Deep-learning system helps determine ideal patient medications on a case-by-case basis

By Monisha Ravisetti
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To help doctors make holistic and informed decisions when determining treatment plans — and minimize erroneous prescriptions — engineers developed a deep-learning system that cross-checks between millions of similar case profiles and predicts how a patient will react to various therapies.

The team trained the system based on a plethora of de-identified medical history records and associated health outcomes that had been pulled from a national research database provided by collaborators in Taiwan, some of whom are doctors themselves. The U.S. Patent and Trademark Office published a patent application for the system on May 6.

"My main belief is that the more knowledge, the more information that you have, the more likely it is you'll provide proper health care and proper treatment," co-inventor Ophir Frieder, a professor in the Department of Computer Science at Georgetown University, told *Fastinform.*

Frieder's algorithm rapidly determines how different medications will fit based on a person's distinct circumstances, such as demographics, concurrent conditions and age, among many others.

The team isn't alone in leveraging computer technology to address the impact that each person's intrinsic traits can have on health outcomes. Researchers from Mount Sinai are also working to create a medical record database that incorporates genetic lineage to inform doctors about people's risk of developing disease in the first place.

While some ailments can be easily treated in a streamlined way, such as a headache being relieved by Tylenol — although even this scenario can vary based on whether one is prone to side effects from acetaminophen — others require a sort of guess-and-check.

Crohn's disease, for example, has a multitude of different treatment options that are meant to induce remission in a patient, as the inflammatory bowel disease is not curable. Doctors typically take into consideration patient-specific features such as age, level of disease progression and affected area of the body, but sometimes the first line of battle proves ineffective.

Particularly with such harsh immunotherapies, a patient may have to undergo harmful short- and long-term side effects just to eliminate one potential medication from the pool.

It's also possible that a doctor prescribes medication that is completely unsuitable for the person under their care. For instance, a recent study found that patients can subtly pressure their physicians into prescribing antibiotics.

"What a medical doctor does is based on their experience or based on guidelines — which by definition are out of date because they're always changing," Frieder said. "I'm trying to give the doctor as much ammunition as possible for when they make that decision."

Frieder explained how the new system finds every patient from the database who is most identical to the patient at hand, studies the medications those patients took and how their body reacted, and then finally derives which outcomes were best.

"If I've got the medical history of 15 million people [or] 20 million people, chances are that somebody is going to have — in fact, a fair number are going to have — the same type of medical history and a similar medical ailment," he said.

From a doctor's point of view, the interface of the system only requires inputting a current patient's information and any medications being considered as therapy options.

"The physician would feed the graph in as input and the system would tell the doctor a result saying that [for] the particular medication, 'This is likely to succeed; this is not likely to succeed,'" Frieder said. "We're not trying to

prescribe anything — we're trying to give guidance to the doctor."

Understanding that a machine may not be able to provide subjectivity in medical decision-making, Frieder's team ensured that the reasoning behind each suggestion can be dissected, as well.

"It's a cardinal rule that if you have to understand how it does it, you probably will not use it," Frieder noted. "But on the other hand, if you want to understand why, the results are interpretable — they will tell you why it said, 'No.'"

Frieder further explained that he hopes to expand the system and train it with even greater precision by incorporating health care data from countries other than Taiwan.

"The reality is, you are only as good or as bad as the training data you have," he said. "If the training data are biased in one way towards a certain segment of the population, then that population is the only one that's really going to be serviced."

And in the future, he says, the goal is to train the software's algorithm such that a concrete database of patient records isn't needed at all — the system will have the ability to identify patient health outcomes without cross-checking each time.

The patent application, "Method and system for assessing drug efficacy using multiple graph kernel fusion," was filed to the U.S. Patent and Trademark Office on Nov. 3, 2020 with the earliest priority date of Nov. 4, 2019. It was published May 6 with the application number US2021/0134418. The inventors listed are Ophir Frieder, Hao-Ren Yao and Der-Chen Chang. The assignee is Georgetown University.

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