total knowledge score for Libyan nurses was 46.4 ± 14.3 and for non-Libyan nurses was 53.3 ± 16.0 (P < 0.005). The mean total knowledge score for nurses with ≤ 10 years of experience was 46.5 ± 14.5 and for those with > 10 years of experience was 57.2 ± 11.7 (P < 0.001) (Burns, Farrell, Myszka, & Park, 2016). The level of knowledge was significantly higher among those nurses with longer duration of work experience in questions addressing exercise (P < 0.005), nutrition (P < 0.001), chronic complications (P < 0.05) and diabetes ketoacidosis (P < 0.005). More than three-quarters of non-Libyan nurses (78.1%) had a duration of work experience of > 10 years, compared with the 8.3% of Libyan nurses (Abduelkarem & El-shareif, 2013; Parwar, 2018).

2.4 Available Training Programs for Nurses

Despite the fact that numerous studies have indicated that nurses lack sufficient knowledge regarding the management of DKA, this may have an impact on their level of familiarity with the management of diabetic ketoacidosis. Knowing that consistent training in DKA care might improve nurses' knowledge and thus have a favorable effect on their performance is optimistic (Abd Elkhalek Mekky, Ahmed Mohammed Hassan & Hi Ali Ibrahim, 2023).

Once again, Shaker et al.'s (2020) study discovered that the average level of nurses' total knowledge was (4.75 ± 1.5), with a statistically significant increase after the implementation of the training program (34±1.5), and the average level of nurses' total practice was (114.3±59.1), with a statistically significant increase following the implementation of the training program.

With the use of the training program, the health outcomes of individuals with diabetic ketoacidosis statistically significantly improved. In addition Abd Elkhalek Mekky, Ahmed Mohammed Hassan & Hi Ali Ibrahim,(2023) conducted a quasi-experimental study in the intensive care unit of the Benha University Hospital to assess the effects of an educational program on nurses' performance and patients' health outcomes regarding diabetic ketoacidosis.

The nurse's self-administered questionnaire, the nurse's practice observational tool, and the patients' health outcome sheet were the instruments employed in the data collection. All nurse cadres must receive regular on-the-job training, according to Kaiser and Razurel (2013). There is a greater need to maintain healthy habits to avoid developing full-blown diabetes in the future, which when not handled well in addition to the several maternal health barriers identified due to gestational diabetes mellitus such as a shortage of trained healthcare professionals, so education of women who had gestational diabetes during pauperism must not be withheld but rather increased with emphasis made on DKA, a life-threatening complication of diabetes mellitus.

In order to support the on-the-job training and development of all of its service providers, of which nurses and midwives play a crucial role, health training is therefore an important tool for human resource development and must be embraced by all health care delivery institutions (Kaiser & Razurel, 2013). DKA management necessitates both a multi-dimensional social strategy at the level of the community and a multi-disciplinary approach at the level of health care, according to Assayed et al. (2013). At the health facility level, management calls for adequate and sustainable drug inventories, cutting-edge laboratory tools and technology, qualified medical staff, and transparent, workable rules.

At the community level, accessible and affordable care, good knowledge and correct personal care practices are required.

2.5 Barriers Nurses Encounter with the Management of Diabetic Ketoacidosis

Diabetes patients in Mozambique and Zambia are not frequently seen by healthcare professionals. DKA which is a life-threatening emergency complication of diabetes is likely to be overlooked or misdiagnosed in many people due to a lack of knowledge and the availability of tools for accurate diagnosis. DKA in diabetic patients may be mistaken as cerebral malaria or HIV/AIDS in people who present in a coma. Even if DKA in diabetic Patients is correctly diagnosed, their referral and treatment may not have been appropriate because neither country had a system of referral channels or treatment recommendations. Particularly in places far from major hospitals (Beran, et al., as cited in Mayabi, 2019).

It is stated in a study conducted by Vigersky, Fitzner & Levinson, (2013) that the management of diabetic ketoacidosis has been proven to be plagued by a number of issues that led to sub-optimal care of patients. Patients with behavioral, psychological, and socio-economic hurdles are faced by healthcare professionals, and obstacles in the delivery system are a few examples of structural and technological problems. Mayabi, (2019) study again indicated that some of the difficulties healthcare professionals face when caring for patients with diabetic ketoacidosis were insufficient medical equipment and supplies, lack of treatment guidelines and standard operating procedures, low levels of staffing and ongoing medical education.

A study was conducted in Saudi Arabia to ascertain the strategies for adopting diabetic ketoacidosis (DKA) care within the Banner system as perceived by emergency department nurses. The study used a semi-structured face-to-face interview as a qualitative descriptive method. The study's twelve (12) participants were emergency room nurses between the ages of 24 and 48. Four (4) main categories and themes regarding participant perceptions of barriers to implementing the DKA care set in the Emergency Department were identified by the qualitative inductive content analysis. These categories and themes are knowledge, experience and competence in identifying cases of DKA, communication, and language. Findings show that it is crucial for nurses to have a thorough grasp of DKA in order to evaluate and differentiate its symptoms from those of other disorders (Zaiton, Relloso, and Manood, 2019).

Participants thought that a nurse's ability to correctly identify and follow the indicators of DKA could be impeded by a lack of knowledge and training. Along with participants' lack of prior emergency department experience when caring for the DKA patients upon admission, the nursing staff's lower educational requirements in comparison to those of other health professionals were also seen as a hindrance (Zaiton et al., 2019). In a case report study which was conducted to illustrates the difficulty of managing people with DKA, both in acute care and in the community.

The study identified several risk factors for the condition, including diminished capacity for self-management, irregular dietary intake, cognitive decline, and communication problems. The difficulties in achieving stable glycaemic control and management options for DKA were discussed (Wangnoo et al. 2013). The findings also highlight the significance of individualized care planning, which takes into account physical and cognitive abilities.

The risks of hypoglycemia, such as falls, fractures, and in some cases death, are highlighted; those who are unaware of their hypoglycemia are particularly at risk. Along with strategies to reduce hospital stays and enhance post-discharge care, the risk of developing diabetic ketoacidosis is reviewed (Wangnoo et al. 2013). Efficacy and safety, influence on convenience and lifestyle, and lack of knowledge and education were the focus of an Indian study that sought to find answers to the problems preventing the successful use of insulin therapy. Findings showed that it is necessary to develop therapeutic modalities that do not impose an excessive load on patients' way of life. These should include team-based approaches to life-style adjustment, patient adherence monitoring, and patient-centric paradigms of diabetes care (Wangnoo et al. 2013).

2.6 Theoretical Framework

The theoretical framework Bergman's model of accountability (Bergman, 1982) was utilized to elaborate on the role nurses play in the management of diabetic ketoacidosis. In the model, Accountability is at the top, followed by Authority, then Responsibility with the base representing Ability which includes knowledge, skills and value.

Figure 2.2 illustrate Bergman's model of accountability (Bergman, 1982).

The fundamental prerequisites are covered in the structure's foundation. The precondition knowledge, skills, and values that an individual need in order to make a decision and take action on a particular matter determine their capacity to perform. The nurse must then be given or take on responsibility to do a particular duty. According to Bergman, accountability is more comprehensive than responsibility, even if responsibility is a vital component of accountability. The nurse's desire to take on a task or activity depends on her level of competence and her capacity to acknowledge her own limitations while committing to

giving patients high-quality care. The nurse needs formal authority, which is the legal right to carry out the obligation, along with the fundamental. Accountability is a higher-level task since the nurse must not only take responsibility for an action but also justify it. Accountability may be necessary both as a monitoring mechanism and when anything goes wrong. The work of caring for a patient with diabetic ketoacidosis is complex, and the nurse must be given all the prerequisites knowledge, expertise, and power to fulfill her duties and be held accountable. In this study the focus is placed on knowledge. Nurses' knowledge in DKA management is the only way his or her role in the management of diabetic ketoacidosis will improve quality care delivery, patient and family satisfaction.

2.7 Conclusion/Summary

The chapter includes review of recent studies on DKA management, nurses' knowledge on DKA, association of nurses' knowledge, and demographic characteristics, Available training programs for nurses and challenges nurses encounter in the management of DKA patients, and theoretical framework on model of accountability of nurses to patients.

CHAPTER THREE
METHODOLOGY

3.0 Introduction

The researcher's procedures for carrying out the study are discussed in this chapter. These include the following: the research setting, the research design, the study population, the sample size, the sampling method, the data collection tool, the data collection procedure, the data analysis, the data management, the methodological rigor/validity and reliability, the ethics statement, and the study limitations.

3.1 Research Design

The research design is a strategy for answering the research questions and defines the overall approach to how data was collected and analyzed (McCombes, 2022). This study adopted Quasi Experimental design to evaluate nurses level of knowledge on the management of DKA in the New Tafo Government Hospital, and as well as established the association of nurses' level of knowledge to their demographic characteristics.

The quasi-experimental approach used in this study is sometimes referred to as a non-randomized pre-post intervention research design since participants were not randomly assigned to conditions while the independent variable was changed (Creswell, & Creswell, 2018). A cause-and-effect link between the independent and dependent variables is always the goal of this approach. Through this, there were pre-post assessment studies (Creswell, & Hirose, 2019). The benefit of this study design was that it allows for directionality in the research study as a dependent variable (knowledge) is tested both before and after an intervention with an independent variable (Health education on DKA) (Creswell, & Hirose, 2019).

Study respondents were exposed to an intervention in the form of health education after knowledge in the research area has been assessed by using pretest questionnaires to determine their specific need when it comes to management of diabetic ketoacidosis. The Post Intervention Questionnaire helped determined if there had been any change in knowledge after the post test. This was more of pre- experimental design because there was no control group, only the situation of one group of respondents were analyzed before and after the intervention to test for any difference in the group.

3.2 Research setting

The physical, social, or experimental framework in which research is carried out is referred to as the study setting (Editage, 2020). The New Tafo Government Hospital, a municipal hospital in the Abuakwa North District of the Eastern Region, bordered by Atiwa, Fanteakwa South, Yilo Krobo, and the New Juaben North District, served as the study's location. To care for the employees and families of the Cocoa Research Institute of Ghana (CRIG), the hospital was founded in 1962. When the government realized that the hospital needed to serve more than only the personnel and families of CRIG, it changed its name to New Tafo Government Hospital.

The Hospital provides 24hour services including OPD, In-Patient, General surgery, Obstetrics and Gynecology, Psychiatry, Dental clinic, Antenatal Care (ANC), Post Natal Care (PNC), Counselling (HIV/Adolescents), X-ray, Laboratory, Electrocardiography (ECG) and ultra-sonographic services and Pharmacy. The Facility runs a Diabetic clinic twice a week thus Tuesdays and Thursdays and the number of clients that visit the clinic on annual basis was 269 in the year 2020, 380 in the year 2021 and 130 in the year 2022 representing both old and new cases respectively (District Health Information Management System Two (Dhims 2), NTGH).

3.3 Study Population

The target population's subset from which the sample was actually chosen is known as the study population (Hu, 2018). The study's participants were midwives and nurses who were at least 20 years old and had earned a nursing certificate. The total number of the study population was156 nurses and midwives.

3.3.1 Inclusion and Exclusion criteria:

Inclusion criteria involved nurses at the Casualty unit, the Male, Female, Maternity and Pediatric wards. It also includes nurses at the Theatre, Adult and Pediatric Out Patient Department (OPD) who have worked on the general wards before, and as well as midwives working at the Ante Natal care (ANC) Unit who have worked on the maternity unit before.

For exclusion criteria, nurse**s** at the mental health (MHU) unit, ophthalmic unit and (ENT) unit were excluded from participating in the study. These are specialized fields of nursing practice and do not attend to general medical conditions. They only see cases on outpatient bases, and when their cases need general medical attention then they are admitted on the general wards.

3.4 Sample size estimation and sampling procedures

3.4.1 Sample size estimation

The sample size represents the portion of the population that was selected to represent the entire population (Creswell, & Creswell, 2018), and hence this was determine using Yamane's sample size determination formula to calculate the sample size from study population 156 given that

$$n = \frac{N}{(1 + N(e^2)}$$

n=N/ (1+N (e) 2), where n is the sample size, N is the study population, (e) is the margin of error (0.05) resulting in 112 sample size.

$$n = \frac{156}{(1 + 156(0.05^2)}$$

$$n = \frac{156}{(1 + 0.39)}$$

$$n = \frac{156}{(1.39)}$$
$$n = 112$$

As a result, a sample of 112 was required. With a 5% estimated non-response rate, the sample size was increased to **118** nurses for the study. Stratified allocation formula; sample size /study population x stratum size to get the number of respondents in strata. Below is a table showing sample size for each strata;

Strata	Strata size	Strata sample size
Maternity unit	25	19
Casualty unit	25	19
Male ward	19	14
Female ward	22	17
Pediatric ward	17	13
Adult OPD	15	11
Pediatric OPD	9	7
Theatre	17	13
ANC	7	5
Total	**156**	**118**

3.4.2 Sampling method

In order to derive reliable conclusions from research findings, a researcher must carefully choose a sample that is typical of the group as a whole (McCombes, 2022). The stratified random sampling approach was employed in the sample selection process. In this probability sampling technique, strata were created from groups of the population based on a shared trait. The stratification used in this study was based on the department in which the study population was employed at the New Tafo Government Hospital. Following stratification, respondents were chosen at random from each stratum to create the necessary sample size for the study. A simple random sampling method in the form of balloting was used. By balloting, the investigator with support from the unit in-charges met eligible respondents during their shift hours when they were less busy and with their consent, piece of papers was written either “yes” or “no” whereby each eligible respondent was asked to pick at random a folded sheet of papers written “yes” and “no” which were mixed together in a bowl. Respondents were then asked to pick the folded pieces of papers one after the other, and the respondent who pick “yes” was selected from each stratum to sum up the entire sample size needed for the study. This was done every day until the sample size was achieved. All those who picked “no” did not take part in the study, except only those who picked “yes”. This procedure was repeated in each stratum until the desire sample size was achieve, and the determined sample size for the study.

3.5 Data Collection Instrument

This study has adapted a 19 structured questionnaire developed by Mayabi, (2019), and the researcher has modified this adapted questionnaire by making some changes on some of the questions and other new questions were added to make a total number of 41 questions in order to meet the objectives of this study. The questionnaire was in alignment with literature from the Joint British Societies for Diabetic Inpatient Care guide line (Dhatariya, & JBDS -IP, 2022)**.** The questionnaire focuses on respondent’s socio-demographic characteristics, and basic general knowledge on the management of DKA.

It was both theory and practice-based knowledge on the management of DKA. The questionnaire was in four sections. The first section of the questionnaire was on respondents' demographic data. The second section was on nurse's knowledge in DKA management which was measured using Likert scale from 1 to 5 as the higher score. On a scale of 1 (strongly disagree) to 5 (Strongly Agree). At the end, the knowledge scores were ranked as "1 = Poor", "2 = Average", and "3 = Good" based scores of 1 to 5 (average scores of 0-2 = Poor, 2.5-3.5 = Average, and 4-5 = Good).

Respondents showed their level of agreement to questions to assess their knowledge in the DKA management. The third section was on the available training programs for nurses on DKA management and the training needs of nurses in DKA management and the fourth section was on barriers to the management of DKA as well as factors influencing the knowledge level of nurses on the management of DKA.

3.6 Data Collection Procedure

Data collection took 4 weeks, which was in two phases. The first phase was the random selection of respondents through balloting. All the unit in charges within the study inclusion criteria were engaged. At a planned scheduled meeting, respondents were chosen through balloting with the help of unit in-charges and all those who picked "yes" had the chance to be part of the study. After the random selection of respondent, they were put into two groups. The first group were nurses from the Male Ward, Female Ward, Casualty and Adult OPD and the second group were the Nurses from Pediatric Ward, Pediatric OPD, Maternity, ANC and Theater.

On a specific date agreed on by all of them, met in the conference room of the NTGH for the second phase of the data Collection. The second phase involved the training section in the form of health education to sensitize Nurses on the early identification and management of DKA. Before the presentation, a pre-test assessment was carried out using a structured questionnaire consisted of closed questions to assess the level of knowledge of nurses on the topic, DKA and this took about 25 minutes then followed by the training section in the form of presentation. Immediately after the Health training presentation, respondents were given 25 minutes to fill post- test assessment questionnaire.

The training involved using lecture through a language common to respondents thus English and in simple words, discussions and YouTube demonstrations on DKA management for 60 minutes then post- test assessment of respondents with the same questions for 25 minutes. The post-test questionnaire was same as the pretest questionnaire. Questionnaires were collected and sealed in an envelope by the investigator. The first group section started at 8:00am and lasted to 10:00am then the second group started at 10:00am and ended at 12:00pm. All Covid-19 protocols were adhered, which involved the wearing of nose marks and hand hygiene before and after interactions with respondents and administration of the questionnaires to avoid cross infections.

3.7 Data Analysis

Quantitative analysis was the method used to analyse the data, which was extended for further statistical manipulation and presented in terms of measurement scales. Statistical Package for Social Sciences (SPSS) version 29 was used to evaluate the information collected from respondents to the questionnaire item. The first section of the questionnaire demographic data, was analyzed descriptively using mean, standard deviations, percentages and showing in tables, and the second section on the relationship between nurses' level of knowledge and their demographic characteristics were analyzed using multiple regression

statistics at a significant level of 5%, and 95% confidence level. The third and fourth sections which was on Nurses training needs and barriers encountered was reported descriptively.

3.7.1 Data management

Safety and confidentiality of data was highly assured since respondents' names did not appear on the questionnaire. All questionnaires were collected same day by researcher and was locked in a safe custody. All filled questionnaires were validated by cross-checking by the researcher to ensure that the right responses were provided before analysis. After ensuring that, all questionnaires were properly filled, the responses were coded before keying them into the computer software for the analysis. The computer for analysis had security passcode and was only accessible to the researcher and statistician who helped in the analysis of the data.

3.8 Validity and reliability

3.8.1 Validity of results

Items on the questionnaire were subjected to scrutiny, suggestions, corrections and approval by the project supervisor and other experts through face validation to evaluate if questionnaires effectively capture the topic under investigation, and as well validate the structure of the questions. Piloting of the study was done on 12 nurses in a different Hospital, Kukurentumi Community Hospital to pretest the questionnaires, and validity of the expected responses from the study subjects.

Pre-testing enables the researcher to restructure and reframe some questions to give proper meaning of the study objectives, and as well as correct all errors that were identified in the questionnaires to enhance the findings of the study. Data entering and cleaning were done and pretest results analyzed to assess for any error with item construction and content accuracy and if results truly measure study objectives. The researcher did this with the assistance of a statistician.

3.8.2 Reliability of the study

The researcher took every precaution to prevent data bias in order to guarantee that the study's findings accurately reflected the study population. To confirm the validity of the study results, the consistency of the questionnaires was assessed using the Cronbach-Alpha Reliability Coefficient. The range of the Cronbach Alpha Coefficient is (0.05–1.00). Values near (0.7) were at the very least acceptable but not ideal (Jim, 2022) and values more than (0.7) indicated the questionnaire was sufficiently consistent to imply measure was trustworthy.

3.9 Ethics Considerations

Permission to collect data from the New Tafo Government Hospital was sought officially from the Medical Superintendent. An introductory letter from the Ghana College of Nurses and Midwives in addition to an application letter for ethical clearance was submitted to the Ghana Health Service Ethical Review committee for approval before commencement of the study.

A copy of the approval letter was made available to the Director of Nursing Services Administration and the Medical Superintendent of the New Tafo Government Hospital to aid in gaining permission to conduct the study. A signed copy of the letter was made available to the Human Resources Department, the Clinical Coordinator of the Hospital, the In-Service Training Manager and all Nurse Managers of the various units the study took place to gain their cooperation during data collection.

These were set of principles that guides the research designs and practices and were very important to maintain scientific integrity, human rights and dignity of the study respondents (Bhandari, 2022). All

rights of the respondents were respected, and no respondent was coerced into the study.

3.9.1 Informed Consent

Study respondents were informed about the aim of the study, benefits, risk involved, ethical approval letters, and freedom to join voluntarily and sign a consent form but could withdraw at any point without any punitive measure against them.

3.9.2 Confidentiality

Respondent's privacy and confidentiality was maintained throughout the study. All information that was used to trace respondents were excluded or removed from the report example names. Data was protected and handled with care.

3.9.3 Anonymity

Even though respondent's identity was known by the researcher but then anonymity was guaranteed as no personal information like names, email addresses, phone numbers, photos and videos were requested.

3.9.4 Potential for harm

Respondents were assured that there was no exposure to any form of harm, be it psychological, social or physical.

3.9.5 Conflict of interest

Researcher's intention declared as there was no personal or emotional feelings attach to the study.

3.9.6 Research misconduct

Respondents were assured that no part of this study reports or data was falsified, manipulated or misrepresented, it was used for only the original purpose explained. COVID-19 protocols e.g. wearing of mask and use of proper hand hygiene was adhered to throughout the engagement.

3.10 Limitation

Limitations of the study was that, with the Quasi -experimental (Pre-Test-Post-Test) design direct causal inferences cannot be made rather associations between variables. Lack of randomization was another drawback of the quasi-experimental design, which restricted the study's capacity to draw conclusions about the causal relationship between an intervention and an outcome. Because systemic biases may affect group membership when individuals were not randomized to intervention versus control groups. Also, there was the lack of a control or comparison group which equally posed some limitation to the study findings.

CHAPTER FOUR
RESULTS

4.0 Introduction

The Joint British Diabetes Societies of Inpatient Care (JBDS-IP) DKA management guidelines were used in this study to assess the level of nurse knowledge on the management of diabetic ketoacidosis at the New Tafo Government Hospital. The results are presented in this chapter.

The findings have been arranged in accordance with the specific objectives to include the sociodemographic characteristics of the respondents, nurses' knowledge of the management of DKA, the relationship between nurses' demographic characteristics and level of knowledge on DKA, training programs for nurses available for the management of DKA, and challenges nurses face when managing diabetic ketoacidosis at the New Tafo Government Hospital. A total of 116 nurses were studied, and the results have presented below.

4.1 Respondents socio-demographic characteristics

Table 4.1 presents on the respondents' socio-demographic characteristics.

Out of 116 respondents, 37.1% aged between 20-29 years during both pre and post-test, and 1.7% aged between 40-49 years. In term of gender, about 12.9% were males and 87.1% were females. Regarding cadre of health workers recruited into the study, about 65.5% were registered general nurses, less than 20% were registered midwife, and 15% were nurse assistant clinical during both pre-test and post-test.

With educational qualification, 68.1%were Diploma holders, and less than 20% were Certificate and degree holders. In term of rank of respondents, 39.7% were staff nurse, and less than 1% were principal nurse assistant clinical. In term of current department of work, about 16.4% were working at the casualty unit, and 4.3% were working at the antenatal care unit.

About 85.3% have ever nursed a patient with Diabetes Mellitus, and less than 20% have nursed a patient with diabetic ketoacidosis. About 34.5% said to have ever had training in diabetic ketoacidosis management, and about 65.5% said they have never had training in the management of diabetic ketoacidosis.

Table 4.1: Respondents socio-demographic data

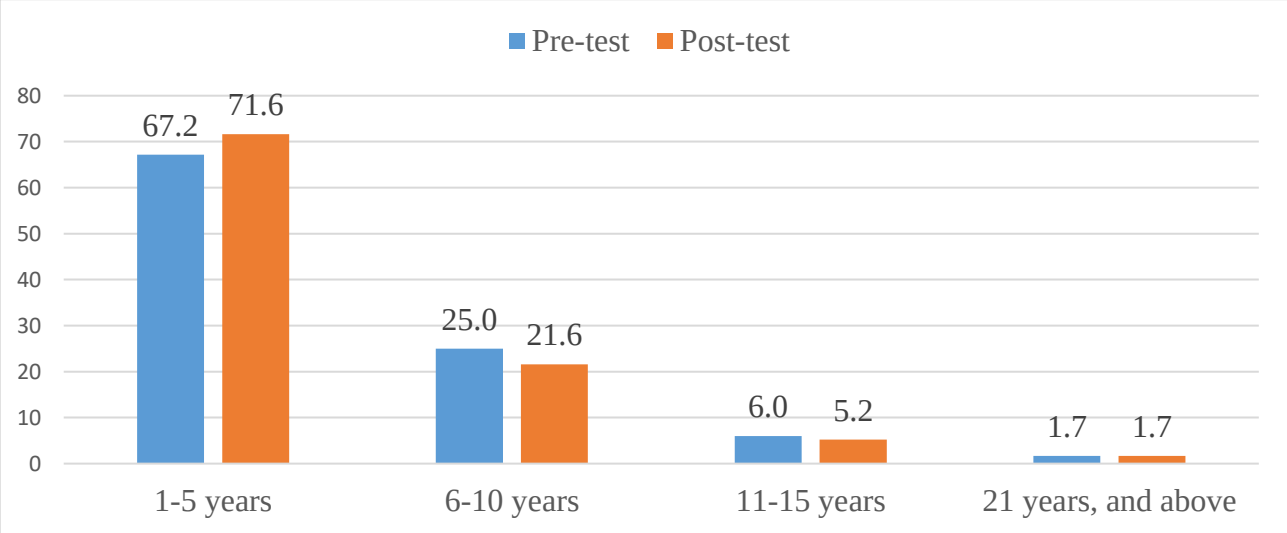
Variable	Pre-test (N = 116)		Post-test (N = 116)	
	Frequency	Percent (%)	Frequency	Percent (%)
Age of respondents				
20-29 years	43	37.1	45	38.8
30-39 years	71	61.2	69	59.5
40-49 years	2	1.7	2	1.7
Gender				
Male	15	12.9	13	11.2
Female	101	87.1	103	88.8
Marital status				
Married	63	54.3	61	52.6
Single	53	45.7	55	47.4
Cadre of health workers				
Registered General Nurse	76	65.5	75	64.7
Registered Midwife	23	19.8	23	19.8
Nurse Assistant Clinical	17	14.7	18	15.5
Level of qualification				
Certificate	17	14.7	18	15.5
Diploma	79	68.1	80	69.0
BSc. Nursing	20	17.2	18	15.5
Rank of respondents				
Staff Nurse	46	39.7	48	41.3
Senior Staff Nurse	20	17.2	19	16.3
Nursing Officer	9	7.8	7	6.0
Senior Nursing Officer	3	2.6	1	0.9
Staff Midwife	8	6.9	9	7.8

Senior Staff Midwife	9	7.8	9	7.8
Midwife Officer	3	2.6	3	2.6
Principal Midwife Officer	2	1.7	2	1.7
Nurse Assistant Clinical	8	6.9	8	6.9
Senior Nurse Assistant Clinical	8	6.8	10	8.7
Current department work				
Adults OPD	10	8.6	10	8.6
Paediatric OPD	7	6.0	7	6.0
Paediatric ward	13	11.2	13	11.2
Male ward	14	12.1	14	12.1
Female ward	17	14.7	17	14.7
Maternity ward	18	15.5	18	15.5
ANC	5	4.3	5	4.3
Theatre	13	11.2	13	11.2
Casualty unit	19	16.4	19	16.4
Nursed a patient with condition before				
DM	99	85.3	90	77.6
DKA	14	12.1	23	19.8
Not at all	3	2.6	3	2.6
Ever had training in DKA management				
Yes	29	25.0	40	34.5
No	87	75.0	76	65.5

Source: Field data, 2023

4.1.1 Years of Clinical Experience

Figure 4.1 presents on the respondents' years of clinical experience. About 71.6% had 1-5 years of clinical experience during the post-test, and 67.2% at pre-test. About a quarter (25%) had 6-10 years' experience during pre-test, and 21.6% at post-test, and 1.7% had 20 years and over in clinical experience.



Source: Field data, 2023

Figure 4.1: Years of clinical experience

4.2 Nurse Knowledge on DKA management

4.2.1 Pre-test results of Nurse Knowledge on DKA management

Table 4.2 presents on the nurse knowledge on DKA management. About 50.9% strongly agreed that, DKA is a life threatening, medical emergency complication of diabetes caused by the build-up of glucose in the blood stream, and 3.5% strongly disagreed. About 56% agreed that, the biochemical criteria for diagnosing Diabetic ketoacidosis is hyperglycaemia ≥11mmol/l, Blood PH >7.3, Bicarbonates < 15mmol/l and Blood ketones ≥ 3mmol/l or Urine ketones ≥ 2+, and 3.5% strongly disagreed. Also, 36.2% agreed that, in Euglycemia Ketosis blood glucose levels are less than 11mmol/l while 1.7% strongly disagreed. Also, about 45.7% agreed that, the pathogenesis of DKA includes breakdown of glucose from the liver, metabolism of glucose from non-carbohydrate sources with the exception of ketone bodies formation, while 4.3% strongly disagreed. About 56.9% agreed that, the major causes of DKA are Type 1 DM, Type 2 DM and Diabetes Insipidus, while 3.5% had strongly disagreed. Also, 38% had agreed that, all the following, surgery, infections, pregnancy, suboptimal insulin use with the exception of trauma are precipitating causes of DKA, while 5.2% had strongly disagreed. Also, about 47.4% had agreed that, all the following signs and symptoms such as increased urine output, weight loss, fruity breadth, Dehydration are clinical features of diabetic ketoacidosis (DKA) except abdominal pain, nausea or vomiting, while 4.3% had strongly disagreed. About 45.7% had also agreed that, the following laboratory investigations, blood glucose, blood ketones, urine dipstick can help with the early identification of DKA except Venous PH levels, while 4.3% had strongly disagreed. Also, about 37.1% had agreed that, the following are not true indicators of severe DKA: blood ketones>6mmol/l, bicarbonates <5mmol/l, Ph. < 7.1, potassium <3.5mEq/I, Glasgow coma scale (GCS) < 12, persistent hypoxia, persistent bradycardia or tachycardia, while 4.3% had strongly disagreed. About 32.8% had agreed that, the following are essential in the management of a child or adult with DKA: free weight, Antibiotic therapy if febrile, fluid therapy, electrolyte replacement with the exception of insulin therapy, while 5.2% had strongly disagreed. Also, 40.5% had agreed that during management of DKA, one must start fluid therapy then insulin therapy one to two hours later, while 5.2% had disagreed. About 38.8% had agreed that, if a patient being managed for DKA is already on long-acting basal insulin, it is not necessary to administer the long-acting basal insulin at patient's usual dose, while 2.6% had strongly disagreed. To add, about 35.3% had disagreed that, ringers Lactate is the Ideal fluid therapy for DKA resuscitations, while 6.8% had agreed. About 31% had disagreed that calcium is the most important electrolyte to monitor during management of DKA, while 10.3% had strongly disagreed. About 37.1% agreed that the standard IV Insulin drip rate used in DKA management is 0.1 units/kg/hours, while 5.2% had strongly disagreed. Also, about 43.1% agreed that, during DKA management, when blood glucose reduces to ≤14mmol/l, it is not necessary to Start 10 %dextrose infusion at 125mls/minute, reduce insulin infusion rate to 0.05 unit/kg/hour, while 8.6% had strongly disagreed. About 26.7% disagreed that when managing a patient with complicated DKA, do not referrer unless status of patient is deteriorating, while 14.7% had agreed.

Table 4.2: Nurse Pre-test Knowledge on DKA Management

Statements	Likert scale on Nurses level of agreement to Diabetic Ketoacidosis (N = 116)				
	Strongly agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly Disagree n (%)
Diabetic ketoacidosis (DKA) is a life threatening, medical emergency complication of diabetes caused by the build-up of glucose in the blood stream.	59 (50.9)	42 (36.2)	2 (1.7)	9 (7.8)	4 (3.5)
The biochemical criteria for diagnosing Diabetic ketoacidosis is hyperglycaemia ≥11mmol/l, Blood PH >7.3, Bicarbonates < 15mmol/l and Blood ketones ≥ 3mmol/l or Urine ketones ≥ 2+	29 (25.0)	65 (56.0)	12 (10.3)	6 (5.2)	4 (3.5)
In Euglycemia Ketosis blood glucose levels are less than 11mmol/l	30 (25.9)	42 (36.2)	29 (25.0)	13 (11.2)	2 (1.7)
The pathogenesis of DKA includes breakdown of glucose from the liver, metabolism of glucose from non-carbohydrate sources with the exception of ketone bodies formation	26 (22.4)	53 (45.7)	11 (9.5)	21 (18.1)	5 (4.3)
The major causes of DKA are Type 1 DM, Type 2 DM and Diabetes Insipidus	30 (25.9)	66 (56.9)	8 (6.9)	8 (6.9)	4 (3.5)
All the following, surgery, infections, pregnancy, suboptimal insulin use with the exception of trauma are precipitating causes of DKA	29 (25.0)	45 (38.8)	10 (8.6)	26 (22.4)	6 (5.2)
All the following signs and symptoms: Increased urine output, weight loss, fruity breadth, Dehydration are clinical features of diabetic ketoacidosis (DKA) except abdominal pain, nausea or vomiting	31 (26.7)	55 (47.4)	5 (4.3)	20 (17.2)	5 (4.3)
The following laboratory investigations, blood glucose, blood ketones, urine dipstick can help with the early identification of DKA except Venous PH levels	27 (23.3)	53 (45.7)	9 (7.8)	22 (18.9)	5 (4.3)
The following are not true indicators of severe DKA: blood ketones>6mmol/l, bicarbonates <5mmol/l, Ph. < 7.1, potassium <3.5mEq/I, Glasgow coma scale (GCS) < 12, persistent hypoxia, persistent bradycardia or tachycardia.	13 (11.2)	43 (37.1)	28 (24.1)	27 (23.3)	5 (4.3)
The following are essential in the management of a child or adult with DKA: free weight, Antibiotic therapy if febrile, fluid therapy, electrolyte replacement with the exception of insulin therapy.	18 (15.5)	38 (32.8)	16 (13.8)	38 (32.8)	6 (5.2)

During management of DKA, one must start fluid therapy then insulin therapy one to two hours later.	18 (15.5)	47 (40.5)	17 (14.7)	28 (24.1)	6 (5.2)
If a patient being managed for DKA is already on long acting basal insulin, it is not necessary to administer the long acting basal insulin at patient's usual dose	21 (18.1)	45 (38.8)	15 (12.9)	32 (27.6)	3 (2.6)
Ringers Lactate is the Ideal fluid therapy for DKA resuscitations	8 (6.9)	34 (29.3)	21 (18.1)	41 (35.3)	12 (10.3)
Calcium is the most important electrolyte to monitor during management of DKA	12 (10.3)	34 (29.3)	26 (22.4)	36 (31.0)	8 (6.9)
The standard IV Insulin drip rate used in DKA management is 0.1 units/kg/hours	17 (14.7)	43 (37.1)	32 (27.6)	18 (15.5)	6 (5.2)
During IV fluid and insulin therapy, one should aim blood glucose drop of 10mmol/l per hour	18 (15.5)	41 (35.3)	17 (14.7)	34 (29.3)	6 (5.2)
During DKA management, when blood glucose reduces to ≤14mmol/l, it is not necessary to Start 10 %dextrose infusion at 125mls/minute, reduce insulin infusion rate to 0.05 unit/kg/hour	17 (14.7)	50 (43.1)	22 (18.9)	17 (14.7)	10 (8.6)
Frequent monitoring of biochemical changes during management of DKA includes hourly glucose monitoring, 2 hourly venous PH check, 2 hourly bicarbonate and potassium check with the exception of hourly ketone check	19 (16.4)	43 (37.1)	21 (18.1)	30 (25.9)	3 (2.6)
All the following are true during potassium replacement therapy when managing the patient with DKA: call senior review when blood potassium is <3.5mEq/I, do not replace when blood potassium level >5.5mEq/I with the exception of replacement with 20 -40mmol/l of potassium chloride (KCL) when blood potassium level is between 3.5-5.5mEq/I	20 (17.2)	51 (43.9)	33 (28.5)	8 (6.9)	4 (3.5)
Cerebral oedema is rare but lethal complication of DKA management. The following: confusion, irritability, lethargic, headache and vomiting are not true clinical signs and symptoms of cerebral oedema	18 (15.5)	29 (25.0)	19 (16.4)	40 (34.5)	10 (8.6)
During management of DKA, the most effective fluid for treating cerebral oedema immediately it is suspected is 0.9% Normal saline and Mannitol	21 (18.1)	62 (53.5)	15 (12.9)	13 (11.2)	5 (4.3)
Hypokalaemia and Hypoglycaemia are not the most common complications of DKA management	21 (18.1)	25 (21.6)	16 (13.8)	39 (33.6)	15 (12.9)
When managing a patient with complicated DKA, do not referrer unless status of patient is deteriorating.	17 (14.7)	41 (35.3)	10 (8.6)	31 (26.7)	17 (14.7)

Source: Field Data, 2023

4.2.2 Post-test results of Nurse Knowledge on DKA management

Table 4.3 presents on the post-test results of nurse knowledge on DKA management. From the post-test results, about 56.9% had disagreed that, DKA is a life threatening, medical emergency complication of diabetes caused by the build-up of glucose in the blood stream, while 12.9% had strongly agreed. Also, 56.9% had disagreed that, the biochemical criteria for diagnosing Diabetic ketoacidosis is hyperglycaemia ≥11mmol/l, Blood PH>7.3, Bicarbonates <15mmol/l and Blood ketones ≥ 3mmol/l or Urine ketones ≥ 2+, while 5.2% had agreed. Over two-third (72.4%) strongly agreed that in Euglycemia Ketosis blood glucose levels are less than 11mmol/l, while 3.5% had disagreed. More than half (57.8%) had disagreed pathogenesis of DKA includes breakdown of glucose from the liver, metabolism of glucose from non-carbohydrate sources, while 6% had agreed. About 57.8% disagreed that, the major causes of DKA are Type 1 DM, Type 2 DM and Diabetes Insipidus, while 2.6% had agreed. Almost two-third (62.9%) disagreed that, all the following, surgery, infections, pregnancy, suboptimal insulin use with the exception of trauma are precipitating causes of DKA, while 4.3% had agreed. About 61.2% had disagreed that, DKA clinical signs and symptoms includes; Increased urine output, weight loss, fruity breadth, and Dehydration, while 4.3% had strongly agreed. Also, 60.3% had disagreed that, all these laboratory investigations, blood glucose, blood ketones, urine dipstick help in early identification of DKA, while 3.5% had agreed. More than 58.6% had disagreed that, the following are not true indicators of severe DKA: blood ketones>6mmol/l, bicarbonates <5mmol/l, Ph. < 7.1, potassium <3.5mEq/I, Glasgow coma scale (GCS) < 12, persistent hypoxia, persistent bradycardia or tachycardia, while 6.9% had strongly disagreed. About two-third (65.5%) had disagreed that, the following are essential in the management of a child or adult with DKA: free weight, Antibiotic therapy if febrile, fluid therapy, electrolyte replacement with the exception of insulin therapy, while 4.3% had agreed. Also, about 78.5% strongly agreed that, during management of DKA, one must start fluid therapy then insulin therapy one to two hours later, while 9.5% had disagreed. Findings also revealed that, more than half (59.5%) had disagreed that, if a patient being managed for DKA is already on long-acting basal insulin, it is not necessary to administer the long-acting basal insulin at patient's usual dose, while 4.3 had strongly agreed. About 62.1% had disagreed that, Ringers Lactate is the Ideal fluid therapy for DKA resuscitations, while 1.7% had strongly agreed. About 56.9% had disagreed that Calcium is the most important electrolyte to monitor during management of DKA, while 1.7% had agreed.

Table 4.3: Post-test results of Nurses Knowledge on DKA management

Statements	Likert scale on Nurses level of agreement to Diabetic Ketoacidosis (N = 116)				
	Strongly agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly Disagree n (%)

Diabetic ketoacidosis (DKA) is a life threatening, medical emergency complication of diabetes caused by the build-up of glucose in the blood stream.	15 (12.9)	6 (5.2)	0 (0.0)	66 (56.9)	29 (25.0)
The biochemical criteria for diagnosing Diabetic ketoacidosis is hyperglycaemia ≥11mmol/l, Blood PH>7.3, Bicarbonates <15mmol/l and Blood ketones ≥ 3mmol/l or Urine ketones ≥ 2+	15 (12.9)	6 (5.2)	0 (0.0)	66 (56.9)	29 (25.0)
In Euglycemia Ketosis blood glucose levels are less than 11mmol/l	84 (72.4)	21 (18.1)	0 (0.0)	4 (3.5)	5 (4.3)
The pathogenesis of DKA includes breakdown of glucose from the liver, metabolism of glucose from non-carbohydrate sources with the exception of ketone bodies formation	9 (7.8)	7 (6.0)	0 (0.0)	67 (57.8)	33 (28.5)
The major causes of DKA are Type 1 DM, Type 2 DM and Diabetes Insipidus	10 (8.6)	3 (2.6)	1 (0.9)	67 (57.8)	35 (30.2)
All the following, surgery, infections, pregnancy, suboptimal insulin use with the exception of trauma are precipitating causes of DKA	8 (6.9)	5 (4.3)	1 (0.9)	73 (62.9)	29 (25.0)
All the following signs and symptoms: Increased urine output, weight loss, fruity breadth, Dehydration are clinical features of diabetic ketoacidosis (DKA) except abdominal pain, nausea or vomiting	5 (4.3)	0 (0.0)	0 (0.0)	71 (61.2)	40 (34.5)
The following laboratory investigations, blood glucose, blood ketones, urine dipstick can help with the early identification of DKA except Venous PH levels	5 (4.3)	4 (3.5)	1 (0.9)	70 (60.3)	36 (31.0)
The following are not true indicators of severe DKA: blood ketones>6mmol/l, bicarbonates <5mmol/l, Ph. < 7.1, potassium <3.5mEq/I, Glasgow coma scale (GCS) < 12, persistent hypoxia, persistent bradycardia or tachycardia.	8 (6.9)	9 (7.8)	2 (1.7)	68 (58.6)	29 (25.0)
The following are essential in the management of a child or adult with DKA: free weight, Antibiotic therapy if febrile, fluid therapy, electrolyte replacement with the exception of insulin therapy.	5 (4.3)	5 (4.3)	1 (0.9)	76 (65.5)	29 (25.0)
During management of DKA, one must start fluid therapy then insulin therapy one to two hours later.	91 (78.5)	13 (11.2)	1 (0.9)	11 (9.5)	0 (0.0)
If a patient being managed for DKA is already on long-acting basal insulin, it is not necessary to administer the long-acting basal insulin at patient's usual dose	5 (4.3)	5 (4.3)	2 (1.7)	69 (59.5)	35 (30.2)
Ringers Lactate is the Ideal fluid therapy for DKA resuscitations	2 (1.7)	2 (1.7)	0 (0.0)	72 (62.1)	40 (34.5)
Calcium is the most important electrolyte to monitor during management of DKA	0 (0.0)	2 (1.7)	1 (0.9)	66 (56.9)	47 (40.5)

The standard IV Insulin drip rate used in DKA management is 0.1 units/kg/hours	78 (67.2)	14 (12.1)	1 (0.9)	20 (17.2)	3 (2.6)
During IV fluid and insulin therapy, one should aim blood glucose drop of 10mmol/l per hour	6 (5.2)	8 (6.9)	1 (0.9)	65 (56.0)	36 (31.0)
During DKA management, when blood glucose reduces to ≤14mmol/l, it is not necessary to Start 10 %dextrose infusion at 125mls/minute, reduce insulin infusion rate to 0.05 unit/kg/hour	10 (8.6)	10 (8.6)	1 (0.9)	56 (48.3)	39 (33.6)
Frequent monitoring of biochemical changes during management of DKA includes hourly glucose monitoring, 2 hourly venous PH check, 2 hourly bicarbonate and potassium check with the exception of hourly ketone check	5 (4.3)	3 (2.6)	0 (0.0)	74 (63.8)	34 (29.3)
All the following are true during potassium replacement therapy when managing the patient with DKA: call senior review when blood potassium is <3.5mEq/I, do not replace when blood potassium level >5.5mEq/I with the exception of replacement with 20 -40mmol/l of potassium chloride (KCL) when blood potassium level is between 3.5-5.5mEq/I	14 (12.1)	11 (9.5)	2 (1.7)	65 (56.0)	24 (20.7)
Cerebral oedema is rare but lethal complication of DKA management. The following: confusion, irritability, lethargic, headache and vomiting are not true clinical signs and symptoms of cerebral oedema	4 (3.5)	2 (1.7)	0 (0.0)	73 (62.9)	37 (31.9)
During management of DKA, the most effective fluid for treating cerebral oedema immediately it is suspected is 0.9% Normal saline and Mannitol	13 (11.2)	11 (9.5)	0 (0.0)	67 (57.8)	25 (21.6)
Hypokalaemia and Hypoglycaemia are not the most common complications of DKA management	7 (6.0)	2 (1.7)	0 (0.0)	60 (51.7)	47 (40.5)
When managing a patient with complicated DKA, do not referrer unless status of patient is deteriorating.	8 (6.9)	7 (6.0)	0 (0.0)	64 (55.2)	37 (31.9)

Source: Field data, 2023

4.2.3 Average scores of Nurses Knowledge scores on DKA Management

Table 4.4 presents on the average scores of nurse knowledge in the management of DKA. From the pre-test assessment, the highest average knowledge score of nurses on the management of DKA showed 3.13 on Ringers Lactate is the Ideal fluid therapy for DKA resuscitations, followed by 3.02 on Hypokalaemia and Hypoglycaemia are not the most common complications of DKA. On the statement of Cerebral oedema is rare but lethal complication of DKA management. The following: confusion, irritability, lethargic, headache and vomiting are not true clinical signs and symptoms of cerebral oedema was 2.95 scores, and 2.94 on Calcium is the most important electrolyte to monitor during management of DKA. Also, 2.91 was on When managing a patient with complicated DKA, do not referrer unless status of patient is deteriorating. On during IV fluid and insulin therapy, one should aim blood glucose drop of 10mmol/l

per hour was 2.73, The following are essential in management of a child or adult with DKA: free weight 2.79, The following are not true indicators of severe DKA: blood ketones >6mmol/l 2.72, During management of DKA, one must start fluid then insulin therapy one to two hours later 2.63, and Frequent monitoring of biochemical changes during management of DKA includes hourly glucose monitoring was 2.61, and the least of all the knowledge score of DKA management was 1.76 for DKA is a life threatening, medical emergency complication. During post-test assessment, Ringers Lactate is the Ideal fluid therapy for DKA resuscitations was 4.26, followed by 4.19 on Hypokalaemia and Hypoglycaemia are not the most common complications of DKA. Also, 3.99 was on When managing a patient with complicated DKA, do not referrer unless status of patient is deteriorating. During IV fluid and insulin therapy, one should aim blood glucose drop of 10mmol/l per hour was 4.01, The following are essential in management of a child or adult with DKA: free weight 4.03, The following are not true indicators of severe DKA: blood ketones >6mmol/l 3.87, All these laboratory investigations, blood glucose, help in early identification of DKA 4.10, and Frequent monitoring of biochemical changes during management of DKA includes hourly glucose monitoring was 4.11, and the least of all the knowledge score of DKA management was 1.41 for during management of DKA, one must start fluid then insulin therapy one to two hours later.

Table 4.4: Nurses Knowledge scores on DKA Management

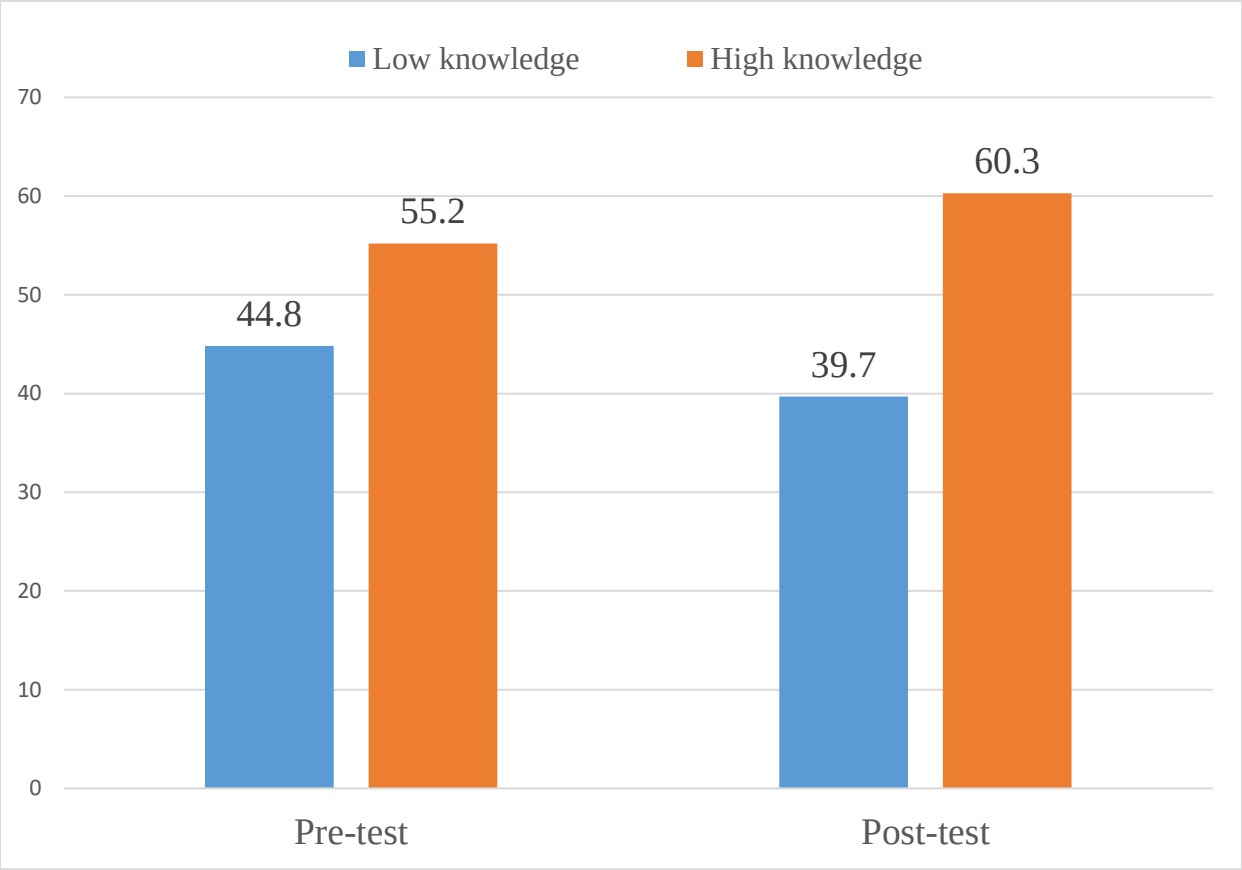
Statements	**Pre-test (N = 116)**	**Post-test (N = 116)**
	Mean ± SD	**Mean ± SD**
Diabetic ketoacidosis (DKA) is a life threatening, medical emergency complication of diabetes caused by the build-up of glucose in the blood stream.	1.76 ± 1.04	3.75 ± 1.25
The biochemical criteria for diagnosing Diabetic ketoacidosis is hyperglycaemia ≥11mmol/l, Blood PH >7.3, Bicarbonates < 15mmol/l and Blood ketones ≥ 3mmol/l or Urine ketones ≥ 2+	2.06 ± 0.93	3.75 ± 1.25
In Euglycemia Ketosis blood glucose levels are less than 11mmol/l	2.26 ± 1.02	1.63 ± 1.59
The pathogenesis of DKA includes breakdown of glucose from the liver, metabolism of glucose from non-carbohydrate sources with the exception of ketone bodies formation	2.36 ± 1.14	3.93 ± 1.11
The major causes of DKA are Type 1 DM, Type 2 DM and Diabetes Insipidus	2.05 ± 0.95	3.98 ± 1.09
All the following, surgery, infections, pregnancy, suboptimal insulin use with the exception of trauma are precipitating causes of DKA	2.43 ± 1.23	3.94 ± 1.03
All the following signs and symptoms: Increased urine output, weight loss, fruity breadth, Dehydration are clinical features of diabetic ketoacidosis (DKA) except abdominal pain, nausea or vomiting	2.25 ± 1.15	4.21 ± 0.83
The following laboratory investigations, blood glucose, blood ketones, urine dipstick can help with the early identification of DKA except Venous PH levels	2.35 ± 1.15	4.10 ± 0.92

The following are not true indicators of severe DKA: blood ketones>6mmol/l, bicarbonates <5mmol/l, Ph. < 7.1, potassium <3.5mEq/I, Glasgow coma scale (GCS) < 12, persistent hypoxia, persistent bradycardia or tachycardia.	2.72 ± 1.07	3.87 ± 1.09
The following are essential in the management of a child or adult with DKA: free weight, Antibiotic therapy if febrile, fluid therapy, electrolyte replacement with the exception of insulin therapy.	2.79 ± 1.21	4.03 ± 0.91
During management of DKA, one must start fluid therapy then insulin therapy one to two hours later.	2.63 ± 1.16	1.41 ± 0.91
If a patient being managed for DKA is already on long acting basal insulin, it is not necessary to administer the long acting basal insulin at patient's usual dose	2.58 ± 1.15	4.07 ± 0.94
Ringers Lactate is the Ideal fluid therapy for DKA resuscitations	3.13 ± 1.15	4.26 ± 0.71
Calcium is the most important electrolyte to monitor during management of DKA	2.94 ± 1.14	4.36 ± 0.59
The standard IV Insulin drip rate used in DKA management is 0.1 units/kg/hours	2.59 ± 1.08	1.76 ± 1.25
During IV fluid and insulin therapy, one should aim blood glucose drop of 10mmol/l per hour	2.73 ± 1.19	4.01 ± 1.03
During DKA management, when blood glucose reduces to ≤14mmol/l, it is not necessary to Start 10 %dextrose infusion at 125mls/minute, reduce insulin infusion rate to 0.05 unit/kg/hour	2.59 ± 1.16	3.89 ± 1.21
Frequent monitoring of biochemical changes during management of DKA includes hourly glucose monitoring, 2 hourly venous PH check, 2 hourly bicarbonate and potassium check with the exception of hourly ketone check	2.61 ± 1.12	4.11 ± 0.88
All the following are true during potassium replacement therapy when managing the patient with DKA: call senior review when blood potassium is <3.5mEq/I, do not replace when blood potassium level >5.5mEq/I with the exception of replacement with 20 -40mmol/l of potassium chloride (KCL) when blood potassium level is between 3.5-5.5mEq/I	2.35 ± 0.96	3.64 ± 1.25
Cerebral oedema is rare but lethal complication of DKA management. The following: confusion, irritability, lethargic, headache and vomiting are not true clinical signs and symptoms of cerebral oedema	2.95 ± 1.25	4.18 ± 0.82
During management of DKA, the most effective fluid for treating cerebral oedema immediately it is suspected is 0.9% Normal saline and Mannitol	2.30 ± 1.03	3.69 ± 1.23
Hypokalaemia and Hypoglycaemia are not the most common complications of DKA management	3.02 ± 1.34	4.19 ± 0.99
When managing a patient with complicated DKA, do not referrer unless status of patient is deteriorating.	2.91 ± 1.34	3.99 ± 1.09

4.2.4 Pre-Posttest Knowledge level of nurses on DKA management

Figure 4.2 presents on the knowledge level of nurses on DKA management during pre-test and post-test of nurses' knowledge on various statements regarding DKA management at the hospital. Results showed

nurses knowledge increased during the post-test as almost two-third (60.3%) had high (>80) knowledge score in DKA management while 39.7% had low knowledge on the management of DKA. However, during the pre-test, about 55.2% were reported to have had high (>50) knowledge score on DKA management, while 44.8% were found to have had low knowledge regarding the management of DKA.

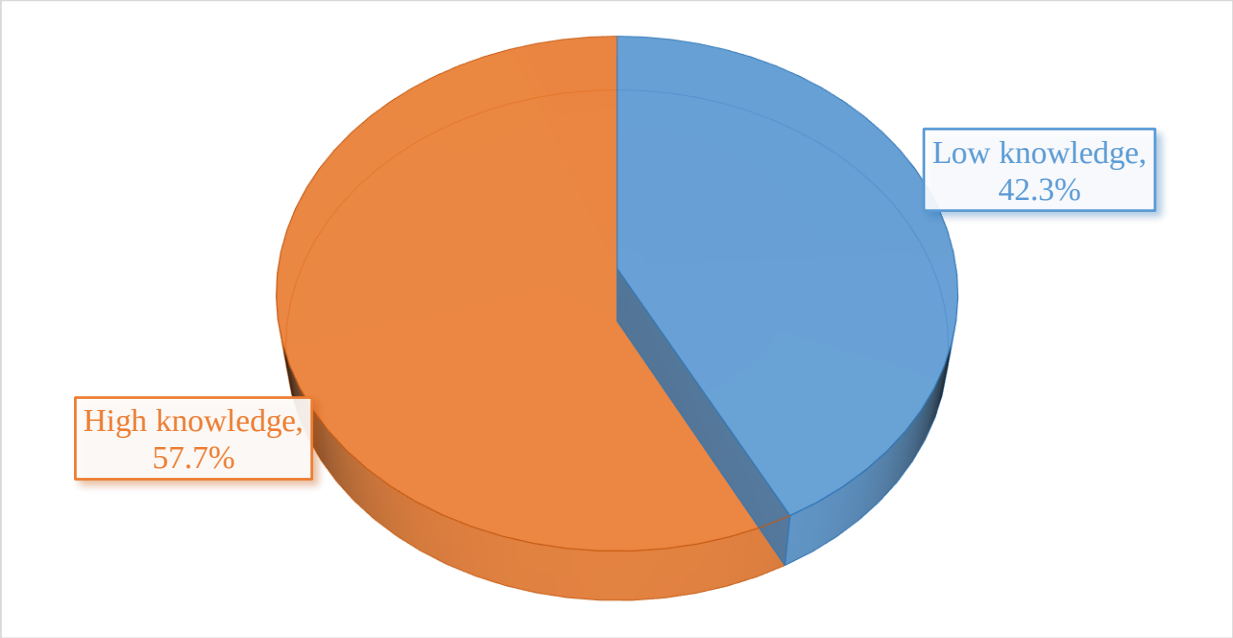


Source: Field data, 2023

Figure 4.2: Pre-Posttest Knowledge level on DKA management

4.2.5 Overall knowledge level of nurses on DKA management

Figure 4.4 presents on the overall knowledge level of nurses on diabetic ketoacidosis management. Results from both pre-test and post-test showed overall knowledge level of nurses on DKA management indicate more than half (57.7%) had increased/high level of knowledge on the management of diabetic ketoacidosis, while 42.3% of the nurses were found to have low level of knowledge on the management of diabetic ketoacidosis in the New Tafo Government Hospital.



Source: Field data, 2023

Figure 4.3: Overall knowledge level of nurses on DKA management

4.3 Training Needs of Nurses for Diabetic Ketoacidosis Management

Table 4.4 presents on the training needs of nurses for diabetic ketoacidosis management. During the pre-test 74.1% have never had training on the management of DKA, and 73.3% have never had training on the management of DKA during post-test. About 13.8% for the post-test had training in DKA management in the last 3 months, and 2.6% during the pre-test. About 12.1% had training in DKA management in the last 2 years, and 8.6% training in last 2 years in DKA management in the post-test. During the pre-test, about 46.5% reported to have protocol on the management of DKA at their unit, and increased to 56% during the post-test.

During the pre-test, about 99.1% said they would recommend training in DKA management, and during the post-test, 97.4% said they would recommend training in DKA management. In term of the frequency of training in DKA management, about 44% cited quarterly training during the pre-test, and has increased to 56% during the post-test. Also, 36.2% reported half yearly training in DKA management during the pre-test, and 35.3% during the post-test. About 17.2% cited annual training in DKA management during the pre-test, and 7.8% during the post-test.

Table 4.5: Training Needs of Nurses for Diabetic Ketoacidosis Management

Variable	Pre-test (N = 116)		Post-test (N = 116)	
	Frequency	Percent (%)	Frequency	Percent (%)
Last time had training in DKA management				
Last 3 months	3	2.6	16	13.8
Last 6 months	2	1.7	0	0.0
Last 1 year	11	9.5	5	4.3
Last 2 years	14	12.1	10	8.6
None of the above	86	74.1	85	73.3

Have Protocol on the management of DKA at unit				
Yes	54	46.5	65	56.0
No	62	53.5	51	44.0
Would recommend training in DKA management				
Yes	115	99.1	113	97.4
No	1	0.9	3	2.6
Frequency of training in DKA management				
Quarterly	51	44.0	65	56.0
Half yearly	42	36.2	41	35.3
Annually	20	17.2	9	7.8
Every 2 years	1	0.9	0	0.0
Not at all	2	1.7	1	0.9

Source: Field data, 2023

4.4 Barriers to Diabetic Ketoacidosis Management

Table 4.5 presents on the barriers to the management of diabetic ketoacidosis. Over three-quarters (80.2%) of the respondents reported that they do not always have enough medical supplies and equipment for management of DKA, only 19% of the respondents said they sometimes have enough medical supplies and equipment for the management of DKA. In term of having challenges in distinguishing cases of DKA from other conditions showed 45.7% said they sometimes have challenges, 7.8% said they most of the time have challenges in distinguishing cases of DKA from other conditions.

Types of challenges most often faced that affect the efficient management of DKA patients showed 19.7% reported lack of in-service training in the management of DKA, 17.2% reported delay in getting results of requested laboratory investigations, 15.6% cited patients inability to pay cost of frequent laboratory investigations, 11.1% cited inadequate knowledge on the management of patients with DKA, 10.9% reported absence of standard operating protocols and treatments, 10.4% cited insufficient point of care equipment for monitoring patients, and least of the challenges was high workload making it difficult to provide continuous monitoring representing 3.2% during post-test assessment.

Table 4.6: Barriers to Diabetic Ketoacidosis management

Variable	**Pre-test (N = 116)**		**Post-test (N = 116)**	
	Freq	**Percent (%)**	**Freq**	**Percent (%)**
Have enough medical supplies for management of DKA				
Sometimes	28	24.1	22	19.0
Always available	7	6.0	1	0.9
Not always available	81	69.8	93	80.2
Have challenges distinguishing cases of DKA from other conditions				

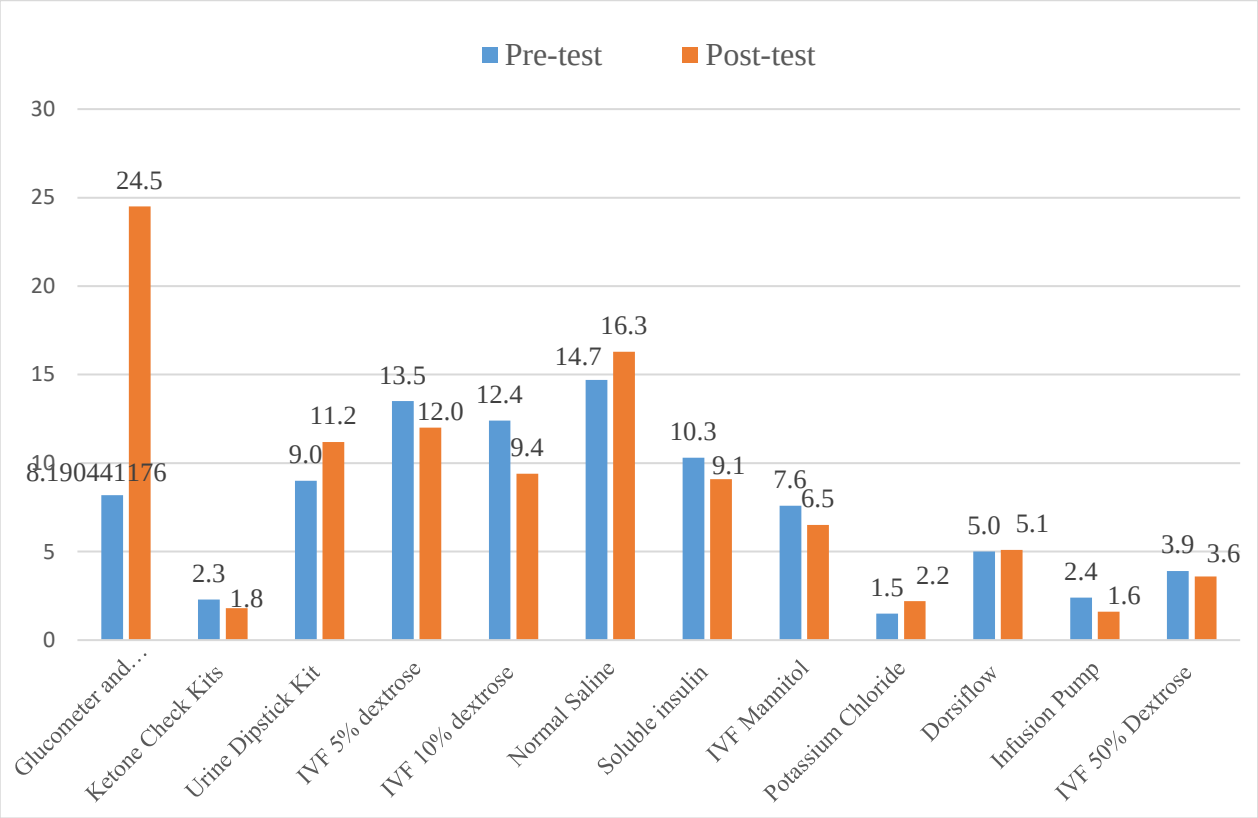
Most of the time	17	14.7	9	7.8
Sometimes	66	56.8	53	45.7
All the time	17	14.7	9	7.8
Not at all	16	13.8	45	38.8
Type of challenges to efficient management of DKA patients				
Inadequate knowledge on the management of patients with DKA	88	16.8	49	11.1
Absence of standard operating protocols and treatments	73	14.0	48	10.9
High workload making it difficult to provide continuous monitoring	25	4.8	14	3.2
Lack of in-service training in the management of DKA	101	19.3	87	19.7
Delay in getting results of requested laboratory investigations	65	12.4	76	17.2
Patients' inability to pay cost of frequent laboratory investigations	73	14.0	69	15.6
None adherence to treatment regimen by known diabetic patients	50	9.5	20	4.5
Lack of supportive supervision	36	6.9	32	7.3
Insufficient point of care equipment for monitoring patients	12	2.3	46	10.4

Source: Field data, 2023

4.4.1 Availability of resources for DKA management

Figure 4.3 presents on the available resources for the management of DKA. During the pre-test, it shows 17.4% had glucometer and stripes, 14.7% had normal saline, 13.5% had IVF 5% dextrose, 10.3% had soluble insulin, 12.4% had IVF 10% dextrose, and least among all was potassium chloride representing 1.5%.

During the post-test assessment there was no significant improvement in the availability of resources for DKA management as about 24.5% reported the availability of glucometer and stripes, normal saline 16.3%, IVF 5% dextrose was 12%, Urine dipstick kit 11.2%, and the least available resources in the management DKA in the hospital was Ketone check kits 1.8%, Potassium chloride 1.5%, and Infusion pump 1.6%.



Source: Field data, 2023

Figure 4.4: Availability of resources for DKA management

4.5 Association between respondents' socio-demographic data and pre-test knowledge level

Table 4.7 presents on the association between respondents' socio-demographic and pre-test knowledge level. Years of clinical experience of the respondents was found to have statistically significant association with pre-test knowledge level (p = 0.01).

Also, ever had training in DKA management was equally found to have statistically significant association with the pre-test knowledge level of respondents (p = 0.01). Aside these, all other variables such as age of respondents, gender, marital status, cadre of health worker, and level of qualification were found to showed no statistically significant association with the pre-test knowledge level of the respondents.

Table 4.7: Association between respondents' socio-demographic data and pre-test knowledge level

Variable	Pre-test Knowledge level		Chi-square value	P-value
	Low n (%)	High n (%)		
Age of respondents				
20-29 years	20 (46.5)	23 (53.5)		
30-39 years	30 (42.3)	41 (57.8)		
40-49 years	2 (100.0)	0 (0.0)	2.701	0.26
Gender				
Male	8 (53.3)	7 (46.7)		
Female	44 (43.6)	57 (56.4)	0.503	0.48
Marital status				

Married	29 (46.0)	34 (54.0)		
Single	23 (43.4)	30 (56.6)	0.081	0.78
Cadre of health workers				
Registered General Nurse	35 (46.1)	41 (54.0)		
Registered Midwife	13 (56.5)	10 (43.5)		
Nurse Assistant Clinical	4 (23.5)	13 (76.5)	4.436	0.11
Level of qualification				
Certificate	4 (23.5)	13 (76.5)		
Diploma	39 (49.4)	40 (50.6)		
BSc. Nursing	9 (45.0)	11 (55.0)	3.78	0.15
Years of clinical experience				
1-5 years	28 (35.9)	50 (64.1)		
6-10 years	20 (69.0)	9 (31.0)		
11-15 years	2 (28.6)	5 (71.4)		
21 years, and above	2 (100.0)	0 (0.0)	12.556	0.01
Nursed a patient with condition before				
DM	46 (46.5)	53 (53.5)		
DKA	6 (42.9)	8 (57.1)		
Not at all	0 (0.0)	3 (100.0)	2.567	0.28
Ever had training in DKA management				
Yes	19 (65.5)	10 (34.5)		
No	33 (37.9)	54 (62.1)	6.692	0.01

Source: Field data, 2023

4.6 Association between respondents socio-demographic data and post-test knowledge level

Table 4.8 presents on the association between respondents' socio-demographic data and post-test knowledge level of respondents. From the study, respondents who have ever nursed a patient with condition of DM or DKA before was found to have a borderline statistically significant association with the post-test knowledge level of respondents ($p = 0.05$).

Also, respondents who have ever had training in DKA management in the hospital were found to have a statistically strong association with the post-test knowledge level of respondents in the hospital ($p = 0.001$). However, all other variables such as age of respondents, gender, marital status, cadre of health worker, and level of qualification were found to showed no statistically significant association with the post-test knowledge level of nurses working at the hospital.

Table 4.8: Association between socio-demographic data and post-test knowledge level

Variable	Post-test Knowledge level		Chi-square value	P-value
	Low n (%)	High n (%)		
Age of respondents				
20-29 years	19 (42.2)	26 (57.8)		
30-39 years	27 (39.1)	42 (60.9)		
40-49 years	0 (0.0)	2 (100.0)	1.446	0.48

Gender				
Male	4 (30.8)	9 (69.2)		
Female	42 (40.8)	61 (59.2)	0.483	0.49
Marital status				
Married	24 (39.3)	37 (60.7)		
Single	22 (40.0)	33 (60.0)	0.005	0.94
Cadre of health workers				
Registered General Nurse	29 (38.7)	46 (61.3)		
Registered Midwife	8 (34.8)	15 (65.2)		
Nurse Assistant Clinical	9 (50.0)	9 (50.0)	1.064	0.58
Level of qualification				
Certificate	9 (50.0)	9 (50.0)		
Diploma	31 (38.8)	49 (61.2)		
BSc. Nursing	6 (33.3)	12 (66.7)	1.133	0.57
Years of clinical experience				
1-5 years	34 (41.0)	49 (59.0)		
6-10 years	11 (44.0)	14 (56.0)		
11-15 years	1 (16.7)	5 (83.3)		
21 years, and above	0 (0.0)	2 (100.0)	2.896	0.42
Nursed a patient with condition before				
DM	32 (35.6)	58 (64.4)		
DKA	11 (47.8)	12 (52.2)		
Not at all	3 (100.0)	0 (0.0)	5.839	0.05
Ever had training in DKA management				
Yes	24 (60.0)	16 (40.0)		
No	22 (29.0)	54 (71.1)	10.560	0.001

Source: Field data, 2023

CHAPTER FIVE
DISCUSSIONS

5.0 Introduction

The goal of the study was to determine the level of nurses' knowledge on the treatment of diabetic ketoacidosis at the New Tafo Government Hospital. This chapter presents the study's findings along with pertinent literature. The conversations were structured based on the study's specific objectives to aid in drawing valid results and providing pertinent advice to stakeholders and policymakers.

5.1 Nurses knowledge level on diabetic ketoacidosis management in the New Tafo Government Hospital

The prerequisite for effective management of diabetic ketoacidosis depends on the skills and knowledge level of healthcare workers especially nurses. This study examined the knowledge level of nurses on the management of diabetic ketoacidosis using a five points Likert scale. The nurses' knowledge of the clinical protocol for the Joint British Diabetes Societies of Inpatient Care (JBDS-IP) DKA care guidelines is

evaluated using the knowledge scale. To determine the level of nurses' knowledge on DKA management, a pre- and post-test evaluation was done on the recommendations.

According to the study's findings, during the pre-test, roughly half of the participants firmly agreed that DKA is a serious medical emergency complication of diabetes brought on by the accumulation of glucose in the bloodstream. On the contrarily, as the same statement was posed to respondents during the post-test, the results revealed that, a little over half had disagreed with statement. From the assessments of pre-test and post-test results relating to this statement, one can conclude that, knowledge of nurses during the post-test had improved as most had responded rightly to statement. This could be attributed to the training provided to them before the post-test assessment which could result in the increased knowledge of nurses. Having good knowledge of a disease condition is fundamental to effective management of the condition such as DKA.

Similarly, in relation to a statement on the biochemical criteria for diagnosing Diabetic ketoacidosis is hyperglycaemia ≥11mmol/l, Blood PH >7.3, Bicarbonates < 15mmol/l and Blood ketones ≥ 3mmol/l or Urine ketones ≥ 2+ showed over half had agreed to the statement during the pre-test, while in the posttest assessment more than half of the respondents had disagreed with the statement. This equally gives indication that, nurses' knowledge increased during the post-test assessment because most were able to respond rightly to the statement. These results on nurses understanding of DKA was in tandem with Shaker, Faltas and Abdelhady, (2020) study which equally reported that nurses' knowledge had improved during the post-test assessment on biochemical monitoring and management of DKA management. The results were also found to shared similarities with the studies of Hamed, Gawaly, Abbas and El-Ahwal, (2017); and Ameyaw and Agyei, (2017) study in Ghana equally reporting increased knowledge level of nurses during the post-test assessment. But, these results varied with the results of Kamleshun and Jyotsnav, (2020), and Alotaibi et al., (2020) studies indicating that, it was critical for experienced staff with increased knowledge to promptly identify diabetic ketoacidosis patients with inexperienced staff to initiate intensive treatment protocol to achieve efficient management of diabetic ketoacidosis.

From the current study, the results further revealed that, during the pre-test assessment, more than a quarter had agreed that, in Euglycemia Ketosis blood glucose levels are less than 11mmol/l, while in the post-test assessment, over two-third had strongly agreed to the statement These results therefore revealed that, majority had gotten the statement right after training in the post-test assessment, and does goes to affirmed the previous statements which indicate that nurses knowledge regarding DKA had increased after the training and post-test assessment.

Also, less than half had agreed that, the pathogenesis of DKA includes breakdown of glucose from the liver, metabolism of glucose from non-carbohydrate sources with the exception of ketone bodies formation. This indicate most had responded wrongly to the statement during pre-test, but after the training and post-test assessment, most had increased knowledge and have therefore disagreed to the statement. This shows that providing nurses with training and education influence their knowledge, and contribute to improve understanding of the condition, and thus help them to respond positively to the statement the right way. These results were in support of literature findings reported by Mayabi, (2019) in Mbagathi Country Hospital, Shaker, Faltas and Abdelhady, 2020); and Abdelrahma, Mohammed, Abdelaziz and Ahmed, (2020) all found nurses to have had increased knowledge level on DKA management after the post-test assessment. However, studies such as Ameyaw and Agyei, (2017) in Ghana; Rosenbloom, (2016); and Grinslade and Buck, (2019) were in contrary views to the results of the current study.

Furtherance to these, in the current study, it also revealed that, about half of the respondents had agreed that, the major causes of DKA are Type 1 DM, Type 2 DM and Diabetes Insipidus in the pre-test assessment, but in the post-test assessment, the results showed contrary opinion whereas over half had disagreed. Results thus indicate that, the post-test results showed nurses knowledge on DKA management had improved after the training. This was supported by the studies of Eledrisi, and Elzouki, (2020); Dhatariya, Ketan and Umpierrez, (2017); and Bratton and Krane, (2022) which results equally indicate that providing in-service training to nurses contribute to improve knowledge, but these results showed dissimilarities with the studies of Castellanos, Tuffaha, Koren and Levitsky, (2020); Savage et al., (2018); and Dhatariya and JBDS-IP, (2022).

To add, in the current study, results showed a little over a third had agreed that, all the following, surgery, infections, pregnancy, suboptimal insulin use with the exception of trauma are precipitating causes of DKA during the pre-test assessment, and during the post-test assessment almost two-third had disagreed to the statement. Most respondents had answered the statement right after the post-test assessment, and was supported in the literature of Brandi, (2022); Dai, Chen, Huang, Wu, and Yang, (2022); and Papanastasiou et al., (2020) which results showed that, nurses' knowledge increased after training on DKA management through workshops and seminars on the job contribute to additional knowledge gain.

From all other statements relating to the assessments of nurses' knowledge on the management of DKA showed most respondents have good understanding of each statement after the training, and was able to respond correctly during the post-test assessment. These were reflective in the knowledge scores of pre-test and post-test assessments as the results showed nurses knowledge scores increased during the post-test assessment as almost two-third had high score (>80) of more than average knowledge in DKA management, while a little more than a third had a low knowledge of less than the average on the management of DKA. These were supported by the literature of Dhatariya and JBDS-IP, (2022); and Flores et al., (2020). But, these results also showed variation with the studies of Umpierrez and Murphy, (2022); and Mills and Stamper, (2014).

From the current study, overall knowledge score of nurses on diabetic ketoacidosis management from the combined results of both pre-test and post-test assessment showed respondents had increased/high knowledge level on the management of diabetic ketoacidosis, while less than half (42.3%) of the nurses were found to have had low level of knowledge on the management of diabetic ketoacidosis in the New Tafo Government Hospital. This is similar to the assertion by Beck et al., (2017); American Diabetes Association, (2018); Dyson et al., (2014); and Parry Strong, Lyon, Stern, Vavasour, and Milne, (2014) cited adequate knowledge of nurses on DKA management. But this was different from the study of Shaaban et al., (2017) which results revealed that, 75% of nurses had unsatisfactory level of knowledge regarding diabetic ketoacidosis management, and 85% had unsatisfactory level of practice.

5.2 Relationship between nurses' level of knowledge on diabetic ketoacidosis management and their demographic characteristics

Nurses' knowledge level on the management of diabetic ketoacidosis could be influence by various factors. From literature number of factors have been cited to influence the knowledge level of nurses on the management of diabetic ketoacidosis. These factors range from socio-demographic factors, personal factors relating to knowledge and skills, and capacity building factors such as training and educational workshops and seminars.

From the current study, factors that were found to have had statistically significant association with the knowledge level of nurses on the management of DKA during the pre-test assessment was in relation to their socio-demographic. Results showed that respondents years of clinical experience was found to have a statistically significant association with the knowledge level of respondents ($p = 0.01$). Respondents who have had increased years of clinical experience of least 10 years were more likely to have had increased in knowledge in the management of DKA as compared to those who had less than 10 years of clinical experience in the management of DKA.

Years of clinical experience been associated with increased knowledge level of respondents in the management of DKA could be attributed to the fact that, improvement in knowledge and skills in clinical care depends on exposure and years of experience, because one constant exposure to a clinical procedures over the years help the individual to develop mastering skills and knowledge in the procedure, and thus contribute to increment in knowledge and skills of the procedure relating to how to care for a patient with diabetic ketoacidosis. This was found to shared similarity in a quasi-experimental study conducted by Shaker et al., (2020) on the topic "effect of training program on Nurses Performance and Health Outcomes for Patients with Diabetic Ketoacidosis". The study established that ninety-seven percent (97%) nurses with less than 5 years' experience had low knowledge on management of DKA as compared to those with more than 5 years' experience.

Among other factors identified in the study which were different from the current study to have influence on the knowledge level of nurses with DKA management include age category of nurses as those who were under 30 years old, with a mean age of (26.4±3.8) years, a mean duration of work experience of (3.1 ± 1.2) years had significant influence on their knowledge level relating to the management of DKA. The study also found that been a female (55%), and been single (69%) as well as having technical nursing level education (81.4%) were associated with the knowledge level of nurses on the management of DKA. These factors were however found in the current study to show no statistically significant association with the knowledge level of nurses on the management of DKA.

Also, in the question, ever had training in DKA management was found to have had statistically significant association with the pre-test knowledge level of respondents ($p = 0.01$) as those who have ever received training on the management of DKA have had increased knowledge in the management of DKA as compared to those who never had any training in the management of DKA. Aside these, all other socio-demographic variables such as age of respondents, gender, marital status, cadre of health worker, and level of qualification were found to showed no statistically significant association with the pre-test knowledge level of the respondents in the current study. This was similar to assertion of Balmier et al., (2019) and LoraJor an, Dawn, Njalalia Pitre, Umpierrez, and Umpierrez, (2021), which equally found that nurses who have had training in DKA management had increased knowledge in DKA management.

Notwithstanding, from the post-test assessment on the association between respondents' socio-demographic data and knowledge level on the management of DKA. Results further affirmed that, respondents who have ever had training in DKA management in the hospital were found to have had a strong statistically significant association with the knowledge level of respondents ($p = 0.001$) in the post-test assessment as reported in the pre-test. This could be attributed to the fact that, having training contribute to increase in knowledge of respondents, because, the training sessions are handle by experts in the field and thus have impact on the knowledge level of respondents regarding the management of DKA. This was supported the literature of Eledrisi, Alshanti, and Shah, (2015); and Castellanos, Tuffaha, Koren, and Levitsky, (2020) equally found increased knolwedge relating to the training of nurses on DKA

management. The results also shared similarities with the studies of Eledrisi, and Elzouki, (2020) which established that overall knowledge of diabetes among the nursing staff was found to be lacking, and that educational training programmes covering diabetes and in-patient diabetes management would be useful to improve nurses' knowledge on the management of DKA. However, this result was different from the studies of Mayabi, (2019); and Scheiderich and Peterson, (2018) which found no statistically significant association between nurses' level of knowledge and their previous training experience.

From the current study, it was further established that respondents who have ever nursed a patient with condition of DM or DKA before was found to have a borderline statistically significant association with the post-test knowledge level of respondents as those who ever took care of a patient with DM or DKA had more increased knowledge relating to the management of DKA as compared to those who never managed a patient with the condition of DM or DKA. Having the experience of managing patient with the condition of DM or DKA influence the understanding and knowledge level of nurses regarding the management of DKA, and thus could have contributed to the improved knowledge level of the respondents.

5.3 Available training programs for nurses on the management of diabetic ketoacidosis

Ensuring the training needs of nurse's help improve on their skills and knowledge in the effective management of diabetic ketoacidosis. According to Parwar, (2018), inadequate training of nurses on the various protocols and guidelines influences their knowledge and affect the quality of work on patients care and management of diabetic ketoacidosis. From the current study, almost three-quarters of the nurses interviewed said they have never had training on the management of DKA during both pre-test and post-test assessment.

Lacked of training affect the skills and knowledge level of nurses in providing quality healthcare services to the patients. Because, from the study, findings have revealed the effect of lacked of training on the overall knowledge of nurses in the management of diabetic ketoacidosis, from the knowledge assessment, it was observed that most of the respondents have inadequate knowledge during pre-test assessment regarding guidelines and protocols for diabetic ketoacidosis management. It was also observed in the study of Abd Elkhalek Mekky, Ahmed Mohammed Hassan & Hi Ali Ibrahim,(2023) citing inadequate of training of nurses on care guidelines to affect the quality of healthcare service they provide, and therefore recommend the need for regular training programs for nurses in DKA management to enhance their knowledge in healthcare delivery and thus have a positive impact on their overall performance in the healthcare facility.

From the current study, it was also observed that less than a quarter said to have had some form of training in DKA management and other nursing care services in the last 3 months during both post-test and pre-test assessment. Also, about 12.1% said they had training in DKA management in the last 2 years during pre-test assessment and 8.6% said they had training in last 2 years in DKA management in the post-test. These variations in percentages regarding ever had training in the management of DKA was meagre and alarming because, it has the potential to influence the quality-of-care nurses provide at the hospital, and especially to patients with diabetic ketoacidosis which is a life-threatening emergency complication which requires optimum care from the providers.

This result was found to shared similarities with Shaker et al., (2020) which found out in his quasi-experimental Pre-test and Post-test study which findings assessed the impact of training on nurses' performance and health outcomes for patients with diabetic ketoacidosis. From the current study, it also

revealed that, the hospital has inadequate supply of protocol on the management of DKA because, from the pre-test assessment less than half of the respondents reported to have had protocol on the management of DKA at their unit, and had increased to a little over half during the post-test assessment. This was found to be alarming because, protocols play vital role in the effective management of patients with diabetic ketoacidosis.

Lacked of protocols in DKA management will definitely affect the quality-of-care nurses provide to patients with management, and their knowledge regarding how the protocol is use in the management of patients with diabetic ketoacidosis in the hospital. This result however shared a dissimilarity in the study conducted by Eledrisi, and Elzouki, (2020), which reported the need for frequent training of nurses on the job to be very critical among all cadre of nurses, and thus can contribute to effective and efficient care of patients with diabetic ketoacidosis.

The study results further emphasize the importance of health training as an important tool for human resource development and must be embraced by all health care delivery institutions to help with the on-the-job training of nurses and development of all its service providers. Notwithstanding, Umpierrez and Murphy, (2022) study shared similar views with the current study on the protocol availability at the facility level, and equally reported the need for an appropriate and sustainable stocks of medicines availability, sophisticated laboratory tests and equipment, and trained health personnel to enhance the quality of healthcare provided to patients with DKA.

From the current study results, from the pre-test assessment, over three-quarters of the respondents said they would recommend training in DKA management, and almost same proportion agreed to the recommendation for training in DKA management during the post-test assessment. In term of the recommended frequency of training in DKA management, less than half said it should be quarterly training during the pre-test, and a little over half agreed to the quarterly training during the post-test.

Also, a little over a third reported half yearly training in DKA management during the pre-test, and same proportion during the post-test. About 17.2% cited annual training in DKA management during the pre-test, and less than a tenth during the post-test. Providing regular training to nurses on DKA management help improved on their knowledge and skills towards the management of DKA, and the provision of other health services at the facility. These findings were found to shared dissimilarities with studies of Castellanos et al., (2020); and Mayabi, (2019), which revealed that, there were the need to ensure good control of blood sugar as the key to avoid patients from suffering the complications of diabetic ketoacidosis such as diabetic coma and among others.

5.4 Barriers nurses encounter with the management of diabetic ketoacidosis

Barriers and challenges nurses encountered with the management of diabetic ketoacidosis could affect the healthcare that nurses provide to patients with diabetic ketoacidosis. Various studies from literature have identified numerous barriers and challenges that nurses faced during the management of diabetic ketoacidosis.

From the current study, from both pre-test and post-test assessment, over three-quarters of the respondents reported that they do not always have enough medical supplies and equipment for management of DKA. Inadequate supply of medical supply and equipment affect quality healthcare delivery, and the care nurses provide to patients with diabetic ketoacidosis. Results revealed that less than 20% said they had supplied of glucometer and stripes, and almost same proportion reported the supply of had normal saline, IVF 5% dextrose, soluble insulin, IVF 10% dextrose, and the least of all supply and equipment were potassium

chloride, and Infusion pump which were less than 2%. These reported medical supply and equipment were found to be inadequate, and thus have influence on the healthcare service provided to patients with diabetic ketoacidosis. These were found to shared relation with the studies of Mayabi, (2019); Shaker, Faltas and Abdelhady, (2020); Abdelrahma, Mohammed, Abdelaziz and Ahmed, (2020) and the American Diabetes Association, (2018) which indicate that some of the difficulties healthcare professionals face when caring for patients with diabetic ketoacidosis were insufficient medical equipment and supplies, lack of treatment guidelines and standard operating procedures, low levels of staffing and ongoing medical education. Aside these, from the current study other challenges identified were related to patients with behavioral, psychological, and socio-economic hurdles faced by healthcare professionals, and obstacles in the delivery system were identified as structural and technological barriers that healthcare professionals faced in the delivery of quality. This was supported by the literature of Beck et al., (2017); Scheiderich and Peterson, (2018); and Shaaban et al., (2017) who reported similar barriers and challenges.

Again, in the current study, results revealed that, most respondents lament over the availability of medical supply and equipment as results showed almost a third of respondents said that, there was no significant improvement in the availability of resources for DKA management during the post-test assessment. In term of availability of medical supply and equipment, less than a quarter cited the availability of glucometer and stripes, normal saline IVF 5% dextrose, urine dipstick kit, and the least available resources in the management DKA in the hospital were ketone check kits, potassium chloride, and infusion pump having the least proportions. These were related to the studies of Shaker et al., (2020); Scheiderich and Peterson, 2018; and Burns, Farrell, Myszka, and Park, (2016) reported similar challenges regarding the availability of resources for DKA management. Unavailability of medical supply and equipment affect quality healthcare delivery, and also exposed nurses and other healthcare workers to occupational healthcare hazards, injuries and transmission of infections among healthcare workers. This therefore impede quality healthcare delivery and effective management of patients with diabetic ketoacidosis, and was supported by the studies of Parwar (2018); Abd Elkhalek Mekky, Ahmed Mohammed Hassan & Hi Ali Ibrahim, (2023); and Zaiton, Relloso, and Manood, (2019).

In term of having challenges in distinguishing cases of DKA from other conditions showed less than half of the participants said they sometimes have challenges distinguishing cases of DKA from other cases of disease conditions, and only a tenth said they most of the time have challenges in distinguishing cases of DKA from other conditions. Having challenges in cases identification could be attributed to inadequate knowledge and training on cases definition of the various conditions which can help healthcare workers such as nurses to isolate cases that are diabetic ketoacidosis from other case conditions. Therefore, to improve nurses' ability in DKA identification and isolation from other cases requires increased training and education of nurses on DKA cases definitions and various protocols and guidelines for managing diabetic ketoacidosis in the hospital. This was similar to the assertion of Zaiton et al., (2019); and Wangnoo et al., (2013) reporting similar challenges of nurses regarding the identification of cases of DKA.

Again, types of challenges most often faced that affect the efficient management of DKA patients showed less than a quarter of the respondents reported lack of in-service training in the management of DKA, delay in getting results of requested laboratory investigations, and patients inability to pay cost of frequent laboratory investigations. These barriers were reported among healthcare workers to impede the quality of healthcare services that nurses provide to patients with DKA. Because, patients' inability to pay for the cost of laboratory investigation interfere the nurse ability to monitor the patient progress with the care regimens, and as well as determine the patient response to the treatment regimens. These were different

from Zaiton, Relloso, and Manood, (2019) study in Saudi Arabia which identified barriers to include knowledge, Experience and Competence in identifying cases of DKA, Communication, and Language. Additionally, other barriers identified in the current study were found to include inadequate knowledge on the management of patients with DKA, absence of standard operating protocols and treatments, insufficient point of care equipment for monitoring patients, and least of the challenges was high workload making it difficult to provide continuous monitoring to patients with DKA. These obstacles were similar to those found in Zaiton, Relloso, and Manood's (2019) study in Saudi Arabia, which contends that the obstacles of communication, language, and knowledge in identifying cases of DKA have had a significant impact on the success of implementing the DKA Care Set. Both Wangnoo et al. (2013) and Zaiton, Relloso, and Manood (2019) studies noted the need to incorporate patient-centric paradigms of diabetes care, team-based approaches for life-style modification, and monitoring of patients' adherence to therapy in the management of DKA. These studies also identified the barriers to include the need to avoid placing an undue burden on patients' lifestyles.

CHAPTER SIX
SUMMARY, AND CONCLUSIONS

6.0 Introduction

An overview of the study, its findings, and their implications for nursing practice, nursing education, and nursing research are provided in this chapter. Conclusions and suggestions resulting from this study for ongoing nursing care in the management of DKA.

6.1 Summary of the study

6.1.1 Methodology

The objective of this study was to establish a cause-and-effect link between the independent and dependent variables using a quasi-experimental approach, also referred to as a non-randomized pre-post intervention. The study's participants were male and female nurses and midwives working at the New Tafo Government Hospital who were at least 20 years old, had at least a certificate in nursing, and were both genders.

To gather the total sample size required for the study, respondents were chosen at random from each stratum (unit). Data was collected using a structured questionnaire, and descriptive statistics were used to summarized continuous variables into mean, and standard deviations, and categorical variables into percentages. Relationship between nurses' level of knowledge and their demographic characteristics was analyzed using multiple regression at a significant level of 5%, and 95% confidence level.

6.1.2 Purpose of the study

The goal of this study was to assess the level of nurses' knowledge regarding the treatment of diabetic ketoacidosis using the Joint British Diabetes Societies of Inpatient Care (JBDS-IP) DKA management guidelines and to see if there was a relationship between this knowledge and the nurses' demographic characteristics at the New Tafo Government Hospital. This study also examined the nurse training programs for managing diabetic ketoacidosis, the challenges in managing patients with this condition at the New Tafo Government Hospital, and the ongoing training, education, and research requirements for managing diabetic ketoacidosis patients.

6.1.3 Main Objectives

The objectives of this study were to:

- assess the knowledge level of nurses on the management of diabetic ketoacidosis.

- determine relationship between nurses' level of knowledge on diabetic ketoacidosis management and their demographic characteristics
- explore the training programs available for nurses on the management of diabetic ketoacidosis.
- identify the barriers nurses encounter with the management of diabetic ketoacidosis

The results for each objective has been discussed as follow:

6.1.3.1 Objective 1

In measuring nurse's knowledge in DKA management, the Likert knowledge assessment scale was used. Twenty-three items were listed on this scale and items were scored on a five-point Likert scale ranging from 1 that was "strongly disagree" to 5 which was "strongly agree". Results from the knowledge level scale of nurses on DKA management during pre-test and post-test assessment showed nurses knowledge increased during the post-test as almost two-third (60.3%) had high (>80) knowledge score in DKA management while 39.7% had low (< 80) knowledge scores on the management of DKA.

But from the pre-test assessment, about 55.2% had high (>50) knowledge score on DKA management, while 44.8% were found to have had low (<50) knowledge score on the management of DKA. The combined effects of both pre-test and post-test assessment showed the overall knowledge level of nurses on DKA management indicate more than half (57.7%) had high knowledge score on the management of diabetic ketoacidosis, while 42.3% of the nurses were found to have had low knowledge score on the management of diabetic ketoacidosis.

6.1.3.2 Objective 2

The Likert scale knowledge assessment was used to determine relationship between nurses' level of knowledge on diabetic ketoacidosis management and their demographic characteristics. Results showed nurses socio-demographic characteristics that were having significant association with their knowledge level during both pre-test and post-test assessment were found to include respondents who have ever nursed a patient with condition of DM or DKA before indicate a borderline statistically significant association with the post-test knowledge level of respondents ($p = 0.05$).

Ever had training in DKA management was found to have a statistically significant association with both pre-post-test knowledge level of respondents in the hospital ($p = 0.001$). Also, years of clinical experience of the respondents was found to have a statistically significant association with pre-test knowledge level ($p = 0.01$).

6.1.3.3 Objective 3

Regarding which training programs were available for nurses on the management of diabetic ketoacidosis. Results showed majority (74.1% vrs 73.3%) of respondents indicated during the pre-test and post-test assessment that they have never had training on the management of DKA. Only 13.8% had indicated they had training in DKA management in the last 3 months during post-test assessment, and 2.6% during the pre-test.

Both pre-test and post-test results showed (46.5% vrs 56%) do not have the available protocols on the management of DKA at their unit. From both pre-test and post-test assessment, about 99.1% vrs 97.4% said they would recommend the need for training in DKA management, and frequency of training in DKA management showed 44% vrs 56% said quarterly training during both pre-test and post-test assessment. Available resources for the management of DKA during pre-test and post-test shows glucometer and stripes (17.4% vrs 24.5%), normal saline (14.7% vrs 16.3%), and IVF 5% dextrose (13.5% vrs 12%).

6.1.3.4 Objective 4

In term of barriers nurses faced in the management of diabetic ketoacidosis. About 69.8% and 80.2% said they do not always have enough medical supplies and equipment for management of DKA during both pre-test and post-test assessment.

Types of challenges most often faced by nurses during pre-test and post-test assessment showed 19.3% vrs 19.7% reported lack of in-service training in the management of DKA, 12.4% vrs 17.2% reported delay in getting results of requested laboratory investigations, 14.0% vrs 15.6% cited patients inability to pay cost of frequent laboratory investigations, 16.8% vrs 11.1% cited inadequate knowledge on the management of patients with DKA, 14.0% vrs 10.9% reported absence of standard operating protocols and treatments, 2.3% vrs 10.4% cited insufficient point of care equipment for monitoring patients, and least of the challenges was high workload.

6.2 Nursing Implications of Results and Recommendations

Nursing implications and recommendations for this would be discussed under three headings: nursing practice, nursing education and nursing research.

6.2.1 Implications for nursing practice

From the study results, it was revealed that most respondents said they have never had on-the-job training on the management of DKA. This interestingly has the potential to influence nursing practice and the quality of palliative and clinical care they provide to patients with diabetic ketoacidosis. Thus, to improve nursing practice and clinical care of patients with diabetic ketoacidosis, there must be regular protocol and guidelines based on-the-job training to help promote sound nursing practices and adherence to clinical procedures and protocols on the management of patients with diabetic ketoacidosis and other related health conditions.

The study results also revealed that a little over of the respondents said they do not have the available protocols on the management of DKA at their unit. Nursing practice is a practical based care nurses must provide to their clients, and therefore requires the use of protocols and guidelines to adequately manage patients with diabetic ketoacidosis, and so therefore it is important authorities ensure that protocols and guidelines are available at each unit to ensure optimum patients care.

Results of the study also point out that more than three-quarters of the respondents have said that they do not always have enough medical supplies and equipment such as glucometer and stripes, normal saline, urine dipstick kit, ketone check kits, IVF 5% dextrose, and IVF 10% dextrose for management of DKA. These medical supplies and equipment availability are essential for effective nursing care and practices, and therefore unavailability of these supplies and equipment hamper the effectiveness of nursing practice to promote optimum patient health in the management of diabetic ketoacidosis. It is therefore paramount; the nursing managers and authorities of the healthcare sector ensure timely procurement of these medical supplies and equipment to guarantee patient safety and the safety of the healthcare worker during the management of diabetic ketoacidosis.

Again, results revealed that, during the management of diabetic ketoacidosis, most challenges nurses faced were attributed to delay in getting results of requested laboratory investigations, patients' inability to pay cost of frequent laboratory investigations, absence of standard operating protocols and treatments, and insufficient point of care equipment for monitoring patients. These challenges have effects on sound nursing practice, and thus affect the care provided to patients during the management of diabetic ketoacidosis. The management should streamline healthcare services such as laboratory investigations to

ensure results are received on timely basis, and as well as create an affordable payment system through the National Health Scheme to ensure all patients are able to pay for the cost of the frequent laboratory investigations patients undertake.

6.2.2 Implications for nursing education

Results on the knowledge level of nurses on DKA management showed most had an average knowledge on the management of patients with diabetic ketoacidosis. This therefore has negative impact on the palliative care and patient education nurses provide on diabetic ketoacidosis and clinical procedures of managing diabetic ketoacidosis. It therefore important that, management of the hospital provide on-the-job training, and in-service training to nurses through conferences, seminars, and workshop on diabetic ketoacidosis management guidelines and procedures to help boost the knowledge of nurses on DKA, and can contribute to effective patients care and more especially management of patients with diabetic ketoacidosis.

Also, from the study results, it established that, respondents' socio-demographic characteristics which had significant association with their knowledge level were years of clinical experience, ever nursed a patient with DM or DKA, and ever had training in the management of DKA. These were profound because, these factors have influence on the knowledge level of respondents, and were in line with literature findings which equally reported these factors to have significant influence on the knowledge level of nurses regarding the management of DKA. So therefore, allowing nurses undertake educational training programmes on DKA as specialty area can help increased their understanding on the management and nursing care of patients with DKA. Also, ensuring newly recruited nurses and midwives are under the mentorship and coaching of experienced nurses and midwives can help improve on their knowledge regarding the management and nursing care of patients with DKA.

Again, results revealed that, during the management of diabetic ketoacidosis, most challenges nurses faced were attributed to lack of in-service training in the management of DKA, and inadequate knowledge on the management of patients with DKA, poor knowledge of nurses relating management procedures and protocols of diabetic ketoacidosis affect the quality of healthcare provide either palliative or clinical, and thus there should be frequent in-service training provided to nurses on the management protocols, guidelines and procedures of diabetic ketoacidosis to help avert wrong nursing care and practice of patients with diabetic ketoacidosis.

6.2.2 Implications for nursing research

It is advised that more research be done into the difficulties nurses encountered while managing diabetic ketoacidosis in this study population, and researchers should be aware of the variety of factors that affect how well-versed nurses are in managing diabetic ketoacidosis at the New Tafo Government Hospital. Future studies should thus be designed to assess the underlying causes of these difficulties as well as other potential barriers to the delivery of compassionate nursing clinical and palliative care to patients with diabetic ketoacidosis and their families.

It is also recommended that future research should be conducted to associate nurses' knowledge on diabetic ketoacidosis management to patient health outcome, and established the causal effect relationship of nurses' poor knowledge of clinical procedures on the patient. Future research should consider inclusion of direct observation of how procedures are discharge by nurses on DKA management or interviews with patients with diabetic ketoacidosis themselves on the nurse understanding of the procedure. A larger population of nurses from other facilities both private and public sector hospitals should also be used for the study sample to be more representative.

6.3 Conclusion

The purpose of this study was to assess the knowledge level of nurses on the management of diabetic ketoacidosis using the Joint British Diabetes Societies of Inpatient Care (JBDS-IP) DKA management guidelines, and as well determine whether an association exist between nurses' level of knowledge on diabetic ketoacidosis management and their demographic characteristics in the New Tafo Government Hospital. In accomplishing this, there was an average level of knowledge of nurses on management of diabetic ketoacidosis, which was highlighted with a statistically significant association between nurses' level of knowledge of DKA management and years of clinical experience, ever had training in DKA management, and ever nursed a patient with the condition of DM or DKA. This result is of consequence to the nursing practice because of the potential myriad of problems related to effective management of patient with diabetic ketoacidosis to enhance the quality of life of patients with life threatening medical emergency condition of DKA.

6.4 Recommendations

The following recommendations have been suggested to stakeholders and policy makers toward improving nurses' knowledge in the management of patients with diabetic ketoacidosis in the hospital;

1. From the study results, there were inadequate supply of protocols and guidelines on DKA management and therefore management of the hospital should collaborate authorities of the Ghana Health Services to ensure the availability of protocols and guidelines in each unit.
2. Also, there should be regular on-the-job training on the protocols and guidelines to help promote sound nursing practices and adherence to clinical procedures on the management of patients with diabetic ketoacidosis.
3. Again, the nursing managers and authorities in the healthcare sector should institute an evaluation system to evaluate nurses' knowledge on the protocols and guidelines and ensure timely procurement of medical supplies and equipment to guarantee efficient patient care and the safety of the healthcare worker in the hospital regarding care provided to patients with diabetic ketoacidosis.
4. The management should streamline healthcare services such as laboratory investigations to ensure results are received on timely basis, and as well as create an affordable payment system through the National Health Scheme to ensure all patients are able to pay for the cost of the frequent laboratory investigations patients undertake.
5. To add, nurses and other healthcare professionals who are providing care to DKA patients should be allow to regularly undertake educational training programmes on DKA as specialty area to help increased their knowledge and understanding on the management of patients with DKA. Also, ensuring newly recruited nurses and midwives should be put under the mentorship and coaching of experienced nurses and midwives before undertaken activities on their own.
6. There should also be frequent in-service training through conference, seminars and workshops to regularly update their knowledge on DKA management, and use of protocols, guidelines and procedures in the management of diabetic ketoacidosis.

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