

Sustainability of Improvement Project by Implementation of Clinical Practice Pathway (CPP): To Reduce Length of Stay, Decrease Burden of Cost and Mortality in Diabetic Ketoacidosis (DKA)

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Abstract

Background: DKA is a major acute metabolic complication of diabetes. Recent data indicates increase in hospitalizations worldwide during 2009 - 2014. Diabetic ketoacidosis (DKA) is one of the life-threatening acute complications of diabetes mellitus. DKA clinical pathway was approved based on most recent international evidence and guidelines and structured to be as simple and as safe as possible in the light of evidence based practices. A standard clinical practice pathway if applied in the institute for management of DKA, it will optimize the management and decrease the length of stay and substantial decrease in cost and better utilization of beds. Department of Endocrinology in cooperation with CQI&PS Department developed a pathway. The pathway aimed to facilitate evidence-based practice in managing DKA patients, provide patients with uniform care and ensure effective and safe management of DKA. DKA pathway approved by the Hospital Director and implemented as official management tool for DKA patients in 2014. To reduce the length of stay (LOS) and comparing with national and international benchmark and complication. The study carried out over 5 years, since January 2015 to December 2019.

Methods: The quality improvement methodological framework adopted in this study based on FOCUS- PDCA improvement model.

Interventions: Implementing diabetic ketoacidosis clinical pathway.

Results: A total number of 576 patients admitted with a diagnosis of DKA from January 2015 to December 2019 treated with standard clinical practice pathway. DKA average length of stay per year significantly decreased from an average, 2.14 to 1.47 days, which is below the national and international benchmark. Zero mortality rate is highly outstanding in our study compared with the rates found in other studies conducted in KSA and other Europeans institutes. The impact analysis was calculating the potential gain in beds from LOS reduction comparing with the international benchmark of DKA patient with estimated cost of 2054/day and the gain in available beds by 1.6 beds per month.

Conclusion: Most DKA episodes require hospital admission, but mortality is zero, and length of stay at the ER and medical ward depends on the initial severity of the episode.

Keywords: Diabetes Mellitus; Ketoacidosis; DKA; Length of Stay

Introduction

Diabetic ketoacidosis (DKA) is one of the life-threatening acute complications of diabetes mellitus (DM) that mainly occurs in type 1 diabetes patients. True annual incidence rate for DKA is difficult to establish, but population-based studies have reported ranges from 4.6 to 8 cases per 1,000 patients with diabetes.

DKA has considerable cost to health care system with mean cost for DKA each admission is \$17142. Delays in length of stay may cost more for health care providers and suboptimal bed utilization.

A standard DKA clinical practice pathway for guiding all physicians and nursing staff managing DKA may help to optimize the management, shorten hospital stay, and decrease the cost to health care providers.

The most common precipitating factors for the development of DKA related to infections and non-compliance to insulin therapy and diet [1]. A study conducted in Riyadh found that the precipitating factors were missed insulin dose in (51.2%) patients and infections in (22.5%) patients. The hospital stay (mean) was 6.56 ± 3.4 days with no mortality because of DKA [2]. DKA is a major acute metabolic complication of diabetes. Recent data indicates increase in hospitalizations worldwide during 2009 - 2014.

Rationale

Prior to the implementation of the DKA pathway, an audit was conducted in October to December 2013 on DKA patients and data revealed that readmission rates for DKA patients after 30 days of discharge was very high at 13.70% compared to the international benchmark of 2.8%.

Due to the high-risk nature of the disease, the Department of Endocrinology and Diabetology in cooperation with CQI&PS Department developed a pathway. The pathway aimed to facilitate evidence-based practice in managing DKA patients, provide patients with uniform care and ensure effective and safe management of DKA. The DKA pathway approved by the Hospital Director and implemented as official management tool for DKA patients in 2014.

Specific Aims

Primary outcome:

- To reduce the length of stay (LOS) of DKA admissions less than international benchmark 3.24 days.
- To aim mortality rate less than international benchmark 0.4%.

Secondary outcome:

- Reduce DKA severity scores.
- Reduce burden cost of DKA admissions.

Methods

Using the international guidelines and best practice principle of managing DKA patients a standard clinical pathway developed. The pathway approved by the medical administration and the CQI&PS.

All stakeholders involved in the management of DKA hospitalizations oriented about the use of the pathway.

All patients admitted due to DKA treated with the pathway from January 2015 to December 2019 were included in the study. The median length of stay calculated for all patients and compared to international benchmark.

FOCUS—PDCA improvement model is used.

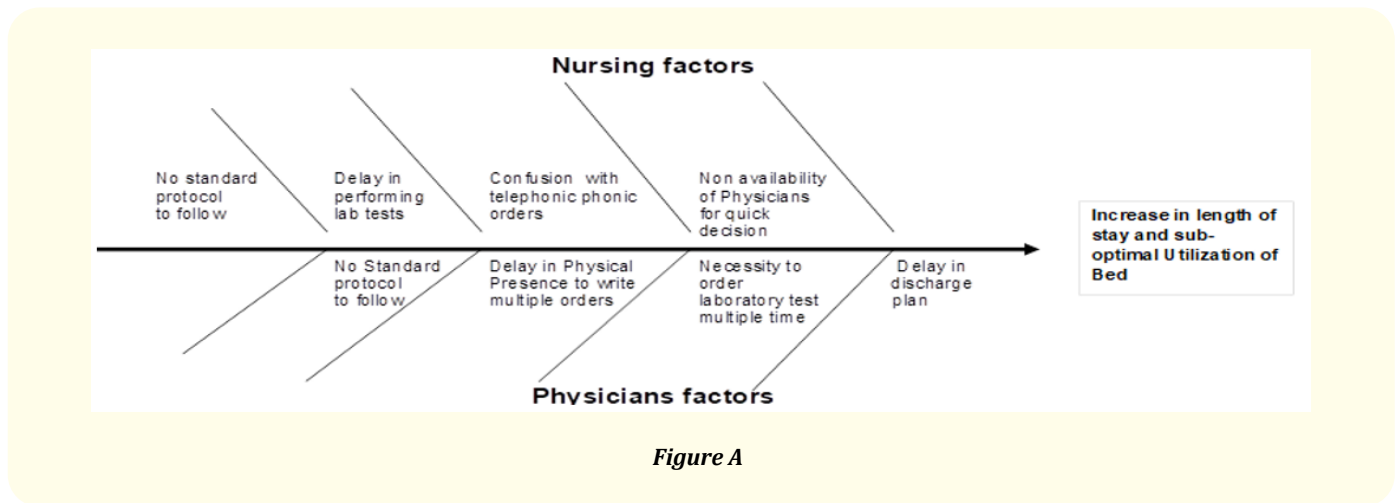


Figure A

Intervention(s):

- Multidisciplinary team was formed to address DKA that consist of:
- Endocrinologist
- Diabetic educators
- Dieticians
- Social workers.
- Using the international guidelines and best practice principle of managing DKA patients a standard clinical pathway developed.
- All stakeholders involved in the management of DKA hospitalizations oriented about the use of the pathway.
- All patients admitted as DKA treated with the pathway and the length of stay calculated and compared to international benchmark.
- The audits for DKA done by endocrine department and CQI&PS department to assess utilization and efficacy of approved DKA pathway in KFAFH in Jeddah.
- Updating the management according to recent research data to further reduction of length of stay and mortality.
- Determine the appropriate course of management by peer reviewing the medical files and ensure the medication supply given.

Figure B

Study of the Intervention(s)

All type 1 diabetes patients with DKA who admitted at KFAFH aged above 12 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.

Outcome measures

Length of stay, severity of DKA, burden cost.

Data collections tools

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 for enrollment in this concurrent cohort study. Case report forms completed for each patient.

Analysis

Data retrieved processed using the Statistical Package for Social Sciences (SPSS®) program version 25. Data of numerical values compared using chi-square t-tests while the categorical comparisons tested by Fisher exact test.

Ethical considerations

This project initiated and approved hospital director. No consent from the patient is required for this project.

Results

A total number of 576 patients admitted with a diagnosis of DKA from January 2015 to December 2019 treated with standard clinical practice pathway. More than 60% of DKA cases admitted were moderate to severe DKA (Figure 1).

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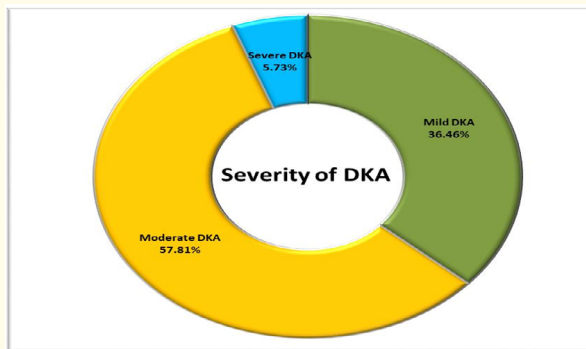


Figure 1: Severity of DKA.

DKA mean length of stay, over 5 years of the study, significantly decreased from, 2.14 to 1.47 days, which is below the national and international benchmark (Table 1 and figure 2). Zero mortality rate is highly outstanding in our study.

Years	No	Mortality (0.4%**)	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	0.00	1-6	2.147 ± 1.179	0.354	0.724	10.200	<0.001*
2016	119	0.00	1-6	2.018 ± 1.280	0.699	0.486	12.630	<0.001*
2017	124	0.00	1-4	1.551 ± 0.842	7.261	<0.001*	25.776	<0.001*
2018	128	0.00	1-3	1.510 ± 0.877	7.611	<0.001*	25.672	<0.001*
2019	126	0.00	1-2	1.475 ± 0.755	9.292	<0.001*	30.107	<0.001*
ANOVA			F	5.155				
			P-value	0.001*				

Table 1: Length of stay and mortality across 5 years.

** International benchmark.

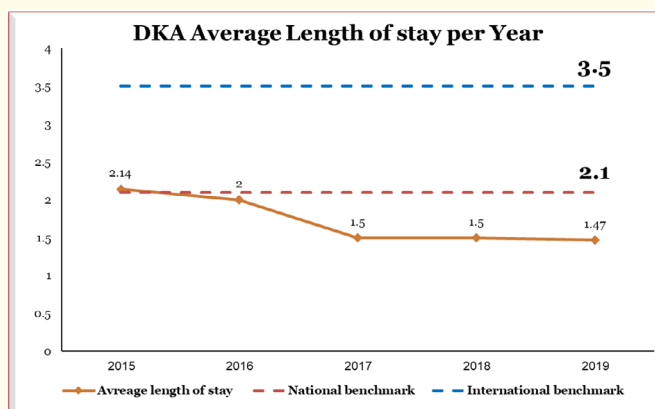


Figure 2: DKA average length of stay per year.

The impact analysis was calculating the potential gain in beds from LOS reduction comparing with the international benchmark of DKA LOS. As shown in table 2 and figure 3 in spite of steady increase in annual admissions in KFAFH, bed gain has improved from 1.0 to 1.6 and operational efficiency has increased from 702,924.44 SAR to 1,175,800.89 SAR. The cost of hospitalization have decreased significantly over five years as shown in table 3 and figure 4 which indicating valuable care intervention.

Year	# of beds	Occu-pancy rate	Current bed used W	LOS (Interna-tional)	LOSa (After) X	LOS reduc-tion	Bed demand with new LOS (Y)	Gain available beds (Z)	Cost per z	Monthly operational efficiency	Daily op-erational efficiency (SAR)	Annual operational efficiency (SAR)
2015	4	70%	2.8	3.24	2.14	1.1	1.849383	1.0	1952.6	58,577.04	2,054	702,924.44
2016	4	70%	2.8	3.24	2	1.24	1.728395	1.1	2201.1	66,032.30	2,054	792,387.56
2017	4	70%	2.8	3.24	1.5	1.74	1.296296	1.5	3088.6	92,658.22	2,054	1,111,898.67
2018	4	70%	2.8	3.24	1.5	1.74	1.296296	1.5	3088.6	92,658.22	2,054	1,111,898.67
2019	4	70%	2.8	3.24	1.4	1.84	1.209877	1.6	3266.1	97,983.41	2,054	1,175,800.89

Table 2: Estimated operational efficiency per year.

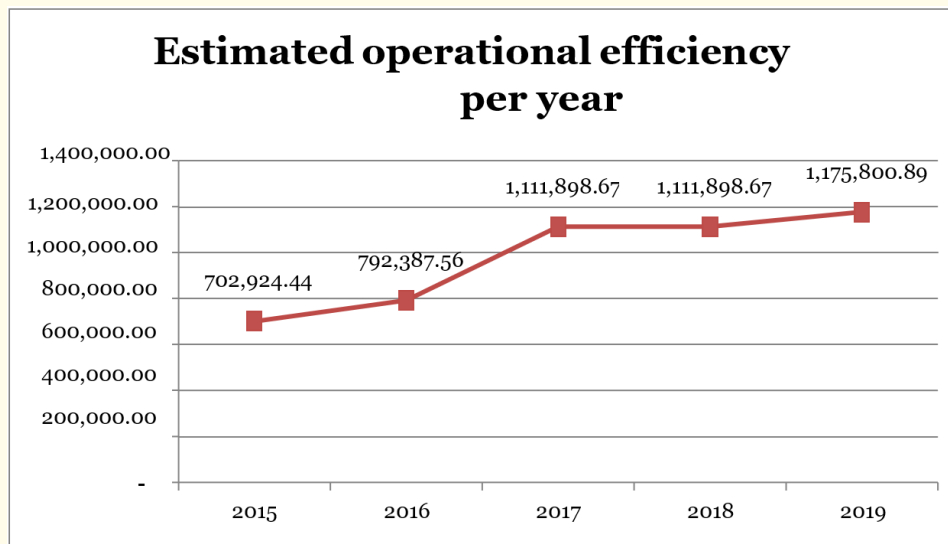


Figure 3

Years	2015	2016	2017	2018	2019	Total cost
Cost saved per year	298,569.44	449,743.84	468,640.64	483,758.08	476,199.36	2,176,911.36

Table 3

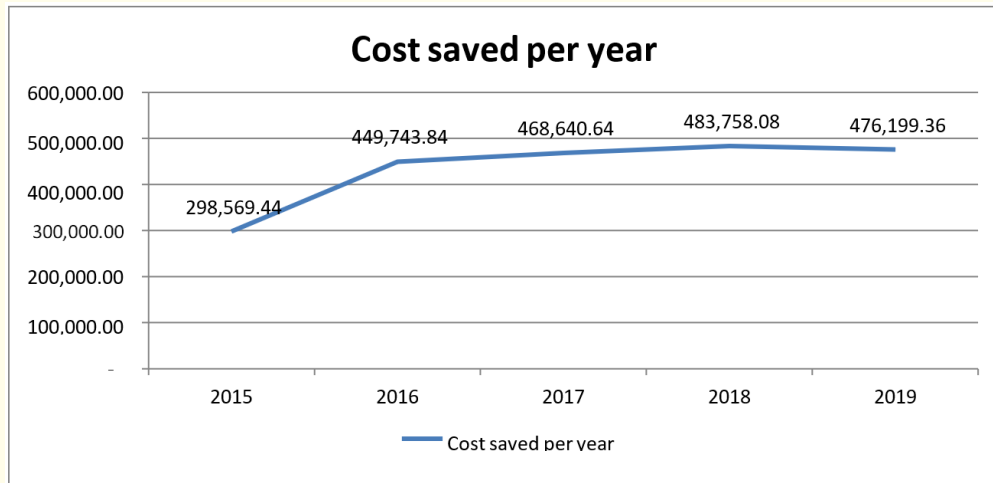


Figure 4

Impact analysis

The impact analysis was calculating the potential gain in beds from LOS reduction comparing with the international benchmark of DKA patient according to the following table with estimated cost of 2054/day and the gain in available beds by 1.6 beds per month.

Interpretation

National wide analysis in US shown length of stay significantly decreased from an average of 3.64 days in 2003 to 3.24 days in 2014 and reported mortality rate of 0.4%. Our study showed an average of length of stay 2.14 to 1.4 days with Zero mortality that is remarkably below international benchmark.

Although more than 60% of DKA cases admitted were moderate to severe DKA, zero mortality rate is highly outstanding in our study compared with the rates found in other studies conducted in KSA (value of 2.9%, 4.1% and 3.5% reported in three previous studies from the KSA2) and European study in tertiary centre showed mortality rate of 1.2%.

This result can be attributed to immediate medical attention given at the centre in management of DKA.

Summary

The hospital stay for DKA patient shortened without major consequences as regard patient safety reflected in zero mortality. DKA mean length of stay per year decreased from an average 2.14 to 1.47 days, which is below the national and international benchmark.

Identify the severity of DKA and motivate special care to acutely ill patient during admissions play rule in determining the course of treatment plan, Severity of DKA and length of stay significantly decreased after implementation of safe and end user friendly clinical pathway. The impact analysis was calculating the potential gain in beds from LOS reduction comparing with the international benchmark of DKA patient projected as annual operational efficiency [3-6].

Conclusion

Most DKA episodes require hospital admission, but mortality rate, and length of stay at the ER and medical ward depends on the initial severity of the episode.

Implementation of well design clinical practice guidelines, ensure of continuous auditing synchronized length of stay, and burden cost. A standard clinical practice pathway if applied in the institute for management of DKA optimizes the management and decrease the length of stay and substantial decrease in cost and better utilization of bed.

It is our hope that a major reduction in morbidity and hospitalizations due to DKA achieved following our Improvement project.

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