PRINT-Emergency department overcrowding: Can AI, predictive modeling and simulation fix it?
Jump ARCHES research tackles persistent problem

It seems almost everyone has a story about how long they had to wait to receive care in an emergency department due to overcrowding. In fact, research shows patient congestion is one of the main factors threatening efficiency, safety and quality of care.

The pressure is even greater following the COVID-19 pandemic, as more people feel comfortable returning to hospital emergency departments at the same time many health systems are dealing with a nursing shortage. William Bond, MD, is an emergency department (ED) physician at OSF HealthCare Saint Francis Medical Center in Peoria, Illinois. He also directs simulation research at Jump Simulation, a collaborative effort between OSF and the University of Illinois College of Medicine Peoria (UICOMP).

Dr. Bond and fellow researchers, including co-lead Hyojung Kang, PhD, a visiting assistant professor at the University of Illinois Urbana-Champaign (UIUC), will use a nearly $100,000 Jump ARCHES grant to develop innovative models aimed at reducing ED wait times.

"To acknowledge that suffering, to use compassion, which is part of us at OSF HealthCare, and to address those needs as quickly as we can; to acknowledge that timeliness is part of the quality of care, and we really want to have as timely of care as we possibly can for our emergency department patients."

Improving time to treatment

The project is called: *STREAM-ED: Simulation to Refine, Enhance and Adapt Management of Emergency***.** Dr. Bond explains his team is creating models to predict short-term, mid-range and long-term demand using historic data in de-identified electronic medical records (EMR). The goal is to combine machine learning prediction, discrete event simulation (a method to test processes and interventions ideally prior to intervention) and optimization techniques to determine best possible operational changes in emergency department management.

"We can say that based on past and current data inputs, here's where we think we'll be in the next 12, 24, to 72 hours in the emergency department … and of course, the further out you go in time, just as with weather forecasting, the more the uncertainty grows."

Assistant professor Kang says the EMR information leveraged by researchers to create predictive models includes chief complaints, acuity levels, whether a patient was discharged, and timestamps collected throughout the patient's time in the emergency department. They'll also use data about physical resources and providers, including nurses and technicians who deliver assessments or care in different pods within the emergency department.

Kang specializes in discrete simulation, which provides a layered analysis of non-linear relationships among factors such as patient flow, availability of resources and operational policies that influence where patients are placed and for how long. The process provides a more comprehensive understanding of the way the system performs.

Dr. Bond says it also offers a way of testing interventions and timing without having to do it in real life.

> ***"This will give us the tools to practice those 'what if' scenarios without spending   a lot of resources building a new area of emergency department to find that that wasn't the right thing to do."-Dr. William Bond***

Dr. Bond adds, "Instead, we may find that staffing an area with a more balanced team is the thing to do, staffing the team earlier in the day or later in the day. These types of things may make significant changes in our ability to care for patients."

Running those scenarios will help identify high-reward interventions that can make the biggest impact with the fewest resources to increase efficiencies that can also help providers from feeling burnt out.

There have been studies that use forecasting and modeling approaches in the past, but assistant professor Kang says their practical application and integration into real-world operations have been limited. The project should result in helping decision-makers understand feasible actions they can take to improve emergency department flow.

"Our research team aims to empower ED leaders with the necessary, data-informed tools to navigate the complexities of resource allocation, making a tangible difference in the daily functioning of the ED."

Time-to-treatment will be a key metric for success because it is such a critical indicator of patient and medical provider satisfaction, Dr. Bond stresses.