

Utilizing Health Analytics in Improving Emergency Room Performance

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Abstract. Emergency room performance improvement has been a major concern for healthcare professionals and researchers. ER patients' length of stay and percentage of patients leaving without treatment are two of the most important indicators for performance monitoring and improvement. The main objective of this study is to utilize health analytics methods in identifying areas of deficiency, potential improvements and recommending effective solutions to enhance ER performance. ER data of 2014 were retrospectively retrieved in January 2015 and analyzed for significant variables affecting inpatient admission rates. Patient Acuity Level was the significant variable on which the recommendations were based. A Fast-Track area was redesigned and dedicated for managing lower acuity level patients; CTAS levels 4 and 5. The performance of the ER has been monitored for the first six months of 2015 and compared to 2014. 29% improvement was achieved on shortening the total ER LOS and 30% improvement was achieved on the percentage of patients leaving ER without treatment.

Keywords. Health Analytics, Emergency Room, Improving Performance, ER Length of Stay, Patients Left Without Treatment.

Introduction

Crowding in Emergency Room (ER) and impaired performance has become a major concern for healthcare professionals and researchers. ER impaired performance is a major barrier to receiving effective and efficient emergency care. Patients who present to ER face long waiting times to be treated and those under treatment face longer treatment time till they are admitted to the hospital or discharged home [1]. Some researchers analyzed the ER crowding and classified its related factors into three interdependent components: input, throughput and output [2]. Other researchers studying emergency room length of stay divided this key performance indicator into three intervals; waiting time, treatment time and boarding time; for patients to be admitted from ER to the hospital [3]. Using these conceptual models we can work on developing strategies and solutions to decrease the crowding of the ER and improve its performance. The problem of inadequate staffing, due to lack of physicians or nurses, low ER physicians and nurses' productivity, low efficiency of ER staff and shortages of treatment areas are commonly studied throughput factors that may cause ER crowding and prolonged LOS [4]. Lower staffing levels or productivity of physicians and triage nurses predisposed patients to wait longer for care [5]. Competency of attending physicians in ER, in terms of skills and efficiency, and lack of, or slow,

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responsiveness of ER nurses has been associated, in many studies, with patients leaving without being seen or leaving before complete treatment. The use and/or delays of the ancillary services, including lab, radiology and other procedures, usually prolong the ED length of stay [6]. This article describes in details the processes implemented in ER performance improvement at King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia. The executive management of the medical and clinical affairs of the hospital decided to utilize health analytics methods to identify areas of deficiency and suggest potential improvements then implement solutions and finally monitor ER using two main key performance indicators; the total ER length of stay for ER patients, reflecting the efficiency of performance [7], and the percentage of patients leaving the ER without treatment, including both patients who left without being seen and those who left before complete treatment, reflecting the effectiveness of ER performance [8].

1. Methods

This study was planned on two phases. The first was to perform a retrospective analysis of ER data; early January 2015. The study data was retrieved from the data warehouse system including all data of all emergency encounters of the last year; 2014. A total of 26,948 encounters with valid data were retrieved. Descriptive analytics techniques were used in the form of calculating different variables and testing for any relationships between those variables and the admission status probability of the patient to determine which variables could be used to support executive management decisions regarding suggesting changes or recommending process redesign in order to improve the ER performance. The second phase of the study started in mid-January 2015, immediately after getting the full results of the analysis of the ER data. This phase included implementing a Fast-Track for lower acuity level ER patients; dedicating 20% of the ER bed capacity in addition to an added internal waiting area for those patients who can stay vertical instead of occupying an ER bed. Two consultant family medicine physicians were assigned to manage those patients with acuity level 4 and 5. The main objective was to assign ER physicians only to cases with higher acuity levels, 1 to 3, and in the same time to reduce the demand for other resources by less acute patients. The ER performance was monitored for any potential improvement using two indicators; ER length of stay and percentage of patients leaving ER without treatment.

2. Results

ER data was cleaned and validated then processed and analyzed exploring different variables that could predict any significance, deficiency or room for potential improvement. Eight main variables could be identified for evaluation using health analytics; these were: Patient Gender, Age Group, Nationality, Patient Acuity Level, Patient Mode of Arrival, Patient Discharge Destination, Day of Encounter and Session of Encounter. Three variables only had statistically significant influence on the admission rates of emergency patients to the hospital inpatient departments and services; those were Patient Acuity Level, Patient Mode of Arrival and Patient Age Group. Other variables did not have any significant effect on the rate of admission, where the most influential variable among these three variables was the Acuity Level of the patient which is following the CTAS – The Canadian Triage and Acuity Scale.

The Acuity Level of all ER patients during 2014 were analyzed and categorized, counting total patients visiting the ER in each acuity category and number of patients admitted from ER to inpatient departments and services in each category and the percentage of admission. The results are summarized in table 1. As the acuity level goes down; become less severe, the percentage of admission becomes less, which is very logic. About third of the cases, 32.8%, were of the acuity levels 4 and 5 where less than 0.5% of those patients were eventually admitted to the hospital.

Table 1. Patients admitted through ER compared to Total ER Patients sorted by Acuity Level during 2014.

Code	Acuity Level	Admitted Patients	%	All ER Patients	%	% of Admitted to All
1	1-Resuscitation	95	2.6%	145	0.5%	65.5%
2	2-Emergent	913	24.8%	2,470	9.2%	37.0%
3	3-Urgent	2,636	71.5%	15,489	57.5%	17.0%
4	4-Less Urgent	38	1.0%	7,575	28.1%	0.5%
5	5-Nonurgent	5	0.1%	1,269	4.7%	0.4%
Total		3,687	100%	26,948	100%	13.7%

The explanation of this, after investigation, was that many eligible patients might have problems accessing their primary care or long waiting for an outpatient appointment, so they come to the ER instead when they feel sick. The decision of the executive management of the hospital was to redesign part of the ER into a Fast-Track area that contained 20% of the ER bed capacity and to dedicate this area to receiving only patients of the least two acuity levels; 4-Less Urgent and 5-Nonurgent and in the same time to dedicate two consultant family physicians, who worked primarily in the ER, to manage only patients of these two acuity levels on a 24 hours basis and then to monitor the performance of the ER for a few months after this change. Starting from January 2015 the ER performance was monitored for both ER length of stay and percentage of patients leaving ER without treatment. The average ER LOS was consistently decreased from around 22 hours in January 2015 to less than 10 hours in June 2015. The ER LOS was also less comparing each month in 2015 with respective months of 2014, except for January, which included the implementation of the new Fast-Track workflow change. The numbers of patients visiting the ER over 2015 months and respective 2014 months were insignificantly different and nearly the same and the numbers of working physicians and nurses were also the same, this indicates that the achieved improvement was mainly due to the change made in the workflow.

Table 2. Total ER LOS in Hours Comparing First 6 Months of 2014 to First 6 Months of 2015.

ER LOS (Hrs)	2014	2015	Improvement %
January	22.4	22.7	+1.3%
February	18.9	17.5	-7.4%
March	20.7	14.8	-28.5%
April	25.1	15.1	-39.8%
May	18.5	11.3	-38.9%
June	23.2	9.8	-57.8%
Average 6 Months	21.4	15.2	-29.0%

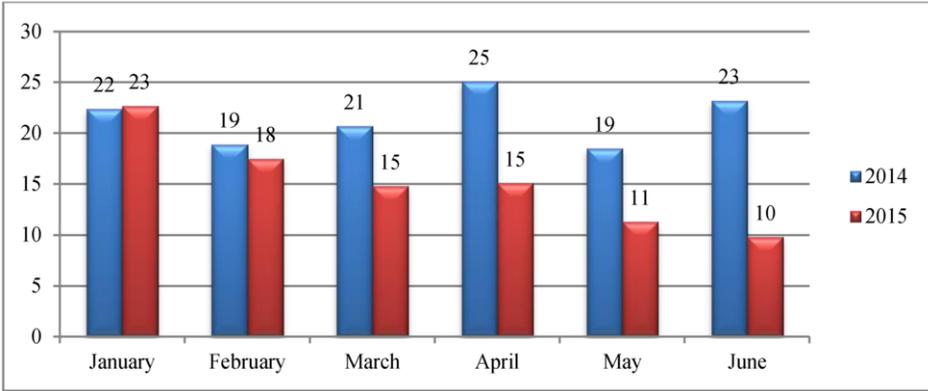


Figure 1. Comparing Total ER LOS during the first 6 months of 2014 and 2015.

The percentage of ER patients who left without treatment was also consistently decreased from around 19% in January 2015 to 7% in June 2015. The percentage of ER patients who left without treatment was also less comparing each month in 2015 with respective months of 2014, except for January, which included the implementation of the new Fast-Track workflow change. Since the numbers of patients visiting the ER and the number of working staff over 2015 months and respective 2014 months were the same, this indicates that the achieved improvement in the percentage of ER patients who left without treatment was mainly due to the change made in the workflow.

Table 3. Percentage of ER Patients Left Without Treatment; comparing 2014 & 2015.

ER Patients Left Without Treatment	2014	2015	Improvement %
January	15.6%	19.4%	24.4%
February	14.6%	14.8%	1.6%
March	17.1%	10.9%	-36.0%
April	19.6%	9.9%	-49.4%
May	13.9%	7.3%	-47.8%
June	17.2%	7.4%	-57.2%
Average 6 Months	16.4%	11.5%	-29.9%

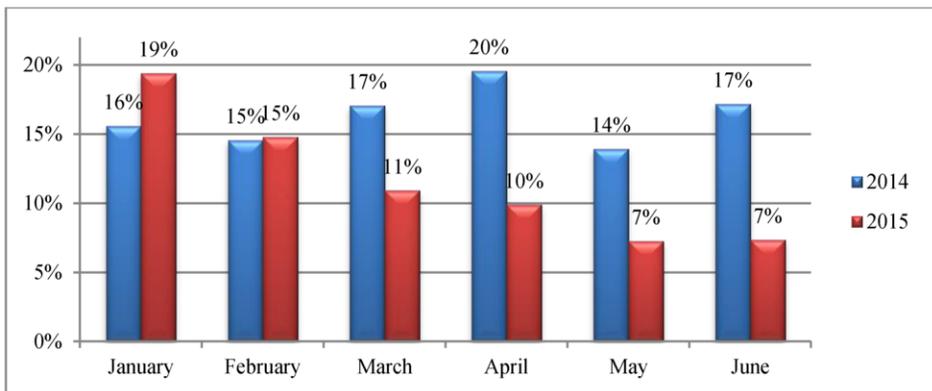


Figure 2. Percentage of ER patients Left Without Treatment during the first 6 months of 2014 and 2015.

3. Discussion

Timeliness is considered an essential quality indicator for many healthcare services, especially for emergency conditions [9]. The Institute of Medicine defines six domains of quality of care: safety, patient-centeredness, timeliness, efficiency, effectiveness, and equity. ED crowding is associated with increased mortality or complications and morbidity in patients with time sensitive conditions or those who leave without treatment. At least two domains of quality of care, safety and timeliness, are compromised by ED crowding [10]. Many studies investigated the association between increased hospital occupancy rates and the increased ER crowding and prolonged ER length of stay or increased percentage of patients leaving without treatment [11-13]. Our study examined utilizing health analytics methods in identifying areas of deficiency, potential improvements and recommending effective solutions to positively enhance ER performance. Data and analysis can be used for process improvement through identifying variables, conducting measurements and exploring areas and methods of potential improvement. This study had two main limitations; 1) it examines the effect of one solution, implementing a Fast-Track area for low acuity ER patients, on the performance of the ER. 2) It examines the improvement in the ER performance along only two indicators. More solutions should also be examined for their effects on improving ER performance and more indicators should also be monitored.

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