New artificial intelligence program could help treat hypertension

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For the nearly half of Americans with hypertension, it's a potential death sentence—close to 700,000 deaths in 2021 were caused by high blood pressure, according to the US Centers for Disease Control and Prevention. It also increases the risk of stroke and chronic heart failure. But while it's relatively easy to prevent or moderate if caught early—eat well, exercise more, drink less—it can be tough to treat. Although

physicians have a bevy of potential hypertension medications to choose from, each is littered with pros and cons, making prescribing the most effective one a challenge: Beta-blockers slow the heart, but can cause asthma; ACE inhibitors relax blood vessels, but can lead to a hacking cough. Now, a new artificial intelligence program may help doctors better match the right medicines to the right patients.

The data-driven model, co-developed by Boston University data scientists and physicians, aims to give clinicians real-time hypertension treatment recommendations based on patient-specific characteristics, including demographics, vital signs, past medical history, and clinical test records. The model, described in a recent study published in *BMC Medical Informatics and Decision Making*, has the potential to help reduce systolic blood pressure—measured when the heart is beating rather than resting—more effectively than the current standard of care. According to the researchers, the program's approach to transparency could also help improve physicians' trust in artificial intelligence–generated results.

"This is a new machine learning algorithm leveraging information in electronic health records and showcasing the power of AI in healthcare," says Ioannis Paschalidis, a BU College of Engineering distinguished professor and director of the Rafik B. Hariri Institute for Computing and Computational Science & Engineering. "Our data-driven model is not just predicting an outcome, it is suggesting the most appropriate medication to use for each patient."

Currently, when choosing which medication to prescribe a patient, a doctor considers the patient's history, treatment goals, and the benefits and risks associated with specific medicines. Oftentimes, selecting which drug to prescribe when there are multiple options—and of the options, neither drug is better or worse than the other—can be a bit of a coin toss.

By contrast, the BU-developed model generates a custom hypertension prescription using an individual patient's profile, giving physicians a list of suggested medications with an associated probability of success. The researchers' aim was to highlight the treatment that best controls systolic blood pressure for each patient based on its effectiveness in a group of similar patients.

"Our goal is to facilitate a personalization approach for hypertension treatment based on machine learning algorithms," says Paschalidis, "seeking to maximize the effectiveness of hypertensive medications at the individual level."

The model was developed using deidentified data from 42,752 hypertensive patients of Boston Medical Center (BMC), BU's primary teaching hospital, collected between 2012 and 2020. Patients were sorted into affinity groups, based on similarities of clinically relevant characteristics, such as demographics, past blood pressure records, and past medical history. During the study, the model's effectiveness was compared to the current standard of care, as well as three other algorithms designed to predict appropriate treatment plans. The researchers found it achieved a 70.3% larger reduction in systolic blood pressure than standard of care and performed 7.08% better than the second-best model. The algorithm was clinically validated, with the researchers manually reviewing a random sample of 350 cases.

The model also showed the benefits of deprescribing—reducing or stopping prescriptions for some patients taking multiple medications. According to the research team, because the algorithm provides physicians with several suggested optimal therapies, it could give valuable insights when the medical community is divided on the effectiveness of one drug versus another, a situation known as clinical equipoise.

"These advanced predictive analytics have the ability to augment a clinician's decisionmaking and to have a positive impact on the quality of care we deliver, and therefore the outcomes for our patients," says Rebecca Mishuris, who previously taught at BU and recently became Mass General Brigham's chief medical information officer. "This is an important first step that shows that these models actually perform better than standard of care, and could help us be better doctors."

While many recognize that machine learning's ability to handle large amounts of data and uncover patterns and correlations could benefit healthcare, its adoption has been limited, in part due to difficulties interpreting the results—and because of low levels of trust in artificial intelligence. In the past, machine learning in healthcare has also been hampered by incomplete or inaccurate data, as well as sparse patient histories, which can skew prediction results. An important aspect of this study was to ensure data was transparent and that clinicians—particularly those without technical expertise—clearly understood how the algorithm worked, and how and why the model proposed specific therapeutic recommendations.

"Using data from the diverse patient population of Boston Medical Center, this model provides the opportunity to tailor care for underrepresented populations, with individualized recommendations to improve outcomes for these patients," says Nicholas J. Cordella, a BU Chobanian & Avedisian School of Medicine assistant professor and BMC medical director for quality and patient safety. "Personalized medicine and models like this are an opportunity to better serve populations that aren't necessarily well represented in the national studies or weren't taken into account when the guidelines were being made."

More information: Yang Hu et al, Personalized hypertension treatment recommendations by a data-driven model, *BMC Medical Informatics and Decision Making* (2023). DOI:

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