Fortune telling

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Research letter

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Fortune telling: predicting hospital admissions to improve emergency department outflow

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Emergency departments (EDs) are struggling to provide timely care due to crowding problems [1]. Crowding results in longer waiting times, increased length of stay (LOS) in the ED and patient and staff dissatisfaction [1]. The inability (or delay) to hospitalize ED patients may result in an ED outflow obstruction and thereby contribute to an increase in LOS in the ED. A timely initiation of the admittance process could theoretically contribute to minimize this outflow obstruction [2,3].

The admittance process is generally initiated when ED evaluation and treatment has completed [4]. Initiating the admittance process earlier, by making an admission request earlier (parallel to the ED evaluation process), may enhance the outflow of ED patients [5,6]. However, starting the admittance process earlier can only improve ED throughput times if admissions are accurately predicted. In various previous studies, both physicians and nurses performed poorly on predicting admissions [7–10]. Although prediction models have been developed to improve prediction accuracy, most are difficult to adopt and therefore barely used in practice [4,8,9]. Alternatively, it has been suggested that admission predictions later in the course of the ED visit (as opposed to right at triage) might improve admission prediction accuracy [8].

Therefore, we performed a prospective, observational cohort study to assess the accurateness of admission and discharge predictions 1 h after triage at the ED. The secondary aim was to compare the prediction accurateness of physicians and nurses. The study was conducted in the ED of a teaching hospital in the Netherlands [Medical Center Leeuwarden (MCL)] with an annual ED census of 26 000 patients. The average LOS for discharged and admitted ED patient is, respectively, 137 and 174 min. The average time until an admittance request is made is 2.5 h, with 3.8% of the requests being made within 1 h of ED triage. The most appropriate ward is contacted after specialist acceptance when an admittance request is made.

Data on the predictions of physicians and nurses were collected during a two-week period in April 2019 (on weekdays between 8 a.m. and 5 p.m.). Participating physicians were residents or consultants working in ED ($n = 33$). Nurses were all qualified ED nurses ($n = 47$). Patients were included if they were at least 18 years of age, gave consent for participation, and stayed for more than 1 hour at the ED. The study was approved by the local ethics committee of the MCL (protocol nr. NWMO-362). Both the physician and nurse with primary responsibility for the patient were independently asked to predict admittance to a hospital ward or discharge after the ED visit. After the sampling period, predictions were compared with the final disposition recorded in the electronic hospital record (EPIC) of each patient. Overall prediction accurateness [area under the curve (AUC)], sensitivity, specificity, positive predictive value (PPV) and negative predictive value were calculated. Differences between physicians and nurses regarding prediction performance were tested with McNemar's test. All analyses were done using SPSS for windows version 22.

During the study period, 324 patients visited the ED on weekdays between 9 a.m. and 5 p.m. Fifty-nine patients did not meet the inclusion criteria (of whom 28 left the ED within 1 hour of presentation, three were children and 28 were unable or unwilling to give consent), leaving 265 patients for whom predictions were obtained. Two patients only had a prediction by either a nurse or a physician.

Ultimately, there were 143 actual admissions and 122 actual discharges, resulting in an admission rate of 54%. Average LOS during the study period was 151 min for discharged patients and 221 min for admitted patients. Physicians predicted 147 admissions and 117 discharges, whereas nurses predicted 141 admissions and 123 discharges. Overall, the accurateness of admission prediction was 86.4%. Table 1 shows the prediction performance stratified by profession. Independent of the applied performance metric physicians performed slightly better than nurses [AUC of 0.889 for the physicians and an AUC of 0.837 for the nurses ($P = 0.026$)].

Table 1 Prediction performance of emergency department physicians and emergency department nurses for hospital admission 1 h after triage in the emergency department

	Overall (%)	Physicians (*n*=33) (%)	Nurses (*n*=47) (%)
Accurateness	86.4	89.0	83.7
Sensitivity	88.0	91.6	84.5
Specificity	84.4	86.1	82.8
Positive prediction value	86.8	88.4	85.1
Negative prediction value	85.8	89.7	82.1

In this study, we found that ED physicians and nurses performed well on predicting admissions 1 h after triage. This is in sharp contrast to previous studies, wherein admission prediction accuracy at triage was reported to be poor [7–10]. Observing and treating the patient for 1 hour likely resulted in a better understanding of the nature of the patient's presenting problem. Although we have not quantified this in our current study, availability of (point of care) test results and radiological studies performed during the first hour of ED evaluation may have contributed to this.

It is likely that predictive accuracy would even have been higher 2 or 3 h after ED triage. However, this would have limited the potential to improve throughput times, as admission requests before the study were placed 2.5 hours after triage on average. Only 3.8% of the admission requests were placed within 1 hour of triage prior to the study. Therefore, with an overall PPV of 86.8% for the prediction of hospital admission, we think the 1-h point is optimal to evaluate the need for hospital admission, allowing bed-requests to be placed early and correctly for the vast majority of patients.

Our study has several limitations. First, our results cannot be generalized to populations with different (lower) admission rates, a higher mean age or a different patient acuity, as these factors likely affect prediction accuracy. The admission rate was high (54%) in our study, but representative of the annual admission rate, largely due to a well-developed primary care system. Second, the optimal time after triage to predict the need for admission may vary with availability of resources, and the relative benefit may vary with the average length of stay of admitted patients in the ED. Furthermore, we could only compare our findings with historical cohorts, as we have not asked participating physicians and nurses to predict admission at different moments over time. Finally, there is no guarantee that accurate admission prediction and a timely initiation of the admittance process will result in a reduction of outflow obstruction, as many other patient and hospital factors also moderate this relation. Despite these shortcomings, our study shows the potential for early admission predictions on ED outflow (and thereby throughput times). Future studies should focus on the effect of these early-predictions on ED throughput times.

In conclusion, ED physicians and nurses can accurately predict which patients have to be admitted to a hospital ward 1 h after triage in the ED. This has the potential to improve patient outflow (and thereby throughput times) in ED.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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