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Near Real-Time Prediction of Hospital Performance Metrics Using Scalable Random Forest Algorithm

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While previous studies have shown the potential value of predictive modelling for emergency care, few models have been practically implemented for producing near real-time predictions across various demand, utilisation and performance metrics. In this study, 33 independent Random Forest (RF) algorithms were developed to forecast 11 urgent care metrics over a 24-hour period across three hospital sites in a major healthcare system in and around Bristol, England. Metrics included: ambulance handover delay; emergency department occupancy; and patients awaiting admission. Mean Absolute Error (MAE), Root Mean Squared Error (RMSE) and Symmetric Mean Absolute Percentage Error (SMAPE) were used to assess the performance of RF and compare it to two alternative models: naïve baseline (NB) and Auto-Regressive Integrated Moving Average (ARIMA). Using these measures, RF outperformed NB and ARIMA in 76% (N = 25/33) of urgent care metrics according to SMAPE, 88% (N = 29/33) according to MAE and 91% (N = 30/33) according to RMSE. The RFs developed in this study have been implemented within the local healthcare system, providing predictions on an hourly basis that can be accessed 24/7 by local healthcare planners and managers. Further application of the models by another healthcare system in South West England demonstrate the wider scalability of the approach.

Keywords

Machine learning; Random forest; Forecasting; Urgent care; Predictive analytics; Time series

Classification

Mainly application

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