

AI-powered personalized recommendation system helps lower blood pressure

November 16 2021, by Katherine Connor

Your BP report from 3/30-7/1

Summary of your SBP/ DBP (254 readings)

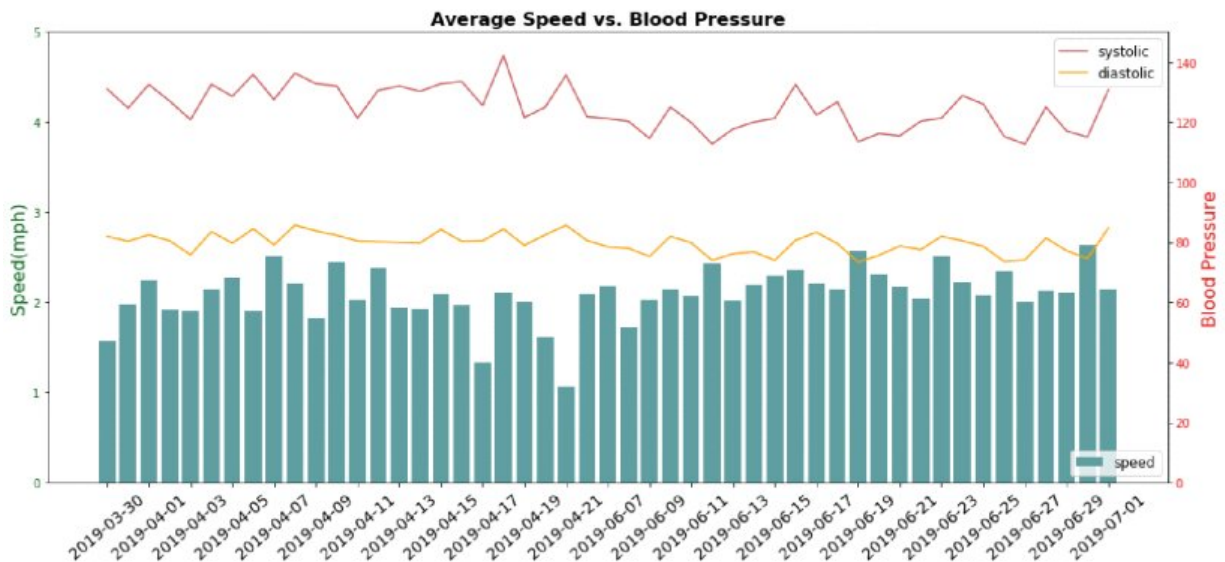
average 125/80
 lowest 94/57
 highest 159/96

Based on your blood pressure and lifestyle data, our analysis shows your blood pressure has the greatest correlation with the following:

- Daily average walking/running speed; increasing walking/running speed may positively influence (reduce) your future BP

The following graph(s) depict your daily blood pressure as compared to the following variable(s):

- Average walking/running speed



An example of the personalized recommendation provided to a patient. Credit: University of California - San Diego

Engineers at UC San Diego have developed an artificial intelligence platform that fuses data from disparate health and lifestyle sensors, wearables and apps into one site, using this combined data stream to paint a broader picture of a user's health, and make personalized recommendations for them to improve a specified health outcome. In a clinical trial with hypertensive patients, those using the P3.AI platform saw their systolic and diastolic blood pressure decrease by 3.8 and 2.3 points respectively, compared to 0.3 and 0.9 points for subjects in the control group who did not receive personal recommendations.

Researchers detailed the early findings of the Proactive, Personalized and Precise Insights and Recommendations using AI project, or P3.AI, in the *IEEE Journal of Translational Engineering in Health and Medicine*.

In addition to the clinical trial with hypertensive patients, this P3.AI platform powered the eCOVID app used in a clinical trial of patients with moderate cases of COVID-19 in San Diego. The same methodology, though a slightly different platform, was used to predict depression and recommend personalized mental health treatment, to participants in a UC San Diego School of Medicine study.

"This personalized model is not just a trove of data—its much smarter than that," said Sujit Dey, professor of electrical and computer engineering at UC San Diego, and director of the Center for Wireless Communication, who is leading this P3.AI (Proactive, Personalized and Precise Insights and Recommendations using AI) project. "It's trying to learn your habits in terms of sleep, activities, nutrition, stress level and mood, and how this is all correlated to your mental health or chronic

conditions like blood pressure."

Early results demonstrate the power of personalized recommendations in healthcare.

"Instead of telling you 10 different generic things to do, and encouraging you to totally change your life—which is often what hypertensive patients are currently told—this system will recommend one or two specific actions for you to take that would be most effective for you, and will show you with easy to interpret data how effective the changes are. Since your model will keep changing with your lifestyle changes and personal conditions, the specific recommendations may also change over time. We've seen again and again that general guidance leads to poor compliance; this system is capable of providing the personalized, explainable recommendations needed."

Eventually, the goal is for patients and their doctors to be able to use this AI platform to improve any number of health conditions through personalized, data-driven recommendations. The platform can be integrated with electronic health records using APIs, enabling [healthcare providers](#) to get a more accurate and holistic picture of patients' well being through a personalized dashboard for each patient. Healthcare providers can receive notifications if certain metrics hit a specified level, but are not bogged down by sifting through and interpreting the data.

A larger clinical trial of the P3.AI personalized recommendation system for hypertensive patients began in October through UC San Diego Health's Population Health Services.

"Getting patients engaged in evidence-based priorities by using this AI hypertension platform to better manage their lifestyle and environmental factors seems to help improve their cardiovascular health," said Dr. Parag Agnihotri, Chief Medical Officer of the Population Health

Services Organization at UC San Diego Health. "This collaborative project between the Jacobs School of Engineering and UC San Diego Health to test the P3.AI integrated hypertension care platform has the potential to help prevent avoidable heart attacks and strokes in our community."

The platform and research challenges

The platform works by fusing together data from a variety of sources—fitness trackers, sleep trackers, mobile apps and questionnaires, blood pressure cuffs and more—transmitted at a variety of timescales, from every millisecond to daily or weekly—and in a variety of modes, including numerical data points, photos, written text, and more. Finding a way to sync all of this data into one site and make it interpretable was one of three key challenges that engineers tackled when developing P3.AI.

Once the data is in one place, the researchers had to develop an AI system capable of fusing the multi-modal data and creating a personalized model of the user, constantly learning about the user's lifestyle and habits and their impact, and updating the model. The model also reveals the top factors that influence the patient's blood pressure, so that precise insights into the patient's health can be generated.

The third significant challenge that the team is now working through, is developing an AI system capable of interacting with a human, and able to translate the data and insights into recommendations in a way the user would understand and be more willing to comply with.

"An AI system directly collaborating with a patient is uncharted territory," said Dey. "We keep learning about it, the job is not complete yet, but we're getting positive results. That can be exciting, but we know we still have a lot of learning left to do."

While [clinical trials](#) for the personalized health app for hypertensive patients continue to scale up, the initial results of this AI-patient teaming are promising. In the clinical trial of 25 patients, 83% of the subjects in the experimental group improved their mean systolic blood pressure, compared to only 47% of subjects in the [control group](#), while 100% of the experimental group improved their mean diastolic blood pressure, compared to 53% of people in the control group.

Similarly, all subjects in the experimental group improved their maximum systolic and diastolic, compared to only 63% and 58% of the subjects in the control group respectively. Finally, in the last 30 days, the blood pressure trend of subjects in the control group was relatively flat, while a decreasing trend was observed in the experimental group.

Connected Health

This AI platform for personalized health is one of several projects at the UC San Diego Center for Wireless Communications focused on applying advances in wireless technologies to Connected Health challenges. The P3.AI [platform](#) underpins the Personalized Hypertension Care project, as well as the eCOVID monitoring and guidance project, and was crucial to the Personalized Machine Learning of Depressed Mood effort.

In addition, engineers and physicians at the Center for Wireless Communications are working to advance an on-demand virtual physical therapy system; developing an Image Processing Platform for MRI-based Rectal Cancer Diagnosis; and are working to reduce the power constraints and advance the communication capabilities of Internet of Medical Things devices.

"While amazing discoveries keep on happening on the pharmaceutical side, the surgery side, on using various kinds of sensors, yet health and

[health](#) care have become more and more elusive to large swaths of populations," said Dey. "When you hear 'virtual healthcare,' people often think of an inferior version of what you do at the clinic. But what we're working on here is truly proactive and personalized care, empowering patients, with insights from their doctors, to make changes in their daily lives."

More information: Po-Han Chiang et al, Using Wearables and Machine Learning to Enable Personalized Lifestyle Recommendations to Improve Blood Pressure, *IEEE Journal of Translational Engineering in Health and Medicine* (2021). [DOI: 10.1109/JTEHM.2021.3098173](https://doi.org/10.1109/JTEHM.2021.3098173)

Provided by University of California - San Diego

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