

The aim of these background papers is to stimulate thinking and debate about the future of health and care. Each paper focuses on one area, summarising key narratives, tensions and debates raised in stakeholder interviews and discussions before the event.

Technology

Different types of innovation

Health and care systems have long involved different types of innovation. **Biomedical innovation** has been the core of health and care system innovation, with development of pharmaceuticals and surgical techniques particularly visible. Alongside every biomedical innovation, though, are the changes in professional practice, organisation and system structures needed to accommodate it. These **organisational innovations** are less visible but are a central challenge in the impact of innovation in practice.

Technological innovations are increasingly relevant. Engineering innovation has long been present through medical devices. In recent years, information and communication technologies ('e-health') has been playing a greater role, such as through data collection and sharing, telehealth and self-monitoring. Initially focused on facilitating existing processes, the spectre of technological innovation has increasingly involved rethinking and redesigning care processes, practices and system structures.

Already today, digital technologies enable family carers to be close, they can be very helpful. Allowing people to live in their homes for longer.

There is now increasing attention given to emerging capabilities from robotics and **artificial intelligence**. But for all the attention, it is not clear how much of this is hype – how far are robotics and artificial intelligence already making a difference in health and care? How might this change?

For combination of AI and humans to be effective we need to engage with other issues than in the past—behaviour, teamwork, professionalism, much softer stuff that we've typically not worried about in AI.

Data a central issue in technology

Linked to increasing use of information and communication technologies is the role of data, in many different forms. **Genomics** represents a new kind of

biomedical data offering the potential to understand, diagnose and perhaps treat illness and disease in a fundamentally different and more personalised way.

Information technology also potentially enables the use of **existing types of data generated through the care process in new ways**, such as supporting the monitoring of performance, more efficient practices, or potentially new forms of analysis through artificial intelligence.

There's a reason why it's called healthcare. The caring aspects of health are not going to be done in my lifetime by AI machines. But there are some things which genuinely are already starting to make a difference. For example, personalised medicine, in terms of identifying likelihood of diseases earlier, and treating earlier, will happen. Technology will never solve end of life issues. That's the bit that never gets talked about.

There is a high level of uncertainty about the accessibility, reliability, relevance and usability of different elements of data. Despite much discussion of genomic data, current use in health and care systems remains limited and suggestions of its potential for radically reorienting treatment and provision has been overstated. The **potential of better data sharing** and use through information technology has been discussed for a long time but has proved difficult to realise in practice; there are many isolated examples of valuable initiatives but they have proved hard to scale up and sustain. Likewise, the current and future value of artificial intelligence remains unclear.

Health is 15 years behind finance in this respect.

The potential of data raises issues of **values and privacy**. As awareness of data breaches has risen, so trust in data sharing within health and care systems has been undermined. There are questions about when it is appropriate to access, share and make use of data, and in what ways. Do people wish to know if they are likely to get dementia on the basis of their genomic data, for example?

I recognise we should be very concerned about privacy. But it happens anyway, we have to talk about it. It is like nuclear energy. One side is power plants—on the other side its nuclear weapon. It's a dual use technology—

genomic tools can be used for personalised medicine or to block people from insurance.

As health and care systems are faced with choices about more sophisticated use of related data (such as through artificial intelligence) so system leaders will need to consider the value of such data. There is as yet **no social consensus** about how data can or should be reused, though public perceptions appear to be linked to the purpose for which the data is being used and the actors involved. Who owns what data? Who can we trust when it comes to sharing data, and why?

The anxiety is definitely real—just look at Cambridge Analytica to know that.... But if people think their data was going to be used and the NHS will benefit, they are much more relaxed about data being used.

Health and care relatively slow in using information and communication technology

Recent decades have seen significant changes in many sectors of the economy due to use of information and communication technology. Yet despite examples of the potential of these technologies to improve health and care, there remains a gulf between ambitions and achievements across most health and care systems. For example, basic data collection and sharing structures are still frequently lacking; timely data that can support learning by professionals is mostly absent; and thus widespread use of artificial intelligence depends on data systems that are still a very long way off.

Why has it been so difficult to implement innovation in health and care? The processes of adoption and organisational change that are required are currently not well understood. The vast bulk of research funding in health and care goes towards biomedical and technological innovation with far less to organisational and system innovation. Improving adoption and implementation through organisational change remains central to improving productivity and ensuring sustainability of health and care systems. How can this be better supported?

Innovation systems: what technologies are we getting? What are we missing?

The most visible innovation system for health and care is the **pharmaceutical innovation** system. This is a mixed system, with public funding for much initial basic science followed by private sector research and development for specific medicinal products, which are then licensed and evaluated by health systems. Development is typically concentrated on **products likely to do well in developed-country markets**, especially the United States. Pharmaceutical innovation has provided enormous benefits to health through direct therapies and through medicines enabling other therapies such as surgery or radiotherapy.

There are concerns that this process is no longer providing the results that it used to, whilst incurring high costs; and that despite efforts to direct development towards specific needs, the innovation system is not well aligned with health needs.

The very big issue for me is the development of new therapies, true in my field but true across the board. The cost of developing a new drug is increasing massively and so is the failure rate. This is not a sustainable model.
