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Publication(s)

External Link(s)

- From the lab of Dr. Will Knechtle, MBA, MPH
- From the lab of Dr. Brent Jason Theiling, MD
- Development of Machine Learning Models to Predict Admission from ED to Inpatient and Intensive Units (Duke Institute for Heath Innovation, 2020)

Reducing emergency department crowding through machine learning technology

Unmet Need

Over the last 40 years, the number of hospitals and hospital beds in the U.S. has declined, while the demand for emergency department services has increased. As a result, emergency department crowding has not only become a huge challenge, but a health risk as one assessment found crowding to be associated with higher mortality in 45% of studies, decreased quality of care in 75%, and an overall worse perception of care in 100% of the studies. The demand for emergency department services is likely to only increase, making the necessity for improved and efficient patient flow all the greater. One of the untapped possibilities is knowing how critical a patient's condition is and the likelihood of the condition escalating. There is a need for an accurate, efficient, and objective way of triaging patients such that those who are in a stable condition and able to wait for services and those who need immediate care are identified.

Technology

Duke inventors have developed a software that can predict an individual emergency department (ED) patient's needs and move them to the appropriate location within the hospital system. This is intended to be used in emergency departments, particularly by the charge nurses who are tasked with admitting patients and directing them to either inpatient or Intensive Care Units. Specifically, this software is a machine learning model that collects the historical and in-visit data of a patient and outputs their likelihood of admission to a live database that is monitored by a health practitioner. The patient's in-visit data is collected every hour such that if a patient's condition has changed, the likelihood of admission will as well. In this way, nurses who assign patients to beds can plan and make beds more readily available, operation administrators can make more informed decisions around staffing and material resource needs, and health professionals can more quickly identify patients who need immediate attention to begin administering care. This has been demonstrated with a dataset involving over 450,000 encounters and a validation dataset of over 150,000 encounters. The model was able to correctly predict over 80% of inpatient admissions and over 90% of ICU admissions based on numerous patient input data. The top 5 features for predicting inpatient admission were age, white blood cell count, hematocrit, length of stay for discharged ED visits, and platelet count. The top 5 features for predicting ICU admission were age, hematocrit, white blood cell count, number of discharges from ED, and emergency severity index (ESI) score.

Other Applications

This technology could also identify patients who qualify for at-home care or a Hospital at Home program. This allows individuals to receive medical attention in the comfort of their home if their condition is not critical. In turn, this frees up hospital beds for patients who need the constant supervision of medical staff.

Advantages

- Provides close to real-time analytics with a likelihood of admission output updated every hour
- Efficient and objective way of identifying medical needs of patients
- Cost effective method for planning staff and material resource needs
- Includes details for implementing machine learning models in clinical setting