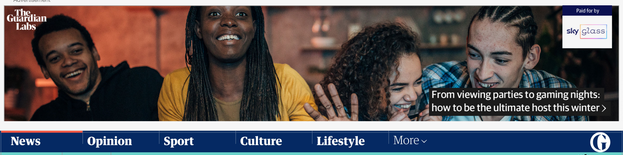

The future of life-saving research

‘It gives doctors the gift of time’: how AI is shaping the future of cancer diagnosis and treatment

AI has the potential to revolutionise cancer research and clinical practice – so how is it being used now, and what developments could be on the horizon?

David Cox

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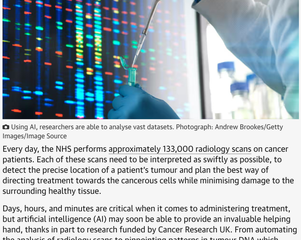


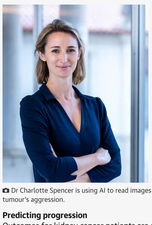
Using AI, researchers are able to analyse vast datasets. Photograph: Andrew Brookes/Getty Images/Image Source

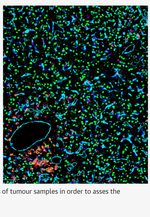
Every day, the NHS performs approximately 133,000 radiology scans on cancer patients. Each of these scans need to be interpreted as swiftly as possible, to detect the precise location of a patient’s tumour and plan the best way of directing treatment towards the cancerous cells while minimising damage to the surrounding healthy tissue.

Days, hours, and minutes are critical when it comes to administering treatment, but artificial intelligence (AI) may soon be able to provide an invaluable helping hand, thanks in part to research funded by Cancer Research UK. From automating the analysis of radiology scans to pinpointing patterns in tumour DNA which could reveal new causes of cancer, machine learning algorithms will have a major role to play in all elements of cancer care.

Cancer Research UK wants to continue to accelerate progress that saves more lives, utilising new technologies such as AI and big data to generate new insights and seek discoveries across all areas of research. In the coming years, its focus within discovery research is to harness the power of AI in delivering precision early detection and to continue to grow its research capacity in the UK.

But only with the support of those generous enough to pledge gifts in their wills can they invest in driving new discoveries at pace. Discoveries that lead to breakthroughs with a lasting impact. Impact that can be felt for future generations, far beyond our lifetimes. Leaving a legacy to Cancer Research UK is a powerful way to ensure your wishes are taken care of and to ensure they can plan and invest in future research to beat cancer.





Dr Charlotte Spencer is using AI to read images of tumour samples in order to asses the tumour’s aggression.

Predicting progression

Outcomes for kidney cancer patients are significantly better if it is diagnosed and treated while still local to the kidney. However, once the cancer has spread to the surrounding tissues, organs and lymph nodes, the outlook is bleaker. Dr Charlotte Spencer, a histopathology registrar and Cancer Research UK-backed clinical research fellow in Samra Turajlic’s laboratory at the Francis Crick Institute, the Royal Marsden NHS Foundation Trust, says that predicting the aggression of a particular patient’s cancer, and how they might respond to treatment remains difficult.

“Currently the tests we use to risk-stratify patients in order to forecast the likely course of disease progression are inadequate, which makes disease management decisions complex,” says Spencer.

However, AI may soon be able to assist oncologists with this decision-making through what Spencer describes as “computational pathology tools”. She is using AI to read images of samples taken from a patient’s tumour and identify subtle molecular changes that can offer clues as to whether their disease is stable or more aggressive.

“We hope that our work will lead to implementation of computational pathology tools that permit delivery of precision medicine to patients in a cost-effective manner,” she says.

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> *Gifts in wills fund one third of Cancer Research UK’s work and are vital to accelerating progress. These legacy commitments enable them to plan for the future, allowing the charity to commit to the large-scale, long-term research projects that yield their biggest breakthroughs. The advantage of pledging gifts in wills is that it means this income stream is guaranteed, and enables Cancer Research UK to invest in the most cutting-edge science with the potential to make the biggest difference to future generations in the UK and around the world.*

Robot radiologists

“When I decided to become a doctor, I didn’t realise that artificial intelligence would play such a big part in my life,” says Dr Raj Jena, an oncologist at Addenbrooke’s hospital in Cambridge who looks after patients with brain and spinal tumours, and is also deputy director of Cancer Research UK’s radiation research network.

Dr Raj Jena, who leads a project using deep learning models to analyse radiotherapy images. Photograph: Cambridge University Hospitals NHS Foundation Trust

Jena is leading Project InnerEye, a collaboration between Addenbrooke’s and Microsoft Research to investigate whether so-called deep learning models can accelerate the analysis of radiotherapy images. Research has already suggested that they can slash the amount of time a doctor has to spend processing scans before treatment can begin by more than 90%.

These tools have now been made freely available as open-source software, and Jena hopes that they will soon be used routinely in clinical practice across the UK.

“The results are incredibly exciting,” he says. “We’ve shown that a computer can perform in just a few minutes what would normally take me several hours to do.”

Improved breast cancer detection

Kidney cancer is just one example of how AI is changing the process of cancer screening. Since 2008, Cancer Research UK has funded a project called OPTIMAM, which aims to improve the accuracy and efficiency of the NHS breast screening programme. Over more than a decade, it has collated a database of more than 3.3m mammogram images taken from more than 170,000 women at different timepoints.

Through collaborations with tech companies ranging from Google Health to Kheiron Medical Technologies, this vast dataset is being utilised to develop and refine AI algorithms that can detect signs of cancer as early as possible.

“Breast cancer detection is one of the hardest detection tasks,” says Sarah Kerruish, chief strategy officer of Kheiron Medical Technologies. “Breast tissue has many features that are confounding to the human eye in terms of what maybe looks like a tumour but actually isn’t.”

New causes of cancer

Finally, while we have become increasingly aware of common cancer risk factors such as excessive sunlight exposure for melanoma and smoking for lung cancer, we still have much to learn about what places us at risk from the disease.

Cancer Research UK-funded scientist Prof Serena Nik-Zainal and a team of scientists at the University of Cambridge are attempting to uncover some of these new causes by using AI to screen the genomes of thousands of cancer patients, using data from the 100,000 Genomes Project.

Prof Serena Nik-Zainal’s team uses AI to screen genomes, identifying causes of cancer and treatment options. Photograph: Lloyd Mann/University of Cambridge

The researchers have used AI to help analyse 12,000 such genomes, which has already yielded what Nik-Zainal describes as a “treasure trove” of clues. In a recent study, the team identified 58 novel mutational signatures – fingerprints in the genetic code of different tumours indicating that a particular patient’s DNA has been altered in some way, creating the cellular malfunctions that lead to disease. She says that as well as identifying new causes of cancer, this could also yield treatment options.

“Some mutational signatures have clinical or treatment indications,” says Nik-Zainal. “They can highlight abnormalities that may be targeted with specific drugs or may indicate a potential achilles heel in individual cancers.”

Overall, many doctors feel that AI is already starting to transform the way we understand, diagnose and treat cancer, as well as allowing them to prioritise patients even more.

“It gives clinicians back the gift of time and it means that we can focus on the parts which only humans can do, which is actually caring for our patients,” says Jena.

Gifts in wills help Cancer Research UK plan for the future, adapting and investing in cutting-edge technology to enhance its capability of beating cancer. Find out more about how you can pledge at cruk.org/giftsinwills

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