The Role of Artificial Intelligence in Transforming Healthcare: The Hospital Readmission Case Study

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BACKGROUND

Since 2021, emboldened by new tools placing the power of artificial intelligence (AI) in the hands of all, there has been an acceleration of healthcare, biotechnology, and government agencies engaging in the impact of AI on health, safety, and trust.

At its' core, AI refers to machines or systems that can perform tasks that typically require human intelligence. These systems are designed to learn, reason, and make decisions based on data, enabling them to recognize patterns, solve problems, and adapt to new information without explicit programming on each new task. As AI has become ubiquitous, some worry about displacement of jobs, misuse of powerful AI systems, privacy, and lack of ability to understand how deep learning models use vast, interconnected, and layered data to arrive at conclusions.

The power of AI is significant – and it has created a Promethean moment in healthcare. AI can assist in diagnosing disease, predicting outcomes, discovering new drugs, enabling precise and efficient care, optimizing workflows, and reducing errors. A recent survey of hospitals indicated that while 80% of hospitals are optimistic towards AI use, only 17% have a robust AI strategy. The top barriers to implementation include lack of a clear ROI, resources to operationalize, and organization buy-in.

At the Mayo Clinic in Arizona Advanced AI & Innovation Hub, AI is being used to solve problems, ease administrative burden, and drive new discoveries. One example of this is hospital readmissions, which is used as an important measure of quality of care. Accurate hospital readmission prediction can identify high risk patients and potentially reduce avoidable readmissions. Previously published use cases leveraging AI for readmission prediction had several limitations including: limited patient populations, lack of accurate data collection, isolated hospital participation and an assumption that individual admissions are independent of each other. Currently the clinical reference standard for hospital admission prediction is the LACE+ index which utilizes a rule-based risk calculation.

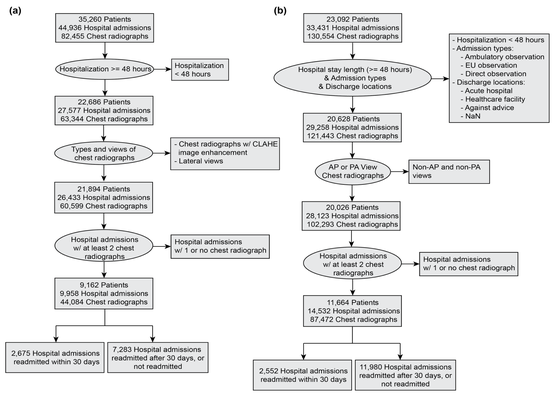
OBJECTIVES

The objective of this abstract is to highlight important emerging trends and use cases of Artificial Intelligence in healthcare by sharing the results of a retrospective study aimed at predicting 30-day readmission risk for hospitalized patients.

METHODS

An interdisciplinary team, including providers, AI scientists, and administrative staff were established to develop a deep learning AI model for 30-day readmission risk prediction. The model utilized a general inpatient population and incorporated data across demographic, diagnostic (imaging and lab), coding, and clinical care. AI scientists utilized a multi-model approach to analyze readmissions leveraging the longitudinal patient record to account for all diagnoses, patient similarity and elimination of any demographic or geographic biases. The team used two cohorts of data. The first dataset represented internal data from two independent hospitals, with 9,958 hospitalizations from 9,162 unique patients, where patients from 2,675 admissions were readmitted within 30 days. The second dataset represented publicly available hospital data with 14,532 hospitalizations from 11,664 unique patients where patients from 2,552 admissions were readmitted within 30 days. The model was then compared to the current clinical reference standard for hospitalization prediction of the LACE+ index.

FIGURE 1

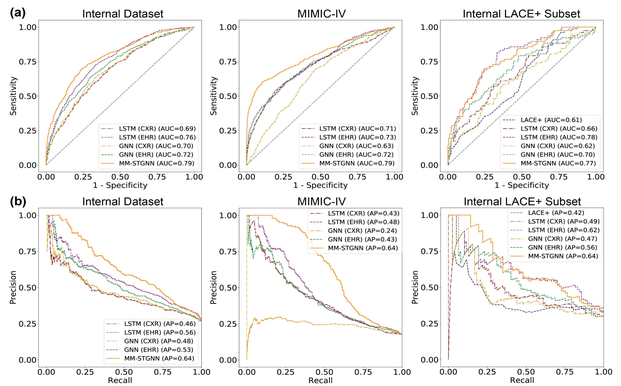


Inclusion and exclusion criteria for (a) internal dataset and (b) public dataset.

RESULTS

The model achieved a 79% accuracy of hospitalization prediction on both the internal dataset and the publicly available dataset. When comparing the performance of the AI model to the clinical reference standard of LACE+ scores, the AI model provided a 16-percentage point improvement in accuracy. In the same cohorts, the LACE+ scores missed 19% of readmissions and had 62% false positive predicted readmissions. The AI model missed roughly 20% of readmissions but had only 40% false positive predicted readmissions.

FIGURE 2



Precision and accuracy curves of internal data, publically available data and LACE+

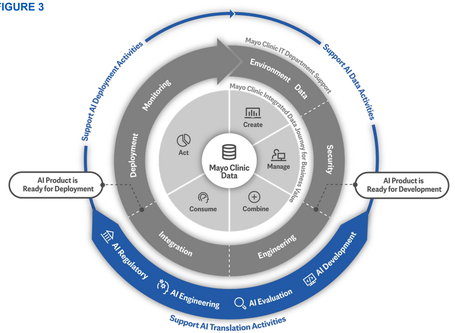
DISCUSSION

The hospital readmission case study provides one example of the power of AI to predict an outcome and provide guidance for early intervention. The opportunities for AI models to improve the quality of care by working in tandem with care teams are difficult to deny.

Successful implementation of AI technology in healthcare is possible with a strong culture of innovation, dynamic partnerships between clinical and technology teams and a robust AI execution strategy. Healthcare leaders should consider:

- Additional investment in education to deepen understanding of AI applicability within healthcare and define areas of opportunity for impactful investment
- Partnering with EHR and other software vendors to evaluate and integrate new algorithms with user-friendly and intuitive interfaces that support clinical care teams and improve patient experience and outcomes
- Implementing mechanisms to evaluate the impact of AI integration on clinical decision making, patient outcomes, and ROI
- Continuous assessment of the ethical, legal, and social implications of using predictive AI methodologies.

FIGURE 3



AI Translational Lifecycle