Abstract

Predictive Modeling of Emergency Hospital Transport Based on a Personal Emergency Response System (PERS): Comparison to Clinical Outcomes

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Abstract

Background: With the worldwide increase in the elderly population, chronic diseases and associated healthcare utilization such as costly emergency department visits and subsequent hospitalizations are also on the rise. Predictive analytics can be used to identify patients at high risk for emergency utilization, using Electronic Health Record (EHR) data collected before or at hospital discharge. In addition, non-hospital data may be useful for prediction of changes in risk outside of hospital settings. Inexpensive monitoring of elderly via a Personal Emergency Response System (PERS) to identify patients at high risk for emergency hospital transport could be used to target interventions and prevent avoidable, costly long-term healthcare utilization.

Objective: The objectives were 1) to develop and validate a predictive model of 30-day emergency hospital transport based on PERS data; and 2) to compare its predictions with clinical outcomes derived from the EHR.

Methods: De-identified medical alert pattern data of 290,434 subscribers to a PERS service were used to build a gradient tree boosting-based predictive model of 30-day hospital transport, including predictors derived from subscriber demographics, self-reported medical conditions, caregiver network information, and up to two years of retrospective medical alert data. Model performance was evaluated on an independent validation cohort (n=289,426). EHR and PERS records were linked for 1,815 patients from the Partners HealthCare at Home program, to compare PERS-based risk scores with rates of emergency encounters as recorded in the EHR.

Results: After feature selection, the predictive model of 30-day emergency hospital transport included 121 predictors. Previous recent incidents and emergency encounters were among the most important variables in the predictive model. Predictors also included the number of self-reported medical conditions, and COPD, CHF, and heart conditions specifically. Other important predictors included age, gender, and the number of responders. Goodness-of-fit test and calibration plot indicated that the model predicted probabilities matched with observed outcomes across ranges of predicted risk. Performance of the predictive model of emergency hospital transport, as evaluated by area under the receiver operator characteristic curve (AUC), was 0.78. In the top 1% predicted high-risk patients, the risk of having one or more emergency hospital transports in the next 30 days was 11.6 times higher than in the overall population. Comparison with clinical outcomes from the EHR showed 3.9 times more emergency encounters in predicted high-risk patients compared to low-risk patients in the year following the prediction date.

Conclusions: Remotely collected patient data, facilitated by personal health technologies, can be used to reliably predict utilization outcomes. These predictive analytics tools can be used by healthcare organizations to extend population health management into the home. By timelier identifying of high-risk patients, interventions can be targeted to them. This could lead to overall improved patient experience, higher quality of care and more efficient resource utilization. Future studies could explore the impact of combined EHR and PERS data on predictive accuracy.

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Multimedia Appendix 1

Full poster.

[PDF File (Adobe PDF File), 781KB - iproc_v3i1e32_app1.pdf]

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