Arab American University
Faculty of Graduate Studies

Improving Management with Point of Care for Children with Diabetic Ketoacidosis in Emergency Care in Northwest Bank

By:
Majdi Fathi Saleh Younis

Supervisor:
Dr. Ahmad Batran

This Thesis was Submitted in Partial Fulfillment of the Requirements for The Master's Degree in Emergency Nursing

Approval form

Improving Management with Point of Care for Children with Diabetic Ketoacidosis in Emergency Care in North West Bank

By:

Majdi Fathi Saleh Younis

This thesis was defended successfully on 31 March, 2022 and approved by:

	Committee Member		Signature
1.	Dr. Ahmad Batran	Supervisor	
2.		Co-Supervisor	
3.	Dr. Ahmad Ayed	Internal Examiner	
4.	Dr. Sumaya Sayej	External Examiner	

II

Declaration

I declare that the content of this thesis is my own research work, unless otherwise referenced. I certify that this thesis does not contain any material published before by another person or has been submitted elsewhere for any degree or qualification.

Name: Majdi Fathi Saleh Younis

Signature: 

Arab American University – Palestine.

Date: 31/3/022

Dedication

To everyone who believed in me and in my abilities to achieve my ambition.

Acknowledgement

I would like to thank “Arab American University – Palestine” and Faculty of Graduate Studies. Special thanks to my supervisor Dr. Ahmad Batran for his guidance and support to complete this study. I would like also to thank the administration of Palestine Ministry of Health who provided help and facilities to complete this work.

Abstract

BACKGROUND: The most prevalent complication in children with T1DM is DKA, which leads to a high mortality rate among children. Prompt Nursing care intervention provision and early management are important alongside continuous follow-up and treatment of DKA patients. Point of care (POC) is the point in time when clinicians and nurses deliver healthcare products and services to patients at the time of care. Early intervention at the point of care at ER units help Palestinian children with DKA at emergency units to have better health outcomes; starting the point of care among children with T1DM and who become with DKA. Detecting early intervention will enhance the outcome of DKA degree children and will add to the body of nursing knowledge about the outcomes and develop DKA management protocol in pediatric units. **AIM**: The purpose of this study is to assess and improve DKA management, starting of the point of care among children with DKA in emergency care units in Northwest Bank. **Methods** The author used a quasi-experimental study that assessed the improvement of DKA management among children upon the point of care in emergency care in Northwest

Bank**. Result:** Sixty children with DKA participated in the study. The average age of the children was 9.38 ± SD=3.1 year. The sample consisted of 29 (48.3%) males and 31(51.7%) females, of those 46 (76.7%) of participants were newly diagnosed with type 1 DM and 46 (76.7%) were diagnosed at earlier times. Two third of the children haven't history of type 1 DM in first degree relative. At arrival the average of HbA1C was 11.74 (2.042). Approximately 75.0% of children haven't other health problems while 1(1.67%) have tonsillitis, epilepsy, or CHD, ASD, VSD. The investigator found that there is significant differences in the vital signs at different point times (p= 0.05), the

Clinical Pattern of DKA at different point times were significant (p= 0.05). The ABG's differences were also significant at different point times (p= 0.05), RBS differences is significant at different point times (p= 0.05) among children with DKA. The severity of dehydration were significant differences at different point times (p= 0.05), and finally the biochemical Parameters were significant differences in at different point times (p= 0.05) among children with DKA admitted to emergency department. **Conclusion:** The study confirmed that DKA management protocol progress in emergency department was beneficial. Also, the study confirmed that physiologic parameters, clinical features, and lab results were improved in different points of time after DKA management protocol intervention.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

AAUP	Arab American University
IDF	International Diabetes Federatio
ADA	American Diabetic Association
CDC	Centers for Disease Control and Prevention
CD	Child Development
DKA	Diabetic ketoacidosis
DM	Diabetic Mellitus
HRQoL	Health-related quality of life
HCPs	Health care professionals
HBA1c	Glycated haemoglobin test
IP	Interpretive phenomenological
IRB	Institutional Review Board
MoH	Ministry of Health
PA	Palestinian Authority
PCBS	Palestinian Central Bureau of Statistics
T1DM	Type 1 Diabetic Mellitus
T2DM	Type 1 2 Diabetic Mellitus
RBS	Random Blood Sugar
WB	West Bank
WHO	World Health Organization
BMI	Body Mass Index
CBC	Complete Blood Count
ABG	Arterial Blood Gas
K	Potassium
NA	Sodium
CL	Chloride
ISPAD	International Society for Pediatric and Adolescent Diabetes
ER	Emergency department

Mg	Magnesium
IV	Intravenous fluid

Chapter One

Introduction

Childhood is a complex and multidimensional stage of human growth and development. This developmental phase is defined as “a fundamental part of human development, emphasizing that the brain architecture is shaped in the first years, from the interaction of genetic inheritance and influences of the environment in which the child lives” (de Souza & Veríssimo, 2015).This stage is also considered as a challenge for T1DM patients, which may adversely affect their quality of life (Luyckx et al., 2008).

In Arab Islamic culture, the Arab family integrates childhood growth, planning, and managing children with chronic illness within the family communication and decision-making processes (Abu Alia &Aboul-Hosn, 2015). Childhood with chronic illness may suffer from physical, emotional, cognitive, and psychosocial changes that affect their lives and relations with their families and friends (Mello et al., 2014). A disruption in Health-Related Quality of Life [HRQoL] among children with T1DM may result in psychological distress ,physical deficits and long life problems resulting from this chronic disease where some changes in HRQoL maybe already manifested during their childhood development (Duru et al., 2015).

Diabetes mellitus (DM) is a common chronic disease among children occurs as a result of partial or complete insulin insufficiency (Saraswathi et al., 2019). Also, it is defined as a "complex endocrinological disorder with altered metabolism of blood glucose". Some short and long-term complications may occur such as diabetic ketoacidosis (DKA); hyperglycemic or hypoglycemic state or both which needs urgent medical intervention and treatment (Umpierrez&Korytkowski, 2016).

T1DM is a pancreatic beta-cell destruction, which occurs more usually in children and young adults (Wysham& Kirkman, 2011). It is now thought to represent a heterogeneous group of conditions that share specific characteristics, with elevated blood sugar as a standard feature (de FariaMaraschin, 2012). T1DM is an autoimmune disease that results individual's self-immunity mistakenlyattacks beta cells in the pancreas that produce insulin (Canadian Diabetes Association, 2014). It also frequents in children and adolescents, where was formerly known as juvenile diabetes, which may develop at any age (Chiang et al., 2014).

T1DM can cause damage to various body organs and can cause poor health conditions that are threatening to adolescents' lives, who are considered a vulnerable group. T1DM Management among teenagers requires to integrate healthy lifestyle habits within adolescents' usual routines, and at the early stages of T1DM onset where T1DM among adolescents is a high-risk factor for T1DM. Not all families can handle T1DM consequences particularly DKA , which is a lot to bear for some families, so some of the parents got divorced, this chronic illness may destroys many people lives, brings pain and suffering for not just the patient but to the whole family (Souza, 2014).

In DKA, homeostasis imbalance occurs in most body processes as disturbed pH, fluid shifts, and impaired tissue perfusion affect many organs' functions that cause electrolyte imbalance (Abbas et al., 2018). Likewise, DKA can be the first presentation for non-diagnosed T1DM patients; T1DM patients with DKA admitted to intensive care units that are responsible for 13% of in-hospital mortality (Efstathiou et al., 2002).

DKA is classified based on blood gases results. The classifications are: mild, moderate, and severe. When blood PH is less than 7.3 and bicarbonate value is less than 15 mmol/l, the DKA is considered mild; when PH value is less than 7.2 and bicarbonate level is less than ten mmol/l the DKA is considered moderate and lastly, when the PH value is less than 7.1 and bicarbonate level less than five mmol/l, DKA is considered severe (Wolfsdorf et al., 2014).

Dehydration, tachycardia, tachypnea and other signs are the clinically DKA signs included besides g (Kussmaul) respiration, acetone breath Oder, abdominal pain accompanied with nausea and vomiting. In some, conditions DKA patients become confusion, drowsiness, and they loss their level of consciousness (Wolfsdorf et al., 2014). Furthermore, Kitabchi et al. (2009) emphasize that the resultant metabolic acidosis and dehydration can lead to confusion, hyperventilation, tachycardia, and severe coma and death forms.

DKA is preventable and associated with critical complication where mortality rate in developed countries was0.4% were it was more developing countries (10%), (Benoit et al., 2018; Jayashree &Singhi, 2004). Also, Saraswathi et al. (2019) pointed that the Middle East has one of the highest prevalence of assortedT1DM among children.

Furthermore, DKA is a comparatively widespread emergency condition in children, and it is the main reason for morbidity and mortality in pediatrics with T1DM; that usually encountered clinically as the first presentation of newly diagnosed T1DM (Wolfsdorf et al., 2014).

Through the last few years, T1DM and T2DM treatment have noticed a vast progression worldwide, and preventing short and long-term complications is a primary goal of DM management of HCPs. However, whether or not T1DM management has decreased DKA occurrence among patients with T1DM, DKA management steps are still unanswered (Ahuja et al., 2019).

The principle goal for DKA management is to maintain patient hydration status to prevent further complications and other possible issue may emerge. Besides, each patient's careful history taking should be performed with physical examination involving body mass index, circulatory and respiratory status, vital signs, hydration status, and level of consciousness (Mohammed, 2018). Also, throughout the treatment of DKA, acid-base status, glycemia, and serum electrolytes are measured regularly to detector the effectiveness of treatment, expose complications of DKA and its management, and define the resolution of DKA. However, there are some differences in DKA management protocols (Barrios et al., 2012).

Moreover, Rosenbloom (2010) indicated that DKA management should be in centers with good experience and where vital signs, neurologic status, and biochemistry can be observed with adequate regularly to prohibit occur complications. Treatment of DKA should be started with fluid resuscitation, whereas the fluid infusion should precede insulin administration (0.1 U/kg/h) by 1-2 hours; an initial bolus of 10-20 mL/kg 0.9% saline is followed by 0.45% saline calculated to supply maintenance and replace 5%-10% dehydration. Potassium (K) must be replaced early and sufficiently. Bicarbonate administration is contraindicated.

Finally, DKA can cause the incidence in all types of DM regardless of age, so it is considered a life-threatening complication. Moreover, most often, it is seen in patients with type 1 DM, either at the presentation of newly diagnosed cases or as a consequence of non-compliance with medical therapy. DKA is distinguished with hyperglycemia, acidosis, dehydration, and electrolyte imbalance, resulting from insulin insufficiency and a rise of counter-regulatory hormones. Management of DKA is purposed to replace fluids, correct acidosis, and electrolytes by administering intravenous insulin and fluid infusion therapy to experience untoward effects such as cerebral edema. Besides, treatment DKA needs to assess the neurologic status and monitor metabolic parameters to detect or avoid complications (WHO, 2017).

When DKA has resolved, treatment with subcutaneous insulin should be initiated with careful consideration of its pharmacokinetics to prevent a period of insulin insufficiency and metabolic de-compensating (Sherry &Levitsky, 2008). Therefore, the current study will assess DKA management progress at different points of time for children with DKA in emergency care departments in Palestine.

1.1 Statement of the Problem.

The most prevalent complication in pediatrics and adolescents with T1DM is DKA, which leads to a high mortality rate among them reached to 3%-13% so that it is important to detect and manage DKA at an earlier stage, which helps in reduce or prevent the incidence of complications and is correlated with the raised incidence of successful recovery (Seth et al., 2015).

Islam (2018) explained that DKA is a complication among patients with both type 1 and 2 DM; it has correlated with large and growing economic effects with associated morbidity. Besides, DKA management in both T1DM and 2 DM has been under practice for many decades. So far, the complications and costs associated with it are still in continuous growth. So, it is essential to look at the proper management of DKA, whereas proper management includes fluid therapy, insulin regimen, and electrolyte replacement. Moreover, management with proper resource utilization is the key to the appropriate treatment of DKA, reduce or avoid complications and length of stay at the hospital, therefore, decreased the cost of treatment.

Moreover, a study carried out by Glaser and Kuppermann (2018) indicated that the ideal fluid therapy protocol for children with DKA has long been an issue of the argument until recently, there was no high-quality evidence from randomized clinical trials to support an optimal guideline treatment for DKA, and recommendations were mainly based on theoretical considerations.

In conclusion, treatment protocols for children with DKA vary between health centers and countries. On the other hand, some authors using fluid rehydration in treating patients in DKA; when developing DKA, the presence of hyperglycemia leads to osmotic urinary diuresis with subsequent dehydration, so dehydration, in turn, stimulates a stress response with counter-regulatory hormone production, leading to greater insulin resistance, thus perpetuating a cycle of hyperglycemia and further fluid loss (Nyenwe & Kitabchi, 2011).

The urgent intervention of health care providers with required experience with the provision of continuous follow-up and treatment of DKA patients may help them. In contrast, serious complications may occur and increase the risk of children to mortality. Therefore, I was curious, and interested to dig deep to have evidence based practice of this topic. Furthermore, there are no previous studies about this DKA management have been studied this realm in Palestine compared with developing countries.

1.2 Goal of the Study

The purpose of this study was to assess DKA management progress at different points of time for children with DKA in emergency care departments in Northwest Bank

Objectives of the study

1. Assess the clinical pattern of DKA (clinical manifestation) at point of care among children with DKA.
2. Assess the degree of dehydration at point of care among children with DKA
3. Assess the effectiveness of clinical management protocol at emergency departments.

1.3 Significance of the Study

This study will assess, explore, and provide DKA management data among Palestinian emergency units starting with the point of care among children with T1DM and develop DKA that will add to the body of nursing knowledge about the outcomes and develop DKA management protocol in pediatric units. Also, this study will recommend suggestions for health care providers to determine the protocol steps taken into conservation, while managing DKA cases to support and improve the quality of care and reduce complications, reduce hospitalization stay with quick recovery of DKA patients' emergency department, and prevent or reduce the incidence of relapsing in patients' condition.

1.4 Research Questions

1. Are there differences in the vital signs at different point times (p= 0.05) among children with DKA admitted to emergency department?
2. Are there differences in clinical pattern of DKA at different point times (p= 0.05) among children with DKA admitted to emergency department?
3. Are there differences in ABG's at different point times (p= 0.05) among children with DKA admitted to emergency department?
4. Are there differences in RBS at different point times (p= 0.05) among children with DKA admitted to emergency department?
5. Are there differences in severity of dehydration at different point times (p= 0.05) among children with DKA admitted to emergency department?
6. Are there differences in biochemical parameters at different point times (p= 0.05) among children with DKA admitted to emergency department?

Research hypothesis

1. Hypothesis 1: There is significant differences in the vital signs at different point times (p= 0.05) among children with DKA admitted to emergency department
2. Hypothesis 2: There is significant differences in clinical pattern of DKA at different point times (p= 0.05) among children with DKA admitted to emergency department
3. Hypothesis 3: There is significant differences in ABG's at different point times (p= 0.05) among children with DKA admitted to emergency department.
4. Hypothesis 4: There is significant differences in RBS at different point times (p= 0.05) among children with DKA admitted to emergency department.
5. Hypothesis 5: There is significant differences in severity of dehydration at different point times (p= 0.05) among children with DKA admitted to emergency department.
6. Hypothesis 6: There is significant differences in biochemical parameters at different point times (p= 0.05) among children with DKA admitted to emergency department.

1.5 Variables of the Study

Independent variables:

Age, Gender, New or previously diagnosed T1DM, History of T1DM in first degree relatives, weight, height and BMI, other health problems or co-morbidities (such as asthma, heart disease, kidney disease, infection).

Dependent variables:

Degree of dehydration, Severity of diabetic ketoacidosis, Clinical pattern (clinical manifestation) of DKA, Vital signs including (pulse, blood pressure,

oxygen saturation (SPo2), respiratory rate), Biochemical parameters (CBC, ABG, Anion Gap, Serum electrolyte= potassium (K), sodium (NA), chloride (Cl), Magnesium (Mg), phosphorus (P), blood sugar, urine analysis, HbA1C). The datasheet was prepared after going through related literature, and the diagnosis was established according to WHO criteria (Gabir et al., 2000) and recommendations endorsed by ISPAD Clinical Practice Consensus Guidelines 2014 (Wolfsdorf et al., 2014).

1.6 Conceptual framework of the Study

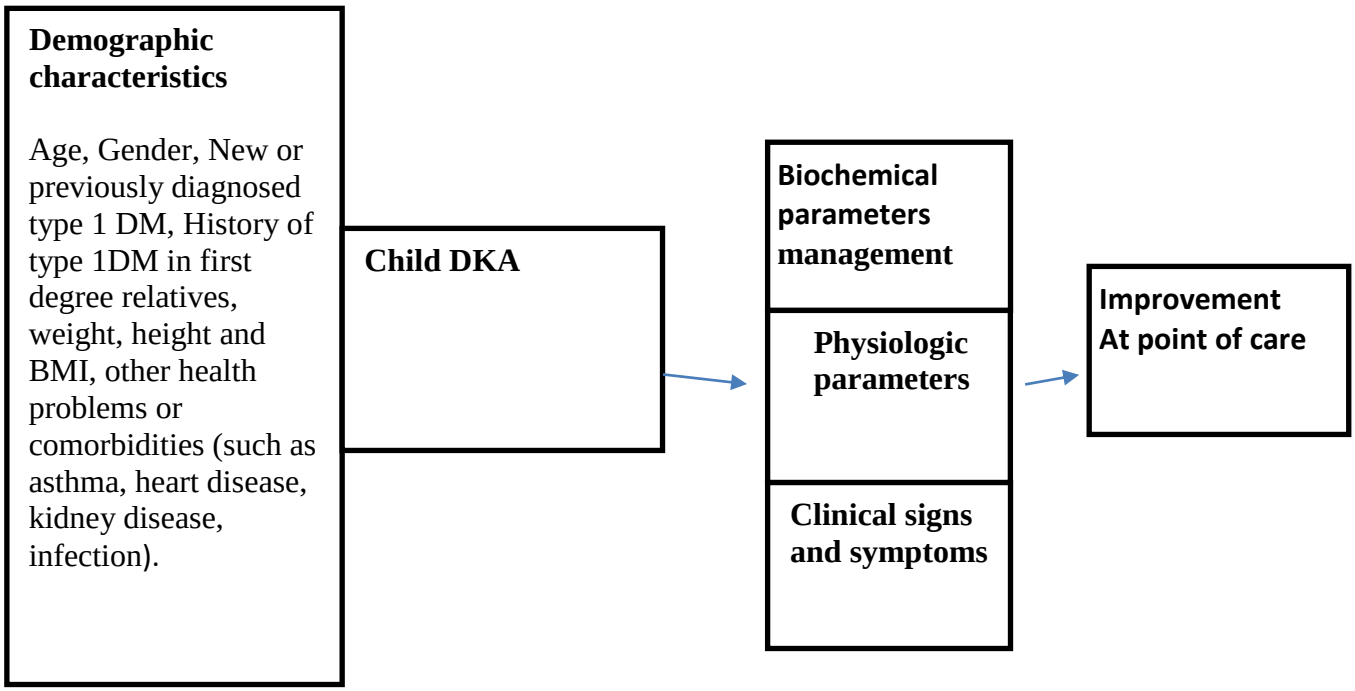

Figure *1-1*: Proposed conceptual framework for DKA Management

Conceptual Definition of Terms

Diabetes mellitus is a group of complex multifactorial metabolic disorders which is characterized mainly by hyperglycemia resulting from defects in the action of insulin and/or the secretion of insulin (American Diabetic association [ADA], 2017)

Diabetic ketoacidosis (DKA) occurs when there is a relative or absolute decrease in circulating insulin levels concerning an increase in counter regulatory hormone levels (Azad et al., 2017).

Dehydration, which refers to a deficiency in total body water, can impair a person's ability to engage in physical activities and increases the risk of urinary system and cardiovascular system diseases (Wolfsdorf et al., 2014).

Glycosylated hemoglobin (HbA1c) is the form of hemoglobin that is used widely to identify the average blood glucose levels of a person over the past three months and also can correlate to complications of high blood sugar (diabetes mellitus) (Nathan et al., 2007).

Point of care: involves site where medical care is received, more specifically, this type of testing is performed as close as possible to the patient, be it at their bedside or near them (Wolfsdorf et al., 2014).

Emergency care: covered inpatient and outpatient services that are furnished by a provider that is qualified to furnish such services and such services are needed to stabilize an emergency medical condition." Nathan et al., 2007).

Operational Definition of Terms

Diabetes mellitus: The following sings and symptoms are clinically present with diabetic patient: frequent urination, extreme hunger, unexplained weight loss, presence of ketones in the urine (ketones are a byproduct of the breakdown of muscle and fat that happens when there's not enough available insulin.

Diabetic ketoacidosis (DKA): clinically develop when the patient body doesn't have enough insulin to allow blood sugar into the cells for use as energy; the liver breaks down fat for fuel, a process that produces acids called ketones; too many ketones are produced too fast, they can build up to dangerous levels in patients' body.

Dehydration: clinically occurs when patients lose sugar and salts, as well as water. That occurs as a diabetic ketoacidosis complication; when the body have much less insulin than the body needs which causes the blood to become acidic and the body to become dangerously dehydrated.

Glycosylated hemoglobin (HbA1c): The higher the hemoglobin A1c, the higher patient risk of having complications related to diabetes if untreated diabetes for a long time; the patient might have a level above 8%. The level is above the target, patients' doctor may change the treatment plan to get the A1C level Below 6.5%.

Point of care is the starting time of examining the patient and diagnosing the patients' clinically , and point in time when clinicians deliver healthcare service at ED to diabetic patients at the time of care.

Emergency Care: treating patients with DKA, with caring delivery of the following and closely monitoring the patient: correction of fluid loss with intravenous fluids,

correction of hyperglycemia with insulin, correction of electrolyte disturbances, particularly potassium loss and correction of acid-base balance.

Chapter Two

Literature Review

2.1 Introduction

This chapter provides a review of relevant studies that examines DKA under the age of 12 , T1DM, and DKA. Moreover, quantitative and qualitative studies were included about T1DM were described utilizing different sources including the Jordanian Database for Nursing Research, Google Scholar, EBSCO host, Ovid journals and SAGE journals. The keywords, which have been used, are T1DM,DKA, protocol, and children. The relevant studies in this literature review were limited to studies in the English language, particularly studies related to T1DM and DKA, and were issued in peer-reviewed nursing journals. This review has excluded studies outside the nursing profession such as abstracts, conferences, duplicated studies, reports, and opinion papers.

2.2 Theoretical Studies

Diabetes Mellitus (DM) is a chronic common disease worldwide. In 2014, the global prevalence rate of DM was 8.5%, and this rate has doubled since 1980 (World Health Organization [WHO], 2017). Moreover, an estimated number of 425 million adults have DM in 2017 (International Diabetes Federation [IDF], 2017). In the United States in 2015, DM was considered the 7th leading cause of death (American Diabetes Association [ADA], 2017). Furthermore, by 2045 the number of people with diabetes globally is expected to increase by 48%, and in the Middle East and North Africa region

the percentage will increase by 110% (IDF, 2017). It was estimated that life expectancy for patients with DM can be shortened by fifteen years as a result of having this disease (Gillies et al., 2007). In Jordan, the prevalence of DM is 13.1%, and it is responsible for 7% of total deaths (WHO, 2016).

According to WHO, DM is a chronic disease that occur when glucose level in the blood increase due to insufficiency in the production of the hormone insulin by the pancreas, or by the ineffectiveness of the insulin produced (WHO, 2017), there are three main types of DM: Type 1 DM: characterized by the inability of the pancreas to produce insulin; Type 2 DM: characterized by the inability of the pancreas to produce enough amount of insulin or the insulin cannot be used by the bod; Gestational DM: characterized by infectivity of the produced insulin during pregnancy. Indeed, type 2 DM is the most common type of DM, accounting for 90% of total cases of diabetes worldwide (IDF, 2017).

Diabetes mellitus is a metabolic disorder that affects most patients' lives aspects; patients mostly experience hyperglycemia due to impaired insulin efficiency (ADA, 2014). DM pathogenic usually includes a range of destruction to autoimmune specific organs; beta (β) cells are responsible for insulin secretion whereby inflammation of islet cells2; insulin resistance occurs as a result (ADA, 2014). When glucose becomes elevated, several complications are associated with the chronic elevation of RBS as peripheral neuropathy, kidney disease, cardiovascular diseases, in addition to diabetic retinopathy (Hall, Thomsen, & Henriksen, 2011). Furthermore, DM is a growing burden worldwide; extending from individuals to families reaching the whole society; DM rates reached alarming proportions worldwide (Atlas, 2015).

Currently, diabetes is classified into four subtypes based on the etiology of the disease These include type 2 diabetes mellitus (T2DM), type 1 diabetes mellitus (T1DM), gestational diabetes as well as drug or chemically induced diabetes. This classification suggest that hyperglycemia can be subcategorized into those that require insulin for survival, those requiring insulin for control (i.e. for metabolic control and not for survival) and those not requiring insulin (i.e. non-pharmacological treatment methods or treatment with drugs other than insulin (WHO, 2017).

2.3 Type 1 Diabetes (T1DM)

Type 1 diabetes (T1DM) accounts for about 5−15% of all cases of diabetes (ADA, 2017). A complicated chronic illness generally attacks the human body in childhood or adolescence. The disease reaches its peak typically at or near puberty (Pundziute-Lycka et al., 2002). According to a Finnish study, the illness has another ridge around the age of five to seven (Harjutsalo et al., 2008). Studies have not found any gender differences regarding T1D; the only exception was that male preponderance from the age of 15 upwards (Gale & Gillespie, 2001, Wandell& Carlsson, 2013).

T1DM remedy regimens consist essentially of exogenous insulin control, carbohydrate consumption control and blood glucose monitoring (International Diabetes Federation [IDF],2017). Additionally, regular physical exercise is beneficial and highly recommended. The principal treatment purpose concentrates on preserving the blood glucose level at normoglycaemic rates to avoid or delay diabetic complications (Ziegler et al., 2013). T1DM is a multifactorial immune-mediated disease targeting the pancreas and until finally the stops producing insulin (Noble, 2015).

Usually, the illness start is preceded by a hidden pre-diabetic phase of changeable length ranging from weeks to decades. At that time, single or multiple types of islet autoantibodies can be identified although there is no evidence of clinical disease. The detection of a single T1DM related autoantibody only seldom leads to clinical disease, and occasionally the discovered seroconversion can also be transient (Knip et al., 2010).However, the detection of multiple autoantibodies increases substantially the risk of developing overt T1DM (Pihoker et al., 2005, Ziegler et al., 2013). According to three prospective birth cohort studies, 84% of children with multiple autoantibodies were diagnosed with T1DM within 15 years from seroconversion (Ziegler et al., 2013). The progression rate to manifest T1DM was unusually rapid when multiple autoantibodies were present before the age of three years (Ziegler et al., 2013). Some individuals will never develop T1DM regardless of predisposing seropositivity and the number of autoantibodies. In those cases, successful immunoregulation is thought to have arrested the disease progression at an asymptomatic pre-clinical phase (Ziegler &Nepom, 2010).

2.4 Diabetic Ketoacidosis (DKA)

Diabetic ketoacidosis (DKA) occurs when there is a relative or absolute decrease in circulating insulin levels concerning an increase in counter regulatory hormone levels (Azad et al., 2017). The incidence of Diabetes Mellitus (DM) is increasing worldwide (Dabelea et al., 2015). Around 30% of children with Type-I DM present with diabetic ketoacidosis (DKA) at diagnosis, and many develop DKA during the disease (Neu et al., 2003). DKA is the leading cause of death in this population, most commonly due to cerebral edema (Bialo et al., 2015). During a DKA episode, multiple abnormal

processes occur in the body, including fluid shifts, decreased perfusion, and deranged pH, which affects many functions and causes electrolyte abnormalities. These can lead to many-body systems and organs being affected (Azad et al., 2017).

The most commonly affected tissue is the brain leading to cerebral edema. Because of its high morbidity and mortality, cerebral edema has been the main focus of research in DKA patients (Siqueira, 2011). However, DKA has been described in the literature as associated with many other complications, including DKA associated with cerebral injury, electrolyte imbalance, vascular, renal, cardiopulmonary, and other complications(Bialo et al., 2015). Reports on isolated complications of DKA have been published in the literature (Khan, Maheshwari, &Haque, 2013). Thrombotic microangiopathic syndrome: a novel complication of diabetic ketoacidosis. However, there is a dearth of literature on all DKA complications in children, leading to more significant morbidity and prolonged stay (Safaei, Maleknejad, & Ebrahimi, 2011).

2.5 Children Development

Child Development (CD) is a fundamental part of human development, emphasizing that the brain architecture is shaped in the first years, from the interaction of genetic inheritance and influences of the child's environment (Shonkoff et al., 2012). Physical Development examines how the brain, nervous system, muscles, sensory capabilities, food needs, drink, and sleep affects behavior (Souza &Veríssimo, 2015). Cognitive Development emphasizes on intellectual abilities, including learning, memory, language development, problem-solving, and intelligence (Alisic et al., 2011). Personality and Social Development explores the enduring characteristics that

differentiate one person from another and how interactions with others and social relationships grow and change over the life span (Guerra, Graham&Tolan, 2011).

T1DM patients experienced a disruption in their quality of life is affected relatedthe disruption in their health continuum; which may result physical deficits, psychological burden of living with the chronic condition. Some changes in HRQoL can manifest themselves already during childhood (Duru et al., 2015).

2.6 Global DKA Studies among Children

Several studies investigated acute metabolic complications classically occurred in children and young people with T1DM. An Indian prospective study conducted by Seth et al. (2015) about the clinical profile of diabetic ketoacidosis in a tertiary care hospital. The study aimed to look into the clinical profile, the precipitating factors, and clinical outcome in the patients presenting with diabetic ketoacidosis in the Emergency of a Tertiary care hospital. The authors examined the clinical profile of 60 diabetic patients admitted in the Emergency with the diagnosis of Diabetic ketoacidosis were analyzed Out of 60 patients, 12 were of Type 1, and 48 were Type 2 Diabetes Mellitus. The mean duration of diabetes was 8.65 years. Only 14 (23.3%) patients were taking regular treatment for Diabetes Mellitus, whereas 32 (53.33%) patients were on rough treatment, and eight (13.33%) were not on any treatment at all. Among 12 Type 1 Diabetic patients, six patients were freshly diagnosed as diabetic when they presented with Diabetic ketoacidosis complication. Nausea and vomiting (63.33%) were the most common symptoms of these patients. Infections (73.33%) were the most common precipitating factor for Diabetic ketoacidosis. The mean fluid requirement on the first day of therapy was 3.51 liters. A mortality of 10% was seen. The study concluded that

diabetic ketoacidosis is a fatal acute metabolic complication of T1DM with heterogeneous clinical presentation, and they recommended early DKA diagnosis and treatment can avoid morbidity & mortality.

Furthermore, another study was conducted to explored DKA initial management performed by Balmier et al. (2019). The study was an observational retrospective design; aimed to measure the time of recovery of DKA patients compared to the metabolic adverse events. The study result showed that; of 122 patients, 49.2% had T1DM; 22.9% were newly diagnosed with diabetes. The median recovery times were not significantly different among 120 T1DM children. Despite receiving lower insulin doses, hypoglycemia was more frequent in patients with type 1 diabetes (76.9%)—the rate of metabolic complications (hypoglycemia or hypokalaemia) and the recovery time. However, the timing of recovery was not significantly different between patients. Metabolic complication rates are associated with DKA treatment that differs significantly relating to DM type. Decreasing insulin dose may limit those complications. Therefore, DKA treatment recommendations should take into account the type of diabetes.

Additionally, Jefferies et al. (2015)assessed the incidence of diabetic ketoacidosis (DKA) among children below the age of <15 in New Zealand, the children were recently diagnosed T1DM between 1999–2013. The research design was retrospective cohort method. The sample size was 730 children who were newly diagnosed with T1DM. 27% ofthecasesdeveloped severe DKA. There was no change in DKA incidence or the proportion of children with severe DKA at presentation. The incidence of DKA among children aged <2.0 years (n = 40) was 53% compared to 25% for those aged 2–14 years (n = 690; p = 0.005). In children aged 2–14 years, increasing

age at diagnosis was associated with a greater likelihood of DKA at presentation (p = 0.025), with the odds of DKA increasing 1.06 times with each year increase in age. Non-Europeans were more likely to present in DKA than New Zealand Europeans (OR 1.52; p = 0.048). Despite a consistent secular trend of increasing incidence of T1DM, there was no reduction in the incidence of DKA in new-onset T1DM in the Auckland Region over time. Thus, it is important to explore ways to reduce DKA risk.

Furthermore, another study conducted in Addis Ababa used a hospital-based cross-sectional among 395 children under the age of 12 years. The children were admitted to pediatric unite have DKA. The DKA diagnostic criteria were; RBS level ≥250mg/dl, ketonuria, ketonemia, and T1DM diagnosed for the first time. Around 142(35.8%) were admitted with DKA, and they were at first diagnosis with T1DM. The average age was ≥9.5years, with children below the age of 12 years with DKA. The knowledge of parents on the sign and symptoms of DKA was (AOR = 0.51[0.27, 0.95]); and infection prior to DKA onset (AOR = 3.45[1.97, 6.04]). The overall conclusion was the DKA children and T1DM newly diagnosed children were high among the age group between 9–12 years; with parents who have poor knowledge of DKA signs and symptoms (Atkilt et al., 2017).

Other studies were found in literature toshed the light on subject assessment of the improving management with point of care for children with diabetic ketoacidosis in emergency care in Palestine. Moreover, all articles discussed in this thesis was found by used the electronic search engines as Google Shcholar and Pubmed. The key words (Diabetes Mellitus; DKA; Management of paediatric DKA, children) was used in searching process. It was selected all articles that related to topic. Moreover, the

researcher depends on primary sources for collecting data that was written by the original researchers.

Another retrospective study was carried out by Naeem et al. (2015) at the King Abdulaziz Medical City, Riyadh, and it included 373 pediatric patients, which focused on evaluating the clinical and biochemical characteristics of children with DKA. Results indicated that (patients 197=52%) children diagnosed as DKA were admitted in PICU, and rest and rest were received treatment in the pediatric ward.DKA patients admitted to PICU were having severe DKA and had high risks such as newly diagnosed DM, aged less than five years, blood PH less than 7.10. Also, they have severe dehydration, hypoperfusion or shock, altered mental status, hypocapnia, and High Blood Urea Nitrogen (BUN). All the patients were observed regarding vital signs, neurological status, Glasgow coma score (GCS), intake/output, etc. In PICU, monitoring was minimum every hour while in the ward; it was 1-4 hourly depending upon the degree of DKA severity at admission and clinical progress in the hospital. Laboratory frequency stayed every 1 to 4 hourly checking of blood glucose, BUN, serum electrolyte (calcium, magnesium, phosphorus), and blood gases being more frequent in patients with higher sickness and/or severity of DKA. Moreover, Blood glucose, pH, anion gap, serum osmolality, serum potassium, and serum phosphate showed the biggest change during the initial 6 hours of management, while serum bicarbonate and BUN trends demonstrated a predominant change in the initial 12 hours. Patients in PICU received insulin intravenously (0.05-01 unit/kg/hr) while in the ward, rapid-acting insulin was administered as q 1-2 hour intravenous or subcutaneously.

Furthermore, DKA's clinical and biochemical characteristics were investigated in a survey by Almalki et al. (2016). It included 400 patients with a mean ± SDage of

21.4 ± 10.1 years. Most of them had type 1 DM (93%). The study showed that the most popularly clinical manifestations that experienced by patients on admission were vomiting (79.8%), nausea (70.5%), abdominal pain (75.8%), and tachycardia (61.8%), besides the predominant precipitating cause of DKA was no adherence with insulin regimen (54.2%).Moreover, recurrent DKA admissions to hospital among patients with type 1 DM(n = 232)was higher than those with type 2 DM (n = 9) with (P = 0.002), and recurrent DKA admissions to hospital among female patients (n = 167)were higher than in male patients (n = 74) with (P = 0.002). It concluded that continued diabetic education and counseling on the importance of adhering to the recommended medical regime, addressing the social and cultural barriers that precipitate DKA, and the provision of timely medical attention might greatly reduce DKA episodes and their associated complications.

A study performed by Burcul et al. (2019) focused on investigating clinical and laboratory parameters and complications in diabetes children type 1 DM with DKA who were managed in PICUs. Data collected from 82 children aged 0-18 years, and variables include age, gender, clinical signs and symptoms, and various laboratory parameters. Patients were divided into two groups to compared data between them: The newly diagnosed group (NT1D= 57) and the previously diagnosed group (PT1D=25). Results showed that those with NT1D were more often treated in the PICU, and two of them developing cerebral edema. Also, the most common frequent clinical sign among patients at admission was dehydration (95%), decreased level of consciousness was found in 41.5% of patients, with most of them being somnolent. Moreover, no difference was found between the two groups, and regarding laboratory parameter data at admission, there was no significant difference. It concluded that management of

patients with moderate or severe DKA in PICUs would provide closer monitoring for their condition, which helps to recognize good management and a better outcome.

Furthermore, in Egypt, a retrospective descriptive study conducted by Mohammed et al. (2018) aimed to assess pediatric patients presented with DKA regarding presentation, findings, management, and potential risk factors associated with DKA. The study included 43 children with type 1 DM, divided into two groups: The previously diagnosed group (n=18) and the newly diagnosed group (n=25). Results concluded that the newly diagnosed group had a more extended mean hospital stay (5.88 days) than the previously diagnosed group, the frequency of severe DKA among newly diagnosed patients (28 %) more than previously diagnosed patients (11.1%), the leading risk factor for DKA was infection (67.8%), and the hypokalemia, acidosis and decreased bicarbonate were significantly associated with the degree of severity of DKA (p values of 0.012, < 0 .001 and < 0.001 respectively). It also showed an association between newly diagnosed cases and severity of DKA where 77.8% of newly diagnosed cases presented with a severe grade of DKA and found no association between age and severity of DKA. Finally, the most common clinical manifestations were polyuria & polydipsia (88.4 %), abdominal pain (72.1%), weight loss (69.8%), fever (67.4%), and Nausea & vomiting (58.1%). There was no difference between the two groups concerning electrolyte imbalance concerning hypokalemia and hyponatremia as a complication of treatment in DKA.

Ugale et al. (2012) performed a prospective observational study aimed to measure the degree of dehydration in children with T1DM and DKA. Depend on the difference between admission and plateau weights; and investigated the relationships between the measured degree of dehydration and clinically assessed degree of

dehydration, the severity of DKA, and routine serum laboratory values. The authors' criteria for diagnosing e dehydration were based on the degree of clinical symptoms on physical examination and the ABGs values; to classify DKA severity. Also, the laboratory values collected at admission involved serum glucose, urea nitrogen, sodium, and osmolality. The result indicated that regarding the degree of dehydration, patients were clinically evaluated as mild (21%), as moderate (74%), and as severe (5%) with a median degree of dehydration was (5.2%), also patients were clinically assessed to have moderately dehydrated were 5.8%; more significant than the mildly dehydrated patients as (3.7%. At the same time, 2.5% were assessed to have severe dehydration. DKA severity was distributed respectively as (14%) mild DKA, (27%) moderate, and (59%) were severe. DKA severity did not differ in the dehydration degree. The authors concluded DKA degrees were between mild to moderate based on weight body change.

Another study was conducted by Bakes et al. (2016). the authors focus was on the fluid volume influenceson metabolic rate normalization with DKA patients. The study included patients (n=50) aged 0 -18 years, and there were categorized into two groups to receive intravenous (IV) fluid: the first group received low fluid volume, and the second group received highfluidvolume.In two groups, dextrose was added to the IV fluids when serum glucose values reached 250–300 mg/dL potassium replacement as per International Society for Pediatric and Adolescent Diabetes (ISPAD) guidelines; both groups received an insulin infusion (0.1 U/kg/h) upon completion of the initial saline bolus. The result concluded time to correct pH to normal value was significantly was rapid in the higher fluid volume administration group compared to group who receive the low fluid volume ($p = 0.04$). Also, the PH return to normal with higher IV fluid volumeinfusion to a greater extent ($p = 0.01$).

Moreover, Jayashree et al. (2019) aimed to assess the perspectives of fluids infusion with DKA children. The author pointed out the role of fluids as an important component of DKA management and described restoring ICF and ECF compartments and hydration effect on renal glucose clearance. Hague debate on fluids infusion management with DKA cases was a subject question of causing cerebral edema (CE). The study results showed that the fluid of choice infused normal saline (0.9%) for deficit replacement and resuscitation when managing DKA. Furthermore, the risk of AKI with its liberal chloride content remains a contentious issue. On the other hand, balanced crystalloids with restricted chloride content need more exploration in children with DKA, both with respect to DKA resolution and AKI. Although fluids are an integral part of DKA management, a fine balance is needed to avoid under-hydration or over-hydration during DKA management.

Moreover, Shafi and Kumar (2018), in their study, discussed the initial fluid therapy in pediatric DKA. It is involved 40 patients with moderate to severe DKA were randomized to receive either 3% saline or 0.9% saline as initial fluid therapy, to compare the effects solutions (3% saline and 0.9% saline) on changes in vital signs parameters, serum sodium, serum chloride, lactate, and pH; the time needed for the correction of hyperglycemia; the time needed for the control of ketoacidosis and occurrence of cerebral edema. The result showed no significant difference between the two groups in the vital signs parameters, time for the correction of hyperglycemia, and acidosis. Also, both types of solutions (0.9% saline and 3% saline) were equally effective as initial fluid in children with DKA with respect to hemodynamic improvement, the correction of hyperglycemia, and acidosis. On the other hand, the use of 3% saline solution did not prevent the development of cerebral edema and had the

possibility to cause hypernatremia, hyperchloremia, and hyperchloremic metabolic acidosis.

Ahmad et al. (2011) investigated the associated risk factors and DM prevalencein India. The study aimed was to measure DM prevalence and DM risk factors above the age of 20 years. The study design was cross-sectional among 1040 subjects (500 males and 540 females). The main study focus was on patients' medical personal history and its association with family history. DM prevalencewas 6.05% among previously diagnosed DM patients, while the DM prevalence was 4.03% amongundiagnosed DM participants. The result showed a significant difference between males and females (3.6% vs. 8.3%, $p < 0.05$). Besides, the obesity prevalence was 36.82%, while positive family history was associated significantly with DM presence($p<0.001$). The study conclusion was that DM prevalence was rising due to lifestyle changes. The risk factors should be controlled aggressively to break this trend

Another study ofGrönberg, Espes, and Carlsson (2020); this research aimed to identify the associated factors with residual C peptide production with the previous diagnosis in children with T1 DM among **73** children, whereby the study period was (2013-2016). The main focus was calculating the average HbA1c. The result was 9.4% (79 mmol/mol). The HbA1c average after the first three years of diagnosis was lower than the detectable C peptide group after ten years of follow-up. Around (12%) were diagnosed with celiac disease; hypothyreosis was seen in (3%) while diabetic retinopathy affected 25% of participants. The study concludes that children developed better HbA1c than others patients at the first three years of diagnosis.

Quinton S, Higgins Y (2012) has developed a Modified Early Warning Score (MEWS). This policy and escalation pathway of Diabetic ketoacidosis (DKA) is issued

in urgent medical conditions; used for persons United Kingdom requires urgent medical care. This study explored the initial assessment that is done at the first hour of admission besides medical treatments. When the rapid assessment is initiated, a framework or tool monitors specific tests such as blood glucose and ketone monitoring and identifying the underlying cause. The treatment phase aims to restore blood volume, reduce RBS levels, correct serum electrolyte imbalances, and decrease ketone to correct the PH level. The treatment involves intravenous fluids, insulin therapy, serum electrolytes, continuous testing, and regulation. Using effective dynamic communication is required, and determining the socioeconomic class and literacy level must be considered to guarantee a better outcome and decrease further complications and future readmissions with DKA.

2.7 Summary

In this chapter, the literature review focused on aspects that have to be considered in a study that aimsto assess DKA management progress at different points of time for children with DKA in emergency care departments in Palestine. In the next chapter, the methodology, the research design, and methodology will be discussed. The findings from this review reveal a lack of extant literature on the DKA management children.

Chapter Three

Methodology

3.1 Introduction

The current study methodology is described in the following sections: study design, setting, population and sample, study instruments, data collection methods, data analysis, and ethical considerations.

3.2 Study Design

This study method was a quasi-experimental study that assessed the DKA management progress at different points of time for children with DKA in emergency care departments in Northwest Bank

The population of the study was all children with type 1 diabetes mellitus and developed DKAwho attended to emergency department at Rafedia governmental hospital from february1, 2021 to May 1, 2021**.**

3.3 Setting

The study was conducted at Rafedia government hospital which considered a referral hospital (provide health care for all North West Bank area) that provide emergency and medical care for patients. The hospital has a pediatric ward contains of 35 beds, also contain Pediatric ICU (three beds).

3.4 Population and Sample

All patients' ages under 12 years regardless of gender with DKA who attended emergency department at Rafidia governmental hospital over a period of 4 months. The study included new and previously diagnosed type 1 diabetes mellitus and developing DKA when attended the emergency department at Rafedia governmental hospital

Inclusion Criteria

1. Children' ages under 12 years' regardless of gender.
2. Patients with new or previously diagnosed type 1 diabetes mellitus and developing DKA.

Exclusion Criteria

1. Othertypes of DM such as monogenic diabetes, secondary diabetes, and steroid-induced diabetes patients with underlying neurological disorders that would affect either mental status testing during DKA treatment or neurocognitive testing after recovery.
2. Patients who present with DKA concomitant with head trauma, meningitis, or other conditions that affect neurological.

3.5 Study Instruments

For the study purpose, after critical reviewing literature, an instrument was developed by the researcher and composed of seven parts; part I: socio-demographic characteristics and comorbidities. Part II: an observational checklist for the assessment of vital sign Part III; observational checklist for Clinical Pattern of DKA (Clinical

Manifestation), an observational checklist for Severity of Diabetic Ketoacidosis; observational checklist for Assessment the Degree of Dehydration, Observational checklist for Biochemical Parameters and observational checklist for the assessment of Random Blood Sugar.

3.6 Data Collection

Tools of data collection

For the study purpose, after critical reviewing literature, the tool was developed by the researcher and composed of seven parts; socio-demographic characteristics and comorbidities, an observational checklist for the assessment of Vital Sign; observational checklist for Clinical Pattern of DKA (Clinical Manifestation), an observational checklist for Severity of Diabetic Ketoacidosis; observational checklist for Assessment the Degree of Dehydration, Observational checklist for Biochemical Parameters and observational checklist for the assessment of Random Blood Sugar .

Data collection

The data was collected after admitting children with DKA to the unit at the emergency department at Rfaida hospital, after receiving the child at ED. the researcher is obtaining the required data and filling the form sheet, then the childe lab tests are performed very 2-hour with continuous monitoring and follow up care with resuscitation at the unit. After confirming the DKA, the child is transferred from EDs to PICUs if the child clinically is deteriorating and is included in the study if the eligible criteria of the patient are applicable, by then post-lab tests result and have DKA clinical manifestation. lab tests result us obtained of the electronic files.

3.7 Ethical Considerations

Ethical approval was obtained from the Arab American University and the Palestinian Ministry of Health (MOH) to conduct the study. Also, Rafedia permission obtained from hospital administrative team. Full explanations of the study's objectives and procedures were provided to the healthcare providers' team (nurses and doctors).

All the participants in the study were coded to keep anonymity and confidentiality. The information will only be used for research purposes, and nobody can identify any participant's information. The medical records will be prospectively reviewed from the hospital electronic system beside the patient's files.

3.8 Data Analysis

Data were analyzed by Statistical Package of Social Science (SPSS, Version 23; SPSS Inc., Chicago, Illinois). Descriptive statistics included the frequency distributions, means, standard deviations, and percentages were used. Also, t test, repeated measure ANOVA, and Chi square were used. Finally, the p-value<0.05 were considered statistically significant.

This study was conducted through selecting all the patients who was admitted with DKA from february1, 2021 to May 1, 2021**.**

3.9 Sampling Method and Sample Size

The researcher used **a purposive non-probability sampling technique** for this study by recruiting all the accessible patients at ED. The researcher used the purposeful sampling related the sample is more readily accessible, more convenient and select only those individual

that are relevant to research design and less costly **(Showkat**, Nayeem & Parveen, Huma.;2017).

Pilot testing was performed for 6 patients of the target population, but they excluded the sample of the study, to check the validity and reliability of the questionnaire via using the psychometrics, of the correlation coefficients via **Cronbach's Alpha** to assess the questionnaire reliability through measuring the internal consistency reliability of questioner Items . Which is best describes and measures the dichotomous choices (Ritter and Nicola, 2010). Pilot study has been conducted after permission obtainment. Information about the study and its objectives was provided to the voluntary participating of the children, then a consent form was signed by parents . As a result of the pilot study, the questionnaire was clear and easy to understand, it also gave a good interpretation of the data and minimum participant errors.

3.10 Validity and Reliability of the Questionnaire

The validity of the study tool was examined by content validity and internal consistency validity. The content validity was evaluated by three multidisciplinary experts of the main thesis supervisor, and statistician. The domains were designed and the items were modified according to experts' opinion. No item was exposed to modification by deletion neither by addition.

3.11 Reliability

The reliability coefficients of the different domains. The Cronbach's Alpha was 0.973 for Clinical Pattern of DKA (Clinical Manifestation),, 0.975 for Severity of Diabetic Ketoacidosis, and 0.956 for Assessment the Degree of Dehydration, and 0.921 for Biochemical Parameters

Variable	No. of item	Cronbach's Alpha
Clinical Pattern of DKA (Clinical Manifestation	5	.973
Severity of Diabetic Ketoacidosis	4	.975
Assessment the Degree of Dehydration	4	.956
Biochemical Parameters	9	.921

3.9 Summary:

These descriptive statistics were used in the current study and the selected instruments were valid and reliable. The data collection took place face to face in 2021. IRB approval was obtained from both Arab American University Palestine and Palestinian MOH. The results of statistical analyses are present in detail in Chapter Four, and the discussion of the results is in Chapter five.

Chapter Four

Results

In this chapter, the results of the study are presented. The purpose of this study was to assess DKA management progress at different points of time for children with DKA in emergency care departments in Palestine. The Statistical Package for Social Science (SPSS, version 23) was used to analyse the data. Descriptive and inferential statistics were used to test the study hypotheses. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to describe the characteristics of the participants. The inferential statistics (independent t- test, paired t-test, and Chi square test) were utilized to test the research hypotheses.

4.1 Participants' Characteristics

Sixty children with DKA participate in the study.The average age of the childrenwas 9.38± SD=3.1 year.The sample consisted of 29 (48.3%) males and 31(51.7%) females, as seen in table

Table 1: Demographic Characteristics of Participants

Variable	Mean (SD)	Frequency (%)
Age	9.38 (3.129)	
Gender		
Male		29(48.3
Female		31(51.7

The analysis revealed that most of the children' not new diagnosed with type 1 DM 46 (76.7%) and 46(76.7%) of them previously diagnosed type 1 DM with average

2.26 ± SD=1.886 years. Two thirds of the children 41± SD=68.3 haven't history of type 1 DM in first degree relative. At arrival the average of HbA1C was 11.74(2.042), as seen in table 2.

Table 2: Comorbidities Characteristics of the Participants (N=60)

Variable	Mean (SD)	Frequency (%)
New diagnosed type 1 DM		
Yes		14(23.3)
No		46(76.7)
Previously diagnosed type 1 DM		
Yes		46(76.7)
No		14(23.3)
If Yes, How many years	2.26 (1.886)	
History of type 1 DM in first degree relative		
Yes		19 (31.7)
No		41 (68.3)
At arrival HbA1C	11.74 (2.042)	

The analysis also revealed that the majority of the children 45(75.0%) do not have any other health problems while 1(1.67%) have tonsillitis, epilepsy, or CHD, ASD, VSD, as seen in figure 4-1.

The results revealed that the average of the participant's weight was 32.77±SD=12.445, height 132.42±SD=20.649, and BMI 17.84(±SD=2.794, as seen in table 3.

Table 3: Anthropometric measurements of the participants (N=60)

Variable	Mean (SD)
Weight	32.77(12.445)
Height	132.42(20.649)
BMI	17.84(2.794)

The majority of the participants 27 (45.0%) at arrival have ketones +3 in urine, but only 1 (1.67%) of the participants haven't ketone as seen in figure 4-2.

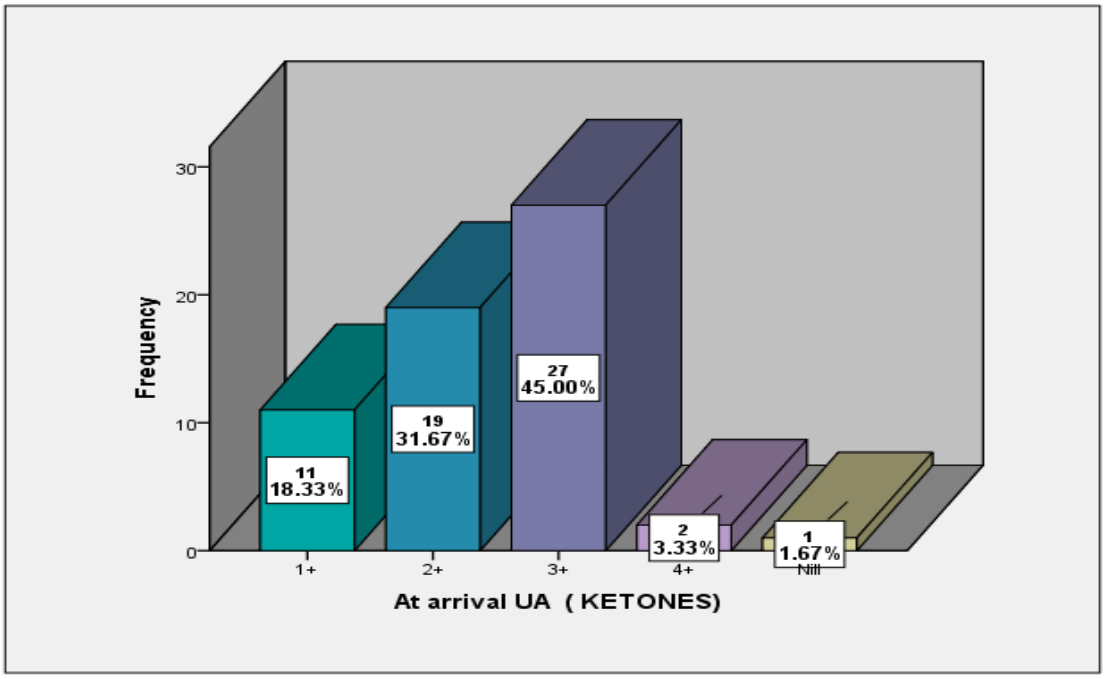

Figure4-2Ketone level in Urine at Arrival of the participants (N=60)

The majority of the participants 24 (40.0%) at arrival have glucose +2 in urine, but only 1 (1.67%) of the participants have +4, as seen in figure 4-3.

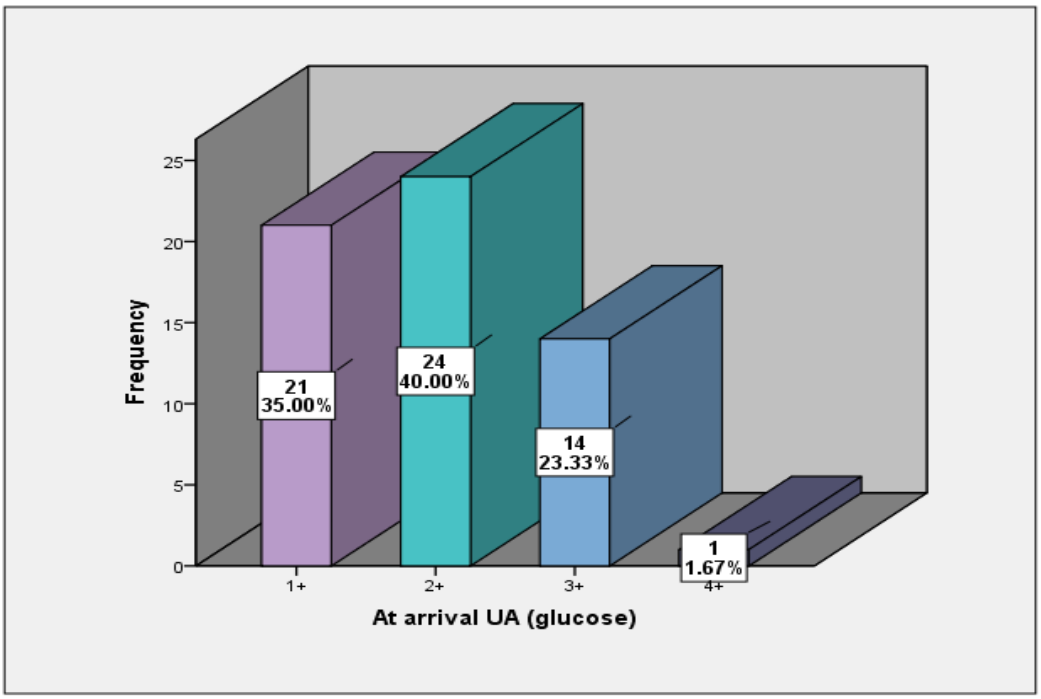

Figure 4-3Glucose level in Urine at Arrival of the participants (N=60)

4.2 Testing Hypothesis

Hypothesis 1: There is significant differences in the vital signs at different point times (p= 0.05) among children with DKA admitted to emergency department

A repeated-measures ANOVA determined that mean systolic ($F = 89.8$, $p < 0.001$), diastolic ($F = 51.8$, $p < 0.001$), HR ($F = 134.0$, $p < 0.001$), RR ($F = 168.2$, $p < 0.001$),O_2 Sat.($F = 0.557$, $p < 0.013$), temperature ($F = 4.435$, $p < 0.020$)scores differed significantly across six time points. A post hoc pairwise comparison using the Bonferroni correction showed significant difference between the initial assessment and follow-up assessment 4hrs later. Therefore, we can conclude that the results for the ANOVA indicate a significant time effect for DKA as measured on the vital signs scale, as seen in table 4.

Table 4: Repeated Measure ANOVA of Vital Signs (N=60).

Vital signs	At arrival	After fluid resuscitation	After start fluid and insulin therapy (1hr)	After start fluid and insulin therapy (2hr)	After start fluid and insulin therapy (3hr)	After start fluid and insulin therapy (4hr)	F	P. Value
Systolic BP	102.3(10.9)	107.8(9.2)	110.7(7.5)	113.4(6.5)	116.0(4.9)	116.3(4.7)	89.8	0.000
Diastolic BP	57.3(7.3)	62.2(6.5)	63.9 (6.5)	66.3(5.4)	67.1(6.4)	67.3(5.9)	51.8	0.000
HR	134.8(16.5)	129.2(16.1)	122.4(16.8)	118.7(15.5)	113.3(15.4)	110.5(14.3	134.0	.000
RR	39.9(8.7)	36.9(7.7)	34.2(7.3)	31.3(7.1)	30.7(6.7)	29.4(6.8)	168.2	.000
O2 Sat.	97.1(1.6)	97.2(1.2)	97.1(1.3)	97.4(1.3)	97.2(1.1)	97.3(1.3)	0.557	0.013
Temp.	37.1(0.4)	37.0(0.3)	36.9(0.1)	36.9(0.1)	36.9(0.1)	36.9(0.1)	4.435	0.020

Note: P. value significant at the 0.05 level

Hypothesis 2: There is significant differences in Clinical Pattern of DKA at different point times (p= 0.05) among children with DKA admitted to emergency department.

Chi square test was performed to assess the significant differences in Clinical Pattern of DKA at different point times. The analysis revealed that clinical patterns differed significantly between the variables at arrival and after start of fluid and insulin therapy (4- 6 hr.) as seen in table5

Table 5: Comparison Between Clinical Pattern of DKA ((N=60).

Clinical Pattern of DKA	At arrival		After start fluid and insulin therapy (4- 6 hr.)		X^2	P. Value
	Yes%	NO %	Yes%	No %		
Dehydration	55 (91.7%)	5 (8.3%)	32 (53.3%)	28 (46.7%)	22.1	0.000
Tachycardia	50(83.3%)	10 (16.7%)	31 (51.7%)	29 (48.3%)	13.7	0.000
Tachypnea	49 (81.7%)	11 (18.3%)	32 (53.3%)	28 (46.7%)	11.00	0.000
Deep, Kussmaul respiration	33 (55.0%)	27 (45.0%)	8 (13.3%)	52 (86.7%)	23.2	0.000
Nausea, vomiting	48 (80.0%)	12 (20.0%)	1(1.7%)	59 (98.3%)	76.0	0.000
Abdominal pain	40 (66.7%)	20 (33.3%)	1 (1.7%)	59 (98.3%)	56.4	0.000
Lossof consciousness	21(35.0%)	39 (65.0%)	2 (3.3%)	58 (96.7%)	19.4	0.000

Hypothesis 3: There is significant differences in ABG's at different point times (p= 0.05) among children with DKA admitted to emergency department.

A repeated-measures ANOVA determined that mean PH ($F = 20.4$, $p < 0.001$), HCO_3($F = 136.74$, $p < 0.001$) scores differed significantly across five time points. A post hoc pairwise comparison using the Bonferroni correction showed significant difference between the initial assessment and follow-up assessment 6hrs later. Therefore, we can conclude that the results for the ANOVA indicate a significant time effect for DKA as measured on the ABGs. Also, Chi square test was performed to assess the significant differences in severity of DKA at different point times. The analysis revealed that severity DKA differed significantly between arrival and after start fluid and insulin therapy (4- 6 hr.) as seen in table 6.

Table 6: Comparison Between ABG's of DKA at Point Times (N=60).

ABG's analysis	At arrival	After fluid resuscitation	After start fluid and insulin therapy (2hr)	After start fluid and insulin therapy (4hr)	After start fluid and insulin therapy (6hr)	F	p. value
PH	7.07(0.15)	7.17(0.27)	7.19(0.10)	7.23(0.09)	7.26(0.09)	20.4	.000
HCO_3	8.31(3.49)	9.05(3.08)	10.23(3.17)	11.49(3.26)	13.00(3.29)	136.74	.000
	MR	MR	MR	MR	MR	Chi-Square	
Severity of DKA	3.77	3.56	2.81	2.44	2.43	59.979	0.000

MR, Mean Rank

Hypothesis 4: There is significant differences in RBS at different point times (p= 0.05) among children with DKA admitted to emergency department.

A repeated-measures ANOVA determined that mean RBS ($F = 160.58$, $p < 0.001$) scores differed significantly across six time points. A post hoc pairwise comparison using the Bonferroni correction showed significant difference between the initial assessment and follow-up assessment 4hrs later. Therefore, we can conclude that the results for the ANOVA indicate a significant time effect for DKA as measured on the RBS, as seen in table 7.

Table 7: Repeated Measure ANOVA of RBS (N=60).

Variable	At arrival	After fluid resuscitation	Random blood sugar After start fluid and insulin therapy (1hr)	After start fluid and insulin therapy (2hr)	After start fluid and insulin therapy (3hr)	After start fluid and insulin therapy (4hr)	F	P. Value
RBS	497.80 (142.57)	395.52 (119.87)	299.20 (96.59)	246.13 (80.06)	198.98 (66.73)	210.08 (62.78)	160.581 .	0.000

Hypothesis 5: There is significant differences in severity of dehydration at different point times (p= 0.05) among children with DKA admitted to emergency department.

Chi square test was performed to assess the significant differences between severity of DKA at different point times. The analysis revealed that severity of DKA differed significantly between arrival and after start fluid and insulin therapy (4- 6 hr). However, there is no differenceinRapid, thread pulse and Shock when comparing the initial assessment to a second follow-up assessment taken after start fluid and insulin therapy (4- 6 hr.) from original assessment, as seen in table 8.

Table 8: Comparison Between Severity of Dehydration At Arrival And After Start Fluid And Insulin Therapy ((N=60).

Dehydration		At arrival		After start fluid and insulin therapy (4- 6 hr)		Chi-Square	p. value
		Yes	No	Yes	No		
Mild	Alert	23 (79.3)	6(20.6)	14(48.3)	15 (51.7)	6.0463	.0139
	Dry mucous membranes	25(86.2)	4 (13.8)	1(3.4)	28(96.6)	40.1538	0 .000
	Decreased skin turgor	25(83.3)	5(16.7)	1(3.2)	30(96.8)	39.095	0.000
Moderate	Lethargy	20(48.8)	21(51.2)	4 (9.8)	37(90.2)	15.7269	.000073
	Hyperventilation	34(82.9)	7(17.1)	24(58.5)	17(41.5)	5.8908	.01522
	Sunken eyes	35(83.3	7(16.7)	11(26.2	31(73.8	27.6796	.0000
	Prolonged capillary refill	35(83.3	7(16.7)	23(54.8	19(45.2	8.0212	.004623
Severe	Sleepy	26(81.2	6(18.8	7(21.2	26(78.8	23.4296	< .00001
	Poor perfusion	16(76.2	5(23.8	3(16.7	15(83.3	13.7453	.000209
	Rapid, thread pulse	1(12.5	7(87.5	0(0.0	8(100.0	0.0	
	Shock	1(12.5	7(87.5	0(0.0	8(100.0	0.0	

Hypothesis 6: There is significant differences in Biochemical Parameters at different point times (p= 0.05) among children with DKA admitted to emergency department.

Paired t test determined that mean Anion Gap ($t = 6.937$, $p < 0.001$), K ($t = 4.650$, $p < 0.001$), and WBC($t = 3.073$, $p = 0.003$), scores differed significantly across Two time points. However, there is no difference in Na ($t = -.887$, $p = 0.379$),Cl ($t = -.019$, p

=0.985), Mg (t = 0.565, p = .574), Phosphorus (t = -1.016, p = 0.333), when comparing the initial assessment to a second follow-up assessment taken after start fluid and insulin therapyfrom original assessment, as seen in table 9.

Table 9comparison between Biochemical Parameters ((N=60).

Biochemical Parameters	At arrival	After start fluid and insulin therapy	T	P. value
Anion Gap	23.39 (6.190)	18.48(6.688	6.937	.000
K	4.60(0.884)	4.18(0.769	4.650	.000
Na	135.07(5.310)	135.60(5.053	-.887	.379
Cl	104.67(5.118)	104.70(11.160	-.019	.985
Mg	2.04(.316)	2.02(.337	.565	.574
Phosphorus	3.96(1.328)	4.03(1.361)	-1.016	.330
WBC	14.49(8.031	12.55(7.787	3.073	.003

Chapter Five

Discussion, Conclusion, and Recommendations

5.1 Introduction

In this chapter, discussion, conclusions, and recommendations will be explained. The conclusion will be formulated according to the purpose of the study. The purpose of this study was to assess DKA management progress at different points of time for children with DKA in emergency care departments in Palestine. This chapter discussed the study findings. It also presented implications, recommendations, strengths, limitations, and conclusions.

5.2 Discussion

All health professionals involved in caring for patients with DKA have a responsibility to ensure safe delivery of patient care in accordance with local and national clinical guidelines. Therefore, Nurses play a substantial role in the emergency pediatric particularly with DKA children management. They provide the care, promote patients' health, provide advice, encourage and activate the level of optimal patients functioning, according to the guideline of MoH. Nurses also provide the treatment and technique have shown efficacy in DKA clinical management, therapy and functional recovery. Assessing the improvements of clinical characteristics of DKA children with at different point of care is a strong indicator of the efficacy of the provided DKA management and ensuring of quality of clinical performance among Palestinian nurses in ER facilities.

5.2.1 Socio-Demographic and T1DM Related Characteristics.

Improving the glycemic control among DKA children is the basis of T1DM management and is challenging and vital to manage risk factors and reduce complications. But T1DM and DKA management for this particular age group leftovers patient, families and the healthcare professionals including nurses.

The findings revealed that 60 children with DKA attended emergency department. The sample consisted of 29 (48.3%) males and 31(51.7%) females. This study finding was supported by Almalki et al. (2016) among 400 T1DM children of the DKA's clinical and biochemical characteristics study. The author found that the DKA admissions to hospitals among female patients were higher than in male patients with (P = 0.002).

The average age of the children was 9.38 ± SD=3.1 years. A similar trend seen in Addis Ababa of Atkilt et al.'s (2017) a hospital-based cross-sectional study; theage category was≥9.5years with children below the age of 12 years with DKA.

The results also indicated that the previously diagnosed children withT1DM was only 23.3 % while mostof the children 46 (76.7%) were newly diagnosed at ER. A similar study resultsshowed that newly diagnosed children with T1DM were(69%) and the previously diagnosed were 23% (Burcul et al., 2019). The study focused on investigating clinical and laboratory parameters, and complications in diabetes children type 1 DM with DKA managed in PICUs among 82 children. Also, the current study supported a previous Indian prospective study which found about 50% of children were newly diagnosed with T1DM (Seth et al., 2015). The study examined the clinical profile of diabetic ketoacidosis in a tertiary care hospital.

However, in a study by Jefferies et al. (2015) in New Zealand, revealed that 27 % were newly diagnosed with T1DM during DKA attack of the children below age 15 years.

Two-thirds of the children 41± hadn't family history if T1DMin the first-degree relative. This result was contrary withAhmad et al. (2011) study which found a positive family history of diabetes among the studied subject.

In addition, the finding of the present study showed that the average HbA1C was 11.74(SD=2.042) on arrival. Otherwise, the average HbA1C was 9.3, lower than that reported by Grönberg et al. (2020) among 73 children in his study of identifying the associated factors with T1DM children.

Different from the findings of Mohammed et al. (2018), who pointed to the other health problems were infection (67.8%), and hypokalemia, and decreased bicarbonate of DKA were significant (p< 0 .001). While the finding of the present study showed that around 75% haven't other health problems as 1(1.67%) have tonsillitis, epilepsy, or CHD, ASD, VSD; and 45.0% have ketones +3 in urine and 40.0% showed glucose +2 in the urine of participants.

5.2.2 Management Outcomes of DKA at Different Points Times

The first research hypothesis: There is significant differences in the vital signs at different point times (p= 0.05) among children with DKA admitted to emergency department and follow up assessment four house later. The findings of the current study showed that the mean of systolic BPwas significant in addition to diastolic BP, HRRR, O_2Sat. ($F = 0.557$, $p < 0.013$), and temperature ($F = 4.435$, $p < 0.020$) scores differed significantly across six time points. However, when comparing this finding to those of

the previous studies, the Byrne (2015) used a modified early warning score (MEWS) (Quinton& Higgins, 2012). The MEWS score gives an indication of risk of deterioration and triggers certain actions and a timelier response to deterioration to improvethe outcome for the patient (Ludikhuize et al., 2012). The authors found that a significant to detect the vital signs as a track and trigger system in all acute settings by detecting the vital sings to assess DKA patient's deterioration as early as possible andrecording the a minimum of heart rate, respiratory rate, systolic blood pressure, level of consciousness, oxygen saturation and temperature both at initial assessment and at regular intervals; at least every 12 hours. Also, apatient has a MEWS of six, the system denotes that her MEWS should be recalculated every 30 minutes until it has decreased to less than four. The Researcher also suggested to calculate the MEWS score, not only at the initial assessment and then every 12 hours, but at regular intervals throughout the day, is effective in recognizing deterioration (Ludikhuize et al., 2014).

However, the current findings were contrary to Shafi and Kumar (2018) that showed initial fluid therapy (3 % saline and 0.9% saline) in pediatric DKA have no changes in vital signs parameters. The result showed no significant difference between the two groups in the vital signs parameters. This referred to the need of more time to correct of hyperglycemia, and acidosis to return back to normal hemostasis.

The second research hypothesis illuminated that there are significant differences in the clinical Pattern of DKA at different point times (p= 0.05) among children with DKA admitted to the emergency department between the variables at arrival and after start fluid and insulin therapy (4- 6 hr.). Bakes et al. (2016) a study shown comparable significant difference at arrival and after start fluid and insulin by on determining the high volume of fluid administration in children with DKA and assessed the influences of

the rate of metabolic normalization among 50 children. Also, higher-volume IV fluid infusion appeared to hasten, to a greater extent, the normalization of pH ($p = 0.01$) than normalization of serum bicarbonate (HR: $p = 0.6$). The role of fluids is an essential component of DKA management. This may be as a result of the time is a significant concern to return pH to average value with the higher-volume infusion.

Moreover, a study conducted by Jayashree et al. (2019); they found that well hydration minimized hyperglycemia and reduced counter-regulatory hormones, enhanced renal glucose clearance by using normal saline (0.9%) as traditional fluid of choice for volume resuscitation and deficit replacement in DKA. The study aimed to discuss the current perspectives on fluids in pediatric DKA which carried out by who pointed that the role of fluids as an essential component of DKA management, and describe the aims of fluid being the restoration of intravascular, interstitial and intracellular compartments. The researcher concluded that the fluids are an integral part of DKA management with abnormal vital signs is needed to avoid under-hydration or over-hydration during DKA management.

The third research hypothesis is the significant differences in ABG's at different point times ($p= 0.05$) among children with DKA admitted to the emergency department. The finding of the present study revealed that the mean of mean PH and HCO3 scores differed significantly across five-time points between the initial assessment and follow-up assessment 6hrs later; which was directly in line with previous study findings, of Ugale et al. (2012) prospective observational study that measured the severity of DKA among children on the difference between admission and follow-up. The resulting severity of DKA was assessed based on physical examination and based on blood gas values. The severity of DKA patients was assessed as mild DKA (14%),

moderate(27%), and severe (59%), which were correlated with abnormal ABGs values. Therefore, the time effect for DKA is significant to measure ABGs. The severity of DKA has significant differences at different point times between arrival and after start fluid and insulin therapy (4- 6 hr.).

Different from the findings of Balmier et al. (2019) who pointed out that the median recovery times were not significantly different among 120 T1DM children. Despite receiving lower insulin doses, hypoglycemia was more frequent in patients with type 1 diabetes (76.9%)—the rate of metabolic complications (hypoglycemia or hypokalaemia) and the recovery time. On the contrary, the fourth current research hypothesis finding presented a significant difference in RBS at different point times (p= 0.05) among children with DKA admitted to the emergency department. The current study results indicated that mean RBS scores differed significantly across six-time points between the initial assessment and follow-up assessment 4hrs later.

The fifth hypothesis was investigated the significant differences in severity of dehydration at different point times (p= 0.05) among children with DKA admitted to the emergency department and assessed the severity of DKA at different point times. The analysis revealed that the severity of DKA differed significantly between arrival and after-start fluid and insulin therapy (4- 6 hr). The present finding was consistent with Bakes et al.'s (2016) study among 50 children. In addition, the result showed that the time to correct pH to normal value was significantly with the rapid high-volume infusion. Early DKA clinical manifestation recognition lead to better management with moderate or severe DKA and helps to provide good management and a better outcome.

The sixth hypothesis stats that thereare significant differences in biochemical parameters at different point times (p= 0.05) among children with DKA admitted to emergency department. There is an anion gap, K, and WBC scores differed significantly across two time points; while, there is no difference in Na,Cl, Mg and Phosphorus; when comparing the initial assessment to a second follow-up assessment taken after start fluid and insulin therapy from original assessment.In this regard, a study of Naeem et al. (2015) retro spectiveevaluatedblood glucose, pH, anion gap, serum osmolality, serum potassium, and serum phosphate; the values showed the biggest change during the initial 6 hours of management, while serum bicarbonate and BUN trends demonstrated a predominant change in the initial 12 hours. The study was included 373 T1DM pediatric patients and it were conducted at the King Abdulaziz Medical City, Riyadh that focused on evaluating the clinical and biochemical characteristics of children with DKA. Because of the significance of this sector for DKA patients, further works are still requisite to reach a clinical and biochemical characteristics of children with DKA.

5.3 Limitation of the Study

1. Limited resource like, literature, books and magazines.
2. Limited, insufficient, and inappropriate data registry.
3. The lack of funds spent on the scientific research.
4. No previous researches about this study in our country –Palestine.
5. Time limitations.
6. Closures regarding COVID epidemic

7. Some potential study patients were initially fluid resuscitated at an outside facility before transfer to our study site, thus making them ineligible for study enrolment.

5.4 Recommendations of the Study

The researcher suggested the following recommendations based on the significant clinical findings of the current study.

Health policy makers

- ✓ Nurses are in need of additional training to integrate theoretical Knowledge in the clinical application of practice because of the practice gap to manage DKA children effectively on time.
- ✓ Health policy makers should update the importance of time management inDKA protocols to prevent further DKA complications.
- ✓ Develop pediatric clinic in primary health care centers for children as a vulnerable age group who have T1DM with comprehensive health education program.
- ✓ Develop master programs for diabetic non communicable disease to increase the number of the qualified staff nurses.

Nurses' education

Nursing education is one of the major nurses' roles that nurses play in this profession worldwide. Nurses as a health care provider can learn by using various research methods as [IP] as a research method to understand various patients' experiences phenomenon of chronic diseases like T1DM illness. Nursing education could teach nursing students how nursing has its own taxonomies in which it can form

as a culture by its own. Nursing students could be taught about compliance toward self-care and following issues that facilitate them to provide such patients with the required information that children may need to expand their awareness as well as guide them to enhance their responsiveness and better T1DM care and management. Awareness health programs may be the initial the first step toward this issue solving. Research findings in nursing education utilizing qualitative research methodologies perspective is a worldwide respectful, treasured process that provide and added value to clients with chronic illness exposure through studying their experiences.

Nursing Practice

The new information of the current study findings can guide and enhance nursing practices as follows: How nursing health care professionals may redirect and joint their efforts to better DKA care provision; especially with children as a vulnerable target who are really existed. Understanding timely management at the point of care impacts among children improvement served as a focal point to start from to improve nursing practice.

Mainly, nurses' understanding of T1DM illness as a chronic disease and considering participants fears and non-compliance, may redirect participants and offer them needed knowledge and could enhance nursing care productivity and the quality of nursing practice serving this vulnerable, marginalized group. Nurses care support practices may enhance resolving T1DM patients' issues to prevent or delay T1DM complications of DKA and avoiding RBS fluctuating among children.

Nurses play an important role in educating participants and their family members, provided them with the power of knowledge toward self-management

behaviors to better their chances in life and complications reduction.

Also, school nurse can play a vital role in educating teachers and peers about their role in supporting diabetic children. Teachers may support participants in their self-efficacy of T1DM and DKA management.

Research

First, future investigation needed to explore children insights into self-efficacy and compliance rather and concentrating on DKA general experiences and may contribute to barriers and factors that promote self-management. Second, investigating to peers' influence on participants' self-management to identify causes hinder participant compliance to prevent DKA.

5.5 Implications of the Study:

Despite the present, the projected future research in this field, this study had contributed to the nursing body of knowledge; the first DKA management improvement impact among participants; tends to develop risky practices and skills that may alter children compliance with T1DM care appointments and follow-ups. DKA impacted participants' clinically; and by then emotionally negatively, which may cause poor adherence, and that lead to a change in children self-care and decision making.

Absence of well T1DM health care screening service for early T1DM detection to prevent DKA and not integrated into MoH health care system various sectors nor in private Primary health care service. T1DM children are poorsociallyactive within the Palestinian community and develop strained personal relations. Social interaction with nurses particularly at MoH is highly essential, which is part of there that might enhance

and assist with T1DM care among this target group.

Participants found themselves are situated into a new existed life with no other choices nor options they can make as a result of T1DM and DKA; all of the children with DKA newly diagnosed have new challenge just has come into their bodies and lives beside T1DM. Those findings were seen in the current study results who had discovered DKA in ER; there experiences are needed to be heard to the world as a real phenomenon which need a future researches to study their experiences.

5.6 Conclusion

The current study is the first study focused on the DKA management progress in ER in Palestine. The study confirmed that DKA management protocol progress in emergency department was beneficial. Also, the study confirmed that physiologic parameters, clinical features, and lab results were improved in different points of time after DKA management protocol intervention.

Referentes

Abbas, Q., Arbab, S., UlHaque, A., & Humayun, K. N. (2018). Spectrum of complications of severe DKA in children in pediatric Intensive Care Unit. *Pakistan journal of medical sciences*, *34*(1), 106.

American Diabetes Association. (2017). Statistics about diabetes. Retrieved 6 December 2017, from http://www.diabetes.org/diabetes-basics/statistics/?loc=db-slabnav

Abu Alia, A., and Aboul-Hosn, N. (2015). Subcultural Narratives of Pediatric Chronic Illness in the Arab Community. **Procedia - Social and Behavioral Sciences,** 165 (2015) 116 – 120

Ahmad J., Masoodi M., Ashraf M., Rashid R., Ahmad R., Ahmad A. and Sheikh Dawood S. (2011): Prevalence of diabetes mellitus and its associated risk factors in Kashmir, India; Al Ameen J Med Sci 4 (1): 38-44.

Almalki, M. H., Buhary, B. M., Khan, S. A., Almaghamsi, A., &Alshahrani, F. (2016). Clinical and biochemical characteristics of diabetes ketoacidosis in a tertiary hospital in Riyadh. *Clinical Medicine Insights: Endocrinology and Diabetes*, *9*, CMED-S39639.

Bakes, K., Haukoos, J. S., Deakyne, S. J., Hopkins, E., Easter, J., McFann, K., ... &Rewers, A. (2016). Effect of volume of fluid resuscitation on metabolic normalization in children presenting in diabetic ketoacidosis: a randomized controlled trial. *The Journal of emergency medicine*, *50*(4), 551-559.

Balmier, A., Dib, F., Serret-Larmande, A., De Montmollin, E., Pouyet, V., Sztrymf, B., ... & Roux, D. (2019). Initial management of diabetic ketoacidosis and prognosis

according to diabetes type: a French multicentre observational retrospective study. *Annals of intensive care*, *9*(1), 1-8.

Barrios, E. K., Hageman, J., Lyons, E., Janies, K., Leonard, D., Duck, S., & Fuchs, S. (2012). Current variability of clinical practice management of pediatric diabetic ketoacidosis in Illinois pediatric emergency departments. Pediatric emergency care, 28(12), 1307–1313.

Benoit, S. R., Zhang, Y., Geiss, L. S., Gregg, E. W., & Albright, A. (2018). Trends in Diabetic Ketoacidosis Hospitalizations and In-Hospital Mortality - United States, 2000-2014. MMWR. Morbidity and mortality weekly report, 67(12), 362–365.

Bialo, S. R., Agrawal, S., Boney, C. M., &Quintos, J. B. (2015). Rare complications of pediatric diabetic ketoacidosis. World journal of diabetes, 6(1), 167–174.

Bradley, C. S., Erickson, B. A., Messersmith, E. E., Pelletier-Cameron, A., Lai, H. H., Kreder, K. J., ... &Kirkali, Z. (2017). Evidence of the impact of diet, fluid intake, caffeine, alcohol and tobacco on lower urinary tract symptoms: a systematic review. *The Journal of urology*, *198*(5), 1010-1020.

Burcul, I., Arambasic, N., Polic, B., Kovacevic, T., Bartulovic, I., CatipovicArdalic, T., &Markic, J. (2019). Characteristics of Children with Diabetic Ketoacidosis Treated in Pediatric Intensive Care Unit: Two-Center Cross-Sectional Study in Croatia. Medicina (Kaunas, Lithuania), 55(7), 362.

Canadian Diabetes Association (2014). **Types of diabetes.** Retrieved November 13, 2018 from http://www.diabetes.ca/about-diabetes/what-is-diabetes

Chiang, J. L., Kirkman, M. S., Laffel, L. M., & Peters, A. L. (2014). Type 1 diabetes through the life span: a position statement of the American Diabetes

Association. **Journal of Diabetes care**, 37(7), 2034-2054. **doi: 10.2337/dc14-1140**.

de FariaMaraschin, J. (2012). Classification of diabetes. In S. Ahmad (Ed.), Diabetes: An old disease, a new insight (pp. 12-19). **New York, NY: Springer Science & Business Media**

de Souza, J. M., &Veríssimo, M. (2015). Child development: analysis of a new concept. *Revistalatino-americana de enfermagem*, *23*(6), 1097–1104. https://doi.org/10.1590/0104-1169.0462.2654.

Duru NS, Civilibal M &Elevli M (2015) .Quality of Life and Psychological Screening in Children with Type 1 Diabetes and their Mothers. Exp Clin Endocrinol Diabetes.

Efstathiou, S. P., Tsiakou, A. G., Tsioulos, D. I., Zacharos, I. D., Mitromaras, A. G., Mastorantonakis, S. E., Panagiotou, T. N., &Mountokalakis, T. D. (2002). A mortality prediction model in diabetic ketoacidosis. Clinical endocrinology, 57(5), 595–601.

Gabir, M. M., Hanson, R. L., Dabelea, D., Imperatore, G., Roumain, J., Bennett, P. H., &Knowler, W. C. (2000). The 1997 American Diabetes Association and 1999 World Health Organization criteria for hyperglycemia in the diagnosis and prediction of diabetes. Diabetes care, 23(8), 1108–1112.

Glaser, N.,&Kuppermann, N.(2019), Fluid treatment for children with diabetic ketoacidosis: How do the results of the pediatric emergency care applied research network Fluid Therapies Under Investigation in Diabetic Ketoacidosis (FLUID) Trial change our perspective?. PediatrDiabetes ;20(1):10-14.

Grönberg, A., Espes, D., & Carlsson, P. O. (2020). Better HbA1c during the first years after diagnosis of type 1 diabetes is associated with residual C peptide 10 years later. *BMJ Open Diabetes Research and Care*, *8*(1), e000819.

International Diabetes Federation (2013) IDF Diabetes Atlas. 6th Edition, International Diabetes Federation, Brussels.

Islam, T., Sherani, K., Surani, S., &Vakil, A. (2018). Guidelines and controversies in the management of diabetic ketoacidosis - A mini-review. World journal of diabetes, 9(12), 226–229.

Jayashree, M., &Singhi, S. (2004). Diabetic ketoacidosis: predictors of outcome in a pediatric intensive care unit of a developing country. Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies, 5(5), 427–433.

Jayashree, M., Williams, V., &Iyer, R. (2019). Fluid Therapy for Pediatric Patients with Diabetic Ketoacidosis: Current Perspectives. Diabetes, metabolic syndrome and obesity: targets and therapy, 12, 2355–2361.

Kitabchi, A. E., Umpierrez, G. E., Miles, J. M., & Fisher, J. N. (2009). Hyperglycemic crises in adult patients with diabetes. Diabetes care, 32(7), 1335–1343.

Ludikhuize J, Borgert M, Binnekade J, Subbe C, Dongelmans D, Goossens A (2014) Standardized Measurement of the Modified Early Warning Score Results in Enhanced Implementation of a Rapid Response System: A Quasi-Experimental Study. Resuscitation 85(5): 676-682

Ludikhuize J, Smorenburg S, Rooij S, Jonge E (2012) Identification of Deteriorating Patients on General Wards; Measurement of Vital Parameters and Potential Effectiveness of the Modified Early Warning Score. Journal of Critical Care 27(1): 424e.7-424e.13 Available from: http://ac.els-cdn.com/ S0883944112000160/1-s2.0- S0883944112000160-main. pdf?_tid=9f378538-c0b6-11e 3-b2a8-00000aacb360&acdnat=1397137814_1a4b5dff6ff22abdbc54a51e770a0d6d [Accessed 23rd may 2021]

Luyckx, K., Seiffge-Krenke, I., Schwartz, J., Goossens, L., Hendrieckx, C., Groven, C., (2008). Identity development, coping, and adjustment in emerging adults with a chronic illness: the sample case of type 1 diabetes. **Journal of Adolescent Health**; 43:451–458.

Mello, D. F. D., Henrique, N. C. P., Pancieri, L., Veríssimo, M. D. L. Ó. R., Tonete, V. L. P., & Malone, M. (2014). Child safety from the perspective of essential needs. *Revistalatino-americana de enfermagem*, *22*(4), 604-610.

Mohammed, N. (2018). Update Regarding Diabetic Ketoacidosis In Children And Controversies In Management. Quality in primary care, 26.

Mohammed, R., Abdalla, N., Mahran, F. (2018). Clinical, and Biochemical Profile of Pediatric Diabetic Ketoacidosis Patients in Al-zahraa Hospital Pediatric ICU. The Egyptian Journal of Hospital Medicine, 73(9), 7507-7511.

Naeem, M. A., Al-Alem, H. A., Al-Dubayee, M. S., Al-Juraibah, F. N., Omair, A., Al-Ruwaili, A. S., & Al-Saleh, A. M. (2015). Characteristics of pediatric diabetic ketoacidosis patients in Saudi Arabia. Saudi medical journal, 36(1), 20–25.

Nyenwe, E. A., &Kitabchi, A. E. (2011). Evidence-based management of hyperglycemic emergencies in diabetes mellitus. Diabetes research and clinical practice, 94(3), 340–351.

Quinton S, Higgins Y (2012) Adult Modified Early Warning Score (MEWS) Policy and Escalation Pathway. Heart of England NHS Foundation Trust Available from: http://www.heartofengland.nhs. uk/wp-content/uploads/MEWS. pdf [Accessed 23rd may 2021]

Rawal, G., Yadav, S., Kumar, R., & Singh, A. (2016). Glycosylated hemoglobin (HbA1C): A brief overview for clinicians. *Indian Journal of Immunology and Respiratory Medicine*, *1*(2), 33-36..

Rosenbloom, A.L. (2010). The management of diabetic ketoacidosis in childre.Diabetestherapy: research, treatment and education of diabetes and related disorders, 1(2).

Saraswathi, S., Al-Khawaga, S., Elkum, N., & Hussain, K. (2019). A systematic review of childhood diabetes research in the middle east region. *Frontiers in endocrinology*, *10*, 805.

Saraswathi, S., Al-Khawaga, S., Elkum, N., &Hussain, K. (2019). A Systematic Review of Childhood Diabetes Research in the Middle East Region. Frontiers in endocrinology, 10, 805.

Seth, P., Kaur, H., & Kaur, M. (2015). Clinical Profile of Diabetic Ketoacidosis: A Prospective Study in a Tertiary Care Hospital. Journal of clinical and diagnostic research: JCDR, 9(6), OC01–OC4.

Shafi, O., & Kumar, V. (2018). Initial Fluid Therapy in Pediatric Diabetic Ketoacidosis: A comparison of Hypertonic Saline Solution and Normal Saline Solution;24,2:56-64.

Sherry, N. A., &Levitsky, L. L. (2008). Management of Diabetic Ketoacidosis in Children and Adolescents. Pediatric Drugs, 10(4), 209–215.

Skitch, S., &Valani, R. (2015). Treatment of Pediatric Diabetic Ketoacidosis in Canada: A Review of Treatment Protocols from Canadian Pediatric Emergency Departments. CJEM, 17(6), 656-661.

Souza, J. M. D. (2014). *Desenvolvimento infantil: análise de conceito e revisão dos diagnósticos da NANDA-I* (Doctoral dissertation, Universidade de São Paulo).

Ugale, J., Mata, A., Meert, K., Sarnaik, S.(2012). Measured degree of dehydration in children and adolescents with type 1 diabetic ketoacidosis. Pediatriccriticalcare medicine; 13:e103– e107.

Umpierrez, G., &Korytkowski, M. (2016). Diabetic emergencies - ketoacidosis, hyperglycaemic hyperosmolar state and hypoglycaemia. Nature reviews. Endocrinology, 12(4), 222–232.

Umpierrez, G., &Korytkowski, M. (2016). Diabetic emergencies—ketoacidosis, hyperglycaemic hyperosmolar state and hypoglycaemia. *Nature Reviews Endocrinology*, *12*(4), 222.

Wolfsdorf, J. I., Allgrove, J., Craig, M. E., Edge, J., Glaser, N., Jain, V., Lee, W. W., Mungai, L. N., Rosenbloom, A. L., Sperling, M. A., Hanas, R., & International Society for Pediatric and Adolescent Diabetes (2014). ISPAD Clinical Practice Consensus Guidelines 2014. Diabetic ketoacidosis and hyperglycemic hyperosmolar state. Pediatric diabetes, 15 Suppl 20, 154–179.

World Health Organization. (2016). Updated guideline: paediatric emergency triage, assessment and treatment: care of critically-ill children. World Health Organization.

Wysham, C. H., & Kirkman, M. S. (2011). Response to Comment on: American Diabetes Association. Standards of Medical Care in Diabetes—2011. Diabetes Care 2011; 34 (Suppl. 1): S11–S61. *Diabetes care*, *34*(5), e54-e54.

Zucchini, S., Scaramuzza, A. E., Bonfanti, R., Buono, P., Cardella, F., Cauvin, V., Cherubini, V., Chiari, G., d'Annunzio, G., Frongia, A. P., Iafusco, D., Maltoni, G., Patera, I. P., Toni, S., Tumini, S., Rabbone, I., & Diabetes Study Group of The Italian Society For Pediatric Endocrinology And Diabetology (2016). A Multicenter Retrospective Survey regarding Diabetic Ketoacidosis Management in Italian Children with Type 1 Diabetes. Journal of diabetes research, 2016, 5719470.

Appendixes

Appendix No (1): Data Sheet

Part I: Demographic data and comorbidities

1) Name:_____
2) ID: _____
3) Age:_____
4) Gender: 1- Male 2- Female
5) New diagnosed type 1 DM: 1- yes 2- No
6) Previously diagnosed type 1 DM: 1- yes 2- No
7) If Yes, How many years: _____
8) History of type 1 DM in first degree relative: 1- yes 2- No
9) Weight:_____
10) Height:_____
11) BMI :_____
12) other health problems or comorbidities:_____

	Part II: Observational checklist for Assessment of Vital Sign						
	Items	**At arrival**	**After fluid resuscitation**	**After start fluid and insulin therapy (1hr)**	**After start fluid and insulin therapy (2hr)**	**After start fluid and insulin therapy (3hr)**	**After start fluid and insulin therapy (4hr)**
1.	**Blood pressure**						
2.	**Heart rate**						
3.	**Respirator rate**						
4.	**O2 saturation**						
5.	**Temperature**						

Part III: Observational checklist for Clinical Pattern of DKA (Clinical Manifestation)					
Items		**At arrival**		**After start fluid and insulin therapy (4- 6 hr)**	
		Yes	**No**	**Yes**	**No**
1.	**Dehydration**				
2.	**Tachycardia**				
3.	**Tachypnea**				

4.	**Deep, sighing (Kussmaul) respiration; breath has the smell of acetone (variously described as the odor of nail polish remover or rotten fruit)**				
5.	**Nausea, vomiting (which may be mistaken for gastroenteritis**				
6.	**Abdominal pain that may mimic an acute abdominal condition**				
7.	**Confusion, drowsiness, progressive obtundation and loss of consciousness**				

Part IV: Observational checklist for Severity of Diabetic Ketoacidosis

	At arrival		**After fluid resuscitation**		**After start fluid and insulin therapy (2hr)**		**After start fluid and insulin therapy (4hr)**		**After start fluid and insulin therapy (6hr)**	
	pH	**HCO3**	**pH**	**HCO3**	**pH**	**HCO3**	**pH**	**HCO3**	**pH**	**HCO3**
Mild: pH<7.3 and pH>7.2 or bicarbonate <15 mmol/L										
Moderate: pH<7.2 and pH >7.1 or bicarbonate <10 mmol/L										
Severe:										

pH<7.1 or bicarbonate<5 mmol/L										

Part V: Observational checklist for Assessment the Degree of Dehydration					
	Items	**At arrival**		**After start fluid and insulin therapy (4- 6 hr)**	
		Yes	**No**	**Yes**	**No**
Mild	**Alert**				
	Dry mucous membranes				
	Decreased skin turgor				
Moderate	**Lethargy**				
	Hyperventilation				
	Sunken eyes				
	Prolonged capillary refill				
Sever	**Somnolent (sleepy)**				
	Poor perfusion				
	Rapid, thready pulse				
	Shock				

Part VI: Observational checklist for Biochemical Parameters		
	At arrival	**After start fluid and insulin therapy**
Anion Gap		
Potassium		
Sodium		

Chloride		
Magnesium		
phosphorus		
Urine analysis		
CBC (WBC)		
HbA1C		

Part VII: Observational checklist for assessment of Random Blood Sugar						
Items	**At arrival**	**After fluid resuscitation**	**After start fluid and insulin therapy (1hr)**	**After start fluid and insulin therapy (2hr)**	**After start fluid and insulin therapy (3hr)**	**After start fluid and insulin therapy (4hr)**
Random blood sugar						

State of Palestine
Ministry of Health - Nablus
General Directorate of Education in Health

دولة فلسطين
وزارة الصحة– نابلس
الإدارة العامة للتعليم الصحي

Ref.: .....
Date:.....

الرقم: عنب/٢٩/٢٠٢١
التاريخ: ٢٠٢١/٣/٩

الأخ مدير عام الادارة العامة للمستشفيات المحترم ،،،
الأخ مدير مجمع فلسطين الطبي المحترم،،،
تحية واحترام...

الموضـــوع: تسهيل مهمة بحث

لاحقاً لموافقة معالي وزيرة الصحة، يرجى تسهيل مهمة الطالب: **مجدي فتحي صالح يونس،** دراسات عليا تمريض/ الجامعة العربية الامريكية، لعمل بحث بعنوان:

"التحسن في العلاج عند نقطة الرعاية لدى الأطفال المصابين بالحمض الكيتوني السكري في رعاية الطوارئ في فلسطين"

وذلك بالسماح له بالحصول على المعلومات من خلال ملفات المرضى في قسم الطوارئ، مع العلم ان مشرفي الدراسة د. احمد البطران، وذلك في:

- **مستشفى رفيديا – مستشفى عاليه – المجمع الطبي**
- **على ان يتم الالتزام بجميع تعليمات واجراءات الوقاية والسلامة الصادرة عن وزارة الصحة بخصوص جائحة كورونا، وتحت طائلة المسؤولية.**
- **على ان يتم تزويدنا بنسخة من نتائج الدراسة، والتعهد بعدم النشر.**

د. عبد الله القواسمي
مدير التعليم الصحي والبحث العلمي

دولة فلسطين وزارة الصحة الإدارة العامة للتعليم الصحي

نسخة: مشرف الدراسة المحترم/ الجامعة الامريكية

Appendix No. (2): Acceptance of proposal

From: **Majdi Younis** <majdiyounis5@gmail.com>

Date: Wed, Jan 6, 2021, 1:13 PM

Subject: Re: Acceptance of proposal

To: Dana Shaban Hasan Eideh<Dana.Eideh@aaup.edu>

Thank you

On Wed, Jan 6, 2021, 1:06 PM Dana Shaban Hasan Eideh<Dana.Eideh@aaup.edu> wrote:

Dear All,

Hope this finds you well.

Following the evaluation for the proposal submitted by **Majdi Younis (** 201812539**) Major Emergency Nursing** , we are delighted to inform you that the proposal has been **accepted** by the council of graduate studies and you will be registered for thesis 1.

We advise that the student can now start working on the thesis.

Good luck,

Dana Eideh

ملخص

خلفية عامة: يُعتبر الحُماض الكيتوني السكري من المضاعفات الأكثر شيوعاً لدى الأطفال الذين يعانون من مرض السكري النوع الأول، والذي يؤدي إلى ارتفاع معدل الوفيات بين الأطفال. ومن الضروري توفير الرعاية التمريضية الفورية والعلاج المبكر الى جانب المتابعة والعلاج المُستمرين لمرضى الحُماض الكيتوني السكري. نقطة الرعاية هي النقطة الزمنية حين يقدّم الأطباء السريريون والممرّضون خدمات الرعاية الصحية للمرضى في وقت الرعاية. ويُساعد التدخل المبكر في نقطة الرعاية في وحدات الطوارئ الأطفال الفلسطينيين الذين يعانون من الحُماض الكيتوني السكري في وحدات الطوارئ على الحصول على نتائج صحية أفضل؛ ابتداءً من الأطفال الذين يعانون من مرض السكري – النوع الأول ووصولاً إلى الأطفال الذين يصبح لديهم الحُماض الكيتوني السكري. وسيُساهم الكشف والتدخل المبكر في تحسين مستوى الحُماض الكيتوني السكري لدى الأطفال وسيضيف إلى المعرفة التمريضية حول النتائج وسيُساهم في تطوير البروتوكول العلاجي للحُماض الكيتوني السكري في وحدات طب الأطفال.

الهدف: تهدف هذه الدراسة إلى تقييم وتحسين علاج الحُماض الكيتوني السكري، ابتداءً من نقطة الرعاية لدى الأطفال الذين يعانون من الحُماض الكيتوني السكري في وحدات رعاية الطوارئ في شمال الضفة الغربية. المنهجيات: استخدم الباحث دراسة شبه تجريبية ساهمت في تقييم مدى تحسّن علاج الحُماض الكيتوني السكري لدى الأطفال عند نقطة الرعاية في قسم رعاية الطوارئ في شمال الضفة الغربية.

النتيجة: شارك ستّون طفلاً ممّن لديهم الحُماض الكيتوني السكري في الدراسة. وبلغ معدّل أعمار هؤلاء الأطفال 9.38 ± انحراف معياري = 3.1 سنة. وتكونّت العينة من 29 (48.3%) ذكور و 31 (51.7%) إناث، 46 (76.7%) من المشاركين تم تشخيصهم حديثاً بداء السكري من النوع الأول و 46 (76.7%) تم تشخيصهم في وقت سابق. وتبيّن بأنّ ثلثي الأطفال ليس لديهم تاريخ مرضي يُشير إلى وجود داء السكري من النوع الأول لدى أقاربهم من الدرجة الأولى.عند وصولهم، تبيّن بأن معدل الهيموغلوبين السكري 11.74 (2.042). تقريباً 75.0% من الأطفال ليس لديهم مشاكل صحية أخرى، بينما 1 (1.67%) لديهم التهاب اللوزتين، أو الصرع، أو مرض القلب التاجي، أو عيب الحاجز الأذيني، أو عيب الحاجز البطيني.

ووجد الباحث بأنّ هنالك اختلافات كبيرة في العلامات الحيوية في نقاط زمنية مختلفة (p= 0.05)، وتبيّن بأنّ وجود اختلافات كبيرة في النمط السريري (الإكلينيكي) للحُماض الكيتوني السكري في

نقاط زمنية مختلفة (p= 0.05). كما تبيّن أيضاً وجود اختلافات كبيرة في غازات الدم الشرياني في نقاط زمنية مختلفة (p= 0.05)، واختلافات كبيرة في تحليل السكر العشوائي في نقاط زمنية مختلفة (p= 0.05) لدى الأطفال الذين يُعانون من الحُماض الكيتوني السكري.

وتبيّن وجود اختلافات كبيرة في شدة الجفاف في نقاط زمنية مختلفة (p= 0.05)، وأخيراً تبيّن وجود اختلافات كبيرة في البارامترات البيولوجية الكيميائية في نقاط زمنية مختلفة (p= 0.05) بين الأطفال الذين يُعانون من الحُماض الكيتوني السكري الذين تم إدخالهم إلى قسم الطوارئ.

الخاتمة: أكّدت الدراسة على أنّ هنالك تقدّم مُجدي وملحوظ في البروتوكول الخاص بعلاج الحُماض الكيتوني السكري في قسم الطوارئ. بالإضافة إلى ذلك، فقد أكّدت الدراسة على أنّ المعايير الفسيولوجية، والخصائص السريرية (الإكلينيكية)، والنتائج المخبرية قد تحسنّت في نقاط زمنية مختلفة بعد البروتوكول المتعلق بالتدخل العلاجي للحُماض الكيتوني السكري.