Accelerating effective and safe adoption of artificial intelligence in the healthcare system: Executive summary & proposed next steps

Artificial intelligence (AI) – algorithms with the ability to perform tasks that would normally require human intelligence – has great potential to improve health outcomes, reduce health inequalities, and improve the efficiency of the healthcare system, as shown by examples of early adoption of AI-based technologies in health and care. However, technical, regulatory, and cultural challenges mean that the adoption and scale-up of AI-based healthcare technologies is currently slow, piecemeal, and variable across the UK. To realise the benefits of AI in health and care more widely, a more streamlined, end-to-end pathway for safe and effective adoption of AI in the healthcare system needs to be developed, with the aim of overcoming these challenges.

In March 2023, the Academy of Medical Sciences' FORUM and the Royal Academy of Engineering co-hosted a meeting to explore the barriers and enablers to adoption of AI in the UK healthcare system and propose potential solutions. Discussions particularly focused on lessons learned from the experiences of early adopters of AI in the healthcare system, particularly for decision support. The meeting was part of the Academy of Medical Sciences' FORUM programme of events, bringing together representatives from academia, industry, and health and social care along with patients, regulators, and other relevant stakeholders. The following four key themes emerged from workshop discussions:

1. Improving confidence and trust of end-users

A lack of confidence amongst end-users (including healthcare practitioners (HCPs) and patients) in AI-based health technologies is a barrier to adoption. This may be caused by **aversion to perceived risk** (e.g. of trying a new technology), concerns about health data privacy and cyber security, and/or a lack of analysis of the limitations of the existing standard of care, which are often caused by shortages of skilled staff.

Participants suggested the following activities to help overcome the lack of confidence and trust of end-users in AI:

* Early and continued engagement with end-users to help ensure AI-based health technologies developed are useful, relevant, and effective. This should include meaningful patient involvement and engagement in technology development where relevant. Early end-user engagement can also help foster **early adopters**, who – with support – can act as ambassadors for the use of AI by the healthcare workforce.
* **Training** HCPs to improve their digital literacy, data skills and understanding of the benefits and limitations of AI.
* **Communicating clearly and accessibly** about how an AI-based health technology functions and particularly communicating the evidence of its effectiveness in real-world settings. Using informational material **co-developed by end-users** and **case studies**, early adopters, and organisations that represent **'trusted voices'** can make this communication more effective.
* **Building a trusted system** for the regulation of AI-based health technologies. In particular, more clarity is needed about where **accountability and liability** lie regarding the use of AI-based health technologies.

- Having **informed dialogue with the wider public about AI** by, for example, setting up a national forum and/or citizen panel(s).

2. Enhancing the capacity and capability of the healthcare system to adopt AI

Cultural, workforce and infrastructure challenges are preventing widescale adoption of AI-based health technologies in the healthcare system. Participants suggested:

- Providing **capital investment and financial incentives to improve the digital infrastructure** of healthcare bodies.
- **Standardising digital systems and data collection to improve interoperability** and make scale-up of AI-based health technologies across different healthcare settings easier.
- **Developing high-quality, diverse datasets** on which to train AI-based health technologies. The introduction of **standards for data quality, collection and metadata** would help ensure the utility of the datasets.
- Ensuring HCPs have the training and capacity (in terms of time and resources) to adopt and use AI-based health technologies for decision support. **Appointing digital innovation teams and creating career pathways** for experts in use of AI in health in the healthcare system would help ensure the healthcare system has the capability to adopt AI.
- **Fostering a culture of useful and usable innovation** in the healthcare system (e.g. by introducing an innovation mandate for healthcare bodies).

3. Better defining the governance of AI in health, including evaluation, reimbursement, regulation, and standards

For any technology in the healthcare system, evaluation of effectiveness and cost-effectiveness is essential. This is a particular challenge for AI. Participants highlighted that:

- The effect of AI can be **context specific** so comparators to judge effectiveness should be chosen with particular care.
- The performance of AI-based health technologies can change over time due to changes in the target population. Robust mechanisms for **post-market surveillance** that include a clear procedure for responding where AI-based health technologies are not or are no longer performing as intended will be important, including potentially withdrawing the technology. Evidence from such surveillance mechanisms can be used to improve the performance of an AI-based health technology, as well as monitoring and maintaining it. **Collaboration between regulators and developers** will be important to ensure surveillance mechanisms are robust yet risk-proportionate for different kinds of AI.
- Economic models that capture and quantify the value of any system-wide effects of AI-based health technologies need to be developed. Communicating the **systemic value proposition** to commissioners and central government will be important to ensure support for the technology is sustained.
- It would be useful to raise awareness of the **guidance provided by the AI and Digital Regulations Service** for developers (and adopters in due course).
- **Standards** for the adoption of AI-based health technologies in the healthcare system could help ensure consistency of performance.

4. Building a system ready for AI adoption

Due to the potentially system-wide effects of AI-based health technologies, it is

important to take a systems approach to adoption and scale-up to realise their potential benefits and avoid unintended consequences. A systems approach involves taking into account the relationships between a broad range of relevant stakeholders and sub-systems. Participants noted that using this approach to gain awareness of any bias in the system can help **turn a risk of exacerbating health inequalities into an opportunity to address them**.

Fragmentation in the healthcare system can lead to inefficiencies. Participants suggested mechanisms to improve the collaboration and coordination of the healthcare system's approach to adoption of AI:

- A **consistent commercial architecture** could allow 'smarter' commissioning and help avoid duplicative commissioning of AI-based health technologies between healthcare bodies or between multiple NHS Trusts.
- **High-level strategic direction, resource and infrastructure** would help facilitate adoption of AI-based health technologies, particularly to capitalise on potential system-wide benefits and ensure interoperability. This could include the development of a data and AI strategic roadmap by government working with partners across the healthcare system.
- **Demand signalling from the healthcare system** at a local, regional, and national level would be useful to enable developers to design technologies that address key problems in the healthcare system.

The complex and potentially wide-ranging impacts of AI-based health technologies on healthcare mean that **coordination and cross-sector collaboration** will be essential in developing principles for safe and effective adoption that are broadly applicable while being useful in specific contexts.

Proposed next steps from the workshop

Workshop participants proposed next steps for the accelerating the safe and effective adoption of AI in the healthcare system within the above themes. These are listed here in brief. For a full discussion of each next step, please see the full report.

1. Improving confidence and trust of end-users

1.1 Developers should work with end-users early during the development of their products and in the development of understandable, accessible, transparent informational material about their products.

1.2 Mechanisms to allow patients and the public to understand and have agency over how their health data is used should be established.

1.3 Support and incentives should be provided to early adopters of AI-based health technologies to share their personal experiences with technologies. The Royal Colleges would be well placed to encourage early adopters.

1.4 Case studies of well-documented success stories of AI adoption in healthcare should be developed, which communicate the value in terms of health outcomes, efficiency, and cost-effectiveness. These case studies should also highlight examples of successful collaborations between developers, end-users and other stakeholders during the development and adoption of AI-based health technologies.

1.5 Organisations that are seen as independent and trustworthy have a role in brokering debate between the public, developers and researchers, and the wider media, to build a better understanding of technology capacity and user needs. Such organisations could make use of such case studies as those mentioned above, to help build trust, confidence and demonstrate cost-effectiveness.

1.6 A supportive framework to clarify accountability and liability should be established to support HCPs using different types of AI-based health technologies and to provide clarity to developers.

1.7 Effective methods to involve and engage with patients and members of the public about AI in healthcare on a national scale should be identified, drawing on existing initiatives where relevant. This may include a national forum and/or one or more citizens' panels. Organisations such as Understanding Patient Data and Health Data Research UK would be well placed to convene this on a national scale.

2. Enhancing the capacity and capability of the healthcare system to adopt AI

2.1 Efforts to improve the digital infrastructure across the healthcare systems of the UK should continue, including providing capital investment and financial incentives to support these efforts. To enable interoperability, digital systems and the end-user interface should be standardised across similar healthcare settings. NHS England and counterparts in other UK nations would be well placed to lead on this work.

2.2 Data standards should be developed to ensure robust, secure collection, curation, and sharing of high-quality data, with sufficient metadata, that can be used to train and monitor the performance of AI-based health technologies.

2.3 Training should be provided to HCPs to improve digital literacy, data skills, and knowledge of the benefits and limitations of AI. Health Education England would be well placed to lead on education of those currently studying in England. Platforms such as the NHS Learning Hub would be well placed to provide relevant educational resources to currently practicing HCPs. Training could also be linked to the adoption of specific AI-based health technologies, with the support of developers.

2.4 Healthcare bodies should provide support to HCPs for the adoption of health technologies. This may include dedicated staff time or the establishment of digital innovation teams.

2.5 Career pathways for experts in AI should be created in the healthcare system. This could include setting up specific fellowships for HCPs to work to solve clinical problems with AI, building on current programmes such as the Topol Digital Fellowships.

2.6 Mechanisms to promote useful and usable innovation to improve health, such as an innovation mandate for healthcare bodies, would be useful, supported by management and leadership.

2.7 Mechanisms to monitor and celebrate positive impacts would be important to build a culture that values and encourages innovation. This could include establishing a national programme of healthcare innovation champions.

3. Better defining the governance of AI in health, including evaluation, reimbursement, regulation, and standards

3.1 Mechanisms to enable post-market surveillance should be developed that use real-world evidence (and potentially human feedback) to monitor, maintain and improve the performance of AI-based health technologies. These could be integrated with any pre-existing audit tools. Health economic analysis should be undertaken for AI-based health technologies.

3.2 There should be support to increase the capacity of the regulatory system to enable it to better address the specific issues and risks of regulating AI-based health technologies.

3.3 Efforts to raise awareness of the AI and Digital Regulations Service amongst relevant stakeholders would be useful.

3.4 There should be further work to explore what standards could be useful to accelerate the adoption of AI-based health technologies in the healthcare system. The British Standards Institute and the AI Standards Hub may be well placed to help take this forward.

4. Building a system ready for AI adoption

4.1 Developers and adopters should take a systems approach to designing and implementing AI-based health technologies, considering a broad range of stakeholders, and bearing in mind potential sources of bias or inequality. Better communication between stakeholders involved in the adoption and maintenance of AI-based healthcare technologies and other digital innovations should be prioritised.

4.2 Consistent commercial architecture should be established to allow joined-up commissioning decisions between different healthcare bodies, including different NHS Trusts.

4.3 There should be coordination between different parts of the health and social care system at a local and regional level to develop solutions to local problems with systemic components. This could involve local system-wide partnership to drive innovation.

4.4 High-level strategic direction and infrastructure is needed to encourage the adoption and scale-up of AI-based health technologies. This could include developing a data and AI strategic roadmap by government working with partners across the healthcare system, with a framework for national implementation and procurement.

4.5 Demand signalling from the healthcare system at a local, regional, and national level would be useful to enable developers to design technologies that address key problems in the healthcare system. The development of a model or framework for gap assessment for completion by ICSs (in England), integration joint boards (in Scotland) or regional partnership boards (in Wales) could be a starting point for this.