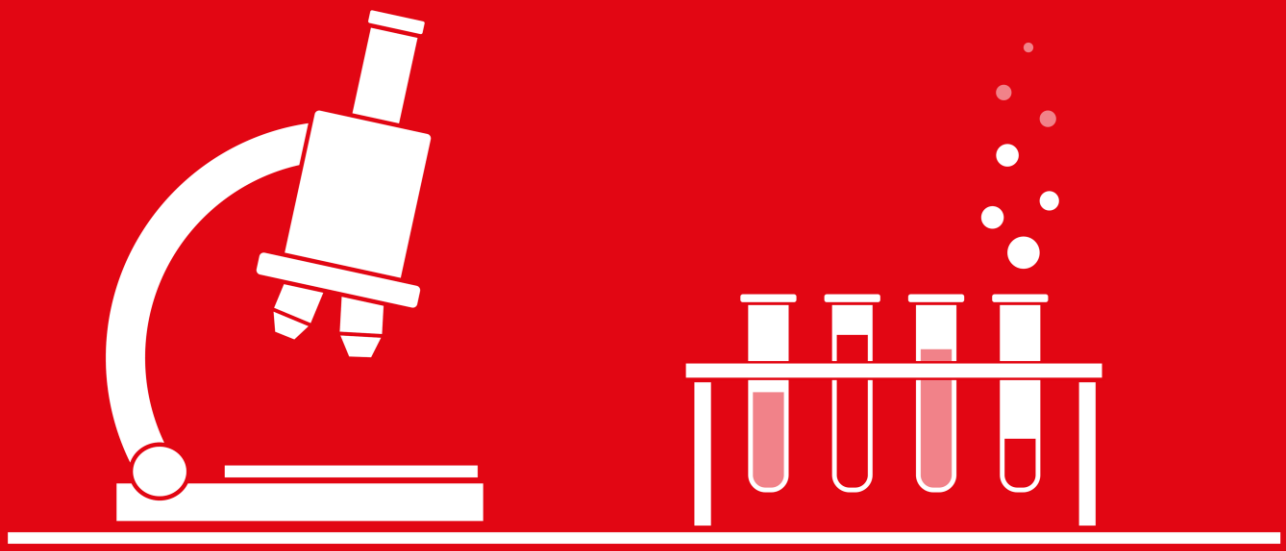
November 2022
APPG AI Evidence Meeting

BIG INNOVATION CENTRE

Advanced Diagnostics: AI-Enabled R&D in Health & Medicine

PARLIAMENTARY BRIEF



Advanced Diagnostics: AI-Enabled R&D in Health & Medicine *is a* Parliamentary Brief based upon the All-Party Parliamentary Group on Artificial Intelligence (APPG AI) Evidence Meeting held in House of Lords: Committee Room 1 on the 14th of November 2022.

This APPG AI is co-Chaired by **Stephen Metcalfe MP** and **Lord Clement-Jones CBE**.

We would like to express our appreciation to the following people for their oral evidence:

- **Dr. Dom Cushnan,** Director of AI, Imaging & Development, **NHS AI Lab**
- **Dr. Keith Grimes,** Medical Director, **Babylon Health**
- **Dr. Natalie Pankova,** Chief Operating Officer, **Cube Labs**
- **Michael Bridges,** Senior Vice President Data Science, **Optum**
- **Dr. Rob Turpin,** Head of Sector (Healthcare), **BSI**
- **Keith Errey,** CEO & Co-Founder, **Isansys Lifecare**

Big Innovation Centre is the appointed Secretariat for APPG AI

- CEO, **Professor Birgitte Andersen**
- Rapporteur, **George Farrer**

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PARLIAMENTARY BRIEF

Advanced Diagnostics: AI-Enabled R&D in Health & Medicine

All Party Parliamentary Group on
Artificial Intelligence

APPG AI Sponsors

The Group supporters – British Standards Institution, Brunel University London, CMS Cameron McKenna Nabarro Olswang, Deloitte, Ernst & Young, Innovate UK – UKRI, Osborne Clarke, PwC, and Rialto – enable us to raise the ambition of what we can achieve.

Contents

1. Introduction

In this meeting, the APPG AI discussed how Artificial Intelligence (AI) is impacting the world of health and medicine, with specific reference to the area of Advanced Diagnostics – where AI is used to help diagnose patients, with more accuracy than clinicians on their own. The potential good that AI can have in diagnosing patients was discussed, due to the inherent benefits of AI as a technology. Critical questions were asked in terms of handling sensitive data and ensuring public trust in the technology. Additional points were made around increasing AI literacy and AI-related skills in order to increase confidence of those implementing and utilising such transformational technologies.

Technological advancements in health and medicine have firmly been on the agenda of policymakers since the COVID pandemic. Therefore, the APPG AI considered what needs to be done in terms of industry, regulator, and government engagement in order to accelerate the adoption of AI into healthcare in a safe, effective, and efficient manner.

Main questions:

- *AI-use in research and for managing health data and patient data: Is AI effective in accessing and analysing large quantities of data efficiently?*
- *Public trust for use of our health data: What health data governance do we need?*
- *AI and the pandemic: How can AI be applied to healthcare in a post-pandemic world? Can it help us to prevent future pandemics?*

List of panellists:

- **Dr. Dom Cushnan**, Director of AI, Imaging & Development, **NHS AI Lab**
- **Dr. Keith Grimes**, Medical Director, **Babylon Health**
- **Dr. Natalie Pankova**, Chief Operating Officer, **Cube Labs**
- **Michael Bridges**, Vice President Data Science, UnitedHealth **Group**
- **Dr. Rob Turpin**, Head of Sector (Healthcare), **BSI**
- **Keith Errey**, CEO & Co-Founder, **Isansys Lifecare**

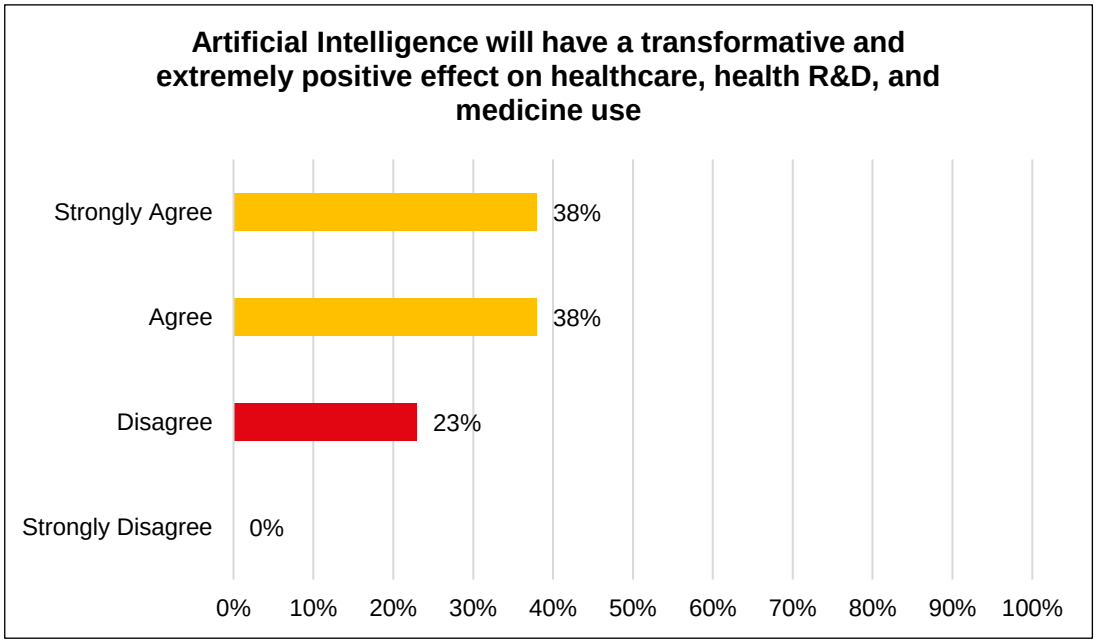
(From L-R: Dr. Rob Turpin, Prof. Birgitte Andersen, Lord Clement-Jones CBE, Dr. Keith Grimes, Keith Errey, Dr. Dom Cushnan, Dr. Natalie Pankova, Michael Bridges)

This meeting was chaired by Co-Chair **Lord Clement-Jones CBE**.

Parliament has appointed Big Innovation Centre as the **Secretariat of the APPG AI**, led by **Professor Birgitte Andersen (CEO)**. The Project Manager and Rapporteur for this meeting is **George Farrer**.

2. APPG AI Pavilion Survey

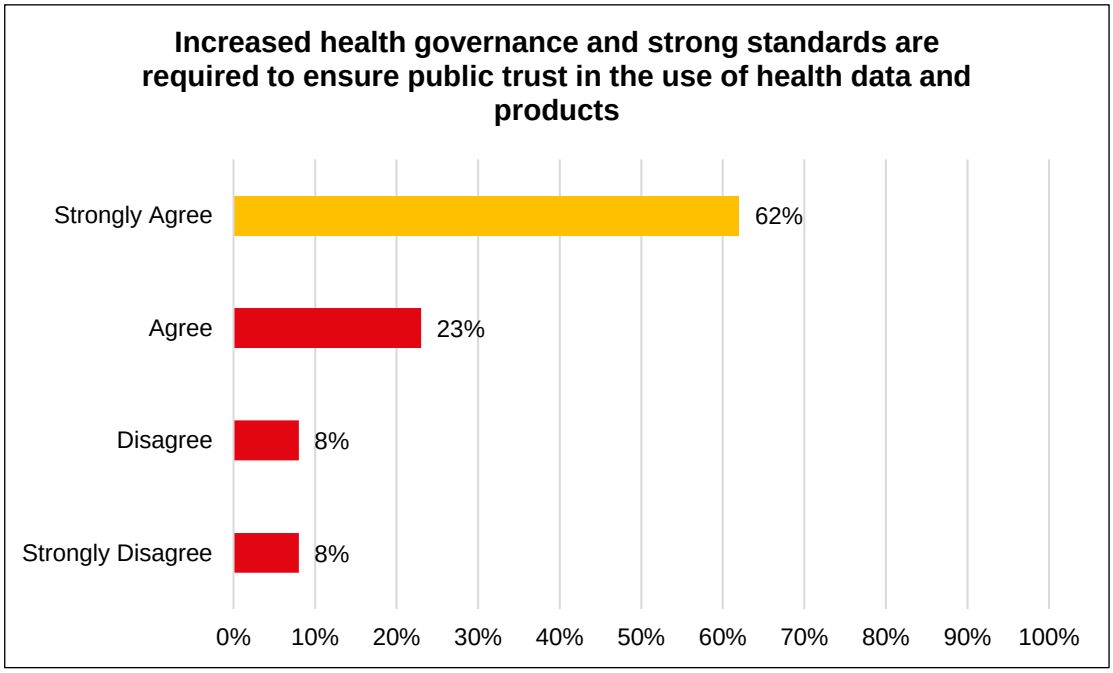
Prior to the APPG AI meeting, a survey was issued on the **APPG AI's Pavilion Platform**.



Question 1 asked APPG members whether they thought that *'Artificial Intelligence will have a transformative and extremely positive effect on healthcare, health R&D and medicine use'.*

It can be seen from the results that this statement reads true. A total of 76% of the APPG AI Community either **'agree'** or **'strongly agree'** with the statement – there was an even split of 38% between the two answers. Furthermore 23% **'disagreed'** that AI will have a transformative and positive effect within healthcare. None of the respondents **'strongly disagreed'** with the initial statement.

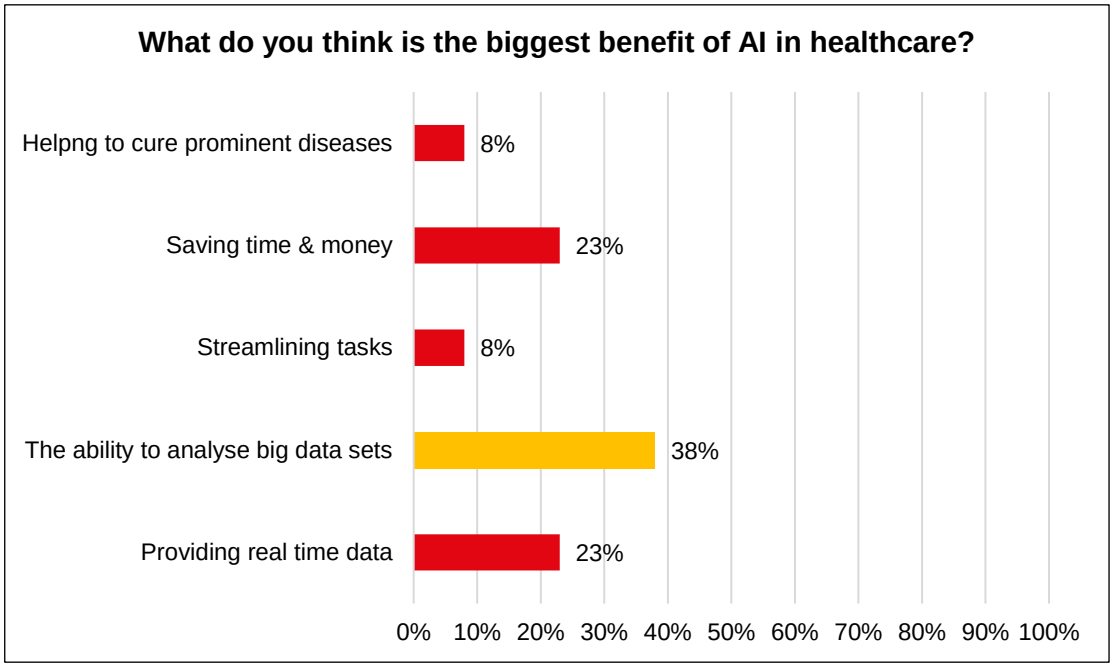
Therefore, it is clear to see here that the APPG AI Community are extremely positive about the potential that AI can have in health R&D, healthcare, and medicine use.



Question 2 proposed the statement that *'Increased health governance and strong standards are required to ensure public trust in the use of health data and products'*. The vast majority of respondents **'strongly agree'** (62%) with this statement, and then a further 23% would **'agree'** that increased health governance and strong standards are certainly required to ensure public trust.

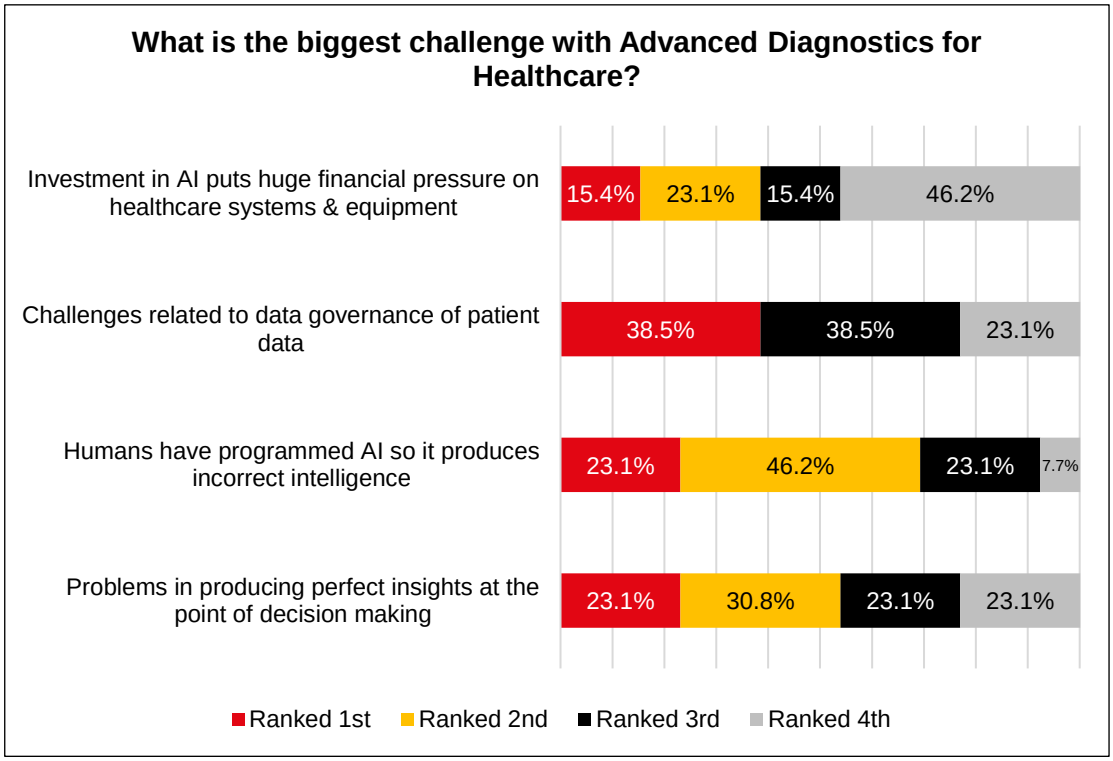
The theme of public trust in health data was picked up on by the expert speakers at this evidence session. There was consensus that public trust was required for Artificial Intelligence AI to be fully utilised within health data and products.

In total 16% either **'disagreed'** or **'strongly disagreed'** with the initial statement. These respondents may put forward the argument that current health governance and standards are enough to gain public trust in the use of health data and products.



Question 3 asked members of the APPG AI Community what they *thought the biggest benefit of AI in healthcare to be*. **'The ability to analyse big data sets'** received the most votes (38%) and was followed by both **'saving time and money'** and **'proving real time data'** which both received 23% of votes of the APPG AI Community. Therefore, it is clear to see that AI has the biggest impact in terms of data, as it has the ability to analyse big data sets and provide the real-time data itself.

Furthermore, 8% of votes went to both of each **'streamlining tasks'** and **'…helping to cure prominent diseases'**. Whilst these are both obvious benefits of AI in the healthcare industry, they were not considered to be as beneficial to the other benefits listed in the poll – notable the **'ability to analyse big data sets'**.



Question 4 asked members of the APPG AI community what *'is the biggest challenge with advanced diagnostics for healthcare?'* '**Challenges related to data governance of patient data'** was ranked as the biggest challenge by 38.5% of respondents, and 'problems in producing perfect insights at the point of decision making' along with **'humans have programmed AI so it produces incorrect intelligence'** both received 23.1% of first ranked votes.

The overall results here are very mixed, **'challenges related to data governance of patient data'**, despite receiving the most first ranked votes, did not receive any second ranked votes, and also garnered the most third ranked votes (38.5%).

'Humans have programmed AI so it produces incorrect intelligence', was ranked second the most often (46.2%), and also received almost a quarter (23.1%) of third ranked votes. Furthermore, this answer was voted the least as the challenge of less importance in Advanced Diagnostics within healthcare. This could show that the human programming of AI is something that needs to be addressed for wide-scale adoption of the technology.

Finally, **'investment in AI puts huge financial pressure on healthcare systems and equipment'**, can be considered the least important challenge in this instance according to the APPG AI community. It received the least first ranked votes (15.4%), and almost half of fourth ranked votes (46.2%).

3. Recommendations for policymakers

1. The **potential for Artificial Intelligence (AI) in the healthcare industry is great** and can make those in the industry job's easier. AI is strong for use in diagnostics due to its ability to classify, predict and utilise from very large quantities of data. Furthermore, due to these characteristics, AI can exceed the ability of nurses, doctors, and clinicians, picking up important signs that they may have missed due to their heavy workload. The use of AI within healthcare and diagnostics must be **embraced to increase efficiency and accuracy**.
2. We must allow healthcare workers to be **confident in the use of AI in their work and practices**. Currently, AI literacy is relatively poor in the industry and there are many "naysayers" on the clinical side that need to have confidence in utilising the technology. Therefore, it was suggested by the expert panellists, that we must **upskill the workforce**, and especially those that will be using AI in their day-to-day work. Giving them **greater skills** will lead to them having more confidence in applying the technology.
3. For AI to be deployed successfully at scale within the healthcare industry, for the aforementioned clinician-confidence in AI, **strong infrastructure is required**. Innovators need to be able to operationalise the technology through this infrastructure. The technology needs to be **integrated within the existing healthcare system**, and able to be easily deployed, making it accessible for the workforce to bring into action when required. It was suggested that more funding is required to bring AI to this workplace safely.
4. There is a need for **high quality data to be fed into the AI system**, otherwise the benefits of the technology would not be fully realised. The AI is only as strong as the data that is provided to it. Alongside this, **the workforce, and the public need to be able to trust the data provided**. Trust is fundamentally paramount, as without trust, clinicians won't want to use the technology, and the patients may feel uneasy with the technology being utilised on them. It needs to be established how this trust is going to be gained, but it is something which is essential to wide-scale implementation of AI in healthcare and diagnostics.
5. When it comes to regulation, there needs to be **a safe and iterative approach**, making sure that we end up with regulation and standards that work for everyone. AI, healthcare, and diagnostics is a fast-moving industry so an iterative approach to this is very important. Furthermore, the **global standardisation of AI** in healthcare is required, for the technology to have the largest impact, worldwide.

Throughout this evidence session, there was widespread consensus about the **need to improve AI literacy and AI skills to ensure the effective and efficient deployment of AI** when it comes to healthcare and diagnostics. It was argued that current AI literacy was ineffective and inefficient. The **current workforce must be upskilled** and taught how to apply new and improving technologies, such as AI, to this industry. They must be ready for vast AI adoption, therefore trained staff and professionals are certainly required. Improved skills and confidence in using AI within healthcare will make the technology, safer and more secure, in turn allowing for patients to trust the technology being used to diagnose themselves. Those that doubt that AI can have that much of an impact, and are adamant about the negatives regarding AI, will need to be shown that the technology can be used safely. **An increase in AI literacy and skills will help to prove the safe adoption**.

Additionally, there was agreement about the usefulness of AI, and the power of what the technology can do in this space – health and diagnostics. **The characteristics of AI in which it can analyse large datasets in real time, and the ability to classify such large data sets make it perfect to help clinicians in this area**. In many circumstances, exceeding the ability of clinicians. Furthermore, AI can then predict future scenarios, which makes the lives of nurses and doctors much easier. AI can spot and bring things to their attention which they may have missed, due to a lack of time or work fatigue. AI does not get tired and can analyse in real-time so is not subject to such downfalls.

Dr. Dom Cushnan, Director of AI, Imaging & Development at the NHS AI Lab, starts by detailing the role of the **NHS AI Lab**[1] in terms of supporting healthcare organisations realise how they can deploy AI effectively and safely. Dr. Cushnan states that most technologies are still in the R&D phase, and there are signs that there is going to be real benefit in diagnostics specifically for clinicians.

Furthermore, Dr. Cushnan explains some of the challenges around utilising AI in this space, and how the diagnostic workforce is supported**. It is important that the technology is integrated and deployed in a safe manner, and this will help to give the workforce confidence in the use of such technologies**. Additionally, Dr. Cushnan describes that this is particularly true for staff on the clinical side of things – they need to be given confidence that this technology is going to revolutionise the way that they work. Dr. Cushnan finishes by asking policymakers to help **build the infrastructure required to deploy AI** and other technologies safely at scale within the healthcare system. This includes the upskilling of the workforce, a point which was picked up, and agreed upon, by many of the expert panellists.

Dr. Keith Grimes, Medical Director at Babylon Health, argues that in order to increase the adoption of AI in healthcare, it is important to make sure that the healthcare professional workforce is **ready, skills wise, to bring AI into the workplace**, but also that they trust the technology. Dr. Grimes, mentions the **Topol Review**[2] which details how the workforce of the future can be trained with new technology, through schemes such as a digital health

[1] **NHS AI Lab.** https://transform.england.nhs.uk/ai-lab/

[2] **The Topol Review**. https://topol.hee.nhs.uk/

curriculum. Additionally, Dr. Grimes states that he supports **Health Education England's AI White Paper**[3], specifically the recommendations about training the next generation of digital healthcare workers.

Dr. Grimes emphasises the point about trust. **He states that without developing trust, through good governance, it is going to be very difficult to get anyone to use the technologies**. Dr. Grimes states that compliance with international safety and regulatory privacy standards is essential to ensure the safe adoption of AI in healthcare. However, he does mention that this is complicated due to the fast-moving nature of the industry itself. Therefore, it is paramount that those in industry work with regulators in this area.

When talking about data, Dr. Grimes explains that the usefulness of AI in general, yet in this case specifically healthcare, is only as effective and strong as the data that is provided to it. In the context of pandemic preparedness, Dr. Grimes states that we are going to have to require access to large and sensitive data, and **the public need to be able to trust that those in the public and private sector, will ensure that this data remains private**. He mentions that privacy and security, is essential from the start when looking at this from an industry perspective. Public trust is also vital in making sure that people are happy that the technology is working for them in practice.

Dr. Natalie Pankova, Chief Operating Officer at Cube Labs, starts by detailing the benefits of AI in terms of diagnostics. Dr. Pankova states that **AI performs the ability to classify and predict extremely well.** AI can analyse large quantities of data, and in certain instances this means the technology performs better than a clinician, as it takes large datasets and information at the same time. With lots of new information coming out in the clinical space, this is important to ensure that a diagnosis of a patient is not missed.

Furthermore, Dr. Pankova, explains a technology she created, with a company called **Metadvice**[4], which uses algorithms to manage chronic conditions, where decisions regarding patients are difficult, and doctors may be left at inaction. She states that the 'wait and see approach leads to poor patient outcomes. However, Dr. Pankova does detail that there were challenges in this process. Instead of the AI being poor at handling the data**, the issues were infrastructural challenges in terms of getting access to the correct data and clinical capacity**. An additional challenge stated by Dr. Pankova, that was shared by many on the panel, was **poor standards of AI literacy** throughout healthcare organisations.

Dr. Pankova closes her evidence by issuing three recommendations for policymakers. First, setting up policies that would subsidise access to data. Pressure is put on innovation funders due to the costs involved with access to data – subsidising access to data will help support innovation in this space. Moreover, **enabling greater education to improve AI literacy across industry – training needs to be provided for all stakeholders**. Finally, incentivising

[3] **Health Education England.** https://www.hee.nhs.uk/

[4] **Metadvice**. https://www.metadvice.com/

clinicians to work with innovators to develop, deploy and evidence the technologies.

Figure 1: What is needed to ensure the effective and efficient deployment of AI in healthcare?

Michael Bridges, Senior Vice President – Data Science, at Optum, explains **that AI can exceed the performance of a clinician in the normal clinical setting**, as AI can empower and augment human decisions. For example, **Optum's**[5] AI can interpret handwritten texts which can help care coordination. A high proportion of clinicians time is spent during administrative duties, so these sorts of benefits are extremely important. Additionally, the AI can identify signs that may be missed by physicians who have a busy workload if they haven't

[5] **Optum.** https://www.optum.com/

had time to review the full patient record. Bridges details that AI's ability to create insights is an extremely important development, especially in a post-pandemic world

Furthermore, Bridges states that **getting the patient onside when the technology is being used is also paramount**. Regardless of how good the algorithm is, patient engagement is extremely important in the final outcome. Bridges explains that Optum have concentrated AI algorithms around finding the best way to engage a patient, which may be a telephone call or a text message. He states that *"knowing the best way to target that patient is hugely important and using AI to prioritise those channels, we found to be extremely effective".*

Finally, Bridges concludes by offering some recommendations for policymakers. He asks that there needs to be a **definition of AI**, as currently around the world there are *"worryingly broad definitions of AI"*. This is not helpful and only stagnates innovation and development. Furthermore, Bridges argues that more **engagement from industry with regulators and policymakers** is certainly required.

Dr. Rob Turpin, Head of Sector (Healthcare) at BSI, starts by stating that he will address how standards ensure that medical AI solutions are deployed in a safe, secure, and effective manner. Additionally, to get the point across the professional and public trust is essential for the deployment of AI in this space going forward. Dr. Turpin explains that standards are used by regulators and medical device manufacturers to display their conformity to regulations. This is for safety, and he describes that in the UK there is a process called 'designation' which provides an accurate link between the criteria in the standard and the safety requirements of regulations.

Dr. Turpin goes on to detail the work of BSI in this space, especially over the past four years. **BSI**[6] initiated a joint initiative with **MHRA**[7] and bodies in the US, to research standards referring to AI deployment in healthcare. This included mapping activities around existing challenges to regulatory safety and performance principles. Additionally, they developed new standards where there were gaps. This requires **a globally aligned approach**, especially with the US and Canada, which is what BSI are aiming for, as working with **global stakeholders in this space is paramount to fully realise the safe, and effective benefits of AI in healthcare**.

Keith Errey, CEO & Co-Founder of Isansys Lifecare, explains how real-time **AI can help produce early warning scores**, and improve their performance – these are scores that indicate whether a patient may deteriorate. **Real time AI can collect the data and process** it in real time. **Isansys**[8] produce the data that feeds these early warning scores, creating a rich digital image of the patient – this could be seen as a digital twin.

Furthermore, Errey goes on to show that AI can help create virtual wards which allow acute

[6] **British Standards Institution (BSI).** https://www.bsigroup.com/en-GB/

[7] **Medicines & Healthcare products Regulatory Agency (MHRA).** https://www.gov.uk/government/organisations/medicines-and-healthcare-products-regulatory-agency

[8] **Isansys.** https://www.isansys.com/

care to be taken outside of the hospital. The AI provides real-time information to care teams, so they know what the situation is with a particular patient. Additionally, this automates one of the most basic processes in healthcare, which is ‘what is happening to the patients’. **This makes nurses more efficient and frees up more of their time**. Finally, AI can help produce extremely high-quality data, of any patient, in any location. Errey details three strong examples of this in his evidence.

Errey concludes his evidence with some important recommendations for policymakers. Errey maintains that the **data used within AI systems is never misused**, and not used for state surveillance for example. **Trust is of the upmost importance**, so that patients consent to having their data used in this instance.

4. Evidence statements

Dr. Dom Cushnan, Director of AI, Imaging & Development, NHS AI Lab

I'm six months into the role of Director of AI Imaging and Deployment and I oversee a program of work that is a joint unit between the **Department of Health and Social Care**[9] and **NHS England**[10] inside the department of the **Transformation Directorate**[11].

NHS AI Lab

The NHS AI Lab is primarily set up to support health and care organizations really come together to understand how they both develop the technology safely and effectively – there is obviously the ethical debate, so we need to think around how we use these technologies. Additionally, also how do we think about deployment. We work with over 100 different types of technologies, 77 of them being used today. What we do know is that most of these technologies that we are testing are very much still in the research and development stage, and there are many promising areas of uses of technologies where we can see some real

[9] **Department for Health & Social Care.** https://www.gov.uk/government/organisations/department-of-health-and-social-care

[10] **NHS England.** https://www.england.nhs.uk/

[11] **NHS England Transformation Directorate.** https://transform.england.nhs.uk/

benefit to clinicians, specifically in diagnostics.

We know that we have a number of challenges ahead of us, not just outside of the pandemic that is hit us all, including how we support our diagnostic workforce, and we support innovators to really get to that point of being able to operationalize the technologies that they've spent some time developing. We have to get them integrated and deployed into the clinical pathways.

The work that we build on is off ongoing work that we have got with the **National Data Strategy**[12] and the **Data Saves Lives program**[13]. That really helps us understand where the commitment of the program is, and we spend time talking about infrastructural needs besides the data sets. The ways we commercialize, the way that we actually buy these technologies, and do we actually know how the workforce really responds to the confidence of using these technologies?

We've just published a new report[14] specifically on that piece because one of the challenges that we've had is that while lots of people are very enthusiastic on the innovator side around using technology, there's a lot of naysayers of clinical staff that really want to be able to be inspired to use the technology, but they need some confidence around how they use that.

In partnership with Health Education England we've completed the second report[15] on how we will think about how we train the workforce to use these data-driven technologies to provide them the confidence that these technologies are appropriate for their use in day-to-day work – they can actually ask some of the questions around sensitivity, specificity, etc.

Recommendations

My big ask for today is that we continue thinking about how we build the infrastructure and how we can get these technologies safely at scale within our healthcare system. We provide the mechanisms for both infrastructures, but also the assurances that these technologies can be used at scale, whether it is in an integrated care system or at scale for the entire National Health Service. Without any doubt, we must make sure that we're upskilling the workforces that are going to be using these technologies.

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[12] **National Data Strategy**. https://www.gov.uk/guidance/national-data-strategy

[13] Department for Health & Social Care, **'Data Saves Lives'**. https://www.gov.uk/government/publications/data-saves-lives-reshaping-health-and-social-care-with-data/data-saves-lives-reshaping-health-and-social-care-with-data

[14] NHS AI Lab & Health Education England. **'Understanding Healthcare Workers' Confidence in AI (Part 1)'** (2022). https://digital-transformation.hee.nhs.uk/binaries/content/assets/digital-transformation/dart-ed/understandingconfidenceinai-may22.pdf

[15] NHS AI Lab & Health Education England. **'Understanding Healthcare Workers' Confidence in AI (Part 2)'** (2022). https://digital-transformation.hee.nhs.uk/binaries/content/assets/digital-transformation/dart-ed/developingconfidenceinai-oct2022.pdf

Dr. Keith Grimes, Medical Director, Babylon Health

I am an NHS trained general practitioner, I'm still doing some general practice as well but several years ago moved into the world of digital health and this is where I spend my time now.

Babylon Health

Babylon's[16] a global health technology company. We focus on delivering digital first primary care, or digital-first health services, both here in the UK, US, and Rwanda – in total about 15 countries around the world.

In the UK you might be aware of what we do with GP at hand, which is an NHS general practice that is digital first with over 100,000 patients. In the last year we've served 1 million consultations, both with that but also with our private services here in the UK. In the US we're over 250,000 members working with our value-based care offering as well. We have got quite a lot of experience in delivering clinical services.

My job at Babylon is specifically Director of Clinical Product Management Digital Health and Innovation. In short, my job is specifically to try and understand the health care system and the healthcare market, principally the problems that patients and clinicians face. Then as a product manager try to identify, design, build, deploy, and assure that the practical solutions are out there as well. My experience in Babylon is working in AI services so I'm particularly interested in the experience of taking AI products and services and actually getting them into operation which is the important challenge.

[16] **Babylon Health.** https://www.babylonhealth.com/en-gb

This involves building risk prediction models which we use to help identify the likelihood of certain outcomes in our patient and to be able to intervene in a timely manner. Also, decision support for patients and clinicians as well to help them understand what next steps they might want to take as well.

How can we increase the adoption of AI in Healthcare?

In terms of increasing adoption of AI, the critical importance here is about the clinician workforce or the healthcare professional workforce and making sure that they both ready to bring AI into their workplace but also trust it. This involves design building and testing it, but also using it. When I joined Babylon back in 2018 one of the problems that we faced was the lack of appropriately trained staff and skilled professionals working in this space. I was fortunate enough to work on the **Topol Review** in 2019 which actually highlighted this and made some recommendations about how we can train the workforce of the future. We helped use that to inform what we did internally within Babylon. We built a digital health curriculum and a digital health guild of clinicians working with the product teams to be able to build the technology.

As a result of this I'm really delighted to see what **Health Education England (HEE)** brought out with the **Healthcare Workers Confidence in AI Pape**r as well. Interestingly one of the authors Annabelle Painter was a former Babylon doctor. Within this the recommendations are great, and in particular I would like to support the recommendations made about training the next generation of these digital healthcare workers particularly as they break down into what they describe as:

- **Shapers** - those that are helped shaping the direction of what we're going.
- **Drivers** - those that champion the use of these technologies.
- **Creators** - those that are building the technology.
- **Embedders** – those that are finding ways to use it in practice.
- Ultimately, the **end users** as well.

Good Governance

Within this report they also talk about the importance of good governance and developing trust. Without trust it is exceedingly difficult to get anyone using these technologies. Part of the work that I do is making sure that we comply with all the applicable regional international safety, and regulatory privacy and security standards, to try and stay abreast of the developments here and around the world. However, it's complicated as things are moving really quickly as well.

So internally what we try to develop as a digital health governance framework to allow us to consider holistically changes in this particular area. We've also developed an internal ethics forum which allows us to consider how we use our technologies as well, trying to bring not just the clinicians in, but all the other members of staff within the company to have their say on

this.

We need to be able to make sure that we work with regulators because things do move very fast, and we need to make sure that the regulation ensures safety but enabling an iterative approach. One of the key features of AI of course is that it learns and develops as well, and that involves a certain pace too, which is something that the regulatory frameworks are starting to deal with as well, so we would very much like to continue working with regulators.

Both us at Babylon, and also within the industry to identify what particular challenges there are with AI when it comes to being used as a device in medical care. Maybe to start looking at some of the approaches like for example the United States under the **FDA**[17], with the self-certification programs which allow regulators to certify the processes within the organizations themselves, allowing them to do appropriate level certification, keeping pace, and ensuring we can make the best use of these technologies.

Pandemic Preparedness

In terms of pandemic preparedness, when we're provided with high quality data in real time it is incredible what we can do. We saw notable examples of this through the pandemic with some great use of analytical technologies and AI in helping in our response here and around the world.

Within Babylon we have to use data scientists, epidemiologists, and population Health experts to make sure we make the best use of this but also, we use explainable or white box AI. This is really important, and the dependency that I want to underline is that all these technologies are only as strong as the data that is provided to them. We continue to face the challenge of COVID now, and we will undoubtedly face novel infections in other public health challenges in the future. This is going to mean that we're going to need to access large and sensitive data, and the public again need to trust that we in the public sector, private sector, academia and so on, will respect and ensure this privacy and security continues.

So, from an industry perspective we try and include privacy and security by design from the start. It's also important to use some of the new technologies as well. Some of those innovative technologies include:

- **Cryptographic techniques**, to make sure that we maintain anonymity while we're training these models.
- We use **differential privacy** or even train AI models, to create synthetic models or synthetic data, which then allow us to develop new models.
- **Federated learning**, where models are trained piecemeal to make sure that things cannot get aggregated in one place and increase the security.

[17] **US Food & Drug Administration (FDA).** https://www.fda.gov/

Request for Government

Our request is that the Government continues to support making this high-quality data securely available to all those working in the sector and encourage the use of best practice to maintain anonymity. In that way we can maintain public trust because this is all about trust and making sure that people are comfortable that the technology is working for them.

Large Language Models

Finally, AI moves very fast, and latterly we've seen the growth of what are called large language models. These are extremely capable models, which can be fine-tuned to provide services in small areas. The pace of change here is very rapid but one of the challenges here is about explainibility and interpretability. These are using technologies that by their nature are very hard to explain and understand. Now whilst technology is being developed to increase explainibility, we do face a point here where we have to consider that some of the technologies that we have may prove extremely useful, extremely valuable, and extremely effective in real world use. However, we may be limited in our ability to explain why it is working that way.

I'd encourage that we really engage with this as well and consider the pros and cons of using these incredibly powerful technologies in healthcare and other areas. This is something that's being discussed globally as to where you'll be able to apply this.

Dr. Natalie Pankova, Chief Operating Officer, Cube Labs

The perspective that I'll display is from an innovator, companies that are developing diagnostic and clinical decision support technologies using AI. This is what I've been doing with companies for over the last decade or so. Primarily I will address questions around how effective and efficient is AI in actually being able to analyze these large quantities of data, and an innovators perspective around the health data governance components as well.

First, I just want to clarify that when we're talking about diagnostics, AI is really good at doing a couple of things quite well:

- The ability to classify. So, whether a patient is falling into a certain category not another.
- The ability to predict whether a patient has some chance of some event happening at some future point in time.

We now do have evidence that AI can do this much better than a clinician in certain instances, taking these large quantities of data and information simultaneously. This is becoming really challenging for clinicians to do, with a lot of information coming out there now constantly – there is constant new evidence generation in the clinical sphere. There was an article published[18] that says that an algorithm can be developed that is better at diagnosing disease accurately than human doctors when you take together a sample set of realistic case studies.

Metadvice

[18] J Richens, **'Improving the accuracy of medical diagnosis with causal machine learning'** (2020). https://www.nature.com/articles/s41467-020-17419-7

There is a technology that I also helped develop and deploy into NHS Primary Care with a company called **Metadvice**, of which I was Chief Operating Officer. Essentially, we have shown that we can use algorithms to better manage complex chronic and multimorbid conditions where decisions about patients are really difficult and leaves doctors at a point that can lead to inaction. This kind of 'wait and see' approach or trial and error approach, which of course we don't want as it leads to poor patient outcomes. This AI is now being used in both research and practice across 10,000s of patient records to identify, for example cohorts of non-responders to certain therapies, such as statins, or cohorts of patients who should be accelerated much more rapidly and will benefit from more aggressive treatments sooner. This manuscript is actually in publication at the moment.

The challenges that we face in this process were really not around how good the AI, the algorithms, or the technology itself was at handling data, but rather its infrastructural challenges of getting access to the right data, getting access to clinical capacity. Additionally, challenges of inefficient or ineffective AI literacy at multiple levels of healthcare organizations and really low availability of funding for the healthcare organizations themselves, to actually implement and spread this technology. This led to a lot of the burden being placed on the innovators themselves in order to be able to do this and effectively spread this.

Novai

The second example I will provide is the AI that I'm currently helping develop at a company called **Novai**[19]. This is a diagnostic imaging AI for Ophthalmology[20]. This is a really well-established area of AI utility now with medical imaging, Novai's technology is successfully used for research purposes across pharmaceutical clinical trials, and at the moment is being developed for deployment into clinical practice. We 're going outside the UK first, because it is so challenging to be able to deploy these kinds of clinical solutions in the UK. We have shown that it is possible to run thousands of images through these algorithms and successfully pick up classifiers and predictors of disease in the eye, and the algorithms do become more efficient with increased quantities of data that they get access to and process.

However, the algorithms don't just get access to good quality data on their own. We have to make that data available to them. Therefore, it is up to organizations, from both the innovator side and the clinical side, to ensure that the infrastructure is either provided or developed that makes such inputs efficient. Data acquisition, data access, data processing, and data modeling pipelines should be built in this manner.

Notably when **Google Health**[21] tried to deploy their real world algorithms in Thailand, it resulted in quite poor clinical effectiveness because their algorithms were built on data that was just too good and not real world. These things do happen, so it has to be built with clinical

[19] **Novai.** https://www.novai.co.uk/

[20] ***Ophthalmology*** is a surgical subspecialty within medicine that deals with the diagnosis and treatment of eye disorders.

[21] **Google Health.** https://health.google/

utility and usability in mind.

Health Data Governance

If we're really saying that AI is only as good as the data and the training information that is provided to it means that data is as equally, or even maybe more important than the actual algorithms and the computing power themselves. While AI models and computing power are now cheap, accessible, and democratized, the data is not. It usually comes with a heavy price tag. For example if you're going through **Clinical Research Practice Datalink (CRPD)**[22] or **Health Data Research Hubs**[23] you've got to pay for this data oftentimes and whether data sets are not available already, there is time and effort required to be able to curate these data sets from scratch. This is a significant burden on healthcare innovators as well and so our experience across several clinics and trusts is that this is about 12 to 24 months of effort required in order to actually get access to these kinds of data sets. This puts a barrier on quality and efficiency of actually developing these Technologies.

So, protracted data access experience can actually deter financial incentives away from building these kinds of innovations. There are learnings that we can take away from these experiences and their projects now across the world, and, across Europe. For example, **Data Lake medical data donation system**[24] in Poland that's now being built for the donation of data in the same way that patients would be donating organs or blood for instance, that the UK regulators can look at in order to expand how they build their own data sharing and governance models.

Recommendations

To close, I propose the following 3 recommendations:

1. Work on setting up policies that would enable and subsidise access to data. Leading edge AI is often developed by new and small companies who cannot afford to pay high prices for data access. Model validation in healthcare is also a long and expensive process, which puts pressure on innovation funders. Subsidising access to healthcare data will support innovation in this space to continue to pull the UK system forward in innovation development.

2. Enable greater education to improve AI literacy across the industry spectrum: doctors, administrators, financiers, and policy makers. The **NHS AI Lab** has recently suggested training for all clinical staff working with AI. We need to go beyond this and provide training for all stakeholders.

3. Incentivise clinicians to work with innovators to develop, deploy and evidence the

[22] **Clinical Research Practice Datalink.** https://cprd.com/

[23] **Health Data Research Hubs.** https://www.hdruk.ac.uk/helping-with-health-data/health-data-research-hubs/

[24] **Data Lake.** https://data-lake.co/

technologies, including collecting, curating, and validating data and analysis if needed. The challenge of insufficient headroom and time for clinicians to work on innovation is now felt in the clinical trial ecosystem, where we have seen a 44% decline in clinical trials run across the UK over last 5 years, which is said to pose an existential threat to the UK life science and healthcare ecosystem. We may have the same problem with healthcare AI if we don't rapidly make strides to course correct.

Michael Bridges, Senior Vice President Data Science, Optum

United Health Group

Optum is part of the **United Health Group**[25], which is a large Healthcare organization based in the US, but we do operate globally and with a big footprint locally in the UK. I have been at Optum for about five years. Prior to that I worked in algorithmic research, and at Optum I lead a team of data scientists, clinicians, and data engineers, who design, build, and deploy AI algorithms for use. This is predominantly in the US, as there is a large market there, with over 100 million patients that we treat, and we have access to. We also operate in other global locations including the UK.

These algorithms centre on large-scale risk prediction, for example: disease prediction algorithms, identifying early stages of chronic disease, and recommending crucially appropriate interventions to the right patient at the right time.

Practical Ways AI is Making an Impact

Lots of great examples about some of the latest technologies have already been spoken about and indeed a lot of the newer AI technologies when applied to longitudinal care records and throwing in medical imagery data, you can exceed the performance of a clinician in the normal clinical setting.

Our AI focuses on empowering and augmenting human decisions, and we do that in some very tangible ways administratively. For example, 25% of clinicians time is spent in administrative duties – we can ease the automated processing of clinical documentation,

[25] **United Health Group.** https://www.unitedhealthgroup.com/

extracting and interpreting handwritten texts for example, which helps care coordination, utilization planning, very practical things that can really make a strong impact on the health outcomes of individual. A key element here is the engagement of patients and 50% of patients are just not engaged with their healthcare treatment. So regardless of the efficacy of the algorithm that you've got in place, getting the patient to be engaged is hugely important to the final outcome. We've concentrated a number of AI algorithms around finding the right way to engage that patient: whether that's a telephone call, a text message, some personal intervention, or someone to visit them at home to engage them in the treatment. This could be for Alzheimer's treatment, diabetic treatments or even control of blood pressure for example. Knowing the best way to target that patient is hugely important and using AI to prioritize those channels, we found to be incredibly effective.

Of course, we do provide enhanced clinical insights to clinicians and to administrators. We've found for example in Alzheimer's, we can identify early stages of Alzheimer's and Dementia, which would typically sometimes be missed by physicians within their busy workload. These are not necessarily ground-breaking insights; these are things that the clinician might have missed because they hadn't necessarily had time to review the full longitudinal patient record. It is like an aid-memoir, a reminder to the physician to check this. It can improve the outcome and close gaps in care.

Tracking infectious diseases post-COVID is incredibly important and using longitudinal health records and demographic data combined with anonymized internet search data you can track the progress of seasonal flu and then target individuals for flu vaccines. If they are, if they're at high risk or get them to shelter for example. A lot of these are just simply not possible with basic analytics. You need AI to make these insights and so it is an incredibly important development, but again a very a very practical one.

Responsible & Safe Use of AI

The responsible and safe use of AI is something we obviously take incredibly seriously. We believe it's a safe and credible technology; we take with utmost primacy patient safety, privacy, and security. Some of the methods that now we can use to remediate some of these concerns include federated data: the data stays where it is, the algorithm goes to the data. Some very practical things we can do to avoid exposing personal identifiable information about a patient but still get the insights, transfer learning is another example. Fairness in AI is something we take very seriously and something we track in all of our deployed AI systems, where we're actively and proactively monitoring to see if some areas of demographics are being negatively affected or targeted by any of our AI algorithms.

There are very practical and tangible things you can do to actually monitor and safely use AI. It's really something that now, particularly the initial concern around the black box mechanisms in AI, can largely be remediated through things like explainable AI. A lot of our physicians can actually see the outcome from our models, they can monitor with tools like explainable AI they can see why the model decided what it did, and they can decide then how best to use that

information.

Recommendations for Policymakers

Finally, I want to turn my attention to some points for yourselves as policy makers and legislators. We've talked a lot about some of the hurdles and the regulatory difficulties that we have, and I think one of the things we've seen globally in a number of different jurisdictions is a worryingly broad definition of AI. Some of the recent European Commission publications give extremely broad definitions of AI that are not helpful and are only going to sedate the development and the innovation - we need to be incredibly careful about that.

Secondly as an overarching point, I think the healthcare space is already a highly regulated space, and so we already rely on high degrees of regulatory oversight peer review, statistical rigor, those same methods applied lend themselves very well to AI risk calculators. Whether we're examining the difference between **Qrisk**[26] or **ASCVD**[27] and an AI CBD model very similar and very easy to compare, so we should not be afraid to throw in our AI algorithms into this mix.

I hope I've highlighted some practical ways that we're using AI globally and, in the UK, to advance health care; some practical steps that we can use to maintain high standards and deploy this this this work safely. I hope also that I have highlighted more engagement with policy makers and Regulators is hugely important particularly when it concerns precise definitions of AI.

[26] **Qrisk**. https://www.qrisk.org/

[27] **Atherosclerotic Cardiovascular Disease Risk Calculator (ASCVD**). https://tools.acc.org/ASCVD-Risk-Estimator-Plus/#!/calculate/estimate/

Dr. Rob Turpin, Head of Sector (Healthcare), BSI

I work in the part of the **BSI** that's appointed by Government as the UK National Standards Body – you'll probably also be aware that BSI also runs a significant notified body and approved body for medical devices, I'm not going to talk about that specific side of the business today, I'm going to cover the standardization pieces. In my role I lead on the development and publication of consensus standards, which provide businesses and organizations with best practices to help them address particular market challenges.

The use of AI in healthcare is currently a key focus area for us, and particularly where it falls within the remit of medical device regulations. Today I'm going to be addressing how standards ensure that medical AI solutions are deployed in a safe, secure, and effective manner, but also how both professionals and the public will trust AI medical deployments going forward.

Medical Device Regulations

Medical device regulations are put in place to protect the interests of patients and the public. This is across a vast range of diagnostic and therapeutic products, including instances where software and AI are used for medical purposes. Standards are widely used by both regulators and medical device manufacturers as a tool for demonstrating conformity to regulations. This applies in the UK market but also across the majority of overseas markets. In the UK we have a process called designation, which provides a very precise link between the criteria set out in the standard, with the safety requirements of a set out in the regulations.

Designated standards aren't mandatory however they do provide manufacturers with a very practical way of demonstrating conformity, so overall not just in the UK but globally we see them heavily applied. In a global context, many medical device regulators are working towards converging their principles around safety and performance, and as a result of this the standardization activities we undertake are almost entirely undertaken at an international scale

rather than rather than a national level. Therefore, BSI's role really is to provide a UK perspective to this global standardization program, which is mature and probably consists of around about 1,200 publications in total.

Recent trends to develop and deploy AI solutions in healthcare have challenged the traditional medical device regulatory thinking, and this is because AI can introduce new hazards and new risks which we haven't really previously considered within the traditional regulatory frameworks and standards that exist. Examples of this could be where we need additional robustness to ensure the appropriate level of safety for AI as a medical device, also relating to a proper consideration of the human interpretability of AI in healthcare, and then finally the adaptive nature of algorithms and how this aligns to the traditional change management processes that we have for medical technologies.

BSI's Work

Over the last four years BSI has been exploring these challenges and we've been working very closely with the regulator **MHRA** in relation to this. When we first started talking, MHRA recognized the need for a modified framework that would address the safety of AI as a medical device, and they also considered that global standardization would be a fundamental component for supporting this. BSI created a joint initiative, did this with MHRA but also with some U.S counterparts, so the USFDA and a standards organization, to research the standards in relation to AI deployment in healthcare. This has included some mapping activities around existing AI challenges to the regulatory safety and performance principles within regulations. In some instances, we've developed some new standards where we perceive that gaps existed.

One quick example of this is around risk management for medical AI, so there was already an established global standard that sets out the risk management process for manufacturers, heavily used across the globe by medical device manufacturers. It identifies hazardous situations that can occur through intended use but also foreseen misuse for a device. We convened a group made up of UK and U.S experts both from a medical device background, and from an AI background to develop some new guidelines. These addressed the application of risk management for AI and Machine Learning in a medical devices context. It highlights some of the potential hazards that we haven't really considered um in explicit detail before. Items such as data quality, bias within data, over trust, and the adaptive nature of algorithms, that manufacturers really need to consider when they're placing a product on the market. This guidance is almost complete, and it will publish in January 2023.

Aligned to that last month **MHRA** published a roadmap for software and AI medical device regulation as they develop their new UK regulations. This has several touch points with standardization throughout it and we're going to be working very closely with them over the coming months to address these. **MHRA's** ambition is to be a global leading regulator and so as they build their framework for software and AI, they're making sure that they align with the thinking from other countries in particular the US and Canada, but there are others they're

working with as well.

Recommendations

My consideration for today would be to think about the role that standards can play in bringing AI to the healthcare market safely, effectively but also in a timely manner. Our purpose within BSI is to convene standards as rapidly as possible, and as early as early as possible in the innovation cycle to make sure we've addressed these challenges. I want to do this by bringing together expertise both from a medical devices background, but also from the generic AI standardized principles that we're working on at the moment to ensure that there's an aligned approach, and that we're not reinventing the wheel. By doing this I think we can really bring together innovation and regulatory thinking through state-of-the-art best practices. In particular, I want to consider how we do this in an international context as well, so in line with the **MHRA** strategy and also the ambitions that have been set out in the UK life science vision.

To sum up, I would just like say as the UK national standards body BSI has already taken steps to support this place and we will continue working with key UK and global stakeholders going forward.

Keith Errey, CEO & Co-Founder, Isansys Lifecare

By background I am a physicist, I've got degrees from the University of New South Wales and Oxford and for the last 30 years been doing entrepreneurial work, and in the last 20, I've been putting wearable technology onto patients and so wearable technology for me is something that's been around for a long time. During that time, I have been trying to get wearable technology into the healthcare system so that if the benefits of wireless wearable technology and connected systems can accrue to all the patients.

Isansys Healthcare Limited

We're a small company but we do have global reach and our best customers, not surprisingly are outside of the UK, more surprisingly in India where we have made it affordable.

What can AI do?

What I really want to talk about is what we would call real time AI. Real-time AI is something that is about collecting data and processing it in real time. We do that within our technology which is a platform for collecting multiple vital signs i.e., physiological data from patients in any location: in a hospital, in a home setting, somewhere in between. In terms of the NHS, what it does is collect this information and produce **NEWS 2**[28] scores among other things. **NEWS 2**, if people are unfamiliar with that, is what is called an early warning score. As the name suggests, this gives an indication that a patient may be heading towards a period where or a point where they might deteriorate.

[28] **National Early Warning Score (NEWS) 2.** https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2

What AI can do is vastly improve the performance of early warning scores. What we actually do at **Isansys** is that we produce the data – the very good data that we've been hearing about as the missing link for AI. We in fact connect a patient into the digital fabric or the digital infrastructure. In doing that what we do is create a very rich a dynamic digital image of the patient, which in the first instance can live in an electronic medical record, but usually includes far too much information for the standard electronic medical record (EMR) system. Some people would call this a digital twin. Because we have this dynamic information there as well and we have all the vital signs plus, other things and it is continuous and it is wireless, then it's universal.

What happens from here?

Three things are really important here:

Initially, it is a remote patient monitoring system, or an inpatient monitoring system. Why is that interesting? Well, because we can create with clinical partners, virtual wards, and the virtual wards we are talking about, are acute care being able to be delivered outside the hospital. We can do that in one or two days. I'm not talking about stuff that doesn't exist I'm talking about a platform which thanks to our notified body is a class 2A medical device under the medical device regulation (MDR) and under the **UKCA Regime**[29]. This gives real-time information to care teams so that they know what is happening to patients.

The second thing this does is automate one of the most basic processes in healthcare which is, what is happening to the patients? This is what nurses do so this is hugely efficient in being able to free nursing time.

The third thing it does, more relevant to the day, is produce the best data; continuous high quality data sets of patients in any location, not strapped down in an intensive care ward, where most of the continuous data comes from but anywhere. We are moving into a new world where this is the way things are going to happen. I will give three good examples of this:

1. A rapid index. This was work we did with Birmingham Women's and Children's Hospital back in 2016. What this did was take over 100,000 hours of training data from nearly 1,000 children and from that, a personalized self-learning early warning score for each and every patient was developed. The first phase of that work has been completed; it has been shown retrospectively to perform significantly better than the pediatric early morning scores. The next phase of this is a prospective study to try to get it into standard care - it is a no-brainer, but can we get that funded in the UK? I'm sorry but this is not the case
2. Another predictive algorithm is developed by our clinical users in Denmark. Using information coming from our platform they have developed a very accurate predictive score, real-time data for post-operative patients. These patients are out of an operating theatre and there isn't time to go and mine an EMR, so this is real-time data.

[29] **UK Conformity Assessed.** https://www.gov.uk/guidance/using-the-ukca-marking

3. Using the same data to predict things like deterioration status of patients with advanced liver disease, cardiac problems, and so on. Once you get this data you can apply the AI to it and it is the same data in a sense it depends how it's cut and sliced, that depends on the patient's conditions.

Recommendations

What I really ask for from this evening is that what we're talking about is the high-resolution surveillance of patients. If it is put like that it suddenly sounds a lot more sinister, and so what we do need is to make sure that these kinds of data are never misused, so that they are not used for state surveillance, and that they are not used to sell or refuse services to anyone. I do not know how that's dealt with through what can be done here but that is so important because if we lose that trust, and we've heard this earlier then patients will not consent to this kind of thing which will make such a difference to healthcare providers everywhere.

5. Speaker Bios

Dr. Dom Cushnan, Director of AI, Imaging & Development, NHS AI Lab

Dominic Cushnan joined the NHS in 2014 and the NHS AI Lab in January 2020 as a Specialist AI advisor.

Dominic previously founded a technology company specialising in computer vision and human interface technologies.

Since his appointment in the NHS AI Lab, he has developed an AI Buyers' Guide for healthcare and developed the National Covid-19 Chest Imaging Database for the training and testing of AI models. Dominic was appointed as the Director AI, Imaging & Deployment in June 2022.

Publications:

- D Cushnan & I Joshi (2020) 'A Buyer's Guide to AI in Health and Care'
- D Cushnan (2021) 'An overview of the National COVID-19 Chest Imaging Database: data quality and cohort analysis'
- D Cushnan (2021) 'Towards nationally curated data archives for clinical radiology image analysis at scale: Learnings from national data collection in response to a pandemic'

Dr. Keith Grimes, Medical Director, Babylon Health

Dr Keith Grimes is Director of Clinical Product Management, Digital Health & Innovation at Babylon. A GP and Honorary lecturer in Digital Health, he has over 20 years of experience of

delivering innovative digital health solutions on the front-line of Primary Care. At Babylon he is Principal Product Manager for AI Services, tackling the challenge of taking the latest AI and data driven technologies and implementing them in a safe and effective manner to solve the problems facing patients, clinicians, and the wider healthcare system

Dr. Natalie Pankova, Chief Operating Officer, Cube Labs

Dr Natalie Pankova holds a PhD from the Faculty of Medicine, University of Toronto and is an experienced Chief Operating Officer working at the intersection of life science and advanced technologies. She has led teams in drug discovery and development, health applications and Machine Learning, building novel technologies from the ground up.

She currently operates Cube Labs, an innovative Italian-based European health technology venture builder, and sits on the Board of Novai, an ophthalmic AI diagnostic and biomarker development company. She previously led operations to build and launch Metadvice – AI-enabled primary care decision support software, currently operating in the UK and Switzerland, and is an Advisor and Mentor to early-stage innovative start-ups, including working with European Innovation Council Accelerator companies developing AI-based and digital health technologies. She is a Digital Health Expert at the WHO, and a Visiting Lecturer at the UCL Global Business School for Health.

Publications:

- N Pankova (2021) 'Catalysing improvements in precision medicine with AI and blockchain technologies'
- N Pankova (2022) 'How Can AI-Enabled Precision Medicine Help Clinical Decisions and Point-Of-Care Diagnosis?' – *Panel Discussion*

Michael Bridges, Senior Vice President Data Science, Optum

Michael is SVP of Data science & Innovation for Optum Ireland & UK. He leads a team that designs data architectures, platforms, and cutting-edge algorithms to impact the cost, quality, and clinical impact of interventions for more than 100 million patients as part of UnitedHealth Groups US and global operations.

UnitedHealth Group (NYSE: UNH) is a Fortune 5 health and well-being company offering health care coverage and benefits through UnitedHealthcare, and technology and data-enabled care delivery through Optum. A supporter of the UnitedHealth Group and Optum innovation agenda, Michael's team leverages longitudinal health records, genomics, advanced analytics, and AI to better understand chronic disease onset and development. Michael joined Optum in 2017 and has 15 years of professional analytics experience.

He holds a PhD in statistical methods from the University of Cambridge. Having authored or

co-authored more than 80 peer-reviewed publications and patents across statistics, data science, astrophysics, and bioinformatics he has more than 12,000 citations and a hindex of 38. Prior to Optum, Michael worked in Deloitte consulting, quantitative finance and held university research positions in Inference, Astronomy and Physics.

Dr. Rob Turpin, Head of Sector (Healthcare), BSI

Rob Turpin joined the British Standards Institution (BSI) in 2001 and is currently Head of Healthcare Standardisation in their Knowledge Solutions division. He leads on the BSI standards strategy that supports growth, innovation and regulation in the medical technologies and data-driven healthcare sectors. Recent work includes the development of white papers and standards to support the application of AI and Machine Learning in the healthcare system, and his focus covers both UK and global markets.

Previously, Rob has been involved in managing national and international standards development programmes across a variety of subject sectors. He has a degree in Chemical Engineering from the University of Teesside, UK.

Publications:

- BSI & AAMI (2020) 'Machine Learning AI in Medical Devices: Adapting Regulatory Frameworks and Standards to Ensure Safety and Performance'.

Keith Errey, CEO & Co-Founder, Isansys Lifecare

Keith is the CEO and co-founder of Isansys and is a strong advocate of digital and data driven methods in healthcare. He has physics degrees from Oxford University and the University of New South Wales and is a founding member of the Bessemer Society.

Isansys is a world leading digital healthcare company which has developed the most complete, scalable and simple-to-use advanced patient monitoring platform: The Patient Status Engine.

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