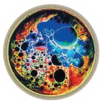
NEWS IN FOCUS

SEISMOLOGY Project off New Zealand probes quake risk **p.295**

BRAZIL Police action against researcher triggers protests **p.296**

RUSSIA Researchers worry about support for science **p.297**



CELL BIOLOGY To better understand the cell, look to the lava lamp. **p.300**

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Researchers are developing artificial-intelligence algorithms to detect breast cancer in mammograms.

MEDICAL RESEARCH

AI researchers embrace Bitcoin technology

Blockchain could let people retain control of data they contribute to health research.

BY AMY MAXMEN

Dexter Hadley thinks that artificial intelligence (AI) could do a much better job of detecting breast cancer than doctors do — if the screening algorithms could be trained on millions of mammograms. The problem is getting access to such massive quantities of data. Because of privacy laws in many countries, sensitive medical information remains largely off-limits to researchers and technology companies.

So Hadley, a physician and computational biologist at the University of California, San Francisco, is trying a radical solution. He and his colleagues are building a system that allows people to share their medical data with researchers easily and securely — and retain control over the information. Their method, which is based on the blockchain technology that underlies the cryptocurrency Bitcoin, will soon be put to the test. By May, Hadley and his colleagues will launch a study to train their AI algorithm to detect cancer, using mammograms that they hope to obtain from between 3 million and 5 million US women.

The team joins a growing number of academic scientists and start-ups that are using blockchain to make sharing medical scans, hospital records and genetic data ▶

more attractive — and more efficient. Some projects will even pay people to use their information. The ultimate goal of many teams is to train AI algorithms on the data they solicit using the blockchain systems.

These efforts come as the public grows increasingly concerned about how tech giants mine and profit from personal data, including some medical information. In 2016, DeepMind, an AI company in London owned by Google's parent, Alphabet, became mired in controversy after press reports revealed that a branch of the UK National Health Service had given the company access to 1.6 million patient records without adequate consent. The information included names and sensitive information, such as whether a person had a sexually transmitted disease.

"Right now, Google and Facebook have siloed repositories of data about you that you have no control over," says Andrew Lippman, a computer scientist at the Massachusetts Institute of Technology in Cambridge. "But in the world of medicine, there is no Facebook." Using blockchain to secure and share decentralized medical information "could be a model of data-identity control" generally, he adds.

Blockchain is a distributed electronic system that records transactions in an expanding chain of 'blocks' that are extremely difficult to alter. To break into one block, a hacker would have to tamper independently with all the blocks that link to it — a daunting task.

In Hadley's study, blockchain will function as a series of switches that guide how data flow between participants, clinicians and researchers. Women taking part will be able to give or revoke access to their data using an online portal, breastwecan.org, that relies on blockchain to secure data stored in the cloud.

The researchers plan to train their AI algorithm on millions of mammograms from healthy women and those with breast cancer. The goal is to classify tumours more precisely than doctors do; physicians miss up to one-quarter of cancers present in mammograms. The accuracy of an algorithm generally grows as it is trained on more, and more varied, data, just as a radiologist's ability to distinguish tumours improves with experience.

Hadley hopes that women will share their mammograms to improve breast-cancer screening generally — and to gain access to, and control over, information that has customarily been held by clinics. Women who participate in the study will be able to view their scans on breastwecan.org, along with standard clinical interpretations of their risk of breast cancer, based on tissue density, age and other known factors.

"We need to engage people so that they show us their data."

Other groups are developing blockchain-based marketplaces to broker data exchanges between individuals and companies or academic researchers — and arrange payment. One such effort is Nebula Genomics, a start-up co-founded by geneticist George Church of Harvard University in Cambridge, Massachusetts. Nebula aims to connect people who want their genomes sequenced with companies willing to pay for that service in return for access to the resulting data. People who pay for their own sequencing will be able to sell access to their genetic information using Nebula; payment will come in the form of digital tokens that can be exchanged for US dollars.

Church says that Nebula will ensure that its partner companies keep any promises they make — on issues such as how long a company will retain a person's data. By contrast, when customers of genomic-sequencing firms such as 23andMe in Mountain View, California, consent to share their data for research, they largely relinquish control over how it is used. Many sequencing firms sell anonymized genetic data in bulk to biotechnology and pharmaceutical firms.

Giving people more control over their medical records could also yield more-immediate health benefits, Lippman says. He and his graduate students have developed a blockchain-based system for sharing health records, called MedRec, that will be tested at Beth Israel Deaconess Medical Center in Boston this year. The system allows users to insert information into their health records, including data from wearable electronic devices such as Fitbits. Clinicians and researchers could use these extra data, with permission, to tailor treatments.

Ultimately, Hadley says, the immense amount of routine medical data that physicians collect can yield medical advances only if the information is shared and studied. "We need to engage people so that they show us their data," he says. "So we need to think in medicine about the technologies that let us have good data governance, and blockchain happens to be one of them right now." ■ SEE EDITORIAL P.285

ENERGY

MIT renews push for fusion energy

Collaboration with company aims to feed grid in 15 years.

BY JEFF TOLLEFSON

The Massachusetts Institute of Technology (MIT) in Cambridge will work with a private firm to develop technology for producing energy from nuclear fusion within the next 15 years. If successful, the multimillion-dollar effort could help to unlock a virtually limitless source of pollution-free energy.

The approach — which has so far attracted US$50 million — is based on high-temperature superconductors that have become commercially available in the past few years, the team announced on 8 March. The new generation of superconductors will allow researchers from MIT and Commonwealth Fusion Systems (CFS) in Cambridge to strengthen the magnetic field that contains the hot-plasma fuel used in conventional tokamak reactors. That could pave the way for reactors that are smaller, cheaper and easier to build than those based on previous designs — including the international ITER project under development in southern France, which is over budget and behind schedule.

"It's about scale, and it's about speed," says Robert Mumgaard, chief executive of CFS. The company — an MIT spin-off — has attracted $50 million from Italian energy giant ENI, and plans to invest $30 million of that sum in research and development at MIT over the next three years. Mumgaard says that the collaboration between academics and industrialists should help to drive fusion technology out of the lab and into the marketplace.

Fusing hydrogen atoms to form helium releases massive amounts of energy, which can be harnessed to produce carbon-free electricity. But sustaining the extreme temperatures that are required for this process in a confined space remains a daunting challenge that has defied most hopes and expectations to date.

CFS is the latest in a series of companies pursuing fusion energy as a clean-power source. Tokamak Energy, a company based near Oxford, UK, is also developing a tokamak reactor using high-temperature superconductors. But observers say that the MIT initiative is the most significant of its kind.

"There are no guarantees," says Stephen Dean, who heads Fusion Power Associates, an advocacy group in Gaithersburg, Maryland. But "if MIT can do what they are saying — and I have no reason to think that they