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CAN PATIENT VARIABLES MEASURED ON ARRIVAL TO THE EMERGENCY DEPARTMENT PREDICT DISPOSITION IN MEDIUM-ACUITY PATIENTS?

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☐ **Abstract—Background: Emergency department crowding has led to innovative "front end" care models to safely and efficiently care for medium and lower acuity patients. In the United States, most treatment algorithms rely on the emergency severity index (ESI) triage tool to sort patients. However, there are no objective criteria used to differentiate ESI 3 patients. Objective: We seek to derive and validate a model capable of predicting patient discharge disposition (DD) using variables present on arrival to the emergency department for ESI 3 patients. Methods: Our retrospective cohort study included adult patients with an ESI triage designation 3 treated in an academic emergency department over the course of 2 successive years (2013–2015). The main outcome was DD. Two datasets were used in the modeling process. One dataset, the derivation dataset (n = 25,119), was used to develop the statistical model, while the second dataset, the validation dataset (n = 24,639), was used to evaluate the statistical model's prediction performance. Results: All variables included in the derivation model were uniquely associated with DD status ($p < 0.001$). We assessed multivariate adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for age (2.50 [95% CI 2.35–2.65]), arrival mode (1.85 [95% CI 1.74–1.96]), heart rate (1.31 [95% CI 1.26–1.37]), sex (1.35 [95% CI 1.28–1.43]), oxygen saturation (1.06 [95% CI 1.01–1.10]), temperature (1.10 [95% CI 1.06–1.15]), systolic blood pressure (1.18 [95% CI 1.12–1.25]), diastolic blood pressure (1.16 [95% CI 1.09–1.22]), respiratory rate (1.05 [95% CI 1.01–1.10]), and pain score (1.13 [95% CI 1.06–1.21]). The validation C-statistic was 0.73. Conclusion: We derived and validated a model and created a nomogram with acceptable discrimination of ESI 3 patients on arrival for purposes of predicting DD. Incorporating these variables into the care of these patients could improve patient flow by identifying patients who are likely to be discharged. © 2016 Elsevier Inc. © 2016 Elsevier Inc. All rights reserved.**

☐ **Keywords—clinical guidelines; general EM practice**

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INTRODUCTION

Background

According to the latest National Hospital Ambulatory Medical Care Survey (NHAMCS), there were an estimated 136.3 million emergency department (ED) visits in the United States (1). Of those visits, a physician or a physician extender evaluated 27% of patients in <15 min and 40.7% of patients in 15 min to 1 h. The rest of the patients had to wait >1 h for evaluation by a licensed independent practitioner. Not every patient's care can be initiated upon arrival, and patients presenting to the emergency department need to be prioritized.

Emergency physicians David Eitel and Richard Wuerz developed the Emergency Severity Index (ESI) tool in the late 1990s. It has been updated since then and is currently in version 4. The tool's use has been facilitated by the publication of the ESI Implementation Handbook. The most recent edition was published and is available for

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review on the Agency for Healthcare Research and Quality website (2).

Importance

ED visits continue to increase every year. This increased demand coupled with ED boarding has resulted in crowding. Efforts to improve wait times and decrease the number of patients who leave without treatment have led to the creation of novel care pathways. Often, these strategies use the ESI triage level to assign patients. The "fast track" model has gained wide acceptance in many EDs. In the NHAMCS survey, 45.3% of EDs reported a "separate fast track unit for nonurgent care." With these lower-acuity patients siphoned off, the medium-acuity cases now wait the longest for care. As such, newer strategies are focusing on these patients (i.e., ESI 3). For example, 1 hospital created a dedicated "mid-track" area. This protocol required physicians to identify ESI level 3 "patients with a high likelihood of discharge home." The trial resulted in decreased length of stay (LOS) and decreased left without being seen (LWBS) for these patients (3). Another decompression strategy uses a process called vertical vs. horizontal streaming. In a more recent survey of academic EDs, this method was being used or implemented in 29% and 41% of EDs, respectively. This process places a provider outside the main treatment area that is responsible for providing care to selected ESI level 3–5 patients (4). Appropriate use of these ED decompression strategies is predicated upon the functionality and accuracy of the initial triage process. Admitted patients typically have a longer LOS than nonadmitted patients, and therefore inaccurate assignment/triage of patients to these special track risks could compromise efficiency and safety.

Goals of this Investigation

Our study seeks to evaluate patient variables that are present upon arrival to the ED that predict the discharge disposition (DD) of medium-acuity (i.e., ESI 3) patients. This information could assist providers with assigning care pathways for this largest cohort of patients.

METHODS

Study Design

The Institutional Review Board of the University of Virginia (UVA) approved our retrospective, observational study. It was conducted at The UVA Health System, a regional referral center located in Charlottesville, Virginia. Our ED provides care to approximately 60,000 sick and injured patients per year. The ED is divided into 3 primary treatment areas. Pediatric patients are seen preferentially in the pediatric ED. During peak hours (11:00 AM–11:00 PM), patients who are deemed suitable by triage are preferentially sent to express care. This treatment area (express care) is staffed by nurse practitioners and physicians and preferentially sees patients with an ESI score of 4 or 5. All other patients are treated in the main/adult ED. Our institution uses the ESI triage tool to assist in this determination.

Selection of Participants

Eligible patients were identified from the electronic medical record (EPIC, Verona, WI). ED visits of all UVA ED patients from April 1, 2013 to March 31, 2014 were extracted for the derivation cohort, and visits from April 1, 2014 to March 31, 2015 were used for the validation cohort. Variable collection was consistent for each year. Patient information was anonymized by removing all Health Insurance Portability and Accountability Act identifiers from the dataset and assigning each patient a unique study number. The raw dataset for the derivation cohort contained 57,481 patients. The raw dataset for the validation cohort contained 58,944 patients.

Patients were eligible if they were ≥18 years of age, if they presented to the ED with an ESI score of 3, and if they had complete data for the following characteristics: ED disposition, sex, age, arrival mode, temperature, systolic and diastolic blood pressure, pulse, respiratory rate, oxygen saturation, and pain level.

Data Collection and Processing

Patients ≥90 years of age were grouped into 1 age category of >89 years old. A minority of patients had both admission and discharge time stamps in the raw dataset; in these cases, the later time was used as the final ED disposition.

Outliers were eliminated by removing extremes from the cohorts, with a goal of removing 0.25% of data at the upper limit and 0.25% of data at the lower limit. The encounters with the highest and lowest values in temperature, systolic blood pressure, diastolic blood pressure, pulse, and respiratory rate were removed. The encounters with the lowest values were removed from oxygen saturation because the upper limit of this characteristic is 100%. In total, 0.52% of data were removed from the derivation cohort and 0.46% were removed from the validation cohort.

Patients were sorted into 3 different modes of arrival: ambulatory, ambulance or police department (PD), and by air. Patients who arrived by air were removed from data analysis because of the acuity of presentation.