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Integrating a machine learning algorithm to forecast daily asthma hospitalizations

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PURPOSE: Acute asthma is one of the most frequent causes of hospital admissions in children. However, there is a lack of deep learning methods for decision making in clinical care for asthma patients. We sought an artificial intelligence (AI) forecasting algorithm for future hospitalizations to improve preventive care to asthma patients.

METHODS: Daily hospitalizations meeting criteria for asthma exacerbations at Cincinnati Children's were collected from the electronic health record, capturing ~95 % of in-county admissions. Hospitalizations from Hamilton County, the City of Cincinnati, and one high morbidity neighborhood were collected from January 1, 2016, to June 30, 2023. We integrated and compared the performance of a traditional forecasting algorithm to a Prophet machine learning algorithm trained on all but the last two years of hospitalizations. We collected qualitative feedback from clinical care providers to calibrate the algorithms.

RESULTS: There were 588 days (21.5 %) with no hospitalizations, 761 days (27.8 %) with one, 566 days (20.7 %) with two, 408 days (14.9 %) with three, and 413 days (15.1 %) with four or more hospitalizations. The Prophet algorithm had better cross-validated prediction accuracy (Median Absolute Percentage Error (MAPE): 0.516) than the traditional forecasting algorithm (MAPE: 0.831). Calibration resulted in a 5 % high-risk threshold (sensitivity: 0.771; specificity: 0.696; AUC: 0.805, 95 % confidence interval: (0.776, 0.834)). The Prophet algorithm was superior to the traditional forecasting algorithm for timing and quantifying future asthma hospitalizations.

CONCLUSIONS: Integrating AI with approaches to pediatric asthma care offers enhanced prediction of future exacerbations that could enable proactive prevention when integrated with clinical operations.

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Declaration of Competing Interest

None.

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