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Reducing Emergency Department Crowding Using Health Analytics Methods: Designing An Evidence Based Decision Algorithm

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Abstract

OBJECTIVE: The main objective of this study is to utilize health analytics methods in designing an evidence based decision algorithm to support healthcare professionals in identifying and safely diverting less risky emergency patients to ambulatory care settings or referring them to other hospitals in order to reduce emergency department crowding. **METHODS:** The study used retrospective analysis methods. Data were retrieved from the hospital data warehouse system including a total of 13,750 emergency encounters conducted over the first six months of 2014. Descriptive analytics were used to explore different variables and test for any relationships between these variables and admission probability of the patient to determine which variables could be used to build the suggested decision algorithm model. **RESULTS:** Three variables; acuity level, mode of arrival and age group were identified as the most influential factors on future admission status of emergency patients and were recommended as indicators for designing the decision algorithm. **DISCUSSION:** Based on the analysis and the suggested decision algorithm, 30% of emergency patients had a 0.2% admission rate; these were suggested to be diverted to urgent outpatient appointments within 24 hours. About 20% of patients can be safely referred to other hospitals, according to the conditions set in the decision algorithm while the remaining 50% of patients should continue their emergency treatment. **CONCLUSION:** Health analytics can support designing evidence based tools to guide the process of performance improvement, in our study reducing emergency department crowding at King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia.

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1. Background and Significance

Emergency department (ED) crowding is a significant international problem, with an increasing research worldwide into this field. It has become a major barrier to receiving timely emergency care for patients all over the world¹. Patients who arrive to EDs often face long waiting times to be treated and, for those who require admission, even longer waiting times are expected for an inpatient hospital bed. Because ED crowding is a reflection of a higher level supply and demand mismatches in the healthcare system, the problem cannot be solved by examining the ED in isolation. A conceptual model of ED crowding could help to understand its causes and develop potential solutions. This model classifies ED crowding into three interdependent components: input, throughput, and output. These components exist within an acute care system characterized by the delivery of unscheduled care. Using this conceptual model we can work on developing strategies and solutions to reduce ED crowding².

1.1. Factors affecting ED Crowding

According to Asplin's conceptual model, factors of ED crowding can be classified mainly into three categories; input factors, throughput factors, and output factors. Input factors usually reflect sources and aspects of increased patient inflow, throughput factors reflect bottlenecks and slow processes within the ED and output factors reflect bottlenecks in other next parts of the health care system that might affect the ED, such as availability of hospital inpatient beds for ED patients to be admitted^{3, 4}. Input factors include the increased flow of patients on the ED, mainly due to increasing numbers of non-urgent visits, the frequently flyer patients and the effects of seasons of some infectious diseases such as influenza which might lead to increased ED crowding. Sometimes low acuity patients frequently seek non urgent care in the ED due to insufficient or untimely access to primary care. Frequent ED visitors, defined by four or more annual visits, account for 15% of the total ED visits in many hospitals, these patients usually do not have urgent complaints but yet they still come to the ED for treatment⁵. The closure of other hospitals and healthcare facilities might lead to increased ED crowding. Ambulance diversion from other hospitals due to acute, complicated or tertiary care cases also can lead to increased crowding. Recently discharged inpatients might not represent a huge percentage of ED visits but when they come to ED they usually have longer ED lengths of stay and more frequent hospital admissions than other patients. Some studies linked lower socioeconomic status with increased waiting times and ED length of stay⁶.

The main throughput factors include inadequate staffing and shortages of treatment areas, which are the two commonly studied factors that may cause ED crowding. The average nurse should be caring for four patients and the average physician should be caring for six to seven patients simultaneously. Lower staffing levels of physicians and triage nurses predisposed patients to wait longer⁷. The training background of attending physicians in charge of an ED has been associated with patients leaving without being seen. The use and/or delays of the ancillary services, including lab, radiology and other procedures, usually prolong the ED length of stay⁸. The usual output factors that might increase ED crowding include mainly the slow inpatient boarding process and hospital bed shortages, which are identified as commonly studied output factors that may cause ED crowding. The increasing hospital occupancy rates and bed shortage are strongly correlated with increased ED patients' waiting times, ED occupancy level and ED patients' length of stay especially when the hospital occupancy levels exceeded 90%^{9, 10}.

1.2. Effect of ED Crowding

The effects of ED crowding can be classified generally into four main categories; adverse clinical outcomes, reduced healthcare quality, impaired access to care and healthcare provider losses. Adverse clinical outcomes reflect health related and clinical patient complications. Reduced healthcare quality reflects below benchmarks quality of care delivery process. Impaired access to care reflects the inability of patients to receive timely care at their preferred institutions. Healthcare provider losses reflect consequences borne by the health care system itself¹¹. Patient mortality is a commonly studied adverse outcome of crowding. Many studies found a significant increase in mortality rates associated with increased ED crowding¹². Transport delays and treatment delays are also effects of crowding and related to reduced quality. Patients who arrive at the ED during crowded periods will wait longer for

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