



How the UK can win the AI race

What we know, what the public think and where we go from here

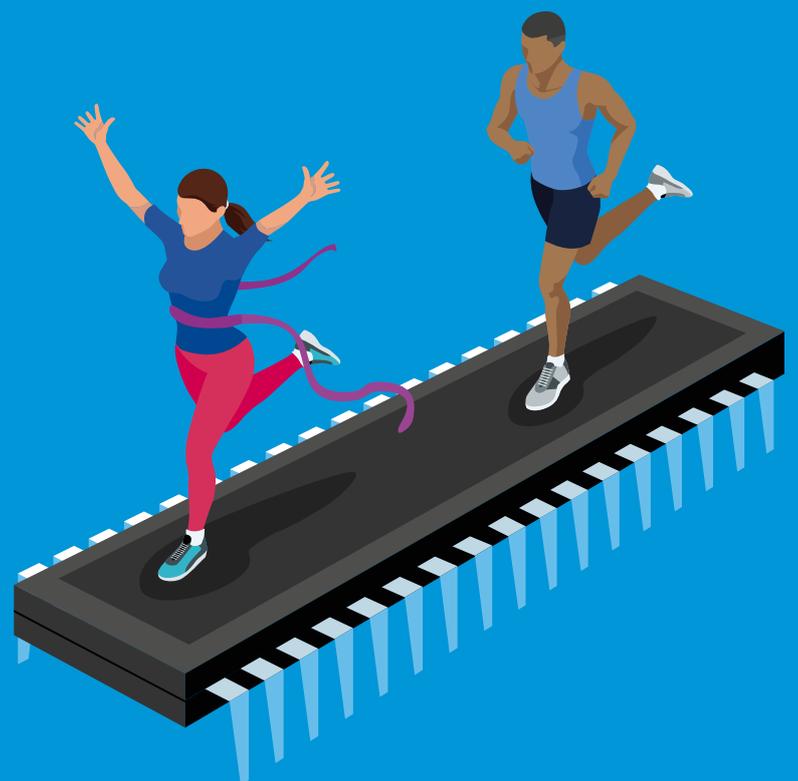


**INDUSTRIAL
STRATEGY**

September 2018

Part of KPMG's
Industrial Strategy series

kpmg.com/uk



Foreword from the Secretary of State



Rt. Hon. Greg Clark MP

Secretary of State for Business,
Energy and Industrial Strategy

A revolution in AI technology is occurring. AI will define this century. This presents a huge opportunity for the UK and if we act now, we can lead from the front. That is why we identified AI and data as one of the UK's four Grand Challenges in the Industrial Strategy and why we are mobilising all of government to seize this opportunity to make the UK a global leader in this technology that will change all of our lives.

As the European powerhouse of AI, our heritage is well known. We are home to some of the industry's biggest names like DeepMind, SwiftKey and Babylon. Our Alan Turing Institute, the national institute for data science and AI, is named after one of Britain's brilliant pioneers. Today, AI is at the centre of a thriving digital tech sector now worth £184 billion to the UK economy. Tech investments in Britain surged nearly 90% last year, more than in France, Germany and Sweden combined. We launched an AI sector deal with industry worth almost £1 billion that is bold and ambitious. We are spending an additional £7 billion in public R&D over five years – the greatest real-terms

increase of any UK government ever – and investing in the skills and world class talent with an additional 1,000 AI-related PhDs.

Quite rightly, this report identified ethics and safeguards as key issues around AI and data. We agree. That's why we created the Office for Artificial Intelligence and the Centre for Data Ethics and Innovation to make sure that AI benefits everyone in the UK.

We know the jobs of the future and the skills needed to thrive will change considerably, so we are investing an additional £406 million in maths, digital and technical education – helping to address the shortage of science, technology, engineering and maths (STEM) skills – and create a new National Retraining Scheme that supports people to re-skill, beginning with a £64 million investment for digital and construction training.

Already, we have put AI at the vanguard of our approach to some of the key issues that we face. The Prime Minister announced our first mission to use data, AI and innovation to transform the prevention, early diagnosis and treatment of chronic diseases by 2030. This ambitious and transformational mission is just one example of how AI can enhance our lives.

This report reflects my belief that the UK can lead the world in AI and data. We have set the ambition through our Grand Challenge and through the work we are doing to ensure that AI is inclusive and enabling to all. The UK has fantastic foundations for AI to flourish.

I am determined to see that it does.

How the UK can win the AI race

What we know, what the public think and where we go from here

Global governments recognise the potential of artificial intelligence (AI) as an accelerator for growth. The UK is a global leader in AI, but needs to act now to protect its position.

What we know

The government and UK business must take action to keep the UK at the frontier of AI advancement. The UK is an AI academic powerhouse, publishing nearly 25,000 research papers on the topic in the past ten years. This puts the UK fourth in the world when it comes to AI research. Our experts give their take on the opportunities we can grasp as a nation, and the hurdles we need to clear to keep Britain in contention.

What the public think

We know new ideas that disrupt the status quo don't have the luxury of public support from the off. Especially ones that require the input of our personal data. So we asked 2,000 people from across the UK exactly what they think about AI.

AI touches nearly every part of our day-to-day lives. In work, entertainment, socialising, government and more. The UK population already has a relationship with this nascent technology.

But when it comes to AI, we found one organisation British people have the most faith in: the NHS.

A majority (53%) of respondents think that AI will have a positive impact on the NHS. Probing further, 56% approve of their data being used to improve the NHS. The contrast with media companies (8%), internet companies (8%), charities (11%) or pharmaceutical companies (15%) is stark.

Where we go from here

The exponential pace of technological change in the next ten years will far outstrip the linear progress of the previous ten. The speed of current breakthroughs has no historical precedent. It is starting to blur the lines between the physical, digital and biological spheres. This chapter of change is termed 'The Fourth Industrial Revolution' and will be a story that shapes our lives for decades to come.



Keeping up with this change is not going to be easy, it never is. But we need to protect the UK's position today.

Three areas are essential to help AI flourish in Britain:

1 Bringing order to disruption

To give our smallest AI start-ups the best chance, the government has to provide a level playing field. The UK has the best system of laws in the world, so playing to these strengths and creating a world leading regulatory environment for AI should be a priority.

The public are open to technology improving their lives, but are wary of poor safeguards that will lead to their data being compromised. A strong regulatory framework is an important step in reassuring the public that proper safeguards are not a nice to have, but a precursor for growing public trust.

2 Future-proofing skills

Our world-leading position in the AI race may be lost unless we urgently address the digital skills gap facing the UK. The public recognise that they need to digitally upskill, with over 60% of survey respondents believing they will need to learn new skills as technology and AI advances.

Modern jobs need modern skills. By investing in the skills— from schools to adult learning — the UK will secure the workforce it needs. Inclusive economic growth will be catalysed by narrowing the skills gap, avoiding the potential social inequality that AI could bring if people can't adapt to change.

3 The NHS: A shot in the arm for AI Growth?

The quantity of data that the NHS holds is a national asset. This data is the UK's key to unlocking a world leading healthcare AI industry. There are however barriers to harnessing this potential. Concern amongst the public on sharing health data with third parties is high.

We found only 15% of respondents are willing to share their data with pharmaceutical firms. Yet 56% are willing to share more personal data with the NHS to improve its service and 53% agreed AI will have a positive impact on the NHS, only 10% thinking that the impact would be negative.

We know people are cautious about who they share their data with. But we found that one organisation is seen as trusted above all else: the NHS. However, we need to address the lack of trust in those companies equipped to kick-start a UK healthcare AI industry.

We found respondents know what AI is, but are less sure on the positive impacts it can have on society. To grow our nation's AI prowess the public need to be on board.

We hope to kick-start that conversation.



James Stewart

Vice-Chair
Head of Brexit and Industrial Strategy
KPMG



Five policy prescriptions to keep the UK ahead

The Industrial Strategy designates growing the AI and data-driven economy as a Grand Challenge and aims to put the UK at the forefront of the AI and data revolution. Any proposal on AI must capitalise on its diverse opportunities, from boosting productivity through new technologies to improving the health of the nation.

To secure the UK's AI future and achieve the government's Grand Challenge aspirations, we recommend:

Short term

- 1 Building on the Government's proposed Digital Innovation Hubs by creating 'Data Innovation Zones' where developers are given access to anonymised, aggregated health data. Unlocking some of the opportunities in NHS data now will help demonstrate to the public how health AI can be a positive to society.
- 2 Convening the public sector, third sector, private companies and academia to work together and persuade the public of the benefits of AI healthcare. Generating open access to health data through a value exchange mechanism will ensure the public are on board.

Medium term

- 3 Formalising the UK's data regulation systems for AI through public debate with individuals and businesses. Such an approach is vital to building public trust in AI technology.
- 4 Establishing a new 'British Standard of Trust' – a kitemark in global regulatory quality – to demonstrate the UK's leadership and commitment to founding trust in new technologies.

Long term

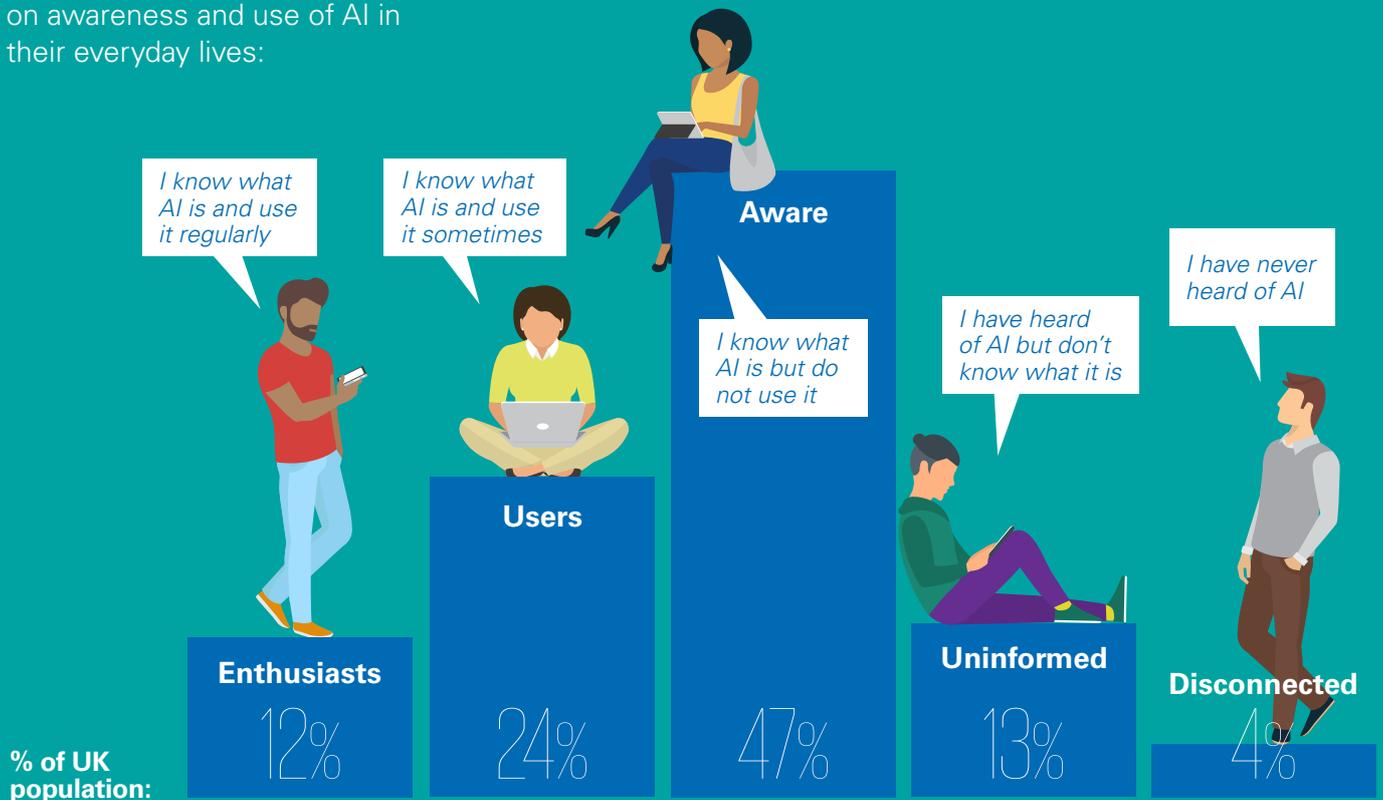
- 5 Addressing the skills gap AI will create via a three pronged approach; digital upskilling in schools, installing a culture of life-long learning and recognising the importance of subjects beyond STEM.



What do the public think?

KPMG surveyed 2,000 members of the general public to assess their attitudes towards AI. We asked 19 questions covering general attitudes to AI and its application in the NHS.

We have split survey respondents into **five distinct groups**, based on awareness and use of AI in their everyday lives:

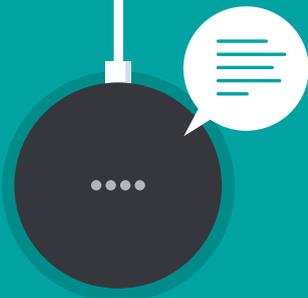


% university educated:



% under 35 yrs old:





47%

know what AI is,
but don't use it



51%

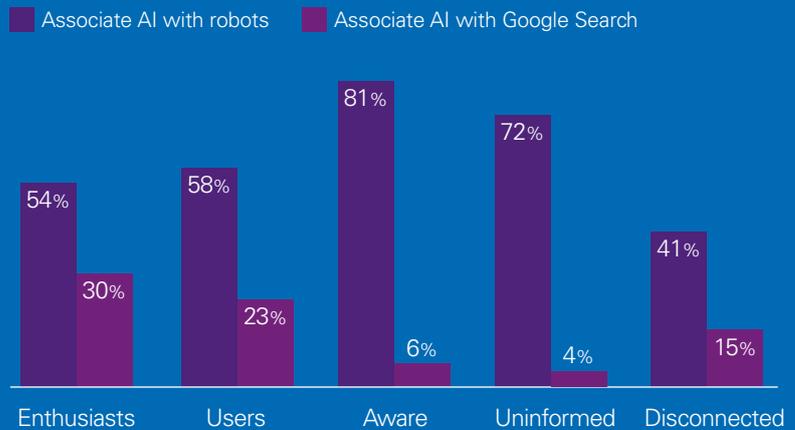
are worried about
data privacy in
light of AI



31%

think the greatest
benefit from AI will
be less human error
in decisions

Which of the following do you most associate with AI?



Respondents who feel they don't understand AI or who don't use it much, are more likely to associate it with robots, rather than services they use in everyday life

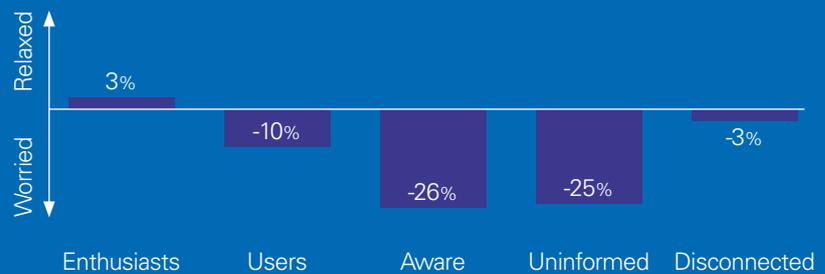
Are you worried or relaxed about your data privacy as the use of AI increases?

Percentage of respondents who are worried



Respondents who have heard of AI but don't understand it are the most concerned about its potential impact on their data privacy

Are you worried or relaxed about AI technology taking your job?



Respondents with low awareness and usage of AI are also the most pessimistic about the impact on their job

Future-proofing skills



Dr. Rebecca Pope
Lead Data Scientist
Health and Life Sciences
KPMG

Without digital skills, the UK will struggle to retain fourth in the AI race

Top universities and world-class public bodies make the UK a natural home for AI. Yet despite this I think our world leading position is under threat.

The reason is simple: a skills gap

AI will revolutionise every sector of our economy, transforming the world of work and crucially the skills base that businesses need. As we approach this change, the UK needs to reskill. Otherwise, we will have a population with a skills mismatch and deepening social immobility.

61% believe as AI advances they will need to learn new skills.

We are in danger of trying to sprint ahead in the AI race, whilst leaving the majority of the population behind. The government recognises the need for a step-change in digital training. They recently announced their plans for a highly skilled workforce: industry-funded post-graduate programmes, online professional development courses and government-funded doctorate programmes.¹

These are a great start, but only help those at the top of the academic pyramid.

We found 61% of respondents believe that as AI advances they will need to learn new skills and only 32% think they already have the skills needed. Those with lower educational attainment are the most worried about the future, having less confidence in their current skills. To maintain the UK's AI advantage, there is an urgent need to address this public concern and reshape the skills of the nation.

When considering the impact AI will have on the workforce, our notion of what constitutes a 'job' comes into question. A job should be thought of as a set of inter-linked tasks, on which AI will have a differential impact. For example, AI will significantly impact manual, repetitive tasks, but have a lesser effect on tasks which are non-routine with high cognitive load. The skills gap AI will create can therefore be divided into two elements:

- i) Jobs where the component tasks are changed and modified by AI. The workforce will need to reskill.
- ii) Jobs that will encompass new tasks due to augmented intelligence, ushered by AI. The workforce will need to learn to use and interpret AI systems.

Notably, the summation of new and modified tasks outlined above will drive job creation (e.g., Chief AI and Robotics Officer in the NHS). The government needs targeted policies to address each of these components of the skills gap:

Developing digital literacy in schools.

Twelve million people in the UK don't have the digital skills needed to thrive in a data-driven economy.² The government needs to react and recognise, as China has, that children are the key to being an AI world leader. We need a clear National Strategy including the training of teachers that specialise in AI and the introduction of computer coding classes across compulsory education. Of course, any change to the curriculum takes time, but making a start now is vital if the same value is to be placed on digital skills as basic literacy and numeracy.

Providing education that reaches beyond the school gates.

AI challenges our current approach to education. As it stands, educational attainment is in incremental steps. To survive the evolution of AI, we need constant, agile, life-long learning. Most weeks I learn of a new approach or advance in the field of AI. We need a society where such continuous learning is supported.

Boosting skills beyond 'STEM'.

Businesses don't just need a workforce equipped with STEM skills. An often overlooked, but crucial attribute, are workers that can communicate and appraise AI to improve decision making. We will stall in the global race if no-one can understand, use and appraise AI in this way. Businesses are finding that technological change makes balancing staff training and the hire of fresh talent harder.³ The introduction of a Chief Technical Officer or Chief Data Officer would help; someone to

grapple with AI developments and keep track of skills the business requires. To support business, government should collaborate with training providers. We need more programmes designed for business to meet these specific needs.

We need investment now – in schools, in lifelong learning and in training programs for business – to sustain our AI advantage. We need to make sure everyone is ready for AI technology, attract innovative start-ups and generate inclusive, economic benefits for all.

The public recognise that they will need to reskill as technology advances, but the majority aren't currently worried about it

Do you believe as technology advances, i.e. through AI, you will be...



1 Department for Business, Energy & Industrial Strategy, *AI Sector Deal*, April 2018.

2 Go ON UK, *Basic Digital Skills*, 2015.

3 KPMG, *Leading from the centre: UK CEO Outlook*, 2018.

Bringing order to disruption



James Stewart

Vice-Chair
Head of Brexit and
Industrial Strategy
KPMG

Building a rigorous AI regulatory environment

Data sits at the heart of AI systems. The bigger and better the data set, the better the results. Yet the laws and regulations in place today were not designed to cope with the changes AI will bring.

Deciphering how this data is gathered, accessed, processed and disseminated is crucial.

GDPR provides a foundation regulatory system for data-driven AI. Despite this, over half of respondents (51%) are concerned about their data privacy as the use of AI increases. Compare that with just 14% who are relaxed. Data privacy and security is the public's main concern with AI, ahead of any impact on jobs. Importantly, we found those who are aware of AI technology but don't know what it is are most concerned about data privacy, and support for increased government regulation is strongly correlated to the concern about data privacy.

51% of the public are concerned about their data privacy as the use of AI increases.

Addressing public trust in AI is essential if we are to capitalise on the opportunities it presents.

There are good examples of successful data sharing that benefits society. Take 'Sat-Nav' technology, for example, which uses shared location information to provide better traffic news. This works on the understanding – and trust – that personal details are not shared. That trust needs to be replicated, across technologies and sectors.

And that means new laws and regulations.

The UK is in a fantastic position to take the global lead. We have set high standards in so many sectors: in energy; in oil and gas; in life sciences; in telecoms. We have a robust and internationally respected legal system. We have experience from being global leaders in privatisation and having the highest number of independent regulators in the world. We can and should exploit our expertise to become the world leaders in AI regulation, whilst also addressing the public trust issues that underpin the success of AI.

First, we must expand our informal data regulation systems. In infrastructure for example, data ownership is mixed. Some data is completely open; other data is owned by the public sector and some data is proprietary with

intellectual property rights attached. We should formalise this system and apply it across industries.

Secondly, the government should establish a new 'British Standard of Trust', a kitemark of regulatory quality. We can become a world leader in AI regulation and law by stepping out and showing leadership, establishing trust around AI products and services in specific sectors.

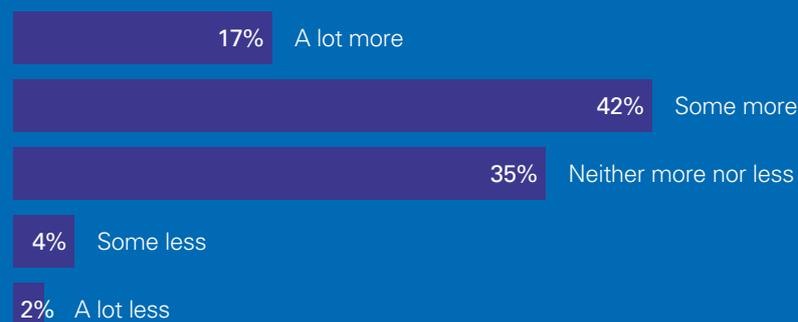
Thirdly, why not open up the regulatory framework design to a thorough public debate, open to individuals and businesses from all sectors who have a stake in the result? Engaging with these stakeholders opens the doors to a healthier discussion, to building greater understanding and public trust in the technology.

Make no mistake: the road ahead will be bumpy.

In the short term, stricter laws and regulations could be a disadvantage and we face tough global competition. Take China. They are set to possess 30% of the world's data by 2030 and are already working on setting the global technical standards for AI.⁴ Recent Chinese data protections introduced in January this year have been hailed by some to be more far

Respondents want more regulation of new technologies such as AI

Q: Do you believe there should be more or less government regulation on new technologies such as artificial intelligence?



reaching than GDPR.⁵ Yet China's increasing use of facial recognition is raising concerns around data security and privacy.

Business will need to be on board too, and whilst 40% of UK CEOs have protecting customer data as a priority, this is less than 59% of CEOs globally.⁶ In the UK, we must recognise that emphasising data protection is a key component to developing our reputation as a global AI leader, even if it may be costly and onerous in the short term.

There is no time to lose.

Regulation of AI is vital in building public trust and easing the apprehensions of the 51% of respondents concerned about data privacy. Yet equally, capitalising on the opportunity and becoming the global leader in AI regulation will help bolster the UK's position as a global leader in the AI race.

⁴ Jeffrey Ding, Future of Humanity Institute at University of Oxford, *Deciphering China's AI Dream*, 2018.

⁵ Ibid.

⁶ KPMG, *Leading from the centre: UK CEO Outlook*, 2018.

The NHS: A shot in the arm for AI growth?



Shamus Rae
Head of Digital
Disruption
KPMG

The barriers and the opportunities in healthcare AI

Governments everywhere are recognising AI as a force to transform healthcare. For example, a £208m investment in Israel is opening up health data to companies and South Korea are consolidating health data into a single national database.⁷ This data is the raw material that will help AI-enhanced healthcare become a reality.

Over one million people use the NHS every 36 hours, generating a huge quantity of health and personal data.⁸ To protect the UK's position in the global AI race we need to unlock the potential of this rich data source.

Over one million people use the NHS every 36 hours. The breadth and quantity of data that the NHS generates is an asset like no other.

By using this anonymised patient data, the UK benefits in two big ways:

Healthcare AI landscape

The NHS is at capacity, struggling to deliver its services. Already, there are some great examples of how AI is tackling this, grappling with some of the biggest challenges facing the NHS.

Take staff pressure. The NHS is short of 100,000 staff; the Royal College of Radiologists think AI can save considerable time for the specialists involved in breast screening.⁹ Or the eight million missed outpatient appointments; AI can help cut missed appointments by automatically sending reminders to those identified as most likely to miss them.¹⁰

Yet the UK is at risk of falling behind. Overseas, countries are reaping the benefits of AI-enabled healthcare already. In China, the first hospital featuring AI opened this year. Here, AI is reducing the time of patient inquiries by 50% and can diagnose 90% of illnesses that were previously treated at community clinics.¹¹

7 <http://www.reform.uk/reformer/international-lesson-to-help-the-nhs-harness-health-data/>

8 Department of Health, Chief Executive's report to the NHS, December 2005.

9 House of Lords Select Committee on AI, *AI in the UK: ready, willing and able?* April 2018.

10 <https://venturebeat.com/2018/05/21/ai-will-be-used-to-reduce-patient-wait-times-in-university-college-london-hospitals/>

11 <http://chinaplus.cri.cn/news/china/9/20180403/112042.html>

Data is the lifeblood of AI

Our global advantage is the NHS dataset. To unlock its benefits, the data will need to be shared with third parties. The NHS alone cannot realise the data's potential. It will need academia, pharmaceutical firms and technology companies to take the lead. By commercialising data in this way, the UK can attract innovative start-ups, who will create jobs and boost R&D along the way.

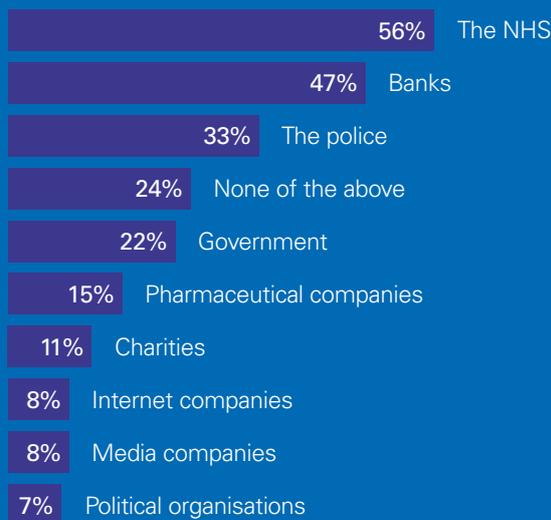
However there are barriers to using NHS datasets in AI development. A NHS patient doesn't have a single health care record. Instead data is fragmented between service providers, including GPs and hospitals. The data needs investment in curation and cleansing before it can be used for AI.

Another barrier is data privacy and security. In our survey, we found 51% of respondents are concerned about their data privacy as the use of AI increases. It was ranked by respondents as the greatest problem with AI, ahead of impact on jobs and concern over less human involvement. Public concern is the greatest barrier preventing NHS data being used in AI development.

Past attempts at using patient data in technology have been fraught with difficulties. Data sharing between NHS trusts and third parties is piecemeal.

Respondents are more likely to share their personal data with the NHS than any other organisation, followed by banks and the police

Which, if any, of these organisations would you be willing to share your personal data with if it meant an improved service or capabilities?



For example in 2016 the Royal Free London NHS Foundation Trust entered into partnership with Google DeepMind. The plan was to test an alert, diagnosis and detection system for acute kidney injury through an app called 'Streams'. In 2017, the Information Commissioner's Office ruled Royal Free London had failed to comply with the Data Protection Act when it shared patient details with Google DeepMind.

Building public understanding and trust in health AI isn't just a nice to have, it is fundamental. The legal framework on sharing patient data is complex. But best practice still recommends explicit consent is sought before patient data is shared. The public need to want to share their data with third parties and become 'data donors' for this to work. Without consent there is no data, and without data there is restricted potential for healthcare AI.

Tackling public mistrust

We asked which organisations respondents would be most willing to share their personal data with. The NHS came out on top.

56% of respondents are willing to share more personal data with the NHS to improve its service and capability. The majority (53%) of respondents agreed AI will have a positive impact on the NHS, with only 10% thinking that the impact would be negative.

We also found some respondents sceptical about the impact of AI on society are more positive about AI in the context of the NHS. For example, 26% of respondents say they are concerned about the impact of AI on their data privacy but are positive about AI when it comes to the NHS. We called these respondents 'switchers'.

However, only a few respondents were willing to share their data with organisations that can unlock the benefits in NHS data. Only 15% would share more data with pharmaceutical firms. Nearly a quarter of respondents are unwilling

to share their data with any organisation we listed, including the police, banks and charities.

This highlights the crux of the UK AI issue: if we want to maintain our position at the frontier of the AI race, we need to specialise. Making healthcare AI our specialism is the right choice. The NHS is our advantage and has a brand trusted above the police and banks. But we need to address the lack of trust in those companies equipped to kick-start a UK healthcare AI industry. We need the public on board.

To start tackling this, the government should:

Build public trust.

We must persuade the public of the benefits AI can bring to healthcare. We need to generate open access to health data through a value exchange mechanism and ensure the public are on board with its principles. To achieve this, the government need to convene the public sector, third sector, private companies including pharmaceuticals and academia who can together drive the tone in a positive direction.

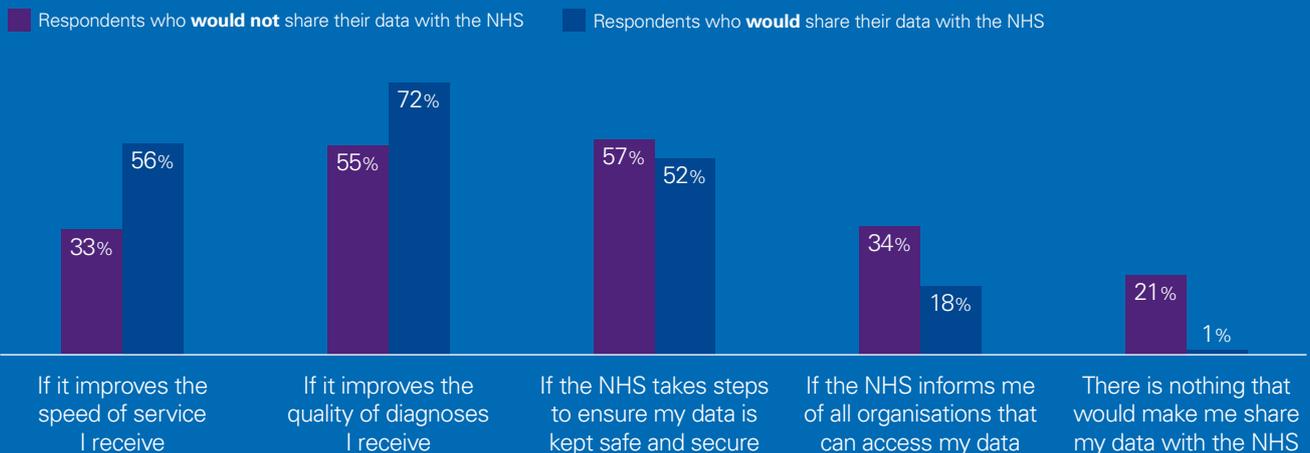
Create 'Data Innovation Zones'

Build on the government's proposed Digital Innovation Hubs by establishing AI sandboxes where aggregated, anonymised health datasets can be accessed freely by developers. With the appropriate safeguards established, setting them up would be quick and easy. They can unlock some of the opportunities in NHS data now, and showcase the high-quality health data we have in the UK. With this, we can begin to demonstrate to the public how healthcare AI can be a positive to society.

Harnessing the power of NHS data can help maintain the UK's position as an AI leader, and attract an ecosystem of data and healthcare specialists to the UK. The added bonus is a shot in the arm for the NHS through improved efficiency, preventative healthcare and diagnostics. We need to build a world-leading healthcare AI proposition to put AI front and centre of our economic and technological progress.

Respondents who say they would not currently share their personal data with the NHS would be more likely to do so if the organisation increased data security and AI was used to improve the quality of diagnoses

Which of these steps would make you most likely to share your personal data with the NHS?



The 'NHS Switchers'

We have identified two distinct groups of 'NHS Switchers': respondents who are generally concerned about the impact AI will have on their lives, but are positive about AI in the NHS.

'A significant percentage of respondents who are worried about the impact of AI on their data privacy are positive about the future impact of AI on the NHS'



'A significant percentage of respondents who are worried about the impact of AI on jobs are positive about the future impact of AI on the NHS'



Contacts



James Stewart
Vice-Chair
Head of Brexit and Industrial Strategy
T: +44 (0)20 7694 5940
E: jamesa.stewart@kpmg.co.uk



Shamus Rae
Head of Digital Disruption
T: +44 (0)20 7694 3056
E: shamus.rae@kpmg.co.uk



Dr. Rebecca Pope
Lead Data Scientist
Health and Life Sciences
T: +44 (0)20 7694 1890
E: rebecca.pope@kpmg.co.uk

Other KPMG titles on AI:



Rise of the humans



Rise of the humans 2



Trust in Artificial Intelligence

kpmg.com/uk



The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavour to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation.

© 2018 KPMG LLP, a UK limited liability partnership and a member firm of the KPMG network of independent member firms affiliated with KPMG International Cooperative ("KPMG International"), a Swiss entity. All rights reserved.

The KPMG name and logo are registered trademarks or trademarks of KPMG International. CREATE | CRT100547 | September 2018