

Factors Affecting the Patients Safety with Diabetic Ketoacidosis in Intensive Care Unit

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Abstract

Background: Diabetic ketoacidosis is an acute, major, life-threatening complications of diabetes. Nurses' knowledge and practice play important role in provision of supportive care to decrease morbidity and mortality secondary to diabetic ketoacidosis. Patient safety is influenced by many factors, identification of these factors can prevent harm and protect patients from any associated complications. **Aim:** was to assess the factors affecting the patients safety with diabetic ketoacidosis in intensive care unit. **Design:** A descriptive exploratory design. **Setting:** The study conducted in intensive care unit at Fayoum University Medicine Hospitals. **Sample:** A convenient sample of all available nurses (no=30) and patients with diabetic ketoacidosis admitted to intensive care unit (no=70). **Tools of data collection:** self-administered questionnaire, nurses' practice observational checklist, patients interviewing questionnaire and patients complications assessment sheet. **Results and conclusion:** Regarding nurses related factors more than half of the nurses had satisfactory level of knowledge and practice regarding safety nursing management of patients with diabetic ketoacidosis (56.7% and 60%) respectively. Also, (63.3% & 70%) respectively of them had satisfactory level regarding factors affecting patients safety. Regarding general nursing safety measures related factors, (73.3%) of the nurses had satisfactory level regarding infection control measures in intensive care unit and (50%) of them had unsatisfactory level regarding medications administration measures. In relation to organizational related factors (73.3%) of the nurses had satisfactory level regarding sufficient staffing and (33.3%) of them had unsatisfactory level regarding hospital facilities and equipment. Regarding patients related factors (61.4%) of them had unsatisfactory level of knowledge regarding diabetic ketoacidosis safety management and (7.1%) of them had diabetic ketoacidosis associated complications. **Recommendations:** Importance of in-service training courses to enhance the nurses knowledge and practice regarding patients safety with diabetic ketoacidosis in intensive care unit to decrease morbidity and mortality rate.

Keywords: Diabetic ketoacidosis, Intensive care unit, Patients safety.

Introduction:

Many patients with diabetic ketoacidosis (DKA) may require admission to intensive care units (ICUs) either because of disease severity or due to coexisting serious illness. However, in certain institutions, patients are admitted in ICUs even if they have mild to moderate DKA for administration of intravenous insulin infusion either due to hospital regulations or because of unavailability of infusion pumps in the general medical wards. (Fernando et al, 2017).

Patient safety is one of critical importance throughout the whole continuum of care, including home, primary and community care, and extending to acute and long-term care and palliative care. It is estimated that 64 million disability-adjusted life years are lost every year because of unsafe care worldwide. This means that patient harm due to adverse events is probably one of the top 10 causes of death and disability in the world (WHO, 2019).

Factors affecting on patients safety including importance and status of human resources, organization and management, interaction and teamwork, medication, equipment and physical environment, patient-related factors and quality improvement, importance of documentation, evaluating and monitoring, medical errors, barriers and challenges (*Naderi, et al 2019*).

Nurses play an important role in caring for patients with DKA and have responsibilities to ensure safe delivery of patient care in accordance with local and national clinical guidelines. The nursing care includes ongoing physical and clinical assessment and monitoring of hemodynamic state for the patients; this involves monitoring of vital signs and level of consciousness and fluid balance includes accurate intake and output charts, capillary blood glucose and ketones: this is required at least hourly during the acute phase (*French, et al (2019)*).

The most important complications of DKA and its treatment are: cerebral edema is the most fatal complication, occurring sub-clinically both before and after treatment. Most common complications of DKA include hypoglycemia and hypokalemia are potentially life threatening conditions during the management of DKA; there is a risk of acute pre-renal kidney injury associated with severe dehydration; severe increases and decreases in the K⁺ levels during DKA occurrence and treatment can be life-threatening, therefore, careful monitoring of K⁺ is essential. Hypoxemia and pulmonary edema are rarely complications (*Gosmanov, et al 2021*).

Significance of the study:

The DKA is one of the most fatal acute complications among patients with diabetes mellitus (DM). The mortality rate ranges from 2 to 5 percent in developed countries and 6 to 24 percent in developing countries. If it misdiagnosed or mistreated, it is 100% fatal. In some studies it has been

reported that DKA can be present in 25% to 30% of patients with type 1 diabetes mellitus (T1DM) at onset and from 4 to 29% in youth with type-2 diabetes mellitus (T2DM) (*Bedaso, et al, 2019*).

Overall mortality rates for DKA are <1%; however, mortality is higher in older patients and in patients with other life-threatening illnesses. Shock or coma on admission indicates a worse prognosis. Main causes of death are circulatory collapse, hypokalemia, and infection. The mortality rate is 2% to 5% in DKA (*Brutsaert, 2020*).

From the investigator experience and clinical observation there were many factors affecting on safety of patients with DKA so this study aimed to assess factors affecting patients safety with DKA. Hopefully, this study was giving insight about such factors to take into consideration while providing care for such group of patients to enhance quality of care and decrease morbidity and mortality rate.

Aim of the study:

This study aimed to: Assess the factors affecting the patients safety with DKA in ICUs .

Research questions

- 1- What are DKA associated complications among the studied patients?
- 2- What are the factors which had high effect on the patients' safety with DKA in ICUs?

Subjects and Methods:

Research design:

A descriptive exploratory research design was utilized to achieve the aim of the present study.

Setting: The study was conducted in ICU at Fayoum University Medicine Hospitals for increasing flow rate of the patients with DKA in the selected setting. The ICU unit located in second floor and consisted of five rooms, each room

covering 5 beds so the total number of beds was 20.

Subjects: A convenient sample of all available nurses (30 nurses) working in ICU & A convenient sample of adults patients with DKA admitted to ICUs in the selected setting (70 patients), using the following equation:

$$n = \frac{N \times p(1-p)}{\left[N - 1 \times \left(d^2 \div z^2 \right) \right] + p(1-p)}$$

$N \times p(1-p)$ = (2281*(0.04*(1-0.04)))/

$N-1$ = (2281-1)*

d^2/z^2 = 0.0025 / 3.8416+

$p(1-p)$ = 0.04*(1-0.04)

N = 70

N = Community size

z = Class standard corresponding to the level of significance equal to 0.95 and 1.96

d = The error rate is equal to 0.05

p = Ratio provides a neutral property = 0.04 (Chow, et al 2007).

Study tools:

Four tools were used in this study.

I-Self-administered questionnaire:

it was developed by the researcher after reviewing the related literatures (Ignatavicius & Workman, 2013; Pellico, 2013; Burk, et al., 2014; Hinkle & Cheever, 2014; Urden et al., 2014 and Pazokian & Borhani, 2017). It used to assess nurses related factors and other factors from their point of view and included three parts as follows:

Part (1): It was concerned about demographic characteristics of nurses under study. It consisted of six questions such as age, gender qualification, training courses and yeas of experiences.

Part (2): It concerned with nurses knowledge regarding safety nursing management for caring of patients with DKA: it included questions related to overview about DKA, complications of DKA and safety management. It contained (43) questions in form of MCQ.

❖ Scoring System:

The correct answer took 1 grade while the incorrect answer took zero score; the total score distributed as the following: $\geq 80\% = \geq 34$ grade considered satisfactory level of knowledge and $< 80\% = < 34$ grade considered unsatisfactory level of knowledge

Part (3): It covered other factors affecting patients safety with DKA from nurses' point of view including 2 components; The first one concerned with general nursing safety measures related factors, covering the following main 6 related factors; patient identification measures (4 questions), effective communication measures between ICU team (4 questions), infection control measures (8 questions), fall preventive measures (3 questions), immobilized complications of preventive measures (7 questions) and medication administration measures (7 questions), total number was 33 questions in form of MCQ. The second component focused on organizational related factors, covering the following main 4 related factors; policy of hospital infection control (8 statements), hospital facilities and equipment (12 statements), sufficient staffing (14 statements) and staff empowerment (8 statements), total number was 42 statements in form of yes or no.

❖ Scoring System:

The response for each questions/ statement was one grade for correct response & zero for incorrect response, so total score was 75 grade, classified as following; $\geq 80\% = \geq 60$ grades considered satisfactory level regarding factors affecting patients safety which reflecting high patients safety effect and $\leq 80\% = \leq 60$ grades considered unsatisfactory level which reflecting low patients safety effect.

II-Nurses practice observational checklist;

it was developed by the researcher based on relevant literature from (Joint Commission accreditation of health organization, 2016 & Perry, et al 2018 & Linda, and Angela, 2019 & Wilkinson, et al 2019). it was used to assess nurses practice regarding safety nursing

management for caring of patients with DKA. It included (17) procedures containing (330) steps.

❖ **Scoring system:**

Each step in each procedure took one grade if correctly done and took zero if done incorrectly/ not done; the total score was distributed as the following: **Satisfactory** level of practice if score $\geq 80\% = \geq 264$ grade and **Unsatisfactory** level of practice if score $< 80\% = < 264$ grade

III- Patients interviewing questionnaire : it was developed by the investigator after reviewing the related literature (*Alagappan, 2015 & Creed, ana Hargreaves, 2016*).It used to assess patients related factors and consisted of three parts:

A-Demographic characteristics of patients; it was used to assess patients demographic data as age, gender, educational level, marital status, job, place of residence and smoking.

B-Medical history; it was used to assess medical data of patients which including Present medical history (type of diabetes, type of treatment to control diabetes, symptoms and signs that currently suffering. Past history (time for diagnosed with diabetes, complications from diabetes, suffering from chronic diseases, recurrent admission to ICU from DKA, taking diabetic medication regularly, following up weight, healthy diet , exercise, blood sugar level regularly, checking the foot for wounds, visiting the doctor to monitor blood sugar and source of knowledge about DKA) and family health history.

C-Patients knowledge; it was used to assess patients level of knowledge regarding DKA and safety management, it included (14 questions) in form of MCQ.

❖ **Scoring system:**

The correct answer took one grade while the incorrect answer took zero grade; the total score was distributed as the following: **Satisfactory** level of knowledge if score $\geq 80\% = \geq 11$ grade and **Unsatisfactory** level of knowledge if score $< 80\% = < 11$ grade.

IV-Patients complications assessment sheet: It concerned with assessment of DKA associated complications among the studied patients.

Preparatory Phase:

This phase included the reviewing of related literatures and theoretical knowledge of various aspects of the study using books, articles, internet periodicals and magazine, to develop the tools for data collection.

Tools validity and reliability:

Validity: It was established by a panel of five expertise (2 professors & 3 assistant professors) from medical surgical nursing department / faculty of nursing / Ain Shams University who reviewed data collection tools for clarity, relevance, comprehensives understanding, applicability, and easiness for administration.

Reliability of the study tools:

Testing reliability of the proposed tools was done statistically by Alpha Cronbach's test for measuring the internal consistency of each used tool as following: self-administered questionnaire (total nursing knowledge & other factors affecting (0.845 & 0.792 respectively), nurses practice observational checklist (0.804), patients interviewing questionnaire (0.857) and patient's complications assessment sheet (0.826).

Pilot Study:

A pilot study was carried out on 10 % of the study subjects (7 patients and 3 nurses) to test the clarity, applicability, feasibility, relevance and estimate time needed to fulfil each tool. According to the results of pilot study, no modifications were

performed so the nurses and patients included in the pilot study were sharing in the study subjects.

Field work:

An approval was obtained from hospital directors of the selected setting. The purpose of the study explained to the nurses and patients under study prior to data collection.

Data were collected within six months from February 2021 to the end of July 2021. The investigator visited medical ICU to collect data from patients and nurses three days per week during actual nurses' work at morning and afternoon shifts.

The investigator observed the nurses during their routine daily work while providing care for patients with DKA by continuous observation techniques to fulfill all the stated procedures included in observational checklist from each one. The investigator observed about (3-4) nurses per visit

Self administered questionnaire distributed among nurses to be filled by each one within 45-60 min. The investigator interviewed each patient individually to fill the questionnaire within 20-30 min and assess any signs and symptoms associated with each DKA complications, it took about 15 min. The investigator met 3 patients per visit.

Ethical considerations:

The research approval obtained from the ethical research committee at faculty of nursing, Ain Shams University before starting the study. Oral consent for nurses' and patients' agreements to be included in the study was obtained after explanation of the nature and purpose of the study. Each subject was free to either participate or not in the current study and had the right to withdraw from the study at any time without any rational. Also, each subject informed that obtained data was collected for the

research purpose, confidentiality and anonymity were assured through coding of all data.

3- Administrative design

An official permission to conduct the study was obtained from Faculty of Nursing and the medical and nursing directors of ICU at Fayoum university medicine hospital.

4- Statistical design

The collected data was revised, coded, and tabulated using Statistical Package for Social Science (SPSS 20). The statistical test included: Mean, standard deviation (\pm SD), chi-square test and anova .

Results:

Table (1): shows that; all the nurses (100%) had age group 20 - 30 and (60%) of them were females. As regards qualification, diploma nurses were (56.7%) and (86.7%) of them had less than 5 years of nursing experience in ICU. Most of the nurses (83.3%) did not attend training courses about DKA and (100%) of them did not attend training courses about patients safety with DKA.

Fig (1): Reveals that, (56.7%) of the nurses had satisfactory level of knowledge about DKA and safety management. While (43.3%) of them had unsatisfactory level of knowledge.

Table (2): Reveals that, (63.3% & 70%) of the studied nurses had satisfactory level about factors affecting patients safety including general nursing safety measures related factors and organizational related factors. Regarding general nursing safety measures related factors, the nurses had satisfactory level regarding infection control measures in ICU (73.3%) and (50%) of them had unsatisfactory level regarding medications administration measures. In relation to organizational related factors, the nurses had satisfactory level regarding sufficient staffing and (33.3) of them had

unsatisfactory level regarding hospital facilities and equipments.

Fig. (2): Shows that, (60%) of nurses had satisfactory level of practice regarding safety nursing management for caring of patients with DKA. While (40%) of them had unsatisfactory level of practice.

Table (3): Shows that, (30%) of patients were in age group 20-25 years, (62.9%) of them were females, (45.7%) were married, (35.7%) had intermediate education, (28.6%) were housewives and (54.3%) of them lived in rural area.

Table (4): Reveals that, there was statistically significant relation between

patient's total complications mean score and nurses qualification, years of experience in ICU and training courses about patient safety with DKA when p-value was <0.05

Table (5): Reveals that, there was relation between patients total complications total mean score and nurses knowledge & practice total level, organizational and general nursing safety measures related factors total level and patients knowledge total level when p-value was <0.001**

Fig. (3): Shows that, (7.1%) of the studied patients had DKA associated complications. While (92.9) of them had no associated complications.

Table (1): Frequency and percentage distribution of demographic characteristics of the studied nurses (no =30).

Items	N	%
Age		
20 – 30	30	100.0%
Gender		
Female	18	60.0%
Male	12	40.0%
Qualification		
Diploma	17	56.7%
Technical institute	7	23.3%
Bachelor degree	6	20.0%
Years of experience in ICU		
< 5 years	26	86.7%
5-10 years	4	13.3%
Mean±SD	3.68±2.05	
Training courses about DKA		
Yes	5	16.7%
No	25	83.3%
Training courses about patient safety with DKA		
Yes	0	0.0%
No	30	100.0%

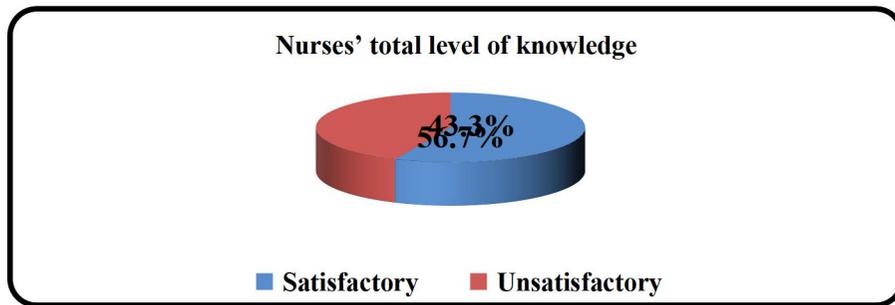


Fig (1): Percentage distribution of nurses' total level of knowledge regarding diabetic ketoacidosis and its management.

Table (2): Frequency and percentage distribution of other factors affecting patients safety with diabetic ketoacidosis from the studied nurses point of view.

Items	Satisfactory level		Unsatisfactory level	
	N	%	N	%
1- General nursing safety measures related factors				
a- Patients identification measures	19	63.3%	11	36.7%
b- Effective communication measures between ICU team	20	66.7%	10	33.3%
c- Infection control measures in ICU	22	73.3%	8	26.7%
d- Fall prevention measures in ICU	18	60.0%	12	40.0%
e- Immobilized complications preventive measures in ICU	21	70.0%	9	30.0%
f- Medication administration measures	15	50.0%	15	50.0%
Total score	19	63.3	11	36.7
2- Organizational related factors				
a- Policy of hospital infection control	21	70.0%	9	30.0%
b- Hospital facilities and equipment	20	66.7%	10	33.3%
c- Sufficient staffing	22	73.3%	8	26.7%
d- Staff empowerment	21	70.0%	9	30.0%
Total score	21	70.0	9	30.0
Total factors score	20	66.7%	10	33.3%

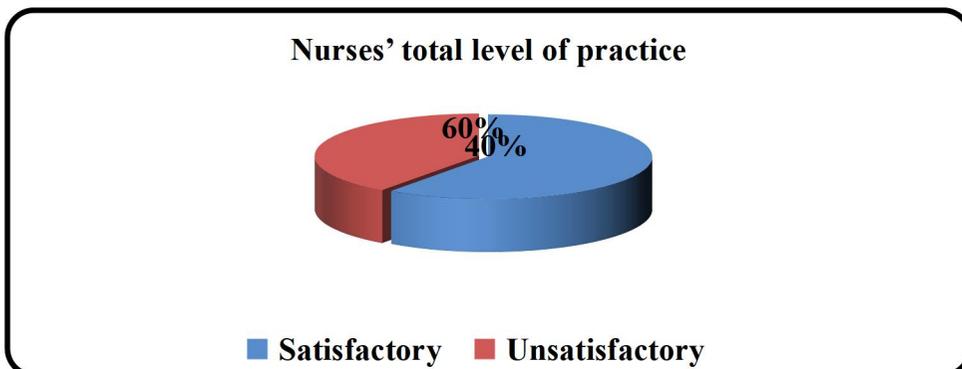


Fig (2): Percentage distribution of the nurses' total level of practice regarding safety nursing management for caring of patients with diabetic ketoacidosis.

Table (3): Frequency and percentage distribution of demographic characteristics of the patients included in the study (no =70)

Items	N	%
Age		
18 < 20	21	30.0%
20	17	24.3%
25	7	10.0%
30	5	7.1%
40	6	8.6%
50-65	14	20.0%
Mean±SD	32.56±5.37	
Gender		
Male	26	37.1%
Female	44	62.9%
Marital Status		
Single	26	37.1%
Married	32	45.7%
Widowed	8	11.4%
Divorced	4	5.7%
Education level		
Neither read nor write	22	31.4%
Read and write	12	17.1%
Intermediate education	25	35.7%
University education	11	15.7%
Job		
Not working	9	12.9%
Student	17	24.3%
Employee	6	8.6%
Housewife	20	28.6%
Freelance work	11	15.7%
Other	7	10.0%
Residence		
Rural	38	54.3%
Urban	32	45.7%

Table (4): Relation between diabetic ketoacidosis associated complications total mean score among the studied patients and the nurses' demographic characteristics.

	Total complications	Tests	
	Mean±SD	t or f	P-value
Sex			
Male	9.58±8.99	t= 0.499	0.622
Female	8.22±6.00		
Qualification			
Diploma	13.82±8.35	f=5.629	0.009*
Technical Institute	7.14±1.95		
Bachelor degree	4.50±1.87		
Years of experience in ICU			
<5 years	13.46±8.08	t=2.242	0.033*
5-10 years	4.25±1.50		
Training courses about DKA			
Yes	5.40±1.14	t=1.739	0.093
No	11.56±7.79		
Training courses about patient safety with DKA			
Yes	6.18±3.61	t=2.656	0.013*
No	12.92±9.67		

T= t-test, f= ANOVA

Statistically significant p-value <0.05*

Table (5): Relation between diabetic ketoacidosis associated complications total mean score & factors affecting the studied patients safety.

	Present			Total complications Absent			T-test	
	Mean	±	SD	Mean	±	SD	t	P-value
Total Nurses knowledge level								
Satisfactory	16.5	±	5.64	27.45	±	4.78	4.880	<0.001**
Unsatisfactory	12.74	±	4.78	20.04	±	3.7	4.170	
Total Nurses practice level								
Satisfactory	134.78	±	25.47	212.35	±	39.64	4.291	<0.001**
Unsatisfactory	114.6	±	23.64	158.5	±	37.15	2.592	
Organizational related factors								
Satisfactory	11.4	±	3.15	28.16	±	4.27	8.573	<0.001**
Unsatisfactory	7.23	±	2.09	16.78	±	3.82	5.501	
General nursing safety measures related factors								
Satisfactory	13.21	±	3.6	27.45	±	4.11	7.517	<0.001**
Unsatisfactory	9.5	±	2.35	18.3	±	3.74	5.163	
Total Patients knowledge level								
Satisfactory	5.57	±	1.28	5.16	±	1.42	3.316	<0.001**
Unsatisfactory	7.33	±	1.24	4.2	±	1.37	2.163	

Highly statistically significant p-value <0.001** In significant p-value was >0.05

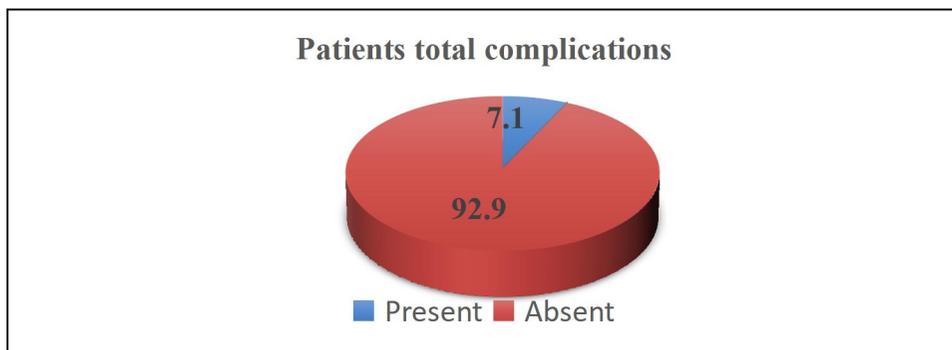


Fig (3): Percentage distribution of diabetic ketoacidosis associated complications among the studied patients.

Discussion:

This current study was carried out to assess the factors affecting the patients safety with DKA in ICUs .

Regarding demographic characteristics the findings of the current study revealed that, the age of all nurses under the study was from twenty to thirty years old. This explained that they were young to tolerate the nature of ICU atmosphere of work.

The finding of this study is consistent with *Ali, et al (2017)* who found that, the majority of the participant their age group were less than thirty years. In the same line with *Abdelrahman, et al (2020)* who found that, the most of nurses had age group less than thirty years and major of the nurses were females.

As regards the gender, the finding of this study revealed that, less than two thirds of nurses were females. This might be due to elevated number of females working in the nursing field more than males and may be due to nursing profession in the past was limited to females only and recently become for both genders.

This current study finding is supported by *Dhudum, (2018)* who reported that, the most of nurses' participant are females. In the same line with *Hadad, et al (2021)* who found that nearly to three quarters of staff nurses were females in ICU.

As regarding of educational qualification, the result of the current study indicated that; less than two thirds of nurses had diploma. This might be due to a lot of bedside nurses in university hospitals were diploma and technical nurses because bachelor nurses in the university hospitals are working as head nurses not bedside nurses but shortage of hospital staff nurses, may forced them to be employed to cover this shortage in ICU.

This study finding is in accordance with *Elsehravy, et al (2015)* who revealed that, majority of staff nurses had nursing diploma. In the same line with *Eldeeb, et al (2016)* who conducted study about "perception of patient safety among nurses at teaching hospital" and found that, more than half of nurses had diploma school qualification.

As regarded to years of experience and training courses about DKA and patients safety, the result of the current study indicated that; majority of staff nurses had less than five years of experience and all of them didn't attend training program about patients safety with DKA. This might be due to most of those nurses were newly graduated, young and tolerate nature of ICU work. But increasing workload and stress on the nurses in this unit, didn't make them to continue for a long period of time in the ICU and didn't attend any training courses or may be due to lack of in-service training programs in the hospital. The training program is important for nurses to give high quality of care for such patients with DKA and prevent complications.

This study finding is in accordance with *Wami, et al (2016)* who found that, nearly two thirds of nurses had less than five years of experience and near to three quarters didn't attend patient safety training. In the same line with *Abdallah, et al (2019)* who found that, more than half of nursing staff had less than five years of experience and more than three quarters of nursing staff didn't previously attend training programs on safety.

Concerning with the studied nurses knowledge total level about all aspects of DKA the current study revealed that, more than half of them had satisfactory level of knowledge. This might be due to increased flow rate of DKA patients in ICU lead the nurses to have knowledge and they were recently graduated and the stated questions based on basic information that had been studied during their years of the study.

This study finding is in accordance with *Abduelkarem & El-Shareif, (2013)* who found that, more than half of nursing staff in ICU units had satisfactory level of knowledge. Also, with *Itani, (2015)* who found that, two thirds of nurses had better knowledge about diabetes and its management and demonstrated strong knowledge of diabetic complications.

Concerning other factors affecting DKA patients safety from nurses point of view, this study result revealed that highest percentage of the nurses had satisfactory level regarding all factors related to general nursing safety measures. From the

investigator's point of view this result related to the studied nurses satisfactory level reflecting high DKA patients safety effect. This result is in accordance with *Breimaier, et al (2015)*, *Tang, et al (2015)*, *Ahmed, et al (2018)* and *Gezie, et al (2019)* who reported that two fifth of nurses had good level about patient identification, most of them had no problems about infection control measures, more than half of them had satisfactory level about fall preventive and half of them had awareness of medication administration.

As well as *Abd Elgwad, et al., (2020)* conducted study entitled "assessment of medication errors among nurses in the ICU " who concluded that, the majority of the studied nurses had unsatisfactory level of practice (knowledge and practice) regarding medication administration in ICU and increased frequency rate of all types of medication errors. Based on the study finding, the author recommended the importance of medication safety guidelines implementation to enhance nurses performance for decreasing frequency rate of medication errors.

Concerning with organizational related factors, the present study indicated that, highest percentage of the nurses had satisfactory level regarding all organizational related factors which reflecting high DKA patients safety effect.

As regard to policy of hospital infection control, the result of current study indicated that, more than two thirds of nurses had satisfactory level regarding such affecting factor on patients safety. This might be due to increased awareness and conducted orientation programs and supervisors during second wave of covid. This finding is in accordance with *Ilyasu, et al (2016)* who found that, most of nurses reported that they had awareness about of such factor effect.

As regard to hospital facilities and equipment the result of current study indicated that, more than two thirds of nurses had satisfactory level regarding such affecting factor on patients safety. This finding is in accordance with *Nuru, et al (2015)* who found that, the major problems were staff shortage, and inadequate facilities and equipment.

As regard to sufficient staffing the result of current study indicated that, more than two thirds of nurses had satisfactory level regarding such affecting factor on patients safety, the shortage of nursing staff is one of the biggest problems they face them and concerned that mistakes they make are preserved in their personnel file. This might be due to increase in staff fatigue and an increase in medical errors. This finding is in accordance with *Eldeeb, et al (2016)* who found that, there was a significant lack in staffing and resource adequacy led to an increase in workload, and this pressure considered a major cause of errors.

As regard to staff empowerment the result of current study indicated that, more than two thirds of nurses had satisfactory level regarding such affecting factor on patients safety, empowering nurses give the ability to effectively motivate and mobilize oneself and others to achieve positive results in the work environment. This finding is in accordance with *Van Bogaert, et al (2015)* who found that, the majority of the study participants mentioned that they were having introduced empowerment principles previously as part of a unit leadership strategy and other participants reported learning about empowerment through previous educational and training programs.

Concerning the studied nurses total level of practice regarding safety nursing management for caring of patients with DKA, the present study indicated that, more than half of them had satisfactory level of practice, from the investigator's point of view such finding indicated knowledge based practice where as the same percentage of the studied nurses had satisfactory level of knowledge that enable them to explain what they do for patients and the reason for their action. This finding is contradictory with *Shaker, et al (2020)* who found that, poor practice of nurses towards DKA.

Regarding to Demographic characteristic of studied patients the age of current study revealed that, more than half of them had <20-25 years, with mean age of 32.56±5.37. The finding of this study is consistent with *Bedaso, et al*

(2019) who found that, two thirds of studied patients were younger age and significantly associated with DKA.

As regards the gender, less than two thirds of the studied patients were females. The finding of this study is consistent with *Kreider, (2018)* who conducted study entailed "updates in the management of DKA" and found that, girls and women population were at higher risk for DKA.

As regards the marital status, more than half of the studied patients were married. This might be due to more than half of them within twenty age usually by this age they are becoming married specially they were from rural area. This finding of study is consistent with *Alhaik, et al (2019)* who found that, two thirds of studied patients were married.

As regards to educational level the current study revealed that, one thirds of the studied patients had intermediate education. This finding of study is consistent with *Bekele, et al (2020)* who found that, two fifth of studied patients had secondary education.

As regards to job the current study revealed that, less than one third of studied patients were housewives. This might be due to less than two third of the studied patients were females, married and lived in rural areas. This finding of study is consistent with *Shohood, (2018)* who found that, nearly three quarters of patients were not working (housewives).

As regards the residence, the current study revealed that, more than half of patients were from rural area whereas there was no proper screening, education about these conditions and lack of health services in rural area lead to increase flow rate of DKA patients in university and governmental hospital. This finding of study is consistent with *Abd Allah, et al (2016)* who found that, more than three quarters of the study sample were from rural area.

Regarding relation between the nurses demographic characteristics and DKA associated complications total mean score among the

studied patients, the results of present study revealed that, there was statistically significant relation between patients complications total mean score and nurses qualification, years of experience in ICU and training courses about patients safety with DKA. This could be attributed to these mentioned variables including high qualification, increasing years of experience in ICU and training courses attendance had positive impact on patients safety and consequently on the complications rate.

As regard to relation between patients' complications total mean score and nurses' total level of knowledge and practice, the results of present study revealed that, there was highly statistically significant. From the investigator's point of view, increase nurses' level of knowledge and awareness about potential complications of DKA, will be reflected on their practice, which leads to the prevention of those complications among such patients.

As regard to relation between patients complications total mean score and other factors affecting patients safety with DKA from nurses point of view including general nursing safety measures and organizational related factors, the results of present study revealed that, there were highly statistically significant relation. From the investigator's point of view these stated factors will be affected positively or negatively on patients safety and complications rate whereas the nurses who had high awareness and satisfactory level regarding such affecting factors reflecting high DKA patients safety effect and low complications rate.

As regard to relation between patients complications total mean score and patients total level of knowledge, the current study indicated that, there was statistically significant relation. This might be due to poor awareness and knowledge of studied patients about DKA associated complications and safety management whereas less than two thirds of them had unsatisfactory level of knowledge. This finding is supported with *Mohammadi, et al (2015)* who found that, lack of knowledge of diabetes care among patients could have adverse effects on

their capabilities to control diabetes and insufficient awareness of complications.

Conclusion:

Regarding nurses related factors more than half of the nurses had satisfactory level of knowledge and practice regarding safety nursing management of patients with DKA. Also, less than two thirds of them had satisfactory level regarding other factors affecting patients safety.

Regarding general nursing safety measures related factors, more than two thirds of the nurses had satisfactory level regarding infection control measures in ICU which reflecting high patients safety effect and around half of them had unsatisfactory level regarding medications administration measures which reflecting low patients safety effect.

In relation to organizational related factors more than two thirds of the nurses had satisfactory level regarding sufficient staffing and around one third of them had unsatisfactory level regarding hospital facilities and equipment. As regards patients related factors less than two third of them had unsatisfactory level of knowledge regarding DKA safety management and consequently little percentage of them had DKA associated complications; namely complication related to therapy followed by complication related to acute disease.

Recommendations:

- Importance of in-service training courses to enhance the nurse's knowledge and practice regarding patients safety with diabetic ketoacidosis in intensive care unit to decrease morbidity and mortality rate..
- Regular follow up for all patients with DKA to evaluate their health conditions and to detect complications early.
- The study should be replicated on large sample and different hospitals setting in order to generalize the results.
- Further study is suggested to develop safety management protocol for patients with DKA in intensive care unit considering all the studied factors affecting their safety and evaluate it effect on the complications rate.

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