<u>Letter to the Editor</u>

Authors' Reply: Predicting the Emergency Department Patient Journey Using a Machine Learning Approach

Dhavalkumar Patel, MSc; Eyal Klang, MD; Prem Timsina, PhD

Icahn School of Medicine at Mount Sinai, Institute for Healthcare Delivery Science, New York City, NJ, United States

Corresponding Author:

Dhavalkumar Patel, MSc
Icahn School of Medicine at Mount Sinai, Institute for Healthcare Delivery Science
7400 River Rd #231
New York City, NJ 10017
United States
Phone: 1 2018794854
Email: pateldhaval021@hotmail.com

We appreciate the letter by Kovoor et al [1] referencing our recent article on predicting hospitalizations from nurse triage notes [2]. We congratulate the authors on their work using XGBoost (extreme gradient boosting), random forest, and logistic regression to predict multiple emergency department (ED) outcomes, including prolonged length of stay and inpatient admissions. Their integration of systemic factors, such as bed occupancy, underscores how operational data can enhance model performance.

One key area of interest is the integration of structured electronic health record data, such as vitals or laboratory values, with free-text triage notes. Our experience suggests that combining narrative descriptions with numerical features can yield deeper insights than either source alone, capturing both clinical context and objective measurements. Furthermore, recent studies point toward improved performance when text-based features are complemented by relevant structured data, offering a richer perspective on patient acuity and ED workflow [3].

Another promising direction involves large language models (LLMs). We have explored the use of GPT-4 for predicting ED admissions using real-world triage scenarios. Our approach used two methods: a naive application of the LLM and an augmented approach incorporating retrieval-augmented generation examples and probabilities derived from established machine learning models. Although a naive LLM approach might be outperformed traditional approaches, providing relevant clinical examples and numeric predictions can significantly enhance its performance, narrowing the gap. This synergy between LLMs and conventional machine learning could pave the way for more adaptive and interpretable decision support tools in the ED [3].

We agree with the authors that incorporating systemic variables can enrich predictive power and look forward to further exploration in real-time settings. Our findings suggest that simpler methods can be effective in resource-limited environments. The authors' demonstration that XGBoost excels in their cohort supports the evolving role of various algorithms across diverse health systems.

We appreciate their contribution and share their view that ongoing validation and broader integration of machine learning can aid ED decision-making.

Conflicts of Interest
None declared.

References

1. Kovoor JG, Carmichael GJ, Stretton B, Gupta AK. Predicting the emergency department patient journey using a machine learning approach. JMIR AI. 2025;4:e67321. [doi: 10.2196/67321]
2. Patel D, Timsina P, Gorenstein L, et al. Traditional machine learning, deep learning, and BERT (large language model) approaches for predicting hospitalizations from nurse triage notes: comparative evaluation of resource management. JMIR AI. Aug 27, 2024;3:e52190. [doi: 10.2196/52190] [Medline: 39190905]
3. Glicksberg BS, Timsina P, Patel D, et al. Evaluating the accuracy of a state-of-the-art large language model for prediction of admissions from the emergency room. J Am Med Inform Assoc. Sep 1, 2024;31(9):1921-1928. [doi: 10.1093/jamia/ocae103] [Medline: 38771093]

Abbreviations

ED: emergency department
LLM: large language model
XGBoost: extreme gradient boosting