The Future of Artificial Intelligence for Health and Social Care

# Enabling a learning health and social care system

Artificial Intelligence (AI) has the potential to make a significant difference to the way health and care services are delivered. Its ability to analyse large quantities of complex information and predict patterns and outcomes provides opportunities to automate routine workflows and provide insights at a scale that transforms how we deliver care. Creating the potential to deliver improved outcomes for the public, target prevention and free-up clinician and care workers time to care.

The NHS Artificial Intelligence Lab was set up in 2019 to start to realise this potential. It has put the NHS in the right place to develop an evidence base to support the development of and deployment of safe, ethical and effective AI. Allowing us to prepare for this technology.

We are now in a place where AI is becoming more pervasive in our society and a key priority of the government’s industrial strategies. This strategy will build on the work of the NHS AI Lab, lessons learnt from supporting the COVID-19 response and firmly sit as an application of the NHS data strategy, [Data saves lives: reshaping health and social care with data](https://www.gov.uk/government/publications/data-saves-lives-reshaping-health-and-social-care-with-data-draft), to deliver a data-driven, continuously improving, “learning” health and social care system.

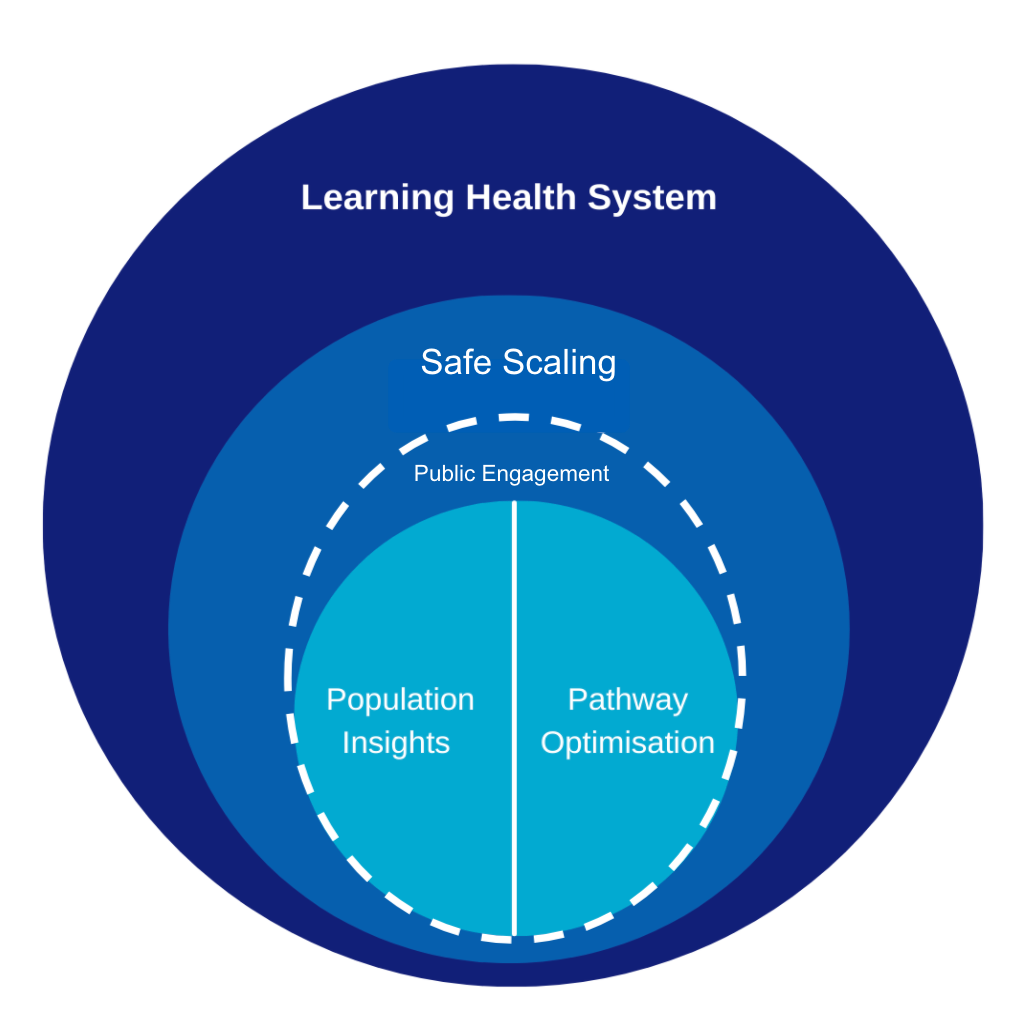
It is not intended to be a comprehensive account of all possible applications of AI for health and social care but instead will provide a guide in how we can systematically support the scaling of these technologies and enable the multidisciplinary collaboration to support this becoming reality. Only by working together can we deliver this step change in the delivery of health and social care in England, the wider UK and set an example to the world.

This document is a living strategy - it will be regularly reviewed and iterated, allowing room to pivot in the face of change, building on data, insights and learning as these get stronger with our stakeholders, health and care professionals and the public.

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# Looking to 2030

Our vision is:

*By 2030, the UK has a* ***learning health and care system*** *delivering* ***better outcomes for the public****, enabled by the use of* ***safe, ethical and effective*** *artificial intelligence, setting an example to the world*

To deliver this vision we will focus on three areas that AI can contribute to:

* [Population Insights](#_om7ppi80nmlc)
* [Pathway Optimisation](#_o2adf8n51o2h)
* [Safer Scaling](#_dptct657dxi2)

Always mindful of our principles:

* Safe
* Ethical and trained on representative data sets
* Making workforce lives easier
* Sustainable
* Equitable
* A proven outcome over alternative

We are dependent on and will need to collaborate with (not exhaustive - please add more):

|  |  |
| --- | --- |
| * NHSX: Data Strategy * Digital Transformation Plans * Common Data Models * Common Technical Architecture * Accelerated Access Collaborative Demand Signalling | * Commercial Innovation Models * Office of AI Strategy * Office of Life Science Vision * UKRI AI Strategy * Centre for Improving Data Collaborations |

### Population Insights:

### Applying AI to our population level data at national, regional and local levels to deliver “insights”, supporting better operational, population and research model decision-making.

This will allow smarter use of resources across health and care, as we’ve seen during the covid-19 pandemic, by using data to predict staffing and resource requirements delivering more targeted care. Our [case studies](#_mjby2w8dh201) show what this means in practice in more detail.

**To achieve this mission, the AI lab needs to, or identify the team that can, localities and regions can also use these steps as a guide:**

#### Prioritise data availability:

* 1. Work across NHSX, NHSE/I and other agencies such as UK Health Security Agency (HSA), Public Health England (PHE), Genomics England to map the availability of population level data, nationally in the first instance
  2. Develop an AI data readiness model, including established legal basis for data collection and storage in trusted environments
  3. Assess identified data against AI data readiness model to prioritise and share

#### Identify AI for generating insights

* 1. [Map](https://www.nature.com/articles/s41746-020-00324-0) existing applications of AI from [NHS AI in Health and Care Awardees](https://www.nhsx.nhs.uk/ai-lab/ai-lab-programmes/ai-health-and-care-award/ai-health-and-care-award-winners/) to assess what can already be applied on available datasets
  2. Work with regions, ICSs, AnalystX and local government digital networks and communities to index where AI and machine learning applications are being trialled for population health insights beyond NHS AI Lab awardees
  3. Conduct a wider analysis on AI technologies from other sectors and countries that may be beneficial for operational and sustainability efficiencies

#### Test identified AI on priority data

* 1. Test and evaluate identified AI technologies to prioritised data use cases
  2. Work collaboratively with regulators in the testing and evaluation of AI technologies to identify and address regulatory issues
  3. Ensure the insights are valuable to end users and can improve procedures before scaling

#### Iterate, demand signal and focus on next priority data

* 1. Establish robust criteria for quality and quantity of data according to AI readiness rating
  2. Continue to refine approaches to developing insights as more data sets become available, work to operationalise learning
  3. Work with ICS and regional teams to increase the sharing of best practices, ideas and insights to technical and non-technical audiences
  4. Based on the insights developed, coordinate demand signaling to industry/central policy makers for future transformation needs, capabilities or capacity 

### Pathway Optimisation:

### Applying AI skills to pathways undergoing transformation to ensure better pathways are realised or enabled in the future.

This will allow us to marry up data science skills with pathway redesign or quality improvement initiatives to allow full transformation to be realised. At the moment these activities can happen independently, which ultimately slows down how quickly full pathway transformation can occur, this may have an impact on patient outcomes overall.

**To achieve this mission, the AI lab needs to (localities and regions may follow these steps)...**

#### Identify priorities set out in the NHS Long Term Plan and pandemic recovery response

* 1. Identification of priority clinical, care and operational pathways for cancer, cardiovascular disease, pulmonary disease, diabetes, and adult mental health and teams involved in making pathway improvements

#### Identify additional resources required to support ML and AI optimisation where relevant

* 1. Work with Data, Digital, and Technology (DDaT) professionals and quality and process improvement teams to ensure that requirements for AI technologies, such as benefits of structured data, feed into their pathway redesign opportunities.

#### Implement AI driven transformation

* 1. Bring together teams from across organisations including the health and care regulators and national policy teams to take joint approaches to generating evidence and agreeing the use of AI technologies in various pathways

#### Evaluate, iterate and set next priority

* 1. Work with policy and commissioning teams to include considerations of how AI may form part of any planned transformations and ratify the lesson learnt into commercial frameworks and policy levers to support spread.

### Safe Scaling:

### Scaling, safe, ethical, cost effective AI applications throughout health and care, globally, with proportionate regulation

This will allow us to take learning from the population insights and pathway optimisation activities and create a framework that allows for the equitable deployment of safe AI technologies by localities, regions or national teams, or indeed, worldwide.

**To achieve this mission, we, the AI lab, need to...**

#### Support the growth of AI innovation

* 1. Working with the Accelerated Access Collaborative and the NHS AI Lab to develop a function for scaling artificial intelligence technologies that work
  2. Work with national commissioners and NICE to identify appropriate ways to signal cost effectiveness and generate a commissioning function to fund the use of AI technologies, that’s useful locally, nationally and regionally
  3. Continue to work with HEE to [ensure that priority workforce skills](https://www.hee.nhs.uk/our-work/dart-ed) are developed for building workforce trust in and opportunities for AI technologies

#### Support the regulatory ecosystem

* 1. Ensure that the [Multi Agency Advice Service](https://www.nhsx.nhs.uk/ai-lab/ai-lab-programmes/regulating-the-ai-ecosystem/the-multi-agency-advice-service-maas/) is continually improved based on learning from population insights and pathway optimisation for health and social care in the UK. All innovators (based in UK or abroad) will have access to clear information on the regulatory requirements for AI for implementation in health and social care in the UK
  2. Provide guidance on generating the appropriate evidence base required to allow the regulatory system to support the equitable spread of trusted technologies
  3. Work with NICE to accelerate the process of healthtech assessment involving AI technologies

#### Develop technical mechanisms for deploying AI at scale

* 1. The NHS AI Lab will build on the [National Covid Chest Imaging Database (NCCID) to trial a National Medical Imaging Platform (NNIP)](https://www.nhsx.nhs.uk/ai-lab/ai-lab-programmes/ai-in-imaging/) which combines a Trusted Research Environment for research and a deployment mechanism for applying AI centrally
  2. Based on learnings from the NMIP alpha, the NHS AI Lab will explore further opportunities to create platforms for developing and deploying AI technologies into health and care settings

#### Address the difficult policy questions

* 1. Working with NHS Resolution we will clearly define responsibility and liability for the use of AI technologies in health and social care
  2. Working with the regulators and academia we will consider the regulation of autonomous algorithms as these become more advanced.
  3. Work to understand the extent to which AI technologies may unintendedly make an impact on our climate if we do not consider this when commissioning services at scale
  4. Continue the AI ethics lab initiatives, working with the public on the ethical questions that AI technologies can bring to the fore, debating and publishing findings as we go.

#### Evaluate and iterate

* 1. Develop methods to consistently prove performance of AI technologies for use in health and social care
  2. Share with the world

## How do we know we’ve achieved this?

We will measure how close we are to achieving our vision by establishing some baselines from work already being done by the NHS AI Lab and incrementally working towards improving these metrics.

Our success criteria include:

* Feeding into ICS maturity models with criteria that move from digital maturity to learning health system maturity, with a goal of demonstrating an incremental increase in this over time
* Proportion of AI Mature data available, with initial establishment of a measure then improvement over time
* Proportion of user cases that an AI technology has been successfully applied to both from our pathway optimisation and population insight analyses
* Criteria established for optimal multidisciplinary team for QI and service design, then measurement how often national teams are hiring for these roles
* Work with Office for AI to provide aggregate measures of improvement in AI technology related skills nationally, and health’s contribution to this, either via increased investment or training and job role growth
* Number of NICE clinical guidelines or standard operating procedures and policies in health and care that incorporate AI technologies
* Number of AI technologies invested in across health and care
* Number of AI technologies across each segment of risk and number being assessed via regulators
* General sentiment analysis on attitudes towards AI and how these are shifting, across public; health and care professionals and industry

## What does this mean:

We have outlined our ambition to enable a learning health and social care system that is routinely delivering higher quality care and better outcomes for the population. We have outlined a set of approaches on how to achieve this and how we will measure our progress. The case studies that follow illustrate what this means in practice for health and care professionals, patients, and innovators. Freeing-up time to care. We hope over the lifecourse of this evolving strategy, these will become evident and new futures can be imagined.

**Case Study #1: James is Mary’s Full-time Carer**

James is a 23-year-old university student and is the lone full-time carer for Mary, his 78-year-old grandmother. Mary was diagnosed with early-onset Alzheimer’s disease (AD) five years ago and has a history of hypertension. They live in the same urban environment but James splits his time between campus and home. Since the pandemic, it’s been easier for James to take lectures from home.

James downloaded an app recommended to him by his university councillor when he shared he cared for Mary. He says it’s really easy to use, because it answers his questions. It combines NHS and council information to provide him information on local community care services, is really up-to-date on upcoming support groups and provides tips to help James anticipate Mary’s care needs.

James is used to using his phone and computer to help Mary manage her health. A few years ago she asked him to keep tracking her neurological health with a well-trusted AI-powered prevention tool, recommended as part of the [Our Future Health study](https://ourfuturehealth.org.uk/our-programme/#htoc-research-protocol), during which Mary found she was at risk of AD. Mary’s GP has also given her a wearable device that keeps her safe, it helps her and James to monitor her blood pressure, activity levels and any falls. This gives James peace of mind when he’s out and about. The brain-training exercises and diet recommendations are also useful, Mary loves puzzles. Even more peace of mind is that the clinical care team receives this data too, it helps James feel supported.

Now he’s in his final year at university, James is short on time, so he dug out the app the university councillor showed him, to ask about care support available in his region. It sent him a quick survey, and he instantly got back a list of means-tested care options for Mary. By selecting he was interested in care resources nearby he was provided an automatic call-back by a local care navigator and a list of care providers shortlisted by rank and location. After speaking with the care navigator he’s decided he’s ok for now, but has options in case Mary starts to decline.

James had just started his internship when Mary's Multidisciplinary Care Team Lead, Sunil, noticed a downward trend in Mary’s daily assessment data. He contacted James, to set up a remote consultation. A mobile CT scan and blood test were requested. Within 24 hours, Sunil notifies James of the results, Sunil mentioned their new AI-diagnostic process is much faster these days, but sadly, Mary is diagnosed with AD. Sunil posted the care recommendations back to James via the app, he knew there was a lot for James to process that day. Luckily, he’ll get sporadic reminders with live information on the care options over the next six months, which helps Sunil feel he’s supporting James, especially as it stays uptodate.

As Mary’s AD worsens, she and James decide to pursue their plan to shift her to a care home. Whilst there, James, the community health team, and Mary’s MDT continue to monitor her neurological health James receives regular updates via the app, it helps him to pick the best days to visit Mary, and means he knows that should anything happen emergency teams will be able to access her latest information and her care plan.

**Draft case studies [We welcome ideas!]:**

**Commercial/reimbursement of well evidenced technology**

**Workforce - pathway transformation MDT approach**

**Population Insights - generating new treatments from aggregating data**

**Innovators from AI award - involved in regs**

**Training a data set from a TRE**

**Commissioner angle -- what does this mean for CFO/or ICS leader.**



## How did we get here

Since we started researching the strategy:

* Members of the AI Virtual Hub shared their hopes and fears for the strategy
* We held webinars and Show&Tells which allowed stakeholders to feedback on the draft as it was being developed.
* Sought direction and advice from our [Working Group](https://www.nhsx.nhs.uk/ai-lab/ai-lab-programmes/the-national-ai-in-health-and-adult-social-care-strategy/) members
* Held 1-1 conversations withgovernment and policy organisations to seek their expertise and feedback to shape our proposals.
* Interviewed a range of people developing, using and commissioning AI, with different levels of digital maturity and in a variety of disciplines, regions and localities, to understand their challenges and opportunities and the support they wanted to see.
* Surveyedmembers of the public to understand attitudes towards the use of AI in health and care.
* Conducted workshops with health and care representative organisations to cast a critical eye one our visions and areas of focus for the strategy.

Alongside the engagement we have reflected on learnings of the NHS AI Lab and conducted research activities to ensure we have captured the current landscape and understanding of AI whilst also exploring the potential of AI in the future.

We collated and synthesised various existing sources of data to ensure the strategy is reflective of the current landscape of AI in health and social care. We combined data from our annual [survey](https://www.nhsx.nhs.uk/ai-lab/about-the-nhs-ai-lab/2020-21-a-year-in-the-life-of-the-nhs-ai-lab/) and further analysis of emerging AI technologies to understand what is on the horizon and see where the greatest benefit may come from over the coming years.

Additionally, our review of national and international policies and strategies highlighted that the UK has an advantageous characteristic as a single payer insurer that provides us with the potential to be a world leader in deployment and diffusion of safe, effective and ethical AI technologies, something that has yet to be done well anywhere in the world.

The aim of our qualitative primary research was to identify the priorities and areas of interest for AI going forward for a range of stakeholders. This involved conducting a survey to gain the views of the public and a series of interviews, focus groups and workshops with various stakeholders including strategy and policy leads, health and social care professionals, members of industry and the public.

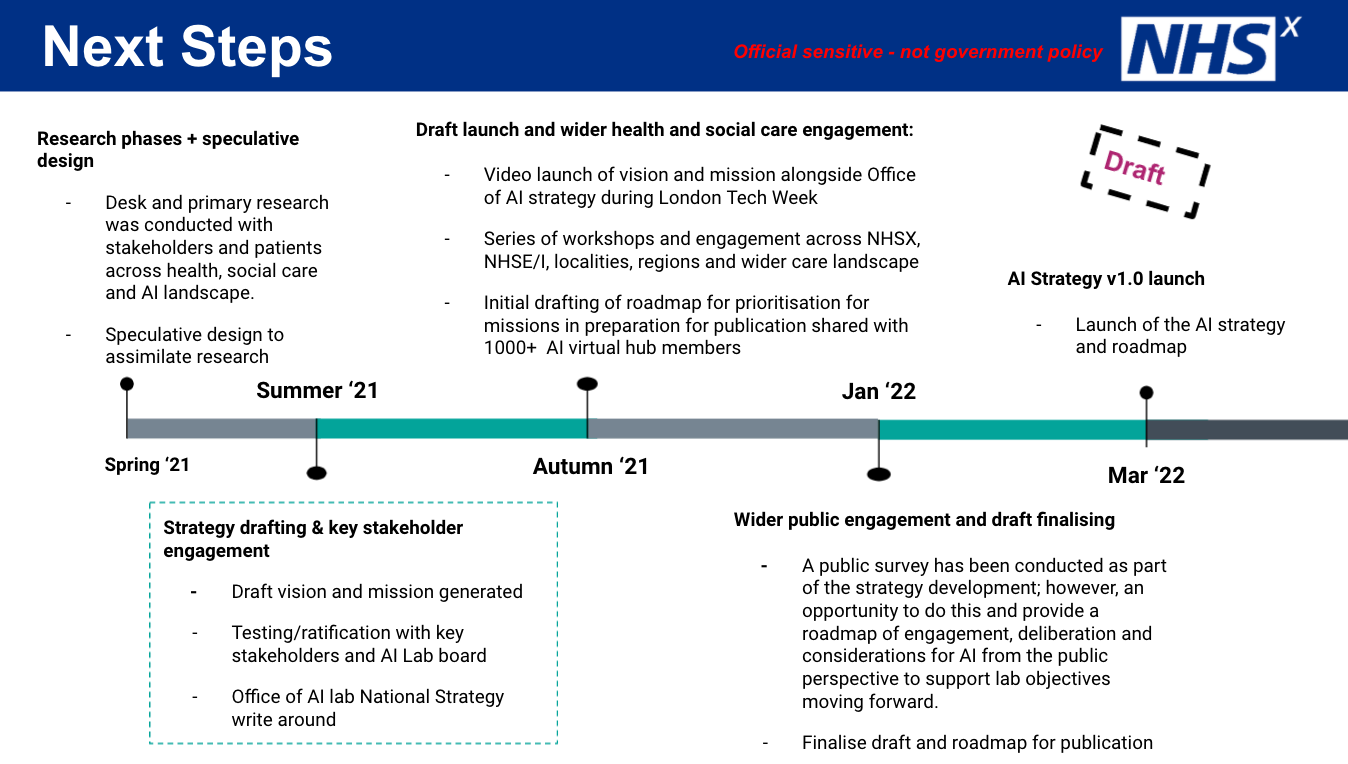
From this research we learnt that there is a considerable scope to increase public and user understanding of the potential for AI, and that the challenges to adopting AI in health and social care are common across different areas. We also found that in all groups of stakeholders, there was support for a nationally coordinated approach to deployment of AI technologies to prevent inequalities and ensure best practices.

To explore how AI may be utilised in the future, we employed a user centred design research method, speculative design. Using this technique, we spoke with numerous experts across multiple sectors to understand possible wider technology and societal trends over the next decade. From here, we were able to examine how AI might be applied and the subsequent consequences, both good and bad. This provocative thinking allowed us to ensure our planned actions were grounded in reality and towards a preferred future state.

## Our next steps:

We welcome your feedback on this draft right now. Below we outline our high level timelines in anticipation of publication, as agreed in draft with the AI Lab Board in September ‘21. As you know things are subject to change, but we are on track at the moment. All comments, criticisms and example case study examples are welcome.

We aim to publish a roadmap alongside this living strategy, so you can monitor our progress, and aspire to (although are not sure how to best do this, yet) have our dependencies mapped too.



## How to get involved:

We are keen to continue to engage with a wide stakeholder group and welcome feedback on all aspects of the draft strategy.

We will continue to share information and engagement opportunities via the [National AI Strategy page](https://future.nhs.uk/AIVirtualHub/view?objectID=27635568) on the [NHS AI Lab Virtual Hub](https://future.nhs.uk/AIVirtualHub/grouphome). You can also contact us directly by emailing [ailab@nhsx.nhs.uk](mailto:ailab@nhsx.nhs.uk).