

## A freezer full of hope for humanity

A biobank of samples from 500,000 people and stored for years is a boon for medicine, writes **Tom Whipple**

**F**ifteen years before scientists found — in news announced this week — a protein signature that predicted if you would get dementia, John, a 60-year-old civil engineer, popped across the road from work to have his blood taken. He had seen there was a new medical study and thought: “Why not?”

Today that blood is stored in a freezer alongside ten million other samples from 500,000 people. But John’s contribution to science is not over. Still in fine fettle, and now retired, he finds himself in an industrial estate outside Reading, just behind Ikea, having his brain scanned. He is the 16,350th person to do so at this site alone.

And if he is a little creakier than he was in the late Noughties? Well, the study he joined that day 15 years ago, one of the most ambitious in medical history, is “reaching the prime of its life”, Professor Naomi Allen, chief scientist of the project, says.

The reason why is precisely because its participants are no longer in their prime. “We have thousands of people with breast cancer, with heart disease, the most common diseases,” she says, bouncily.

Two decades after it began, the UK Biobank is approaching maturity. Run in partnership with the Medical Research Council and the Wellcome Trust among others, it was set up with a bold goal: to recruit half a million middle-aged Britons and find out as much as possible about their health. Everything has been done at scale. When its founders said they aspired to sequence all 500,000 genomes, it was at a time when the cost would have comfortably exceeded the GDP of most countries. Today they have achieved it.

When they decided to do full medical imaging on a subset of participants, including John, they said they would do 100,000. “The funders thought we had an extra zero by mistake,” Allen says. Operating costs thus far are believed to be around £500 million.

The pilot imaging study, on 5,000 people, itself broke records. Imaging has now been carried out on up to 83,000 people.

The scale was the point. They wanted to know everything. They wanted to find out all they could about them, to watch as they aged — and in doing so, find out what makes us well and what makes us ill. They wanted to follow people from health into sickness.

Now, sickness has indeed started to arrive. This week a paper was published, one of 10,000 using Biobank data, that identified the protein signatures of the earliest stages of Alzheimer’s, potentially



Biological samples from the past 15 years are in a freezer in Greater Manchester. A robot, below, pulls them out for scientists

helping doctors to catch it before symptoms arrive.

That, says Allen, is just the start. It’s only going to get better, from an epidemiological perspective. “Over the next 15 years we’re in this golden age where we’ll get thousands of new cases of dementia, arthritis, cataracts, all the things that are going to hobble us as we get older.”

She and her colleagues have, she says, been waiting for this moment — even if the participants have not. “We are just at the right time when we have enough power to start making really robust scientific discoveries.”

In a UK Biobank centre in Cheadle, Greater Manchester, there is a freezer. It is minus 80C, and big — big enough to park two double decker buses inside it. It contains ten million biological samples, including blood, urine and saliva taken from participants. Poised at its entrance, awaiting requests, is its guardian — a robot that can pull

genetics, the lifestyle, the blood biomarkers, imaging, Fitbit data,” Allen says. More than anything, they have the scale. “It becomes this absolute treasure trove to be able to understand the causes of all of those diseases.”

Between 2006 and 2010, for example, of the half million who gave blood to UK Biobank there were 1,417 who, unlike John, did not then spend more than a decade in reasonable health. These specific 1,417, went on to get Alzheimer’s. It was by looking at their blood, stored in the freezer, that this week researchers could publish their discovery of a protein signal unique to them.

Or take another subset — people who gave blood and then wore Fitbit movement sensors. Of them, 266 went on to develop Parkinson’s. By looking at data on how they moved, compared with those who did not later have Parkinson’s diagnosed, scientists could spot signs of their disease before the patients themselves did.

The UK Biobank study was built on a gamble. Normally, researchers look at people when they become sick, to try to work out what caused it. They study a body’s failure, without always being able to compare it with what success looks like.

UK Biobank believed that if you could see healthy people, in their hundreds of thousands, and follow them as they aged, you could find out so much more.

The gamble has paid off. Science has already benefited. And the participants?

The UK Biobank is not very forthcoming if you are a participant. Unless there is something immediately medically relevant, participants do not even see their own results. The Times uses only John’s first name not at his request, but UK Biobank’s — the system only works if data is rigidly anonymised.

John first joined, he said, because

it was convenient. It was across the road from his work in Croydon. Today his visit — at which he will have a full body MRI and a bone density scan — was far from convenient. He had to get up at 5.30am to drive there and then spend four hours in a medical gown in a windowless warehouse. All he has received in return was the offer of a sandwich and a biscuit (there is also fruit, Joanne Gunner, the imaging operations manager, explains, but — alas — despite the ostensible purpose of the study it is not popular), and a tour of the dual carriageways of Reading.

“What’s remarkable is there’s absolutely nothing in it for them,” says Allen, who joined ten years ago.

“There’s no feedback of results. They’re doing it out of the goodness of their hearts. You know, for the hope for future generations.”

Although, John has a different way of putting it. “It has been an adventure. It’s been another experience,” he says.

Now the adventure, for the study itself, is just beginning.



out 4,000 samples a day.

Trundling on rails, the robot works at the behest of researchers who apply from institutions around the world, looking to try new tests and test new hypotheses.

The samples are being stored by UK Biobank, primarily, in anticipation of the day people start to fall ill. Then the biological samples, along with a host of lifestyle data collected over the past 15 years, can be trawled for clues. Where is the villain? What made these people sick? “We’ve got the