

INTELLIGENT HEALTHCARE

*US COMPANIES AND
THE HEALTHCARE REVOLUTION*

Gary Robinson, Investment Manager



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GARY ROBINSON

Investment Manager

Gary is an Investment Manager in the US Equities Team. He graduated MBiochem in Biochemistry from the University of Oxford in 2003 and joined Baillie Gifford the same year. He spent time working on our Japanese, UK and European Equity Teams before moving to the US Equities Team in 2008. Gary is a generalist investor but retains a special interest in the healthcare sector dating back to his undergraduate degree. Gary is also a member of the Global Stewardship Portfolio Construction Group.



Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 www.bailliegifford.com

A detailed electron micrograph of a cell, showing various organelles and structures in shades of blue, orange, and yellow. The image serves as a background for the text.

DECEMBER 2017

INTELLIGENT HEALTHCARE — US COMPANIES AND THE HEALTHCARE REVOLUTION

BY GARY ROBINSON

At Baillie Gifford, we believe the healthcare sector deserves attention. This is reflected in the fact that we invest in a number of innovative healthcare companies in the US.

In addition to the companies that focus specifically on health, other companies have more peripheral involvement and we gain wider exposure through large technology platforms such as Alphabet.

The pace of change is accelerating and this ought to create a favourable environment for identifying exceptional growth companies. We've been dedicating more of our time and thought to understanding the nature and implications of these changes. Our view is that there is little value in routine information and so our efforts have taken the form of in-depth and longer trips to important innovation hubs like the

Greater Boston area and Silicon Valley to talk to thought leaders both inside and outside of the corporate world.

We have also appointed an experienced healthcare journalist to supplement us in this task by producing in-depth reports which draw on the opinions of industry experts. Recent examples include reports on the biological process RNAi and cancer testing, and the next one will cover the broader topic of the application of machine learning to healthcare.

Here, we will give you a deeper insight into why we are so excited about investing in innovative US healthcare companies.



Treatment by educated guesswork could become a thing of the past.
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Costs are growing on an unsustainable path and are expected to eclipse \$5 trillion by 2025.

HEALTHCARE COSTS ARE OUT OF CONTROL

The US healthcare system is large and inefficient. America spends almost 20% of its GDP on health and achieves worse-than-average outcomes. Costs are growing on an unsustainable path and are expected to eclipse \$5 trillion by 2025. The problems are manifold, but the lack of high-quality, transparent and comprehensive data is likely a key contributing factor as it leads to poor decision-making and sub-optimal outcomes. Diseases are often caught late and treatment choices are made on the basis of educated guesswork rather than underlying genetic mechanisms. The result is a lot of wasted time and resource.

However, there is cause for optimism. One of the big opportunities to reduce costs and improve outcomes in healthcare is to find ways to use existing resources more efficiently. This is largely a data problem. Historically it's been expensive and difficult to generate, process and store data but this has changed with the advent of low-cost whole-genome sequencing, machine learning, and cloud computing. A consumer can have their whole genome sequenced with little more than a saliva sample and a cheque for \$999. Population-level genome studies are now affordable and advances in machine learning have made it possible to make sense of the enormous data-sets that come about on the back of them.

WHO ARE THE HEALTHCARE INNOVATORS?

The data-driven nature of the problem raises an interesting question about where the next wave of innovation in healthcare is likely to reside.

Large pharmaceutical companies are accustomed to a slow pace of change; decade-long approval cycles and long patent lives. Their core competencies are in clinical trial design and regulatory manoeuvring rather than bioinformatics and machine learning. For the large platform technology companies, however, data problems are right in their wheelhouse, and they are starting to turn their skills and immense resources towards solving problems in this area.

Indeed, it was notable that Sundar Pichai's keynote at the 2017 Google I/O conference (its annual developer conference) contained a number of references to Google's efforts in healthcare. Some of the early results from these efforts are truly impressive. For example, in a recent study, Google's machine learning algorithm was able to detect diabetic eye disease from pictures of the retina with an accuracy of up to 97.5%. Moreover, in breast cancer screening, initial results from Google's deep learning algorithm are highly promising, with a detection accuracy of 89%. Even amongst



Machine-based diagnoses will become routine.
© CBS/Getty Images.

highly-trained pathologists, agreement on breast cancer diagnosis can be as low as 48%. It is not difficult to imagine a scenario in the near-future where machine-based diagnoses are routine. These digital diagnoses will be faster, more accurate and much more cost effective than current practices.

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A CURE FOR CANCER?

Cancer is an interesting test case for the power of machine-learning in healthcare. One of the issues with cancer is that, on average, it is caught too late. The longer cancer has to grow within the body, the harder it is to treat. Indeed, patients whose cancer is caught at an early stage have survival rates which are five to 10 times higher than those caught at a later stage.

An unlisted company called GRAIL is looking to address this issue of detection through the use of highly-sensitive whole-genome sequencing alongside machine-learning. GRAIL hopes to detect signs of cancer in the blood, long before it would be detectable through traditional screening mechanisms. The development of such a test is an enormous undertaking, but GRAIL has ample funding and ambition, and is approaching the problem with rigour. The company was founded in 2016 inside Illumina (which is held in the portfolio); it became independent earlier this year when it raised \$900 million from a range of investors including Amazon, Tencent, Johnson & Johnson Innovation and Baillie Gifford. Illumina retains a significant minority stake in the business.

GRAIL has hired an incredibly talented team, including a large number of data scientists and ex-Googlers, and has built a significant sequencing and machine learning capability in the heart of Silicon Valley.

Cancer signals in the blood are weak, and their detection requires both sensitive screening equipment and sophisticated algorithms to separate signal from noise. Furthermore, the training of these algorithms requires large data-sets. GRAIL has initiated a huge study called STRIVE which will enrol up to 120,000 women at the time of their mammogram and it plans to supplement this in time with further, larger studies. The long-term aim is to develop a genuine pan-cancer screening test, which could be administered alongside a routine annual medical examination. The path to this outcome will, no doubt, be challenging, but GRAIL has taken a number of steps to stack the odds in its favour and the implications should it achieve its aims are enormous – most cancers would be cured, and treatments would come at significantly lower costs.

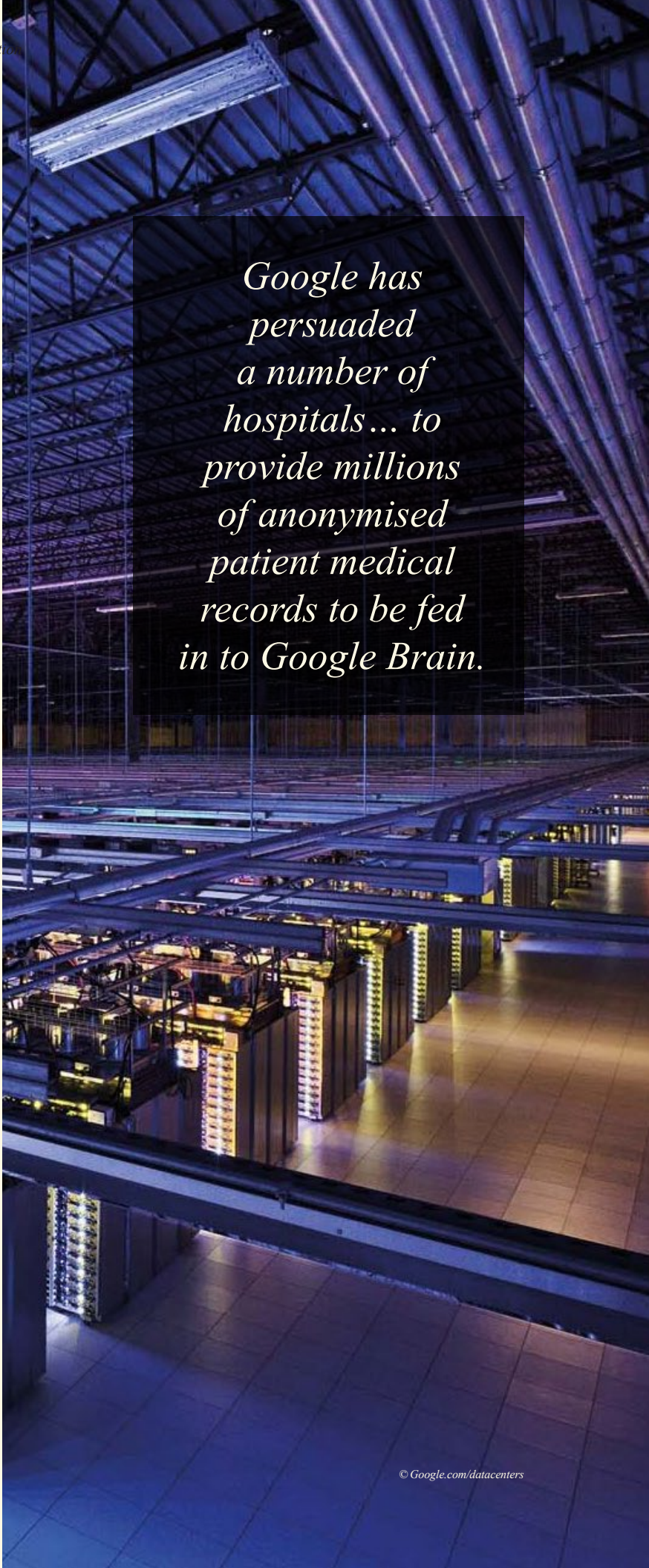
A PICTURE OF HUMAN HEALTH

It is notable that GRAIL has set out to collect the data that it needs to achieve its aims. This is consistent with a broader trend whereby the private sector is no longer waiting for the government to sort out the healthcare data problem.

Due to the complex, fragmented and silo nature of the healthcare system, high quality data is hard to come by. The potential for machine learning to improve healthcare is obvious. The challenge is feeding the beast. It is therefore encouraging to see the large platform companies take the initiative and strive to put the necessary data sets together. For example, Google has persuaded a number of hospitals, such as Stanford Medicine, UC San Francisco, and The University of Chicago Medicine to provide millions of anonymised patient medical records to be fed in to Google Brain.

More recently Verily, another Alphabet-owned company, announced the Project Baseline Study. The study aims to follow 10,000 adults over the course of four years and takes in data from a range of sources, including wearables and physical exams, in order to provide a baseline picture of human health and a query source for future studies.

These studies have been made possible by the emergence of new technologies and, as both sequencing costs and the costs to compute data continue to fall, the pace of collection should accelerate, along with our understanding.



Google has persuaded a number of hospitals... to provide millions of anonymised patient medical records to be fed in to Google Brain.

PERSONALISED MEDICINE — A WAVE OF THERAPEUTIC INNOVATION

The innovations in data collection and processing will provide doctors with earlier and better insights into diseases. An era of personalised medicine is upon us and that is tremendously good news for the system. What's even more encouraging is that wave of data-driven innovation is being accompanied by another wave of innovation on the therapeutic side of the equation.

Up until very recently, doctors had fairly limited options in terms of how they could intervene in a disease. Small molecules and antibodies accounted for almost all drugs on the market. This limited toolbox meant that even in situations where the genetic basis of a disease was well understood, there was often no way to tackle it. However, over recent years, a range of new therapeutic modalities have come of age. Gene therapies have been approved, gene editing tools are making their way into the clinic, and doctors are increasingly manipulating our own immune systems to tackle diseases such as cancer. One recent example of success came in the field of RNAi.

RNAi is a method of regulating gene expression that involves delivering a precise sequence of nucleic acid

into the cells in order to turn down or silence a target gene. This technique was recently used successfully by another of our holdings, Alnylam, to treat a rare and debilitating genetic disease called hereditary ATTR amyloidosis. What was striking about the results from the phase 3 study was that not only was the treatment extremely efficacious, the patients who received the drug reported fewer

adverse events than those in the placebo trial. These results are exciting because they potentially herald the dawn of a new era of highly targeted and specific interventions in diseases of known genetic cause. Moreover, as we build up a more comprehensive understanding of the genetic basis of disease, physicians will be able to use these tools to tackle increasingly complex disorders.

*Gene
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*In summary, the
innovative companies
we hold are accelerating
the pace of change in the
healthcare sector while
at the same time
improving humanity's
long-term prospects.
We will continue with
our efforts to learn more
about the opportunities
in innovative healthcare.*

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CURIOUS ABOUT THE WORLD

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