Use of logistic regression to predict the need for admission among emergency department patients: a model to predict patient suitability for a rapid assessment zone.

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INTRODUCTION: Facilitating patient flow through the emergency department can sometimes be difficult administration task. The ability to predict which patients will require admission to the hospital can be an important factor in facilitating this flow. For instance, patients who are likely to require a short emergency department visit can often be assigned to low acuity areas. Conversely, patients who are likely to require admission to the hospital may be assigned to areas with such resources as cardiac monitors, and nursing staff. The University of Alberta Hospital in Edmonton, Alberta, Canada is a large tertiary care hospital. The emergency department receives approximately 250 adult and pediatric patients each day. In order to facilitate the flow of patients who are likely to be treated in the emergency department and discharged, a new rapid assessment zone (RAZ) was introduced to the emergency department approximately 6 months prior to the present study. In order to be candidates for this rapid assessment zone, patient's are required to be of low acuity and suitable for treatment and discharge in this area. That is, admitted patients are not to be placed in this area. At present there is a brief guiding document for use by the triage nurse to assist in this decision. The goal of this study is to create an admission rule based on logistic regression to predict which patients are unlikely to require admission to the hospital and are thus suitable for inclusion in the rapid assessment zone. A logistic regression model was be fitted to the existing data with the null hypothesis of all coefficients equal to 0 was tested against the alternative hypothesis that some coefficients do not equal 0.

METHODS: In this retrospective cohort study, data from one week of emergency department visits was obtained from the emergency department information system computer. This data included the patient's age, gender, triage score using the Canadian triage assessment score (CTAS), pulse, respiratory rate, Glasgow coma scale, systolic blood pressure, and arrival by ambulance or not. These factors were considered for inclusion, as predictors for the binary outcome measure of admission versus no admission. The observations were used to fit a generalized linear model using a binomial random component and the logit link. Goodness of fit was assessed by the Hosmer-Lemshow statistic, and model adequacy was assessed using the generalized coefficient of determination (R-squared).

RESULTS: Data was available for 2486 emergency department visits. This included 526 admissions and 1960 discharges. Mean age was 48 years. Assigned CTAS was 30 code 1, 484 code 2, 1204 code 3, 615 code 4, and 153 code 5. Only 566 observations included complete data, and these were used to fit the binomial logistic model. Only age, sex, CTAS, respiratory rate, and ambulance arrival had confidence intervals for the coefficients that did not cross 0. Pulse, GCS, and systolic blood pressure coefficients crossed zero. The minimal AIC value of 500.62 for the model included the age, sex, CTAS, respiratory rate, and GCS terms. Notably however, the simpler model without the GCS term had an AIC value of 500.67 – matching the terms that appeared significant in the confidence intervals. Thus, for the sake of parsimony, the final model was fit with only the age, sex, CTAS, respiratory rate, and ambulance arrival terms. The Hosmer-Lemshow statistic was 13.0 ($p=0.11$). The generalized coefficient of determination (R-squared) was 0.306.

CONCLUSIONS: The present study suggests that the factors of age, gender, triage score, respiratory rate, and arrival by ambulance are the most important for predicting need for eventual admission. This is valuable information, since the current criteria for placement in the RAZ does not include the factor of arrival by ambulance or gender, which should be considered for addition. Although, the Hosmer-Lemshow statistic did not reveal statistically significant lack of fit, the generalized coefficient of determination was relatively low indicating that the model could explain only 30% of the variation in admission rate.