Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

Diabetic Ketoacidosis (DKA) Hospitalizations and Reduce Length of Stay of an Adult Patient with Diabetic Ketoacidosis Attending the Emergency Room of King Abdul-Aziz University Hospital-Diabetic Center in Jeddah From 2015-2019

Mohammad Abdulrahman Hassan Faiyadhah[1], Bandar Saber Ibrahim Althbiti[2], Daniah Ebrahim Ghulam Bakhsh[3], Essam Muawadh Awadh Alrihaili[4], Ahmad Hasan M .Alturkstani[1], Mansour Matok Madabighy[1], Ahmad Nabeel Omar Khawandanah[5], Abdullah Mohammed Ali Alsufi[1], Mohammad Abdulrahman Hassan Almalki[1]

[1] General practitioner, Makkah, Ministry of Health, Saudi Arabia.
[2] Public Health specialist, Public Health in Makkah, Ministry of Health, Saudi Arabia.
[3] Ray technician, Makkah, Ministry of Health, Saudi Arabia.
[4] Hospital and health services management specialist, Makkah, Ministry of Health, Saudi Arabia.
[5] Family medicine specialist, Ministry of Health, Saudi Arabia.

Abstract

Background

Diabetic Ketoacidosis (DKA) is a serious and potentially a fatal complication of diabetes mellitus. Diabetic Ketoacidosis (DKA) is a metabolic emergency characterized by the triad of hyperglycemia, high-anion gap metabolic acidosis and ketonemia. Despite its multifactorial etiology, DKA is known to be a preventable acute complication of diabetes mellitus specifically through patient education. Diabetic ketoacidosis(DKA) is the most common hyperglycemic emergency and causes the greatest risk for death in patients with diabetes mellitus, almost a third of the cases occur among those with type 2 diabetes. Although mortality rates from DKA have declined to low levels in general, it continues to be high in many developing countries. DKA is characterized by hyperglycemia, metabolic acidosis and ketosis. Proper management of DKA requires hospitalization for aggressive intravenous fluids, insulin therapy, electrolyte replacement as well as identification and treatment of the underlying precipitating event along with frequent monitoring of patient's clinical and laboratory states. **Aim of the study:** To determine the length of stay and ICU transferee in Diabetic center in Jeddah at Saudi Arabia. To describe the clinical and biochemical characteristics of Diabetic ketoacidosis severity of ICU admission. **Method**: Retrospective observational cohort study of patients with DKA to define the clinical and biochemical characteristics of Diabetes Ketoacidosis at King Abdul-Aziz University Hospital-Diabetic Center in Jeddah. The study included physicians working in the diabetic center that care for DKA patients and follow up diabetic patients. They identified all patients from 2015-2019 with DKA from the medical records. **Result**: There was statistically significant difference in mean of LOS across all years (<0.05). The length of stay in our institute was statistically and graphically shorter than national benchmark to reach 15 hour shorter in 2019. BY doing a multivariate regression analysis, it has been found that presence of ketoacidosis, anion gap, change in bicarbonate level and resorption of DKA in hours are statistically significant and regarded as determinants of LOS in DM patients. **Conclusion:** Decrease length of hospital stay is highly dependent on severity of condition, metabolic derangement the clinical pathways are known

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

to decrease practice variations and improve several essential patient-, practicing physician-and hospital-related outcomes including satisfaction with the service, reduction of work-load, and cutting hospital care costs.

Keywords: Implementation, clinical practice pathway (CPP), diabetic ketoacidosis (DKA), hospitalizations.

INTRODUCTION

Saudi Arabia has probably the most highest rates of diabetic ketoacidosis around the world, with different searches showing that in recently analyzed sort 1 diabetes, these rates are 40% in the Eastern region,[1]55% in the Northwestern region[2] and 67.2% in Riyadh city.[3]

Diabetic ketoacidosis diabetic ketoacidosis is an intense difficulty of uncontrolled diabetes mellitus that is related with expanded bleakness and mortality. Epidemiological searches have discovered that paces of diabetic ketoacidosis in new‐onset type 1 diabetes differ between countries.[4] While searches from Denmark, Kuwait, Canada and Germany have discovered the paces of diabetic ketoacidosis in recently analyzed type 1 diabetes to be 17.9%, 24.8%, 25.6% and 35.2%, individually, in United Arab Emirates, its rate was 80%.[5,6]

diabetic ketoacidosis is perhaps the most fearsome complications of diabetes, with death paces of up to 5% in developed nations.[7,8] up to 30% in less favored health frameworks.[9] and over 90% when convoluted by cerebral edema[10]. Death is usually credited to co-morbidities, yet iatrogenic hypokalemia and liquid over-burden are once in a while responsible. [11]. In this manner, the careful use of acknowledged administration norms in diabetic ketoacidosis is an abrogating priority. For this specific explanation, different global, evidence-based guidelines have suggested the utilization of specific hospital protocols for the care of these patients. [7,2] Notwithstanding medical advances in its DKA management, and diagnosis, diabetic ketoacidosis stays a significant reason for hospital admissions and mortality in kids and grown-ups, especially in developing countries. Truth be told, as of late, there has been a huge expansion in the paces of diabetic ketoacidosis‐related hospital admissions in a few areas worldwide.[12,13] The most habitually revealed markers that relate with hospitalization for diabetic ketoacidosis are poor glycemic control, lower financial status, presence of psychiatric conditions and female gender.[14]

In spite of the fact that there are all around characterized rules for both diabetic ketoacidosis (DKA) and hyperglycemic hyperosmolar state (HHS), it could likewise be found hyperglycemic states with mixed features, depending upon each given case and the basic reason for decompensating.[15] The mortality of DKA and HHS goes from under 5 to 11%, respectively.[16] Moreover, patients with type 2 diabetes mellitus could likewise have DKA emergencies under certain intense pressure catabolic conditions such injury, medical procedure or infection.[17,18]

Literature Review

Some authors (A. Zugasti) [19] have recently announced information on our local area about patients conceded to the emergency department (ED) in university hospital. They reported an frequency of 8.09 scenes of DKA in 105 inhabitants and a death rate of 6.52%. All the more other authors have likewise told a lower DKA death rate at 28 days, ranging somewhere in the range of 3.4%8 and 2.65%.9 Perhaps, these rates may be more like what could be deduced expected in current step by step clinical practice. Notwithstanding, most accessible information on this issue came from

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

referred to manuscripts prior to1985. Therefore, there are not recent studies that show the impact of improvements in the therapy on mortality in grown-ups with DKA. [20,21]

Wang et al. [22] showed a general lessening of DKA mortality of 4.4% each year/105 inhabitants. These outcomes update the information on past decades. [23.24] Ko et al. [25] announced an expanded in ED visits from 1995, yet in setting of a reformist decrease of DKA mortality since the 1980s. In any case, frontal area that the mortality reached 12.2% in patients treated somewhere in the range of 1996 and 2002. Although this death rate is high for the present norms, that may be molded by the low number of patients at last remembered for the searches – a similar issue recognized in different searches of closer geological scope to ours.[25,26]

Razavi Z (2015) announced that the recurrence of hospitalizations for DKA was higher in summer and autumn time and lower in spring. In any case, contrasts were not huge. We have recently shown that the recurrence of T1DM was higher in summer (34%)[27](210. Since most of DKA cases happen in patients without a known history of diabetes, its irregularity is likewise a also a measure of new onset T1DM irregularity. Along these lines, we conclude that seasonal variation of DKA and T1DM in our district is somewhat unique in relation to those revealed in the literature, while at the same time affirming our past discoveries [28].

Similar to the results of Butalia et al. [29], hospitalization because of ketoacidosis was higher in December and September than in different months. In this way, maybe healthcare experts' readiness ought to be expanded, especially during specific months of the year. Polyuria, polydipsia, stomach torment, regurgitating, and modified degree of cognizance were the commonest presenting complaints of DKA predictable with discoveries in past research [30].

Freire et al. [31] who reported nonappearance of contrasts between internal lengths of stay of moderate or potentially extreme DKA scenes (expanded length of stay was characterized as ≥3 days in ICS and ≥6 days in clinical ward). Our ICS confirmation rate came to practically half, steady with other past research that show the standard affirmation of DKA patients in IC units.20 Criteria for ICS affirmation were extreme DKA, yet additionally any serious ailment.

Lone et al. [32] revealed that 55% of kids giving DKA were over 10 years of age. Naeem et al. [30] (16) by inspecting 373 pediatric DKA patients revealed that number of attacks were most noteworthy in patients who matured 10 - 14 years. This finding is in opposition to the previous authors who showed that diabetic ketoacidosis was more common in younger ages [33].

In accordance with our past research in 2010[34], serious DKA was seen in 47.2% of patients which differs from other studies as they found a lower number of severe DKA contrasted and gentle and moderate sort. For example, Schober et al. [35] detailed that of 1,238 Austrian youngsters with DKA, 383 (11.5%) had serious DKA. In the research of Oyarzabal et al. [36] extreme DKA was analyzed in 17.8% DKA scenes. The DKA scenes were serious in 49.4%, predictable with the consequences of Guisado-Vasco et al'. Research. [37]. The conceivable explanation might be because of an absence of admittance to healthcare experts for the research. Populace or deferred finding by primary care doctor. Acknowledgment of DKA can be improved by expanding medical services arrangement and offices just as healthcare experts' sharpness.

1.2 Rationale

Diabetic ketoacidosis (DKA) are acute metabolic complications of diabetes mellitus that can occur in patients with both type 1 and 2 diabetes mellitus. an audit was conducted in October to December

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

2013 on Diabetic ketoacidosis patients and data revealed that readmission rates for Diabetic ketoacidosis patients after 30 days of discharge was very high at 13.70% compared to the international benchmark of 2.8%., is a life-long disorder which can be management by insulin therapy, and electrolyte replacement along with the continuous patient monitoring using available laboratory tools to predict the resolution of the hyperglycemic crisis. The pathway aimed to facilitate evidence based practice in managing Diabetic ketoacidosis patients, provide patients with uniform care and ensure effective and safe management of Diabetic ketoacidosis. The Diabetic ketoacidosis pathway was approved by the Hospital Director and implemented as official management tool for Diabetic ketoacidosis patients in 2014.

1.3 Aim of the study

- To determine the length of stay and ICU transferee in Diabetic center in Jeddah at Saudi Arabia
- Describe the clinical and biochemical characteristics of Diabetic ketoacidosis severity of ICU admission.

1.4 Objectives

- To determine the length of stay and ICU transferee in Diabetic center in Jeddah at Saudi Arabia
- To describe the clinical and biochemical characteristics of Diabetic ketoacidosis severity of ICU admission.
- To determine the resolution of Diabetic ketoacidosis

2. Methodology

2.1Study area :

The study has been carried out in King Abdul-Aziz University Hospital-Diabetic Center in Jeddah which is It's one of the leading centers in KSA to teach and evaluate diabetic patients, it starts to provide services in 1994, the center services evaluate diabetes, teach diabetic patients, conduct researches on diabetes and held scientific sessions and seminars all type 1 and type 2 diabetes patients with DKA attending clinic or the ER at King Abdul-Aziz University Hospital aged 12 years and above. Cases of DKA were identified by American Diabetes Association (ADA 2006) criteria for definition of DKA metabolic acidosis is often the major finding, while the serum glucose concentration is generally below 800 mg/dL (44 mmol/L). However, serum glucose concentrations may exceed 900 mg/dL (50 mmol/L) in patients with DKA who are comatose. We reviewed all the cases and classify them according to these criteria, with previously demonstrated validity.

2.2 Study population:

Patients with DKA attending to the ER at King Abdul-Aziz University Hospital which is a tertiary center serving patients throughout the period of the study and accept to participate in the study.

2.3 Study design :

Retrospective observational cohort study of patients with DKA to define the clinical and biochemical characteristics of Diabetes Ketoacidosis in King Abdul-Aziz University Hospital.

2.4 Inclusion criteria:

- Type I DM patients presenting with DKA above 12 years (males and females).
- Availability of clinical data regarding DKA characteristics, glycemic data
- ICU admission

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

2.5 Exclusion criteria: Referral or consultation from outside the hospital.

2.6 Sample size:

The current study was conducted on 576 patients admitted DKA with the pathway from January 2015 to December 2019. at King Abdul-Aziz University Hospital which is a tertiary center serving patient over three year's period. They have been collected through a secured computerized data basest in referral hospital. Rec ruined according to the inclusion, exclusion criteria shown below.

2.7 Study of the Intervention(s)

All type 1 diabetes patients with DKA who admitted at King Abdul-Aziz University Hospital aged above12 years. Cases of DKA were identified by American Diabetes Association (ADA 2006) criteria for definition of DKA. A follow up audit was performed in all DKA Patients admitted from January 2015 to December 2019 to see the continuation of the effective use of the DKA pathway and improvements in the parameters taken into consideration in the previous Audit of 2014.

2.8 Data Collection technique:

The study included physicians working in the diabetic center that care for DKA patients and follow up diabetic patients. They identified all patients from January 2015-December 2019 with DKA from the medical records for enrollment in this retrospective cohort study. Case report forms were completed for each patient. Following variables were collected from the medical record. demographic and clinical data (Age, sex), type and duration of diabetes, type of insulin and doses, ICU admission , BMI, complications, duration of hospital stay, investigations like antibodies ,electrolytes changes like plasma glucose (mmol/L) arterial pH, serum bicarbonate (mmol/L), urine ketones and anion gap. Definitions were established for all variables to ensure standardization of data collection .

2.9 Data entry and analysis

Data retrieved were processed using the Statistical Package for Social Sciences (SPSS) program version 25. Data of numerical values were compared using chi-square t-tests while the categorical comparisons were tested by Fisher exact test. A P-value below 0.05 was regarded as significant. awkward- selected multivariable logistic regression analysis in models that included statistically significant variables significant from the univariate analysis with $P < 0.10$ was utilized to identify predictors.

2.10 Ethical Considerations:

- This study was conducted under the and approved hospital director, To be conducted in King Abdul-Aziz University Hospital which is a tertiary center serving patients, Jeddah, Saudi Arabia Confidentiality of information was assured and the data were accessed only by the investigators involved in the study.
- No consent from the patient is required for this project.

2.11 Budget: The research has been self-funded.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

3. Results.

A total number of patients were 576 patients admitted from 2015-2019.

Table (1): shows the demographic and clinical data of study participants of (n=576)

Table 1: Demographic and clinical data		
N=576	**N**	**%**
Number of patients		
2015	79	13.7
2016	119	20.6
2017	124	21.5
2018	128	22.2
2019	126	21.8
Sex		
Female	417	72.4
Male	159	27.6
BMI		
Underweight	105	18.2
Normal	272	47.2
Overweight	82	14.2
Obese	117	20.3
Range	10.94-67.55	
Mean±SD	24.266±7.866	
GAD ABS		
Negative	25	4.3
Positive	185	32.1
NA	366	63.5
ICA		
Negative	83	14.4
Positive	105	18.2
NA	388	67.4
IAA		
Negative	75	13.0
Positive	112	19.4
NA	389	67.5
HYPOTHYROIDISM		
Negative	468	81.3
Positive	108	18.8
ICU /Admission		
No	534	92.7
Yes	42	7.3
Complication		
Negative	512	88.9
Positive	64	11.1

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

Shows table1 regarding the number of patients the majority of patients were collected in a year 2018, followed in year 2019 were (22.2%and 21.8%). Most of the admitted patients were female (72.4%). Regarding the majority of BMI of the patients in the normal were(47.2%) while the Range (10.94 to 67.55) Mean± SD(24.266±7.866) the mean BMI was 24 kg/m2. Throughout all years, number of ICU/ admission was indicated in Yes were (7.3%) patients while No were(92.7%), regarding complications were found in 64(11.1%) patients.

Table (2) Description of the laboratory data

Table 2: laboratory data			
	Range	**Mean ± SD**	
AG	13 - 40	26.361 ±	5.572
HCO3	1 - 26	9.044 ±	4.590
BS	5 - 53	26.894 ±	8.493
KET	1 - 4	2.837 ±	0.709
Resorption of DKA Normalization of AG/hours	1 - 72	16.154 ±	13.314
HbA1C before ADMISSION	5.7 - 19.8	11.706 ±	2.443
LANTUS DOSE	10 - 60	33.939 ±	11.285
ULTRASHORT DOSE	0 - 30	14.780 ±	6.280
LEVEMIR DOSE	10 - 52	23.481 ±	11.413
VIT. D	7.5 - 138	39.857 ±	23.724
TSH	0.03 - 43	3.689 ±	5.431
FT4	0.4 - 21.38	12.712 ±	4.192
CREAT	27 - 458	73.521 ±	35.546

In table 2, show of the laboratory data and the data rang were(5.7 to 19.8). The mean of HBa1c prior to admission is above normal 11.706±2.443. Regarding the mean and standard deviation of Resorption of DKA Normalization of AG/hours in our study were 16.154± 13.314 (1to 72). While the mean and standard deviation of the VIT. D(39.857±23.724)and data rang(7.5-138)

Figure 1: Classification of DKA sever

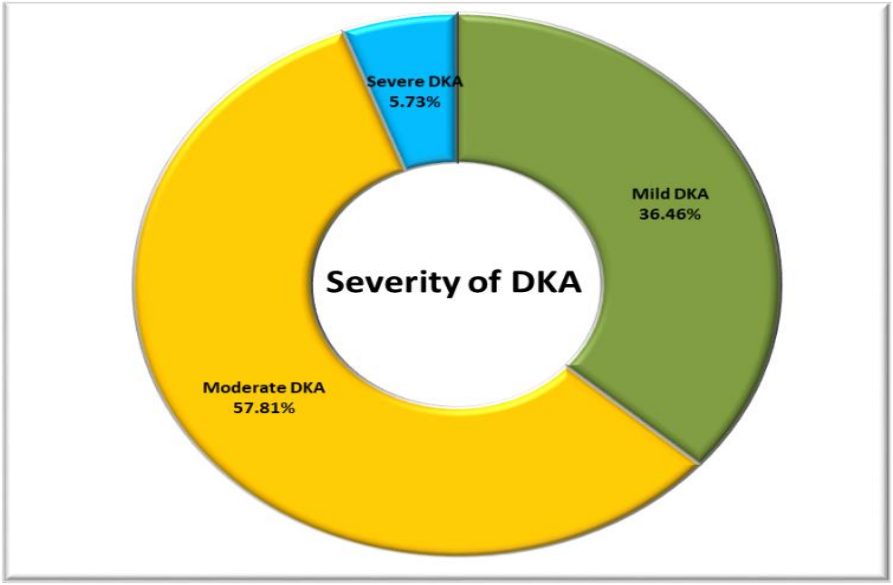


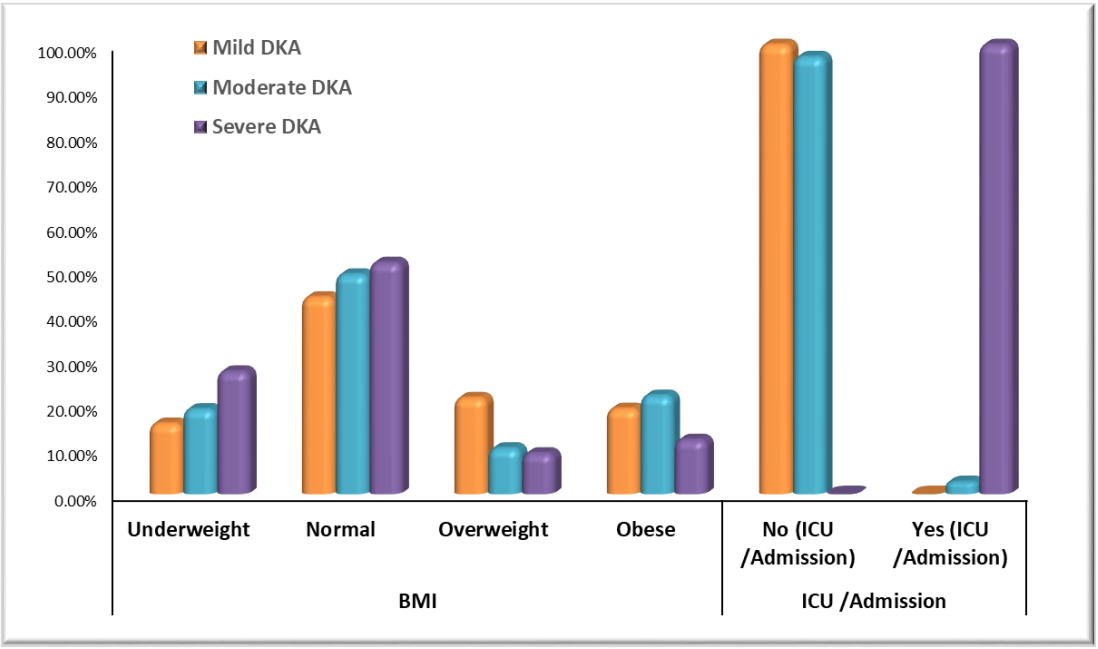
Figure 2: Classification of DKA severity.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

2. Ketoacidosis

Most of cases were either mild or moderate (36.5%, 5738%) respectively as shown in figure

Figure 3: Relationship between DKA severity and study vairables (BMI and ICU admission)



Testing study variables

Figure 4: Relationship between DKA severity and study vairables (BMI and ICU admission).

according to the severity of PH, it has been found that sex (female), normal and underweight and finally ICU admission are statistically significant with severe DKA. IN figure 2.

Table (3)Description of Severity of DKA versus variables (BMI, DM DURATION, Age at Admission, Length of Stay (day), AG, HCO3, BS, KET, ICU stay length , Resoption of DKA normalization of AG/hours, HbA1C priot to admission, LANTUS does, ULTRASHORT dose, LEVEMIR dose, VITD,TSH, FT4,CREAT)

Table 3: Severity of DKA versus variables.

Descriptive	Severity of DKA						ANOVA	
	Mild DKA		Moderate DKA		Severe DKA			
	Mean	SD	Mean	SD	Mean	SD	F	P-value
BMI	25.037	8.669	24.023	7.317	21.243	5.326	3.711	0.025*
DM DURATION	9.362	5.594	9.820	6.567	8.848	5.057	0.616	0.540
Age at Admission	19.233	7.560	20.045	8.019	20.121	9.864	0.704	0.495
Length of Stay (day)	2.076	1.277	2.330	1.407	2.970	1.723	6.615	<0.001*
AG	23.948	5.029	27.633	5.395	30.774	4.287	43.270	<0.001*
HCO3	12.393	3.859	7.296	3.750	4.052	2.347	147.960	<0.001*
BS	25.392	8.532	27.489	7.754	32.342	12.103	10.842	<0.001*
KET	2.524	0.781	3.034	0.509	3.444	0.506	39.938	<0.001*
ICU STAY LENGTH	1.000	0.000	1.710	1.189	1.870	0.815	0.699	0.501

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

Resoption of DKA Normalization of AG/hours	12.554	9.093	17.768	14.227	28.000	21.040	22.724	<0.001*
HbA1C PRIOT TO ADMISSION	11.382	2.161	11.862	2.556	12.871	2.023	6.245	0.002*
LANTUS DOSE	34.712	11.778	33.768	11.108	30.774	8.225	1.708	0.182
ULTRASHORT DOSE	14.826	6.549	15.028	5.931	13.571	7.632	0.697	0.499
LEVEMIR DOSE	26.286	11.628	22.483	11.102			1.374	0.247
VITD	34.414	17.156	41.056	23.715	61.671	39.915	16.690	<0.001*
TSH	4.416	7.034	3.519	4.463	1.131	1.345	5.362	0.005*
FT4	13.220	4.158	12.502	4.316	12.789	2.069	1.806	0.165
CREAT	68.659	45.112	75.332	29.253	81.161	22.996	3.074	0.047*

In table(3)show collective biomarkers of DKA (AG, HCO3, BS) were statistically associated with severe DKA in addition to BMI, ICU admission, vitamin D level and thyroid stimulating hormone level. The mean and stander deviation of HBA1c is significantly higher in severe cases which denoting bad pre-admission control of DM .

Table (4) Describe of the Multi Logistic Regression between PH as depending variables(Constant), Length of Stay (day), AG, HCO3, BS, KET, Resoption of DKA Normalization of AG/hours, HbA1C PRIOT TO ADMISSION, VITD , TSH, FT4, CREAT ICU /Admission)**and Unstandardized Coefficients, Standardized Coefficients**

Table 4: Regression analysis

Dependent variable: PH	Unstandardized Coefficients		Standardized Coefficients	T-test		ANOVA		R^2
	B	SE	Beta	t	P-value	F	P-value	
(Constant)	7.176	0.056		128.462	<0.001*	67.125	<0.001*	73.90%
Length of Stay (day)	0.012	0.004	0.108	3.071	0.002*			
AG	-0.001	0.001	-0.040	-0.902	0.368			
HCO3	0.014	0.002	0.466	9.142	<0.001*			
BS	0.000	0.001	0.003	0.085	0.932			
KET	-0.014	0.007	-0.074	-1.896	0.059			
Resoption of DKA Normalization of AG/hours	-0.001	0.000	-0.117	-2.885	0.004*			
HbA1C PRIOT TO ADMISSION	-0.002	0.002	-0.033	-0.968	0.334			

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

VITD	0.000	0.000	-0.052	-1.478	0.141			
TSH	-1.125E-04	0.001	-0.005	-0.133	0.894			
FT4	0.001	0.001	0.050	1.293	0.197			
CREAT	0.000	0.000	0.003	0.080	0.936			
ICU /Admission	-0.204	0.017	-0.420	-11.998	<0.001 *			

Table 4 show all the final model is affect by explain the regression by $\mathbf{R^2}$ (73.90%) a significant relation between Unstandardized Coefficients and Standardized Coefficients and dependent variables PH . Were F (67.125)and P-value=0.001 .

Regarding the unstandardized Coefficients how that is a significant relation between unstandardized Coefficients and Constant, Length of Stay (day), HCO3, BS, KET, Resoption of DKA Normalization of AG/hours, ICU /Admission were P-value=<0.001, 0.002, <0.001, 0.004, <0.001 and(B = 7.176, 0.012,0.014,-0.001,-0.204 while SE 0.056, 0.004, 0.002,0.000,-0.204)

Table (5): Describe of the mean and standard deviation of LOS across all years of study.

Table 5: mean and standard deviation of LOS across all years of study.

Years	No	Length of Stay (day)					
		Range	Mean±SD	One sample T-test			
				National benchmark test value=2.1		International benchmark test value=3.5	
				t	P-value	t	P-value
2015	79	1-6	2.147±1.179	0.354	0.724	10.200	<0.001*
2016	119	1-6	2.018±1.280	0.699	0.486	12.630	<0.001*
2017	124	1-4	1.551±0.842	7.261	<0.001*	25.776	<0.001*
2018	128	1-3	1.510±0.877	7.611	<0.001*	25.672	<0.001*
2019	126	1-2	1.475±0.755	9.292	<0.001*	30.107	<0.001*
ANOVA	F	5.155					
	P-value	0.001*					

Table 5 show all the final model is affect by Length of stay and a significant relation between year and International benchmark test value=3.5 were P-value=0.001The mean and standard aviation of length of stay (in days) is plotted in table 5. The mean of LOS of all years was 1.087±0.98 days with range of (1-5) days. There was statistically significant difference were F=5.155, P-value=0.001 in mean of LOS across all years (<0.05). Length of stay is declined from 6 days maximum to 1 days with statistically significant difference across all years with international benchmark (<0.05) as seen in table 1. Interestingly, this table showed that LOS is started to become shortened than national benchmark from 2017 and above.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

Figure 6: LOS in our institute versus national and international benchmark

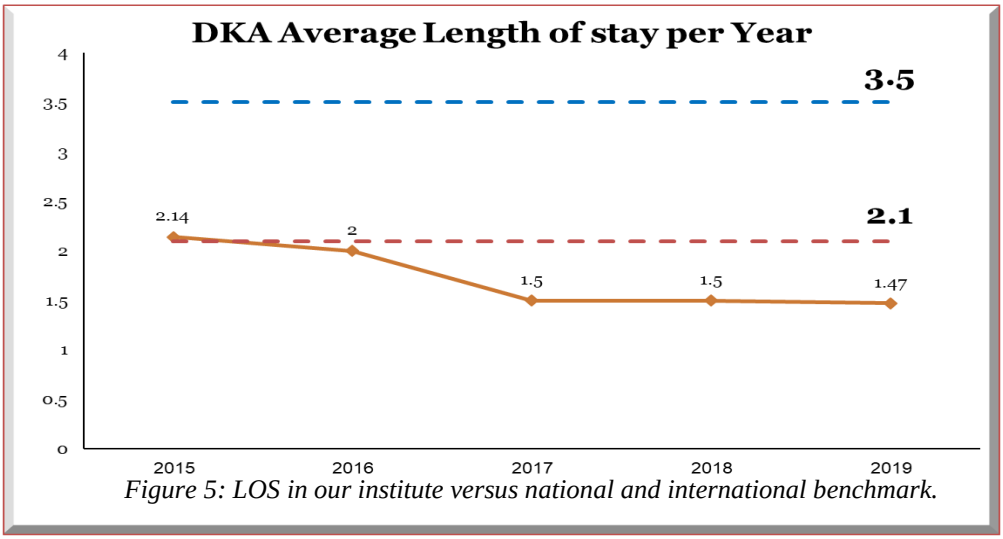


Figure 5: LOS in our institute versus national and international benchmark.

In figure 3, the length of stay in our institute was statistically and graphically shorter than national benchmark to reach 15 hour shorter in 2019. International benchmark is doubled the duration at last year

Table (6) correlation study between delineate the correlators and Length of Stay admission

Table 6: correlation study for LOS.		
	Length of Stay (day)	
	r	**P-value**
PH	-0.129	0.004*
BMI	-0.057	0.171
DM DURATION	0.032	0.449
Age at Admission	0.089	0.033*
AG	0.173	0.000*
HCO3	-0.134	0.001*
BS	0.104	0.013*
KET	0.008	0.876
ICU STAY LENGTH	0.397	0.002*
Resoption of DKA Normalization of AG/hours	0.390	<0.001*
HbA1C PRIOT TO ADMISSION	-0.062	0.138
LANTUS DOSE	0.077	0.083
ULTRASHORT DOSE	-0.012	0.779
LEVEMIR DOSE	0.152	0.292
VITD	0.024	0.596
TSH	0.163	<0.001*
FT4	-0.199	<0.001*
CREAT	-0.065	0.117

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

Table 6 shows a significant negative and positive correlation between delineate the correlates and Length of Stay admission in the (PH, Age at Admission, AG, HCO3, BS, ICU STAY LENGTH, Resoption of DKA Normalization of AG/hours, TSH, FT4) were r (-0.129, 0.089, 0.173, -0.134, 0.104, 0.397, 0.163, -0.199, -0.065) and p-value =0.004, 0.033, 0.000, 0.001, 0.013, 0.002, <0.001)

Table (7) Describe of the Multivariate regression analysis for determinants of LOS.

Table 7: Multivariate regression analysis for determinants of LOS.								
Dependent Variable: Length of Stay (day)	**Unstandardized Coefficients**		**Standardized Coefficients**	**T-test**		**ANOVA**		**R^2**
	B	**SE**	**Beta**	**t**	**P-value**	**F**	**P-value**	
(Constant)	-26.176	8.924		-2.933	0.006*	14.539	0.000	74.80%
PH	2.640	1.244	0.186	2.122	0.042*			
Age at Admission	0.027	0.030	0.118	0.894	0.378			
AG	0.119	0.037	0.376	3.251	0.003*			
HCO3	0.389	0.126	0.588	3.089	0.004*			
BS	0.030	0.024	0.203	1.257	0.218			
ICU STAY LENGTH	0.433	0.371	0.205	1.167	0.252			
Resorption of DKA Normalization of AG/hours	0.067	0.019	0.695	3.502	0.001*			
TSH	-0.049	0.131	-0.070	-0.374	0.711			
FT4	9.710E-02	0.131	0.168	0.742	0.464			

Table 7 show Multivariate regression analysis was done to determine the prognostic factors for lengthy stay. It has been found that presence of ketoacidosis, anion gap, change in bicarbonate level and resorption of DKA in hours are statistically significant and regarded as determinants of LOS in DM patients. Also the Multivariate regression analysis for determinants of LOS by R^2 (74.80%) no significant relation between Unstandardized Coefficients and Standardized Coefficients and dependent variables Length of Stay (day) were F (14.539)and P-value=0.000.

Table (8) Describe of the Complications

Table 8: Complication									
		Complication						Chi-square	
		Negative		Positive		Total			
		N	%	N	%	N	%	X^2	P-value
BMI	Underweight	77	15.0%	28	43.8%	105	18.2 %	35.351	<0.001 *
	Normal	260	50.8%	12	18.8%	272	47.2		

Annals of R.S.C.B., ISSN:1583-6258, Vol. 24, Issue 1, 2020, Pages. 1352 - 1368
Received 15 April 2020; Accepted 23 June 2020.

							%		
	Overweight	73	14.3%	9	14.1%	82	14.2 %		
	Obese	102	19.9%	15	23.4%	117	20.3 %		
GAD ABS	Negative	19	9.8%	6	37.5%	25	11.9 %	7.774	0.005*
	Positive	175	90.2%	10	62.5%	185	88.1 %		
ICA	Negative	74	42.3%	9	69.2%	83	44.1 %	3.576	0.059
	Positive	101	57.7%	4	30.8%	105	55.9 %		
IAA	Negative	63	36.4%	12	85.7%	75	40.1 %	13.486	<0.001 *
	Positive	110	63.6%	2	14.3%	112	59.9 %		
HYPOTHYROIDISM	Negative	413	80.7%	55	85.9%	468	81.3 %	1.106	0.293
	Positive	99	19.3%	9	14.1%	108	18.8 %		
ICU /Admission	No	484	94.5%	50	78.1%	534	92.7 %	16.385	<0.001 *
	Yes	28	5.5%	14	21.9%	42	7.3%		

Table 8 show Complications the number of serious complications was found in 64 patients (11.11%). In table 8, study variables were studied against presence of complications. The complications are highly associated with BMI, GAD ABS, immunoglobulin autoantibodies (IAA) and ICU admission with high significant difference ($p<0.05$). Only six cases died after admission with DKA

DISCUSSION

In our study, the length of stay was associated with severity of condition, ICU admission and resolution of DKA per hours. Our mean LOS was statistically significant shorter than that of international mean throughout all years of comparison. However, national mean of LOS was found to be longer than ours in the last three years (2017-2019). In our study, only six cases died after admission with DKA. They were of type II DM. the low mortality rate might be explained by several reasons; enhanced patients' education with daily glucose monitoring6, increased awareness about DM and its sequel[38,39], and finally, improved dietary and health programs for diabetic patients[40.41] All these causes might explain the decline of DKA development in our environment. Finally they were removed from data analysis.

Decrease in DKA hospitalization is a worldwide finding. Another study reported an increase in ED visit for DM since 1995 with concomitant decrease in diagnosis of DKA since 1980. Indeed, DKA

severity is highly dependent on the severity of coexisting disease and missing insulin therapy. So, presence of severe infection with uncontrollable blood serum sugar level might increase the probability of death[42,33]. The mean of LOS of all years was 1.087±0.98 days with range of (1-5) days. This was shortest than libyian study (7.7 days)4, USA (3.6 days)[29] and Jordan (3.4 days)[32] Longer hospital stay means unnecessary addition of costs during DKA management. Mild case of DKA may need few hours in ED with later on discharge. However, severe DKA cases need immediate admission to ICU for rapid management of biochemical derangement. The most important indication for ICU admission is presence of concomitant infection not only the biochemical profile of the cases .

The number of serious complications was found in 64 patients (11.11%). Our rate of complications is much lower than that seen in many middle east countries[8,42] This rate indicate powerful skills of medical and nursing staff for detecting and managing sequlae as well as higher recruitment of advanced diagnostic and therapeutic facilities in our institute .

In conclusion, decrease length of diabetic Center in King Abdul-Aziz University Hospital in Jeddah stay is highly dependent on severity of condition, metabolic derangement and presence of co-existing diseases .

Conclusion:

Most DKA episodes require hospital admission, but mortality is high, and length of stay at the ER and medical ward depends on type of DM and initial severity of the episode. In our environment, DKA was more frequent in women and in the spring and fall. Most patients had established diabetes and a known precipitating factor. Outcome was favorable in patients without complications such as cerebral edema, ischemic cerebrovascular disease, or respiratory failure. Our results suggest that rapidly increasing episodes of DKA in KSA, in parallel with increases in the numbers of diabetic patients, continue to be associated with significant mortality. The results of the present study suggest temporal variation in hospitalizations for DKA and hypoglycemia, and therefore signal important times of patient vulnerability. Potential mechanisms underlying this pattern warrant further examination. Prevention strategies and resources for patients with T1D may need to be increased at specific times during the year.

References

1. Abduljabbar, M. A., Aljubeh, J. M., Amalraj, A., & Cherian, M. P. (2010). Incidence trends of childhood type 1 diabetes in eastern Saudi Arabia. *Saudi medical journal*, *31*(4), 413-418.
2. Habib, H. S. (2005). Frequency and clinical characteristics of ketoacidosis at onset of childhood type 1 diabetes mellitus in Northwest Saudi Arabia. *Saudi medical journal*, *26*(1).
3. Salman, H., Abanamy, A., Ghassan, B., & Khalil, M. (1991). Insulin-dependent diabetes mellitus in children: Familial and clinical patterns in Riyadh. *Annals of Saudi medicine*, *11*(3), 302-306.
4. Große, J., Hornstein, H., Manuwald, U., Kugler, J., Glauche, I., & Rothe, U. (2018). Correction: Incidence of Diabetic Ketoacidosis of New-Onset Type 1 Diabetes in Children and Adolescents in Different Countries Correlates with Human Development Index (HDI): An Updated Systematic Review, Meta-Analysis, and Meta-Regression. *Hormone and metabolic research= Hormon-und Stoffwechselforschung= Hormones et metabolisme*, *50*(3), e2.

5. Fredheim, S., Johannesen, J., Johansen, A., Lyngsøe, L., Rida, H., Andersen, M. L. M., ... & Svensson, J. (2013). Diabetic ketoacidosis at the onset of type 1 diabetes is associated with future HbA 1c levels. *Diabetologia*, *56*(5), 995-1003.
6. Punnose, J., Agarwal, M. M., El Khadir, A., Devadas, K., & Mugamer, I. T. (2002). Childhood and adolescent diabetes mellitus in Arabs residing in the United Arab Emirates. *Diabetes research and clinical practice*, *55*(1), 29-33.
7. 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.
8. Savage, M. W., Dhatariya, K. K., Kilvert, A., Rayman, G., Rees, J. A. E., Courtney, C. H., & Hilton, L. (2011). Diabetes UK position statements and care recommendations: Joint British Diabetes Societies guideline for the management of diabetic ketoacidosis. *Diabet Med*, *28*(5), 508-515.
9. Mbugua, P. K., Otieno, C. F., Kayima, J. K., Amayo, A. A., & McLigeyo, S. O. (2005). Diabetic ketoacidosis: clinical presentation and precipitating factors at Kenyatta National Hospital, Nairobi. *East African medical journal*, *82*(12).
10. Laing, S. P., Swerdlow, A. J., Slater, S. D., Botha, J. L., Burden, A. C., Waugh, N. R., ... & Keen, H. (1999). The British Diabetic Association Cohort Study, II: cause- specific mortality in patients with insulin- treated diabetes mellitus. *Diabetic Medicine*, *16*(6), 466-471.
11. Hamblin, P. S., Topliss, D. J., Chosich, N., Lording, D. W., & Stockigt, J. R. (1989). Deaths associated with diabetic ketoacidosis and hyperosmolar coma, 1973–1988 (for editorial comment, see page 427; see also page 444). *Medical Journal of Australia*, *151*(8), 439-444.
12. 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. *Morbidity and Mortality Weekly Report*, *67*(12), 362.
13. Zhong, V. W., Juhaeri, J., & Mayer-Davis, E. J. (2018). Trends in hospital admission for diabetic ketoacidosis in adults with type 1 and type 2 diabetes in England, 1998–2013: a retrospective cohort study. *Diabetes Care*, *41*(9), 1870-1877.
14. Butalia, S., Johnson, J. A., Ghali, W. A., & Rabi, D. M. (2013). Clinical and socio- demographic factors associated with diabetic ketoacidosis hospitalization in adults with Type 1 diabetes. *Diabetic medicine*, *30*(5), 567-573.
15. 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.
16. Dhatariya, K. K., & Umpierrez, G. E. (2017). Guidelines for management of diabetic ketoacidosis: time to revise?. *The Lancet Diabetes & Endocrinology*, *5*(5), 321-323.
17. Tan, H., Zhou, Y., & Yu, Y. (2012). Characteristics of diabetic ketoacidosis in Chinese adults and adolescents–a teaching hospital-based analysis. *Diabetes research and clinical practice*, *97*(2), 306-312.
18. Sapru, A., Gitelman, S. E., Bhatia, S., Dubin, R. F., Newman, T. B., & Flori, H. (2005). Prevalence and characteristics of type 2 diabetes mellitus in 9-18 year-old children with diabetic ketoacidosis. *Journal of Pediatric Endocrinology and Metabolism*, *18*(9), 865-872.
19. Zugasti-Murillo, A., Jiménez-Millán, A. I., Bacarizo-Aparicio, P., & Ortiz-Alonso, J. (2005). Características de los episodios de cetoacidosis diabética en adultos evaluados en el Servicio de Urgencias del Hospital General Universitario Gregorio Marañón durante el año 2002. *Endocrinología y Nutrición*, *52*(10), 544-546.

20. Chen, H. F., Wang, C. Y., Lee, H. Y., See, T. T., Chen, M. H., Jiang, J. Y., ... & Li, C. Y. (2010). Short-term case fatality rate and associated factors among inpatients with diabetic ketoacidosis and hyperglycemic hyperosmolar state: a hospital-based analysis over a 15-year period. *Internal Medicine*, *49*(8), 729-737.
21. Guisado-Vasco, P., Cano-Megías, M., Carrasco-de la Fuente, M., Corres-González, J., Matei, A. M., & González-Albarrán, O. (2015). Clinical features, mortality, hospital admission, and length of stay of a cohort of adult patients with diabetic ketoacidosis attending the emergency room of a tertiary hospital in Spain. *Endocrinología y Nutrición (English Edition)*, *62*(6), 277-284.
22. Wang, J., Williams, D. E., Narayan, K. V., & Geiss, L. S. (2006). Declining death rates from hyperglycemic crisis among adults with diabetes, US, 1985–2002. *Diabetes care*, *29*(9), 2018-2022.
23. Johnson, D. D., Palumbo, P. J., & Chu, C. P. (1980, February). Diabetic ketoacidosis in a community-based population. In *Mayo Clinic Proceedings* (Vol. 55, No. 2, pp. 83-88).
24. FAICH, G. A., FISHBEIN, H. A., & ELLIS, S. E. (1983). The epidemiology of diabetic acidosis: a population-based study. *American Journal of Epidemiology*, *117*(5), 551-558.
25. Ko, S. H., Lee, W. Y., Lee, J. H., Kwon, H. S., Lee, J. M., Kim, S. R., ... & Son, H. Y. (2005). Clinical characteristics of diabetic ketoacidosis in Korea over the past two decades. *Diabetic medicine*, *22*(4), 466-469.
26. Casado, M. S., Quintana, M., Izquierdo, M. Á. T., Merlo, V., & Onega, P. L. (2007). Perfil de los pacientes ingresados en UCI con cetoacidosis diabética. *Endocrinología y Nutrición*, *54*(5), 255-258.
27. Razavi, Z., Karimpourian, A., Moradi Aramian, L., & Bazmamoun, H. (2015). Demographic characteristics of type 1 diabetic children and adolescents in Hamadan, Iran. *Journal of research in health sciences*, *15*(3), 196-199.
28. Spaans, E. A., van Dijk, P. R., Groenier, K. H., Brand, P. L., Reeser, M. H., Bilo, H. J., & Kleefstra, N. (2016). Seasonality of diagnosis of type 1 diabetes mellitus in the Netherlands (Young Dudes-2). *Journal of Pediatric Endocrinology and Metabolism*, *29*(6), 657-661.
29. Butalia, S., Johnson, J. A., Ghali, W. A., Southern, D. A., & Rabi, D. M. (2016). Temporal variation of diabetic ketoacidosis and hypoglycemia in adults with type 1 diabetes: A nationwide cohort study: *Journal of diabetes*, *8*(4), 552-558.
30. 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.
31. Freire, A. X., Umpierrez, G. E., Afessa, B., Latif, K. A., Bridges, L., & Kitabchi, A. E. (2002). Predictors of intensive care unit and hospital length of stay in diabetic ketoacidosis. *Journal of critical care*, *17*(4), 207-211.
32. Lone, S. W., Siddiqui, E. U., Muhammed, F., Atta, I., Ibrahim, M. N., & Raza, J. (2010). Frequency, clinical characteristics and outcome of diabetic ketoacidosis in children with type-1 diabetes at a tertiary care hospital. *JPMA. The Journal of the Pakistan Medical Association*, *60*(9), 725.
33. Jefferies, C., Cutfield, S. W., Derraik, J. G., Bhagvandas, J., Albert, B. B., Hofman, P. L., ... & Cutfield, W. S. (2015). 15-year incidence of diabetic ketoacidosis at onset of type 1 diabetes in children from a regional setting (Auckland, New Zealand). *Scientific reports*, *5*(1), 1-7.
34. Razavi, Z. (2010). Frequency of ketoacidosis in newly diagnosed type 1 diabetic children. *Oman medical journal*, *25*(2), 114.
35. Schober, E., Rami, B., & Waldhoer, T. (2010). Diabetic ketoacidosis at diagnosis in Austrian children in 1989–2008: a population-based analysis. *Diabetologia*, *53*(6), 1057-1061.

36. Irigoyen, M. O., Cuartero, B. G., Castellanos, R. B., Lacruz, M. T., Gila, A. G., Casado, I. G., ... & Rigual, M. R. (2012). Ketoacidosis at onset of type 1 diabetes mellitus in pediatric age in Spain and review of the literature. *Pediatric endocrinology reviews: PER*, *9*(3), 669-671.
37. Guisado-Vasco, P., Cano-Megías, M., Carrasco-de la Fuente, M., Corres-González, J., Matei, A. M., & González-Albarrán, O. (2015). Clinical features, mortality, hospital admission, and length of stay of a cohort of adult patients with diabetic ketoacidosis attending the emergency room of a tertiary hospital in Spain. *Endocrinología y Nutrición (English Edition)*, *62*(6), 277-284.
38. Usher-Smith, J. A., Thompson, M., Ercole, A., & Walter, F. M. (2012). Variation between countries in the frequency of diabetic ketoacidosis at first presentation of type 1 diabetes in children: a systematic review. *Diabetologia*, *55*(11), 2878-2894.
39. Alhomood, M. A., Shibli, K. Y., Abadi, S., Mostafa, O. A., & Nahar, S. (2020). Knowledge about diabetic ketoacidosis among parents of type 1 diabetic children. *Middle East Journal of Family Medicine*, *7*(10), 91.
40. Robert, N. (2018). Да Запазим Привлекателността На Одиторската Професия. *ICPA Articles*, *2018*(2), 1-3.
41. Jolobe, O. M. P. (1993). Characteristics of Diabetic Ketoacidosis in Older Patients. *Journal of the American Geriatrics Society*, *41*(8), 888-888.
42. Al-Rubeaan, K. A., Aftab, S. A., Alotaibi, M. S., Alghamdi, A. A., & Rafiullah, M. R. (2011). Clinico-laboratory characteristics of diabetic keto acidosis in adults in a tertiary hospital in Saudi Arabia. *Eur Rev Med Pharmacol Sci*, *15*(10), 1202-1206.

Diabetic ketoacidosis hospitalizations and reduce length of stay of an adult patients with diabetic ketoacidosis attending the emergency room in King Abdulaziz University hospital

Short-Term Case Fatality Rate and Associated Factors among Inpatients with Diabetic Ketoacidosis and Hyperglycemic Hyperosmolar State: A Hospital-Based Analysis over a 15-Year Period

Clinical features, mortality, hospital admission, and length of stay of a cohort of adult patients with diabetic ketoacidosis attending the emergency room of a tertiary hospital in Spain

Diabetic ketoacidosis (DKA) hospitalizations and reduce length of stay of an adult patients with diabetic ketoacidosis attending the emergency room of in a tertiary care in King Abdulaziz University hospital

To assess the number of consultations received to otolaryngology department from variety of departments during the period from 01/06/2015 to 3o/12 /2018through (in hospital) electronic consultation service and use the statistical analysis to pin point and identify changes in the volume of consultations in a tertiary care canter.