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**Winter is coming.  
HealthTech is here.**

**Elliot Jones**

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Any errors and omissions remain our own.

Elliot Jones

December 2018

## Executive summary

The NHS is under immense pressure. Faced with an ageing population and growing demand for its services, coupled with an overstretched workforce, it is facing significant challenges in delivering its services and meeting targets, particularly during the winter months.

Yet healthcare technology can play a transformative role in this perennial cycle of crises. The Secretary of State, Matt Hancock, has championed healthtech, but his ambitious proposals may fall flat if misunderstandings and frustrations between service providers and technologists continue.

On the 22<sup>nd</sup> of November, Demos hosted a roundtable in partnership with Roche Diagnostics, to discuss these pressures and understand how innovation and technology can help provide a solution. The event included NHS representatives, researchers and technologists from across industry who spoke on the opportunities and barriers in using healthcare technology to ease the burden and prevent future crises.

This paper covers potential technological solutions and the key insights that arose from the roundtable. Rapid diagnostics, genetically-tailored medicine, AI-assisted analysis, and new models of remote or self-administered care are all examples of exciting technologically-enabled developments. However, the roundtable also highlighted the challenge of adopting innovation across the current system.

Healthcare professionals emphasised that shifting to an outcomes-first approach and sharing more of this data with patients was essential, to ensure a focus on innovating rather than optimising existing inputs. Further, they noted that technologies were sometimes not designed with the realities of clinical practice in mind. Other problems included inflexible targets, an inability to unlock funds to invest in new technology, and a lack of integrated data-sharing, standards and forecasting.

We recommend that both technologists and healthcare professionals need to be more open to collaboration and listening to one another. For example, when developing standards for healthcare data and interoperability, the NHS should have an open process involving established industry and new start-ups; those same companies also need to listen to and involve on-the-ground clinical staff in the development of their technological solutions.

The healthcare system also needs to take a more outcomes-first approach, publishing more data and providing that data to patients, which will ensure that the NHS is open to and rewards innovations that solve real problems and improve patients' quality of life, directly or indirectly.

# Introduction

It has often been said that the United Kingdom and the United States are 'divided by a common language'. The fact that we both speak English disguises the extent to which we interpret the world differently, which can lead to confusion, misunderstanding, and misdirection.

Something similar is going on between technologists and public services. At Demos, we work extensively with technology companies from social media to cryptocurrencies, from healthtech to govtech. Our role, so often, becomes one of translating, supporting an effective dialogue between companies and public policymakers, and with the public themselves. Only by finding an effective way for the state and technology companies to work successfully alongside one another, in support of common goals, can we deliver on the promise of technology in our public services.

In health, the Secretary of State, Matt Hancock, is an evangelist for technology and a strong advocate for the transformative role that healthtech can play in our NHS. But his ambitious proposals may fall flat if misunderstandings and frustrations between service providers and technologists are allowed to fester

This could not be more important to delivering an NHS that is sustainable in the long term. Our NHS is under immense pressure. Faced with an ageing population and growing demand for its services, coupled with an overstretched workforce, the NHS is facing significant challenges in delivering its services and meeting its targets. A&E performance is already down compared to last year and there is a growing gap between expectations and what is deliverable. Primary care is also under pressure and the NHS workforce is stretched.

This winter is set to be even more challenging than previous years. A&E performance was significantly down and vacancies steeply increased in Q1 this year, leaving a 9% frontline vacancy rate.<sup>1</sup> Acute and ambulance services are expecting to be unable to expand temporarily over the winter period and existing staff will shoulder a heavier burden. This has been compounded by the unexpected summer difficulties due to the heatwave. This has left staff unwilling to commit to extra discretionary shifts this winter and the longest elective care waiting list since records began.

On the 22<sup>nd</sup> of November, Demos hosted a roundtable in partnership with Roche Diagnostics, to discuss these pressures and bring together the purchasers, providers and technology companies to understand the how innovation and technology can help provide a solution. The event included NHS representatives, researchers and technologists from across the industry who spoke on the opportunities and barriers in using healthcare technology to ease the burden on the NHS this winter and prevent future crises.

This paper covers the key insights and recommendations that arose from the roundtable. At the heart of the discussion was the need for greater understanding: for NHS providers to open their doors to innovation; for technologists to listen and respond

to the problems NHS providers faced instead of working in a black box; for common standards to help support a marketplace of ideas and innovation; and for the public to be empowered to influence the system from the patient perspective.

The paper should not be read as speaking for any of the individual participants, nor as representing a consensus view. We thank all participants for generously sharing their time and expertise.

## The short-term problems

In order to develop solutions and make recommendations to resolve the winter crisis, we must first consider the short-term problems and how they are leading to declining performance.

These pressures are exacerbated over the winter months due to the cold weather and an increase in seasonal illnesses such as influenza. The main causes of winter pressures are:<sup>2</sup>

1. Flu – A third of emergency admissions growth between winter 16/17 and 17/18 can be attributed to flu. Patient flow is affected as flu patients have longer stays and are isolated to minimise contagion, reducing the flexibility of beds. A 1% increase in the proportion of beds occupied by flu patients decreased A&E performance by 1% to 1.2%.
2. Bed occupancy – A&Es spend a lot of time looking for available beds; at 85-92% occupancy, this reaches a tipping point and performance rapidly deteriorates.
3. Long-stay patients – The 4% of patients who account for 40% of total bed days reduce the beds available to accommodate urgent patients. A 10% increase in the proportion of stranded, long-stay patients is associated with a 2-3% decline in performance.
4. Admissions and discharge variation – The A&Es with the highest hourly variation had, on average, a 3% worse performance than lowest variation. Areas with more patients under 10, over 60 and referred by GPs have higher hourly variation, due to more evening admissions.
5. Waiting times – Patients are waiting longer to be seen and receive test results. Diagnostic waiting times have worsened since 2013; targets have been consistently missed. This is worsened by an overstretched diagnostic workforce. Throughput in A&E and across hospitals is dependent on the speed of diagnostic tests.

## The long-term problems

The most significant factor that is likely to worsen winter crises in future is the simple demographics of an ageing population, with the number of over 65s expected to increase by 48% by 2040.<sup>3</sup> Older patients have higher admission variation<sup>4</sup>, develop more complex comorbidities<sup>5</sup> and are much more likely to become stranded due to lack of community care.<sup>6</sup>

Another key problem has been resilience<sup>7</sup> - the medium-term institutional capacity in terms of leadership, culture and operational design. This determines how well providers respond to surges and worsening conditions over the whole winter period. The most resilient trusts, compared to the least resilient, experience half the dip in performance from a surge in patients and take one day to recover from a poor performance versus three days, accounting for bed occupancy and workforce seniority. Development of culture and organisational cohesion is a long-term and ongoing project that must be constantly in mind.

The most well optimised and cohesive system still has a maximum possible throughput constrained by its available physical capital, particularly in the workforce. The need for numbers is already apparent but the composition of the staff will make as much of a difference in the long-term. A 1% increase in the proportion of senior staff led to 0.1-0.2% increase in A&E performance in 17/18 and the availability of specialists (who take more than a decade to train) determines how quickly patients with serious and complex needs can be seen, treated and discharged.

The NHS is currently developing a long-term plan to promote a more integrated system and invest in physical capital. It has been promised £20.5 billion (3.4%) of funding over the next 5 years to support this. However, it is estimated that it needs 3.3% funding growth just to stand still, meaning 0.1% isn't going to stretch very far.<sup>8</sup>

# Technological solutions

While pressures on funding and workforce are often cited as a cause for concern for the NHS when tackling these pressures, little attention is given to the role that technological innovation can play in alleviating the strain. But by helping to make the system run more efficiently, healthcare technology and artificial intelligence (AI) can help free up time and resources for healthcare professionals.

As previously noted, the Health Secretary has already pledged his commitment to helping healthtech innovation flourish. This, coupled with his renewed commitment to prevention rather than cure, puts tech innovation in a stronger position than ever to play a key role in helping the NHS through this pressured time.

## Point of care diagnostics

Point of care diagnostics is one technological solution that can significantly help the NHS better triage and manage patients. Diagnostic testing can be used to detect, confirm or rule out diseases or medical conditions, whether it is determining if a patient needs antibiotics to screening those with increased risk of a particular illness.

These simple tests, which are often carried out on the front line by A&E or acute medical care staff, enable healthcare professionals to focus on those who need their specialised care immediately. They can also save on admissions, meaning waiting times for patients should be less and availability of beds should be greater.

One such example that can quickly alleviate pressures in A&Es is a rapid test that determines if a patient has flu.<sup>9</sup> As previously noted, a third of emergency admissions growth between winter 16/17 and 17/18 can be attributed to flu. This test allows medical staff to quickly discharge patients that otherwise do not require hospital treatment, and correctly allocated those that do to side rooms, allowing for a significant reduction in blocked beds and transmission.

### Case study - cobas Liat flu diagnostic test

Norfolk and Norwich University Hospitals NHS Foundation Trust started using Roche Diagnostics' point of care flu diagnostic test in January 2018. The test can diagnose a patient with flu in 20 minutes and identify 43 strains of Influenza A and Influenza B, and seven of respiratory syncytial virus (RSV), a leading cause of respiratory disease. After a four-month trial with the test, the trust found that:

- Out of 277 tests carried out, 128 (46%) came back positive leading to more efficient use of side rooms and quicker diagnosis;
- The number of blocked beds dropped from an average of 11 pre-test to 2 post-test;
- The mean number of patients with flu in a bay dropped from 12.3 to 2.7 during the period the test was used.

## Genomics and precision medicine

A more medium to long-term innovation is genetics. Gene-sequencing is now fast and affordable enough to be used in mainstream healthcare. The 100,000 Genomes Project is sequencing DNA from patients with rare diseases, their families and cancer patient. This is already allowing 'precision medicine', tailoring treatment recommendations based on the patient's genes.

NICE have also given their first positive recommendation for a gene-therapy this year, Strimvelis, for the rare adenosine-deaminase deficiency.<sup>10</sup> Quicker, tailored diagnostics could also prevent the spread of antimicrobial resistance by reducing the misuse of antibiotics in treatment.

While these treatments are still experimental, there is great potential to improve both the effectiveness and value-for-money of treatments, especially for rare conditions and those with simple genetic predictors.

## AI and smarter analysis

Artificial intelligence's (AI's) most promising medium-term application is in diagnosis. For example, companies are developing algorithms to analyse different types of imaging data, which can already outperform doctors on diagnosing specific conditions. Further, greater processing power and improved techniques are allowing previously lab-bound analysis to be conducted by frontline staff. AI holds great promise for pathology too, with new AI systems capable of analysing digital pathology images leading to better diagnoses for diseases like cancer.<sup>11</sup>

Both of these raise ethical issues in their governance and deployment, however. For genomics, personal data is a significant issue. There have already been concerns around DNA testers passing on user's data and patients may worry about their genetic data falling into the wrong hands. For AI, the central question is accountability. Who is responsible when a system misdiagnoses a patient or recommends the wrong treatment? Especially when these are real-time learning systems that are evolving and changing all the time based on real-time data and so have surpassed their initial coding or training models which programmers designed.

This raises a challenge for current data protection regulation: how can data holders tell users how their data is being processed if they themselves face a system that is constantly changing and essentially a black-box in some places?

## New models of care

Patients may soon be able to create their own monitoring systems, allowing them to become highly informed about their own condition and have access to their in-depth clinical information. For example, diabetes is an increasing problem for the NHS. Better real-time self-monitoring of sugar levels could help prevent the condition from worsening, reducing hospital admissions and surgeries for amputations.

# Changing the system

These technological innovations have great potential to improve the quality and efficiency of healthcare, but only if they are adopted by the system. However, there are significant, systemic barriers to the use and adoption of technology by the healthcare system.

## Outcomes first approach

There was a broad consensus among participants in the discussion that we do not worry about outcomes enough and instead focus too much on measuring and economising inputs. Partly, this is because there are such significant budgetary pressures on the healthcare administrators they are forced to be constantly economising and partly because of a lack of outcome data.

For example, many stroke victims die on the wrong medication, even when there were more effective alternatives available. When asked why commissioners were not prescribing these, the commissioners expressed concern at being seen as in the pocket of industry. It was only when partners went back to them with a list of fatalities, a truly emotive set of outcome data, that changes were made. Many NHS staff highlighted the need to relate decisions not only to the outcomes from action but to the outcomes from inaction, (from a lack of change and innovation), and that this would be the only way to ensure the adoption of effective technological solutions.

NICE does a good job providing evidence-based outcomes measures. However, their recommendations are not always adopted across the NHS when a new technology is approved. Fundamentally, many clinical staff and partners don't have time to consider the information that is provided and the recommendations made are not compulsory. Additionally, NICE is generally focused on assessing and encouraging the spread of effective pharmaceutical drugs. The Accelerated Access Review has recommended that NICE refocus on diagnostic and digital technologies and issue funding requirements when those technologies could efficiently improve outcomes.<sup>12</sup>

## Patient information

Improving patient access to information could help to improve the situation through two channels. First, putting information into the hands of patients will drive the adoption and innovation of new technologies, and solutions more generally, as they have a stake in the outcomes from healthcare and so will push to get the most effective treatments.

Second, patients with better information can reduce and rebalance demand in the system. For example, patients turning up at A&E to get immediate care will choose to just go to their closest A&E because they don't know anything about waiting times.<sup>13</sup> If they are provided with these waiting times, they may be more likely to go to a facility

## Case study - WaitLess

WaitLess is an app that reduces pressure on A&E by providing patients with real time information. It informs patients on both waiting and travel times and can route them to where they will get the quickest service, thereby reducing the demand on overstretched A&Es by moving demand to currently underutilised departments. This gives both patients power and manages their expectations.

As of March 2018, it had:

- Led to a 5% reduction in minor injuries activity in A&E across the board where it had been deployed;
- Led to an 11% reduction in minor injuries activity in A&E during the busiest times of day.

that is technically further away but has a quicker queue. However, if choice moves demand but there is a block contract in place, this could place more demand on high-performing places without compensating them.

Some technologists felt that there was a cultural barrier to opening up information to patients, as it would allow greater scrutiny of clinicians. They also noted that the system is generally risk-averse and unwilling to try new approaches for fear of political backlash if things go wrong, for example, accidentally exposing sensitive data.

## Inflexible targets

Hospitals are interconnected systems. The symptoms of the winter crisis are visible in A&E, but these symptoms are relieved by releasing pressure further down the chain by cancelling planned procedures. The current target of 18 weeks creates inflexibility by not allowing us to load-balance throughout the year. We need to change expectations of how demand is dealt with throughout the year. If we are expecting one type of demand to increase, planned operations must be changed.

## Unpredicted but not unpredictable

Commercial organisations, such as pubs and supermarkets, will predict spikes based on weather forecasts and other factors, often down to the exact day, but the NHS – a system with yearly budgets – is currently unable to have the same level of responsiveness.

One healthcare professional highlighted a good example; following a number of celebrities talking about prostate examinations on social media, the NHS was swamped by requests the next week. It was a wholly predictable surge in demand, but the NHS had failed – or had been unable – to prepare for it.

Similarly, while flu and norovirus are predicated over the long-term with yearly cycles, the NHS still doesn't necessarily integrate predictions well enough into its planning. This is indicative of public sector issues in the UK and suggests a lot more could be done to prepare our vital services for demand, which we can easily see coming.

## Integrated and interoperable systems

Currently, a lot of clinical, patient and admin data is collected but there are big gaps in the data; it's not always available at national level for community, social and primary care, and isn't linked together to create national datasets. Those working in a hospital know what's going on but often those in commissioning have little knowledge of what's going on in hospitals; they have no central pool of data to get the bigger picture. This often results in the commissioner having to make phone calls day-in day-out just to get information, leaving little time for the discussion of solutions. A particularly egregious example mentioned in the discussion was that to get an idea of what was going on, some commissioning staff needed to leave their office, go to another building and sit-down at a different terminal there because there was simply no data-sharing going on.

There are already lots of innovative solutions out there, the central issue is integrating those solutions into the NHS. There is a burden of responsibility on both sides. However, developing an interoperable standard for both health data and health systems, so that different trusts and providers can all plug into the same framework and work together (and be replaced more easily), would remove a significant barrier to innovation and monopolisation by legacy providers. Working towards a Chief Clinical Information Officer and establishing a digital academy for health informatics skills is a step in the right direction but there is still more to do.

In future, a truly integrated, national data system could help reduce variation in clinical practice and become a learning system. For example, an electronic health record could prompt doctors to undertake each task in a protocol or even automate some protocols entirely by organising lab tests or administration of medicine simply by selecting the appropriate routine. Data can be collected on how doctors vary from protocol and what impact that has, good or bad. This provides more accountability for doctors and also a way to discover faulty protocols and potential for improvement which can then be rolled out everywhere.

An integrated data system could also help to understand how and why diseases arise. While some diseases are hereditary, many are caused or exacerbated by social factors. Combining socio-economic data with clinical data on diagnoses, treatment, lifestyle etc. could uncover variation in disease across populations and so better predict and prevent illness.

## Needs-based technology

During the discussion, NHS representatives noted that some current systems aren't useful to them because they aren't designed with the NHS's actual problems in mind. A big question that the technology start-ups asked is whether they should understand patients or health providers as their customers. Healthcare providers feel that there is too much consumer-facing tech. Instead, they need innovation that deals with efficiency in hospitals, i.e. bringing the business management tools used by large private firms. An example of this is the lack of oversight on where specialist machinery is located and if it is in use. For example, does London have a shortage of MRI scanners or are clinicians simply unable to find slots due to a lack of coordination?

Another issue raised by NHS representatives is that they often felt healthcare start-ups were pushing technology and trying to find a problem to solve with it rather than developing useful solutions. In order to create a viable business that provides solutions to real and pressing problems, it will likely be necessary to integrate these technologies into existing solutions or to combine the technical insights and developments from several of these start-ups. While some of the burden should be placed on the private sector to meet the needs of the NHS, the healthcare system will also benefit from successful innovation. Technologists expressed the difficulty in engaging with overstretched frontline staff and getting the necessary information to understand the relevant problems but were encouraged that the NHS is becoming more open to engaging with them at an early stage.

It was suggested that there may be a gap for an NHS start-up incubator that provides support for companies to mature their technology into a clinical business while getting consistent feedback from staff across the NHS about whether what they are developing would solve real needs. This would provide a safe space for innovation without fear of regulatory action or over-investment of scarce resources. Additionally, putting in place a Chief Innovation Officer on the boards of trusts would provide a specific point of contact for technology firms trying to communicate with the NHS, to break down adoption barriers, and ensure that the issue of innovation and technology integration isn't forgotten when other staff are overwhelmed with short-term pressures.

Finally, some of the healthcare technology providers noted that they were developing and selling healthcare solutions across the globe and so when localising for the UK, they need the NHS's cooperation in tailoring and integrating solutions into the domestic healthcare system. The burden of costs and effort of implementation between the private companies and the NHS was unsurprisingly contentious.

## The finance model

The procedures around flu vaccinations highlight the problems of planning and coordination within the healthcare system. It is recommended that all staff are vaccinated, and most trusts opt for a trivalent rather than the quadrivalent vaccine, i.e. one that protects against three types of flu rather than four, to save on costs. This proves to be a false economy, as the flu which isn't protected against still ends up infecting staff. Short-term savings lead to higher costs in the long term.

Further, flu vaccines are targeted at at-risk groups during the winter season. However, there is at best 70% coverage as some people can't or won't take the vaccines. Some have suggested that targeting at-risk groups is not the way to solve the problem. If there were a universal vaccination programme, then herd immunity could block transmission of flu within the community, protecting those most at-risk even if they weren't directly vaccinated.

However, a split incentive in how money flows in the system prevents investment to save in the future. The savings would be in the hospitals, but the costs are in GP surgeries, and so GPs have little incentive to take on the extra burden and reduce their profit margins and performance for the sake of the hospitals. Further, for hospitals on payment by results basis, they don't have money to invest and would lose inpatient activity,

meaning there is very little incentive to do so. Block payments have their own problems. For example, hospitals with last minute cancellations have no incentive to fill them as they are not rewarded for higher throughput.

Reform has been tried before, most recently by Andrew Lansley's Health and Social Care Act in 2012.<sup>14</sup> However, under these reforms, GP and hospital payments stayed the same and it simply exacerbated treating hospitals different from other organisations. What needs to change is the underpinning contracts between service providers and a consideration of whether it no longer makes sense to administer hospital trusts and GPs in the same locale as separate organisations.

# Recommendations

## Regulatory action

**Recommendation 1:** Initiate a collaborative exercise with healthcare providers, industry and start-up representatives to develop a single set of standards for healthcare data and system interoperability.

**Recommendation 2:** Medical technology and diagnostics which have been evaluated by NICE, shown to be cost effective and of clinical benefit, should be given equal status to pharmaceutical products in their evaluation, recommendation and funding mandate.

**Recommendation 3:** The Competition and Markets Authority should produce a study of the healthcare technology market and take regulatory action if failures are identified.

## Bringing patients back in

**Recommendation 4:** Publish more outcome data and give patients greater access to that data, so they can make more informed decisions about their choice of healthcare provider and put greater pressure on policy-makers to prioritise outcomes over inputs.

## Systemic reorientation

**Recommendation 5:** Reform the healthcare funding system to allow greater pooling and reallocation of resources across providers. This would unlock existing funds for investment in technologies with high fixed-costs or programmes that would be a net saving for the NHS, e.g. vaccinations or public health interventions, but where the costs and benefits are borne by different providers.

**Recommendation 6:** Expand the Academic Health Science Networks by opening an incubator alongside their existing accelerators. This will allow innovators access to consistent feedback from NHS staff on whether their solutions match real needs and support companies to mature technology into sustainable clinical businesses.

**Recommendation 7:** A Chief Innovation Officer in each trust to provide a specific point of contact between technology companies and the NHS.

# Conclusions

It is clear that there is significant innovation in the UK healthcare ecosystem but that the system struggles to be responsive at times.

This is not the result of laziness by healthcare professionals or intentional bureaucratic opposition - the system is simply under immense short-term pressure. Trying to maintain standards of care for current patients means that there are few resources available to engage in scoping out new solutions or to work with the private sector to integrate them into the current model. Technologists need to understand this and keep the demands of clinicians in mind when developing technology rather than creating a solution in search of a problem.

Ultimately, there will need to be systematic reforms that address the perverse incentives built into the current model of healthcare delivery and an overhaul of the existing systems architecture. However, we have to focus on relieving the short-term pressures in the best way possible just to give the system the breathing room required to be able to step back and take the long view of a sustainable future.

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## Endnotes

- <sup>1</sup> (NHS Providers, 2018)
- <sup>2</sup> (NHS Improvement, 2018, pp. 5-10)
- <sup>3</sup> (Office for National Statistics, 2018)
- <sup>4</sup> (NHS Improvement, 2018, p. 9)
- <sup>5</sup> (Office for National Statistics, 2018)
- <sup>6</sup> (National Audit Office, 2018)
- <sup>7</sup> (NHS Improvement, 2018, pp. 10-11)
- <sup>8</sup> (NHS Providers, 2018)
- <sup>9</sup> (Bodkin, 2018)
- <sup>10</sup> (Castle-Clarke, 2018, pp. 5-6)
- <sup>11</sup> (Castle-Clarke, 2018, pp. 16-17)
- <sup>12</sup> (Accelerated Access Review, 2016, p. 48)
- <sup>13</sup> (Blackwood, 2018)
- <sup>14</sup> (Health and Social Care Act 2012 (c. 7))

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