Machine Learning for Decision Support in the ICU

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INTRODUCTION

Overview of Healthcare Decision Support Ecosystems

Machine learning (ML) technologies have altered the way consumers and businesses interact (Karhade & Kathuria, 2020; Karhade et al., 2015; Kathuria et al., 2020). Using ML models to understand healthcare data is an emerging research area in many disciplines, including information systems. Both researchers and the industry are excited about the potential influence that ever-evolving health care technologies can have on the delivery and operation of healthcare. The future of healthcare is becoming dependent on our ability to integrate ML into healthcare organizations. However, given the constrained resources available, the adoption of ML models into the process of healthcare decision support is not a trivial task for healthcare providers, as the adoption of new technologies require significant changes in their operations, and its benefits remains unclear. Therefore, we need to have a clear picture of the ecosystem of healthcare decision support to determine the best use of these applications in healthcare. We show an overview of the healthcare decision support ecosystem in Figure 1, introducing the ecosystem's three major components: beneficiaries, data, and models.

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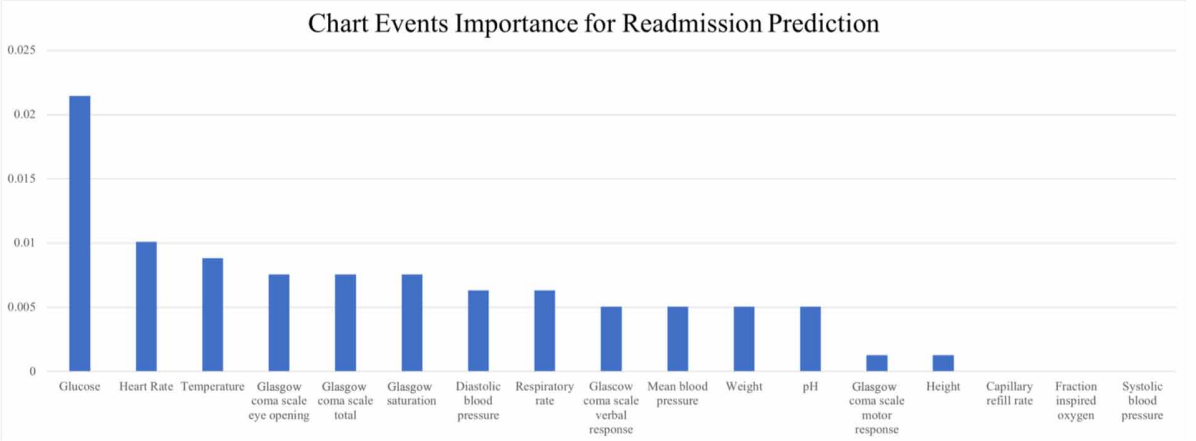
Figure 1. Healthcare decision support ecosystem



Beneficiaries: Doctors, Patients, Platforms

The goal of the healthcare decision support systems (HDSS) is to improve healthcare delivery by integrating different healthcare data, including patient information, patient activities, healthcare knowledge, and other clinical information (Sutton et al., 2020). According to the Office of the National Coordinator for Health IT (ONC), HDSS "provides clinicians, staff, patients or other individuals with knowledge and person-specific information, intelligently filtered or presented at appropriate times, to enhance health and health care."[1] It is necessary to understand whose decision-making can be enhanced and therefore improve healthcare delivery.

Healthcare systems are comprised of providers (e.g., doctors, nurses, hospital managers), consumers (e.g., patients), and platforms (e.g., wearables and mobile device applications, online appointment platforms). These are the three main parties that can benefit from the improvement of HDSS. In the past, doctors used to treat their patients based on their individual experiences—resulting in doctors with less experience being more likely to make poor decisions. Computer-based HDSS can improve clinical decisions by making faster, safer, and better treatment choices with fewer human errors and improve practitioners' overall performance (van Baalen et al., 2021). Given the urgency to make weighted decisions of healthcare, with the help of HDSS, medical providers can consider all available healthcare data, and healthcare knowledge management and transmission is made easier (Wood et al., 2019). HDSS benefits physicians by supporting them during diagnosis, treatment, and follow-up of patients. This support comes in the form of alerts, reminders, diagnostic suggestions, treatment options, and prescribing recommendations, to name a few. For example, HDSS provides alerts and reminders by analyzing changes in vital signs to capture increasing risks to hospitalized patients.

We now turn our attention to the healthcare consumer, patients. In the traditional healthcare model, information flows one way: from physicians to patients. It was acceptable for physicians to recommend a single treatment plan without mentioning alternatives. Under this treatment model, there is little or no input from the patients. Including patients in the decision process has proven to improve healthcare quality. "Empowering patients" is the concept described as giving patients greater control over their healthcare decisions and actions and has been shown to have positive consequences by healthcare research. Patients who actively participate in medical decisions tend to be more satisfied with their care