Firms developing AI-driven heart simulations

Medtech firms get personal with digital twins

By Caroline Copley

Armed with a mouse and computer screen instead of a scalpel and operating theatre, cardiologist Benjamin Meder carefully places the electrodes of a pacemaker in a beating, digital heart.

Using this "digital twin" that mimics the electrical and physical properties of the cells in patient 7497's heart, Meder runs simulations to see if the pacemaker can keep the congestive heart failure sufferer alive – before he has inserted a knife.

The digital heart twin developed by Siemens Healthineers is one example of how medical device makers are using artificial intelligence (AI) to help doctors make more precise diagnoses as medicine enters an increasingly personalized age.

The challenge for Siemens Healthineers and rivals such as Philips and GE Healthcare is to keep an edge over tech giants from Alphabet's Google to Alibaba that hope to use big data to grab a slice of healthcare spending.

With healthcare budgets under increasing pressure, AI tools such as the digital heart twin could save tens of thousands of dollars by predicting outcomes and avoiding unnecessary surgery.

A shortage of doctors in countries such as China is also spurring demand for new AI tools to analyze medical images and the race is on to commercialize products that could shake up healthcare systems around the world.

While AI has been used in medical technology for decades, the availability of vast amounts data, lower computing costs and more sophisticated algorithms mean revenues from AI tools are expected to soar to $6.7 billion by 2021 from $811 million in 2016, according to a study by research firm Frost & Sullivan.

The size of the global medical imaging analytics software market is also expected to jump to $4.3 billion by 2025 from $2.4 billion in 2016, said data portal Statista.

"What started as an evolution is accelerating towards more of a revolution," said Thomas Rudolph who leads McKinsey & Company's pharma and medical technology practice in Germany.

Healthcare

For Siemens Healthineers and its traditional rivals, making the transition from being mainly hardware companies to medical software pioneers is seen as crucial in a field becoming increasingly crowded with new entrants.

Google has developed a raft of AI tools, including algorithms that can analyze medical images to diagnose eye disease, or sift through digital records to predict the likelihood of death.

Alibaba, meanwhile, hopes to use its cloud and data systems to tackle a shortage of medical specialists in China. It is working on AI-assisted diagnosis tools to help analyse images such as CT scans and MRIs.

In this Aug 9, 2018 file photo, a firefighter keeps watch as a wildfire burns in the Cleveland National Forest in Corona, Calif. (AP)

Mental and physical fatigue blamed for injuries

Health, reaction-time declines in firefighters: study

BOISE, Idaho, Sept 2, (AP): Randy Brooks' son had a request three years ago: What could his dad do to make wild land firefighting safer?

To Brooks, a professor at the University of Idaho's College of Natural Resources who deals with wild land firefighting, it was more of a command.

His son, Bo Brooks, is a wild land firefighter who a few days earlier during that 2015 fire season fled a wall of flames that killed three of his fellow firefighters in eastern Washington.

The result of the conversation was an online survey that drew some 400 firefighters who mostly identified mental and physical fatigue as the primary cause of injuries to firefighters who are often confronted with a changing, dangerous environment.

But a self-selecting online survey is not necessarily representative of what's happening in the field. So Randy Brooks decided to apply some science.

That led to an ongoing health-monitoring study involving wrist-worn motion monitors and body composition measurements that last year found health declines and deteriorating reaction times among firefighters as the season progressed.

"A lot of them face peer pressure to perform all the time," Brooks said. "Others feel pressured to protect natural resources and structures at all costs."

Some 19,000 firefighters are currently in the field fighting nearly 40 large wildfires. Fourteen firefighters have died this year as wildfires have scorched about 3,500 square miles (9,000 square kilometers) and destroyed some 3,000 homes.

The study last year found firefighters lost muscle mass but gained fat based on body compositing testing before and after the season.

The firefighters also wore a wrist device called a Readiband from a company called Fatigue Science. The device keeps track of how many hours of sleep a person gets. Formulas developed by the US military then calculate fatigue, based on a lack of sleep. That's used to predict alertness and reaction

times, which get worse as fatigue levels rise.

Firefighters in the field can get as little as six hours of sleep or less each night. The devices found that not only did reaction times falter as firefighters remained longer on a fire before getting a mandatory break, Brooks said, but firefighters also tended to take longer to recover as the season progressed. Sometimes, fatigue levels reached a level that suggested reaction times slowed down so much it took firefighters twice as long to react.

Brooks said his initial thoughts are that wild land firefighters might need better nutrition to stay fit and mentally sharp. But last year's study had only nine firefighters. Brooks this year expanded the study to 18 firefighters, 16 men and two women. They're smoke-jumpers, meaning they parachute from airplanes to fight fires.

Brooks said that next year he hopes to have about 100 firefighters and include hotshot crews, a ground-based wild land firefighter that can, like smoke-jumpers, be

deployed on a national basis.

Smoke-jumpers in the study often eat pre-made meals. Brooks wants to find out if maybe those meals are behind some of the puzzling results from last year's study, such as a loss in muscle mass.

Hotshots, meanwhile, can return to a central spot where they get prepared food supplied by the US Forest Service. That agency has done extensive research on what it takes to keep wildland firefighters fueled, and contractors who supply the meals must meet Forest Service nutritional guidelines.

Forest Service health experts have even followed firefighting crews to take blood samples to check glucose levels, which can indicate alertness.

Joe Domitrovich, an exercise physiologist with the Forest Service's National Technology and Development Program in Missoula, Montana, said that experiment led the agency to change gears and recommend firefighters snack during their shifts to keep glucose levels up.

Siemens Healthineers, which was spun off from German parent Siemens in March, has outpaced the market in recent quarters with sales of medical imaging equipment thanks to a slew of new products.

But analysts say the German firm, Dutch company Philips and GE Healthcare, a subsidiary of General Electric, will all come under pressure to prove they can save healthcare systems money as spending becomes more linked to patient outcomes and as hospitals rely on bulk purchasing to push for discounts.

Siemens Healthineers has a long history in the industry. It made the first industrially manufactured X-ray machines in 1896 and is now the world's biggest maker of medical imaging equipment.

Now, Chief Executive Bernd Montag's ambition is to transform it into the "GPS of healthcare" – a company that harnesses its data to sell intelligent services, as well as letting smaller tech firms develop Apps feeding off its database.

As it adapts, Siemens Healthineers has invested heavily in IT. It employs some 2,900 software engineers and has over 600 patents and patent applications in machine learning.

It is not alone. Philips says about 60 percent of its research and development (R&D) staff and spending is focused on software and data science. The company said it employs thousands of software engineers, without being specific.

Revolution

Experts say the success of AI in medical technology will hinge on access to reliable data, not only to create models for diagnosis but also to predict how effective treatments will be for a specific patient in the days and years to come.

"Imagine that in the future, we have a patient with all their organ functions, all their cellular functions, and we are able to simulate this complexity," said Meder, a cardiologist at Heidelberg University Hospital in Germany who is testing Siemens Healthineers' digital heart software.

"We would be able to predict weeks or months in advance which patients will get ill, how a particular patient will react to a certain therapy, which patients will benefit the most. That could revolutionise medicine."

To this end, Siemens Healthineers has built up a vast database of more than 250 million annotated images, reports and operational data on which to train its new algorithms.

In the example of the digital twin, the AI system was trained to weave together data about the electrical and physical properties and the structure of a heart into a 3D image.

One of the main challenges was hiding the complexity and creating an interface that is easy to use, said Tommaso Mansi, a senior R&D director at Siemens Healthineers who developed the software. (RTRS)