Simulations of the human body and advanced data promise more personalized medical treatment

January 16 2024, by Jack McGovan

Credit: Pixabay/CC0 Public Domain

In a laboratory in the Italian capital Rome, Marco Evangelos Biancolini and his team are poking patients to gauge the effectiveness of different

surgical procedures.

But it's not actual people under a scalpel—it's their digital double projected on a computer screen, each reflecting the person's individual biochemical makeup. And it could open the door to the next frontier of medicine: personalized health care.

Patient doubles

By testing methods and drugs on "digital twins," medical staff can determine the best courses of treatment for the patients themselves. In Biancolini's case, his team is investigating aneurysms, which are abnormal bulges or swellings in blood-vessel walls.

"We definitely don't want to do trial and error on the patient, but with a digital twin we can try the surgery many times," said Biancolini, an associate professor of machine design at the University of Rome.

He leads a research project to train early-stage researchers in the potentially wide range of uses of digital twins for the treatment and prevention of aneurysms. These afflictions can be present in people from birth or result from conditions including high blood pressure, fatty plaques and trauma.

Called MeDiTATe, the four-and-a-half-year project runs through June 2024. It brings together 25 academic and industrial partners from Italy, France, Greece, Norway and Switzerland.

Deadly debilitation

Aneurysms occur in roughly 3% of the world's population, with many people unaware they even have the condition until it's too late.

When an aneurysm ruptures, the consequences are serious. As many as 35% of people who suffer a ruptured aneurysm die and only a third can return to a normal life afterwards.

With such a potentially debilitating condition, which can strike anytime and anywhere in the body's circulatory system, a search is on for ways to save more lives.

Digital twins can improve the detection of early warning signs in the actual patients, enabling speedier preventative steps.

The MeDiTATe researchers hope to increase the survival rates of people who have aneurysms, as well as to improve early detection and prevention of them.

If a patient is diagnosed with, or is suspected of having, an aneurysm, a digital twin can be created based on the person's own physiology. Medical experts can then carry out tests to come up with a tailor-made treatment.

Because collecting data from a person's own body is difficult without invasive procedures, the researchers are also 3D printing patient replicas to gather information needed for digital twins to be as complete as possible.

"Combining the patient, the replica and the digital twin completes the loop," said Biancolini.

Easy to use

While digital twins are already used for research, MeDiTATe aims to make them easier to use for medical professionals.

The team has been working with hospitals and collecting views from health care workers. The aim is to understand what they need in a digital twin to be able to draw a conclusion about a patient's aneurysm.

It intends to make digital twins for treating aneurysms commercially viable and members of the MeDiTATe consortium have already filed a number of patents.

Biancolini believes digital twins will be the future of health care as they become more reliable and accurate, rendering traditional replicas of human body parts less necessary.

"The number of physical prototypes has dropped a lot in the last decades because the accuracy of digital simulations is now so high that you can trust them," he said.

Atrial fibrillation, stroke

Other researchers are turning to the digital world for a different form of health care help. The MAESTRIA project is building a platform for collecting sets of data that will help doctors understand and treat atrial fibrillation—an irregular heartbeat—and stroke in patients. The five-year initiative runs through February 2026.

The researchers are looking for specific biomarkers that signal the risk of both diseases.

The team is developing digital tools based on a new generation of biomarkers that integrate artificial-intelligence processing and big data from cutting-edge imaging, electrocardiography and omics technologies to refine diagnosis and individual treatment for patients.

In the EU, stroke is the second most common cause of death and a

leading source of adult disability.

"When a person has atrial fibrillation and suffers a stroke, it's the result of a pathological process that started many years before," said Stéphane Hatem, a professor of cardiac physiology at the Institute for Cardiometabolism and Nutrition in the French capital Paris.

He thinks that, through MAESTRIA, researchers will be able to show that fatty tissue on the heart is a key biomarker for atrial fibrillation and stroke. The availability of a wide dataset that examines both factors in patents is expected to enable such a conclusion.

Recruiting and testing

Hatem, who coordinates the project, and his team are gearing up to test the platform at the project's core.

The researchers are recruiting patients from European countries including France, Germany and Spain. The testing will be done over two and a half years.

If the test proves successful, people from outside Europe would then be included too. That's because the more they reflect the population spectrum, the more useful datasets are.

"To be useful in clinical care, it is extremely important to validate the algorithm in a broad population, not just western European countries," said Hatem.

The platform they're developing will be available to other medical professionals.

People with different datasets could add them to the platform and

contribute to the conclusions that can be drawn. So, for example, a researcher looking into strokes in Latvia's capital Riga could furnish data and in return gain access to all the information on the platform.

The overall result would be greater understanding of biomarkers by medical experts and more targeted—and by extension more effective—treatments for patients.

Like Biancolinii, Hatem believes digital technologies are vital to improving health care.

"Personalized medicine means that you are able to have a very accurate and precise identification of risk for each individual," Hatem said.

More information:

- MeDiTATe
- MAESTRIA

Provided by Horizon: The EU Research & Innovation Magazine

Citation: Simulations of the human body and advanced data promise more personalized medical treatment (2024, January 16) retrieved 6 May 2024 from https://medicalxpress.com/news/2024-01-simulations-human-body-advanced-personalized.html