

Digital Vision for Health



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AtoS



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Adrian Gregory, Chief Executive Officer, Atos UK & Ireland

Digital Vision for Health

Re-imagining healthcare in the everything-connected world is an immense challenge and opportunity.

Today's healthcare services are becoming more complex as they attempt to meet ever-broadening medical challenges, ever-increasing demand and more numerous choices for healthcare professionals to improve patient outcomes. In this environment, it is becoming clearer that the need for ongoing innovation and digital transformation will be key to meeting those demands - especially as healthcare professionals and patients are increasingly willing to interact and exchange information in different ways, for example using smartphones, tablets and potentially wearables they already have at home.

While technology is an important enabler, it is people - patients, clinicians, carers and families - who must be at the centre of any technological change. I believe there are four key areas where digital technologies can help to drive wider change with people at the heart. Firstly, digital technologies provide the opportunity for more integrated care, by helping health professionals to better coordinate clinical services and improve outcomes. Secondly, they can underpin more collaboration between healthcare providers, patients and

carers to improve care delivery. Thirdly, wider use of mobile devices can put more information into the hands of citizens, support personalised care plans for people at home, and increase the productivity of clinical teams. And finally, more extensive and deeper use of analytics, such as combining patient data with external data, can help to improve clinical decision-making and resource planning.

These and many more opportunities now appear tantalisingly achievable. In this paper, we hope to share just some of the opportunities and solutions that could improve patient outcomes and satisfaction, integrate resources, and release capacity within services. I believe we are on the brink of an exciting era of great change in the design and delivery of health services. We are committed to working in collaboration, helping healthcare organisations to harness technology to meet the challenges they face and advance healthcare for all.

A handwritten signature in black ink, reading "Adrian Gregory". The signature is fluid and cursive, with a long horizontal line extending from the bottom of the name.



A revolution close to home

Advanced gene therapies, the 3D printing of organs, prosthetics and implants, and the use of augmented reality technologies and robotics in surgery are eye-catching examples of how digital technologies are leading the transformation of healthcare. Data scientists, engineers and surgeons are pushing the boundaries of medical science every day.

At the same time, we are witnessing the start of a revolution in healthcare that is much closer to home. The demands on our health services are well acknowledged, with a growing and ageing population and an increased cost of care. Yet there is also growing public awareness of our responsibility as citizens to limit the burden on health organisations. There will always be a premium on accurate diagnosis, effective treatments and patient-centred care and efficiency; but in the digital future, day-to-day experiences and relationships across the health ecosystem will be transformed through new insights and more powerful digital tools.

With today's intense pressures on health professionals, our customers in healthcare need technologies that ensure that the right people, data, equipment are in the right place, at the right time within complex, fast-moving clinical settings. As well as freeing up resources and minimising any margins for error, as these technologies evolve, each patient can be treated as a whole person along the care continuum (not as a series of symptoms), with clinical protocols that are more complete in their assessment, leading to even better day-to-day care.

By offering new clinical insights at every interface, digital technologies are the decision-support tools that today's healthcare professionals need to address challenges that are simply too complex to resolve without access to rich data. Analytical tools are facilitating advances in medical practice, with machine learning to support clinical decision-making and provide a growing repository for the future healthcare community. Remote monitoring is helping clinicians to better understand the progress patients are making and deliver better health outcomes. These tools can be part of a virtuous cycle, targeting more personalised and preventive interventions. In fact, technologies are a powerful catalyst in changing almost every aspect of the relationships between healthcare providers and between clinicians and patients.

Decision-making will become ever more collaborative between clinicians and patients. We are entering the age of the citizen, with power devolving away from centralised services and institutions towards local systems and individuals all enabled by data and digital tools. Governments around the world are starting to stress that the provision of healthcare is a contract between government and the individual citizen. In this context, a health professional's role will be to guide the patient through the correct diagnosis, treatment or prevention strategy. Emerging technology is a critical enabler here for promoting and supporting more distributed trust. With technologies such as Blockchain, relationships that were previously ungovernable technologically can be safeguarded and secured. The 'magic bullet' of giving individuals ownership of their own health information and choosing who they give access to it really does become realisable. This will change the dynamics between government, citizen and health provider. Decision-making will also become more collaborative between providers and other carers. Digital technologies are vital in helping to align capacity more closely with demand through innovative service configurations. They can help to co-ordinate new models of care delivered by professionals collaborating closely across primary and secondary care and wider support networks within communities.

Delivering this scale of digital transformation in high-pressure clinical settings is always challenging – especially with other competing demands. There is huge opportunity and need for new thinking and ways of working together to do things differently. The challenge is to deliver core services to 'keep the lights on' while transforming through a roadmap of digital innovation. This depends on very close relationships between health organisations and their partners to rethink service delivery and coordinate a programme of transformation. Advances are happening very fast. We are at the beginning of a digital journey to empower health professionals in new ways. And that is a revolution in which we can all play a part.





Health at the heart

65.1m

UK population – June 2016 (ONS)

67,772

Registered GPs in the UK - Dec 2016¹

280,882

Doctors registered in UK - Dec 2016²

3.8m

people living with diabetes in the UK and, by 2035/6, this is expected to increase to 6.25 million³

by 2030

there will be 17 million people with arthritis and 3 million with cancer⁴

1m

people with dementia in the UK by 2025⁵

by 2030

the number of older people with care needs is predicted to rise by 61 per cent⁶

Between 2015 and 2020

over a period when the general population is expected to rise 3%, the numbers aged over 65 are expected to increase by 12% (1.1 million); the numbers aged over 85 by 18% (300,000); and the number of centenarians by 40% (7,000)⁷

by 2027

the total UK Population will reach 70 million⁸

11.3 million

people by 2032 are expected to be living on their own, more than 40 per cent of all households⁹

people over 85

living on their own is expected to grow from 573,000 to 1.4 million by 2032¹⁰



¹ http://www.gmc-uk.org/doctors/register/search_stats.asp

² http://www.gmc-uk.org/doctors/register/search_stats.asp

³ https://www.diabetes.org.uk/about_us/news_landing_page/nhs-spending-on-diabetes-to-reach-169-billion-by-2035/

⁴ <https://www.kingsfund.org.uk/time-to-think-differently/trends/disease-and-disability>

⁵ <https://www.alzheimers.org.uk/statistics>

⁶ <https://www.kingsfund.org.uk/time-to-think-differently/trends/disease-and-disability>

⁷ <https://www.parliament.uk/business/publications/research/key-issues-parliament-2015/social-change/ageing-population/>

⁸ <http://www.bbc.co.uk/news/uk-34666382>

⁹ <https://www.kingsfund.org.uk/time-to-think-differently/trends/demography>

¹⁰ <https://www.kingsfund.org.uk/time-to-think-differently/trends/demography>





Precision medicine: the future of health



As science and technologies advance and demand continues to grow, healthcare systems have to evolve into a more sustainable model that maintains people's wellness rather than just treating illness once it has occurred. Through a combination of proactive human interventions and decisions – supported and enabled by rich data and intelligence – that model will be more effective by being much more precisely directed at the individual.

Precision Medicine is based on four key pillars of care: Predictive, Preventive, Personalised and Participatory. A good illustration of how these four pillars work is the story of Dr Martinez, based on The Case for Personalized Medicine, Personalised Medicine Coalition, 3rd edition.

- Dr Martinez is sitting down with his laptop. On the website that he uses to manage his practice, an alert pops up warning him that several new mutations found in 10 percent of people have been discovered to be associated with the likelihood that they might convert to type 2 diabetes. All of his patients have had their entire genome sequenced and entered into their electronic medical record. He conducts a quick search of this 2,000-patient database and finds about 80 who are at risk (**Predictive care**).
- To half of those patients, he sends a strong reminder and advice on diet and lifestyle choices they can take to avoid the disease (**Preventive care**).
- For the other half, whose medical records reveal pre-diabetic symptoms, he sets up appointments to consider more proactive treatment with drugs that can prevent the onset of the disease (**Personalised care**).
- Patients can download an app certified by the healthcare system that will allow Dr Martinez to remotely monitor their glucose blood levels (**Participatory care**).









As that example shows, Precision Medicine depends on clinicians and citizens being proactive and working together to look after health and wellbeing. The success of that partnership relies on the healthcare system's ability to transfer breakthroughs in data analysis across into healthcare settings – 'from the bench to the bedside'. Massive volumes of raw, complex and heterogeneous data have to be acquired, validated, stored, processed and analysed using high performance computing systems. They then need to be interpreted and presented (through dashboards and reports) in meaningful ways to clinicians. Individual citizens can become more proactive in starting specific preventive treatments, or make lifestyle changes that prevent the onset of the disease or minimise its impact.

In this democratisation of medicine, genomic testing plays a very relevant role. DNA sequencing technologies are being adopted as part of routine practice as a powerful tool for early diagnosis and for personalised treatment. Getting access to the molecular profile of patients and correlating this data with phenotypic information (the expression of specific traits, such as stature or blood type, based on genetic and environmental influences) is an enormous cultural shift. This fast-evolving, immensely powerful new diagnostic tool is revolutionising healthcare and supporting clinicians, citizens, carers and society to work together in new ways to make predictive, preventive, personalised, participatory health and social care a reality for all.








A patient's journey

Let's look at an example of how the blend between big data analytics capabilities together with high performance computing systems could bring important outcomes in the healthcare setting.

-  Alison is a 45-year-old British citizen worried about her father's death last year due to a heart attack.
-  She makes an appointment with her doctor, who offers to perform whole genome sequencing with previous informed consent.
-  The doctor carries out real time sequencing by introducing Alison's blood drop into a mini sequencing portable device that plugs directly into the USB port of her laptop.
-  Processing of the genomics data (filtering, mapping and variant calling) is carried out in the mini-High Performance Computer embedded into the sequencing device.
-  Anonymised and encrypted, Alison's processed genomics data is sent to a Big Data Computing Platform where the analysis of the genomics variants is made.
-  The Platform counts also as a repository where the healthcare data gathered through different clinical pathways for every patient in the NHS healthcare system is stored. This Platform is hosted in an NHS Data Centre in the UK and has been implemented by putting in place cutting-edge cloud, security and cybersecurity technologies that are fully compliant with all valid European and UK laws. These technologies ensure the privacy of the data at rest and in movement. The data stored in this Platform can only be accessed by authorised medical doctors and healthcare authorities to decide the better treatment options for the patient or to design preventive measures based on stratification. There is a strict audit programme monitoring this Platform that keeps track of all the processes launched on it.
-  The doctor relies on a decision support system (DSS) that can infer an accurate diagnosis from the bulk of scientific, imaging, medical, clinical, omics, research and social data available. Cognitive computing is the mainstay of the system.
-  Unfortunately, Alison carries three variants that are related to cardiovascular diseases: the same as her father.



-  After validating the diagnosis, the doctor executes another module of the DSS to find the most suitable treatment for her patient based on her clinical (arterial hypertension), social (single and no family support) and genomic profile (three cardiovascular risk variants). The doctor is advised by the DSS to prescribe a medication that has been tested in 100,000 patients with identical genomic profile with good results. She also recommends a diet to control her blood pressure.
-  She suggests the use of a T-shirt that enables monitoring of Alison's electrophysiological heart activity in real time. The T-shirt is connected to a mobile application that sends the data (electrocardiogram and symptoms as requested) to a trained system that can predict any possible anomalous event.
-  Alison stays asymptomatic until the age of 61 when the system alerts her doctor about the risk of arrhythmias. After performing a TT Echocardiogram, an aortic valvulopathy is detected and she programs an aortic valve replacement. The valve is printed on a 3D printer based on the images taken from TT Echocardiogram.
-  The doctor requests the help of a cardiovascular surgery expert in US who proposes robot-assisted surgery with augmented reality.
-  The surgery is successful and Alison is now enjoying a healthy life.



A seismic shift

Moving from provider-driven to citizen-driven healthcare

It's no exaggeration to say that healthcare systems across the world are struggling to keep up. An ageing population, lifestyle factors, changing public expectations, the rise in chronic diseases and scientific advances have all dramatically increased demand. Systems are straining; and the NHS is no different.

While everyone in the health service has been working hard to treat more patients and satisfy demand (with a limited public purse), this is not sustainable. There is now an important opportunity to reconsider how we as citizens view our NHS and how the system can support our health needs. A seismic shift is needed in behaviour to relieve the pressure.

Most experts agree on the need to move from the current situation – in which the system responds to and treats illnesses – to a future state, in which wellness is proactively maintained and illness is diverted. Currently, demand for healthcare services is initiated, for the most part, at the point where we phone our GP or attend A&E when something is wrong. The shift – the tipping point – is to prevent that demand happening in the first place. We need to find opportunities to stop a visit to the GP or a dash to the hospital.

The opportunity – and the challenge – is to dramatically reduce the burden of treatment, particularly in hospitals. That's why digital transformation is so critical. Technology will be an enabler and a catalyst for the seismic shift in citizen behaviour. People can be helped to take more ownership for their own health. It's true that there are plenty of people looking after themselves and taking steps to stay healthy. Yet still, our cultural landscape is that as citizens and patients, we are not always empowered: we are administered to by experts who are in charge of our health and wellbeing.

Let's look to another sector. In the digital age, we have all become our own travel agents – and virtually wiped out high-street travel agencies. We book our own flights and seats (looking at an online plan of the plane), we choose our own hotels, we put together our own packages of activity and entertainment, all based on data (together with feedback and ratings from other travellers). We take responsibility and we self-serve. Can the same happen in healthcare? With help, choice and encouragement, as citizens we can start to change our view of how we interact with health services. To do this, we need digital tools that are easy to use, that have value, and that are more effective than going in person. If, for example, I can have a video-conference call with a clinician about my daughter's rash, then I won't go to my GP or A&E.

When we travel, we know we can search for the cheapest seat on a plane, find out more about the country we're planning to visit, and get details of the last flight we took. When we book a flight, we are signposted to arrange parking at the same time. Similarly, if we can get key health information on our mobiles and smart watches, we could also be signposted to things to think about or do to keep ourselves healthy – a reminder about a forthcoming hospital appointment or an offer at a local gym. I could get my occupational health check results, together with my latest blood-test that was done at a hospital, and my health and fitness app, all on the same device.

The future is bright. Personalised medicine is around the corner. Advances in technology and genomics will enable us to take more ownership of our health, make choices and act to keep ourselves well, and understand what treatments will work for us as individuals – all drawing on rich sources of highly personalised data. Over time, we could shift our behaviours permanently, for example from not just having a flu jab but to building up our health and immunity longer term. Those kinds of relatively small-scale choices are marginal gains which, in combination, could make an enormous difference and transform healthcare commissioning and provision.







How can we empower people to stay out of hospital?

With around 11 million hits a week, the NHS Choices website has proved that people turn to official online resources when they, or someone they look after, are unwell. For day-to-day interactions, we increasingly expect to use our mobile phones – and that's certainly true of digital natives. With the need to manage demand and shift from treating illness towards looking after wellbeing, there's huge scope for a 'My NHS' icon on my phone to empower me to stay healthy.

Empowerment starts with having the right support, tools and information to hand. Many people already use Google to find information on staying healthy or get an answer when they have a symptom. The problem is, that information is often on an unregulated website or app. With hundreds of new apps being released each week, self-monitoring and improvement is a growing trend. The wearables market is exploding; people are happily monitoring their calorie intake, exercise and blood pressure and gathering that data via apps. At the same time, the NHS is investing in telehealth and remote support. So it's worth, then, exploring whether there is a way to flip these resources and services on their head through more pervasive NHS tools that empower citizens day to day.

For the citizen, there's the real challenge of knowing what apps are out there and which ones are safe. So how can the spread of uncertified, unregulated online resources be controlled? It's in everyone's interest to bring good apps to market, so this is not so much about controlling as filtering. Citizens need more information about sources of help, but only when appropriate and relevant. None of us wants to be bombarded.

'My NHS' core app

Thankfully, technology can enable us to make sense of all the information and get a personalised service. A 'My NHS' core app, for example, would be a way of signposting relevant certified services and other apps based on an individual's life circumstances and profile. Other industries such as retail already do this. So, for example, local hospital apps, condition-specific support apps and ways to facilitate the patient journey such as transport, parking and retail apps could all be suggested to an individual patient. This would also help drive the creative development community to continue inventing new apps that are certified and 'ruggedised'. Citizens could make their own choices on which apps to use.

An NHS 'ecosystem' of services, advice, support and resources, all channelled through one simple enduring device could support citizens, as well as carers, family and friends of people who would not naturally access an app themselves. It could also be a powerful tool for people working for the NHS. Every time someone starts at a new location, they could be served up apps for their new role, way-finder apps, health and safety apps, loyalty apps, organisation chart apps and, most importantly, medically focused apps linking them into internal systems.

Just look at the adoption of Facebook: if you give people a 'pane of glass', then they'll populate it. There are, of course, good reasons why this type of social network is more challenging for a system like the NHS. But the world is changing fast, and the Internet of Things is another step change. With citizens connected, monitored and potentially prescribed medicines machine to machine, many of these extraordinary opportunities and transformations will be driven by new apps.

Data from my fitbit could be stored and linked to my own medical records. I could use the app to pay for the pictures of my baby's scan at the hospital or gain access to an NHS building with an eID. I could use 'My NHS' to store notes and information about my history, take a photo of my symptoms or the medicines I use and share these securely with my GP online. I could make or cancel an appointment – even take an appointment slot at very short notice because I'm in the area. I could have a button to press to contact the NHS (via video, voice, instant message or social media) and be instantly triaged and referred to someone who can help me. The possibilities are almost endless – especially with machine learning, payment mechanisms, eID and medical records built in. At the very least, better targeted, more timely and richer interactions will enhance health and wellbeing and prevent problems and avoid costs further down the line.

The future of healthcare has to be about creating a more personalised, empowering and predictive healthcare system – and specifically, more remote monitoring of people in their own homes. There is now a major opportunity to join the dots between what already exists to give people a single 'My NHS' icon for life. We can harness what's already out there, acknowledging what people now want from digital tools and making it part of the fabric of our everyday lives.



Machine learning for health

Since 2009, there has been a quiet revolution in machine learning. It's working behind the scenes in our everyday lives, most obviously on our smartphones' voice recognition and translation tools. Much of this advance is being driven by the Tech Giants, who have been rapidly acquiring niche companies and recruiting from academia to accelerate technologies and applications.

The implications of machine learning for healthcare are huge; computers use algorithms to make instant classifications and find ground-breaking insights without being specifically programmed to do so. These decisions and breakthroughs are based on massive amounts of complex, diverse and sometimes ill-defined data that would take humans years of experience to make sense of.

Where the machine's 'decision' involves complex data yet is a binary one, it's relatively easy to see the case for automation. Google has been experimenting with machine learning intensively for the past few years. Its machine learning has been applied to diabetic screening, making a yes/no classification of an image based on features that are difficult to define and hard for a human to classify. Successes like these herald a future where all kinds of screening decisions (mammography, lung CT, chest X-ray) could be completely automated.

The more data you can expose the computer to, the more effective the machine learning algorithms will become. It's therefore easy to foresee computers outperforming humans on certain tasks. Computers can calculate the risk of adverse events, and the impact on risk of a certain genetic make-up, behaviour or exposure for individuals.

So could machine learning replace humans? I don't believe so. Firstly, even for tasks like image analysis, many of the decisions that need to be made are more complicated than in screening; and although some cognitively demanding tasks could be completely automated and disappear, jobs will not. With powerful machine learning available, there's little point asking a radiologist to carry out relatively simple pattern recognition which, while it requires a great deal of experience, doesn't require the intelligence or the broader training that we give to doctors. Yet interventional radiology, engaging with colleagues, collaborating on treatment and using a more holistic understanding of the person, is something for which we need a human being. It's also hard to imagine machine learning in general practice, where a GP is in a more human, more socially complicated dynamic. And in

surgery, automation will carry out many standard procedures, but surgeons will be needed to oversee these. There's a similarity to the airline industry: much of piloting is automated, but the crew are still critical in safeguarding and intervening in abnormal situations.

Building trust

As citizens, we trust our clinicians to navigate the complexities. Yet as the algorithms become ever more sophisticated and opaque, does this create a problem of trust? What do clinicians feel that they need to know about the computing? Having good, clear statistics on performance will be important. Some mental picture or theory of the algorithm is also useful. Yet as the technologies advance, this may not always be possible. Today's clinicians trust an MRI scanner even though they may not know in detail how it works. It will be the same for machine learning. We need to have our eyes open to issues around trust. Legislation is coming next year in the form of a new EU Data Protection Regulation giving certain rights to people who are subject to a decision made by an algorithm: so, for example, the algorithm will need to be explained. There is also a duty on those using such algorithms to check that the algorithm is fair; and if machine learning is used in conjunction with a dataset that reflects an inherent bias in society, the algorithm may be demonstrably unfair.

The next decade is full of opportunities and challenges for clinicians to navigate a transition in which some of their capabilities are removed. Naturally, it's easier to embrace a system that we see as enabling us than it is to take on a technology that might undermine, replace or overtake us. Getting the balance right is complex: removing a task completely and doing it by machine is more straightforward than having machines to help the human do the job better. Yet clinicians have always embraced and integrated new technologies into their practice. And as Google and many others are proving in fantastically innovative and exciting ways, the immense power and possibility of machine learning can be enormously useful if we are to meet today's healthcare challenges and advance research.



Connected lifestyles

Sensors are everywhere. They are inbuilt into everything from smartphones that record temperature and vibration, to water pumps underneath your street that monitor the flow of water or the pressure of sewage. The Internet of Things (IoT) is the exploitation of sensor-captured data to effect a smarter action, either automated or not. Harnessing all this wonderful data presents opportunities in healthcare to reduce cost, improve efficiency and deliver better patient/physician outcomes.

I want to envision just four examples of how the flow of real-time data could change our lives when it comes to our health.

Keeping us at our best at work

Businesses today are busy experimenting with IoT technologies with the aim of reducing sick days to improve workforce productivity and to reduce risk (you don't want an unwell banker making a mistake with your pension investments). What if you could share these private datasets with a healthcare provider? There are arguments on both sides about whether an employer should share employee health data directly and this will be one to watch.

On one hand, we have a loved and cherished National Health Service in the UK; but demand for that service is always under pressure (at least from what I know!). Patients arriving into all initial touchpoints such as GP surgeries and A&E units come with little information to support their care. But what if the working patient is a connected employee? If the employee's health data is accessible by their employer and their healthcare provider, the onset of an illness can be predicted, treatments immediately recommended and all three parties (employee, employer, provider) get a great outcome. Any recommended medication can be delivered to the office, home or picked up. Likewise, medical assessments can be automatically scheduled for a time that suits all three parties, depending on the seriousness of the problem. All the digital technology is available today to do this, and I believe it's not a case of if, but when.

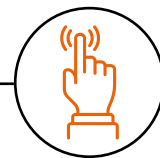
Connecting people's support networks

The connected family, friends and support network is important if, for example, a patient has a fall at home and may forget to take their medication, or for people with dementia who might go for a walk and get disorientated.

The connected support network is something Atos has invested in for many years with prominent universities and local communities across Europe. We have easy-to-implement and non-invasive approaches to monitor people's safety and progress. This has lifestyle benefits for everyone.

Connected wristwatches and bands can be used for remote monitoring. Research shows that the wrist is the preferred location for wearable devices (65% of respondents prefer IoT wearables on the wrist - Source: research company, SSI). Sensors capture if they have fallen, in which case the device automatically alerts 999, a physician, family and any carers. The same device can track if the wearer has walked outside a set boundary and trigger text messages to family who can then track in real time where they are, or even make a telephone call to the device.

Pharmaceutical companies are already optimising their drug R&D through these kinds of interactive living assistants and this is all available on a secure digital platform (Atos Codex) with tangible outcomes for everyone. Alfred (www.alfred.eu) is a great example of our collaborative work in this area.



Analytical insights as a tool for clinicians

Modern medical science uses complex analytics capabilities combined with powerful computing to overcome the vast challenge of turning immensely complex and variable data into something that is actionable for an individual patient.

High performance computing (HPC) speeds up the processing of all this data, while data analytics is used to correlate the outputs from many of these processes in order to extract meaningful insights from them. In current clinical settings, these two domains are closer than ever. We're seeing examples in recent major advances in high-throughput technologies, such as next-generation sequencing, mass spectrometry, and imaging and scans. All these technologies are producing tremendous amounts of 'omic' (microbiology) and other data that all needs to be processed, managed, secured, accessed and analysed. This requires a combination of high performance computing, security, network, integration and big data analytics capabilities.

Atos' ground-breaking Omics & Medical Integrated Compute Systems (OMICS) platform is an enabler for translating research into clinical practice. The platform supports capabilities such as cognitive computing to create 'decision support systems' that help clinicians to make effective diagnoses. Doctors can develop highly personalised drugs and treatment protocols by combining the most recent and most complete patient data (including Electronic Health Records, imaging data and diagnostic procedures data, pharmacological data, medical devices data, data gathered by sensor enabled wearables), together with references to relevant textbooks, scientific papers and clinical trial information. This helps to avoid clinical error and prevent adverse drug reactions.

Getting value from data

While the case for getting new value from data and analytics may be clear, pressing forward with the right strategy is perhaps more complex. Analytics is firstly a business or service issue: what do you need to achieve and what data will support this goal? Then it's a technical issue: how to collect and analyse large amounts of data and interpret and present it meaningfully to different stakeholders.

The Analytics space today abounds with new technologies, and many players address it with a tooling rather than with a business-driven approach. In contrast, Atos has consulting teams and expertise centers (including Data Scientists) to help organisations identify the best analytics opportunities.

Our approach to all things data-driven is a framework called Atos Codex. This is designed to provide organisations such as health providers with a collaborative approach that gives each use case the best chance of success and return on investment. It includes data expert consulting around areas of interest, proven methodologies such as completing rapid Proof of Values to ground a business case prior to investment. This comes with an independent offering on what technology is needed if existing technology can't be reused. Atos Codex is all about delivering the tangible return on investment and outcomes with proven Digital Healthcare experts.



Real forces for change

The core challenges for health services in the developed world are universal. Since the 2008 financial downturn and subsequent slow recovery, medical inflation – partly because of continually emerging treatments and technology – clearly outstrips conventional inflation. People's habits and expectations are also changing. With the arrival of the internet, knowledge is much easier to access, creating increased consumer demand. We have an ageing population; and there are lifestyle changes, with more alcohol consumption, type 2 diabetes and obesity.

All these factors mean that the proportion of Gross Domestic Product spent on health has become unsustainable. There are three principal ways of addressing this. The first is to generate more funding by putting up taxes and/or finding alternative funding mechanisms. The second is to ration healthcare on the basis of need or lifestyle choices. The third is to find a different way of doing things – and in the UK, the Five Year Forward View is about creating an environment where innovations in commissioning and delivering care can make the system significantly more resource-efficient.

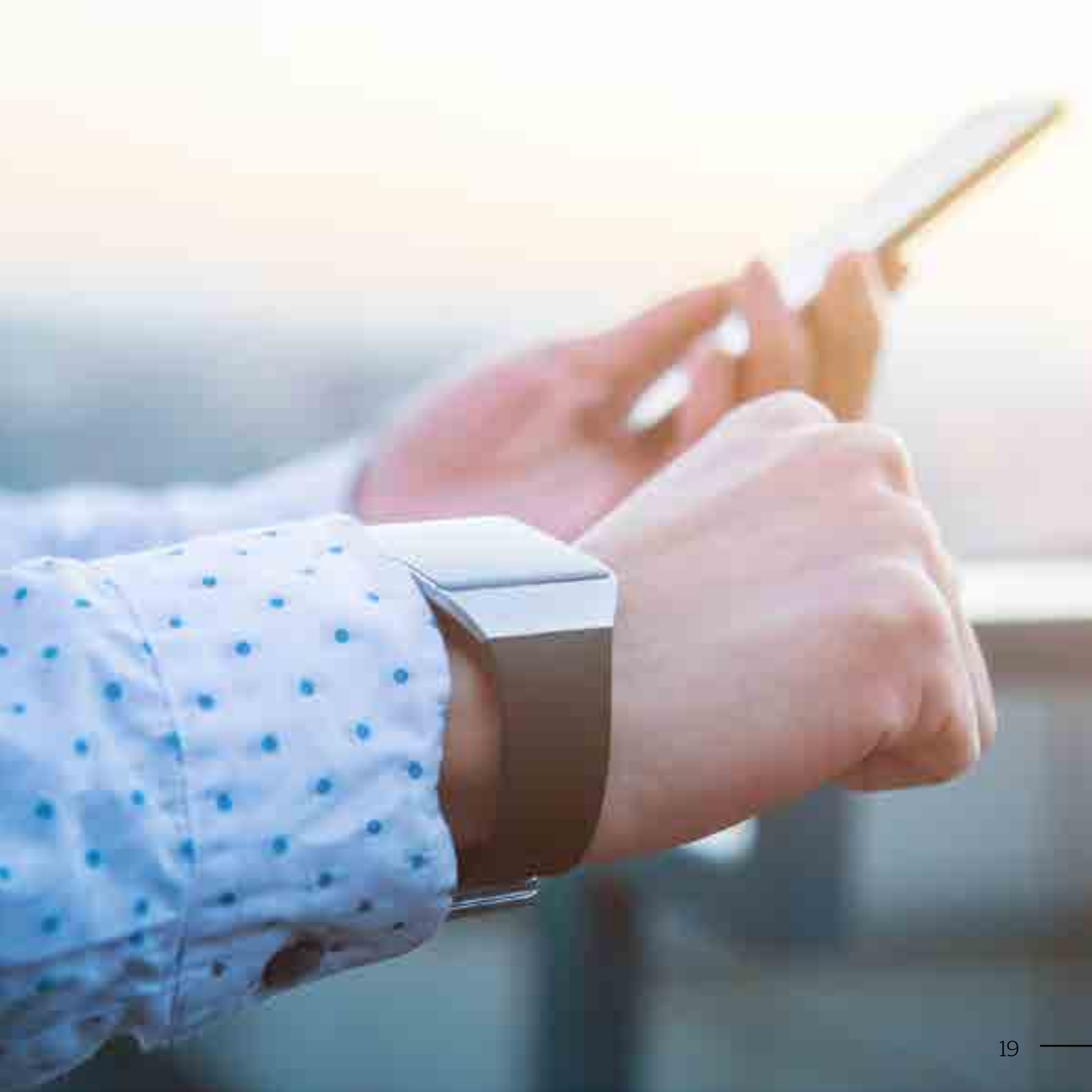
Reducing the burden on healthcare and then introducing operational productivity is simply not possible without a very high degree of transformation. In terms of delivery, we can increase efficiency by more protocolisation and greater centralisation to iron out variations, inefficiencies and poor outcomes. To reduce the burden, we have massive opportunities to make the population healthier. There's plenty of evidence that less alcohol and tobacco, good nutrition, exercise, and so on, plus psychological support together improve general health and make long-term conditions less likely. There is clear evidence that when people are active participants in their own care, there are better outcomes. One powerful example is the treatment of people who are HIV-positive, where we have seen very active citizenship of people with HIV and those who may be at risk.

It is so obvious it has almost become a cliché that while we run our lives through apps and websites, health is bizarrely behind other domains. Some people may be sensitive about confidential data and security, but that does not stack up in comparison with our willingness to share, for example, personal financial data online. I think there is huge untapped potential to better use mobile technologies to encourage people to be

participants in their own health and wellbeing. This extends to any long-term condition: people managing their disease, controlling their own diet and medication supported and enabled through technology to consume less secondary care resource. We are only in the foothills of reaping those kinds of benefits. Exactly the same applies to increasing operational efficiency in the transaction and delivery of care. We book tickets, restaurants and so on online. We need to do the same for our health.

For me, there is an over-arching need for change. The best, well-led healthcare organisations are learning organisations that constantly improve. In introducing new treatments and improving existing ones, we are still wedded to quite traditional approaches such as clinical trials. There are different ways we should evaluate treatments for cancers, liver and kidney diseases and so on using data and analytics. We can also evaluate the pathway of care delivery, using Google Deep Mind, for example, to speed up treatment through machine learning.

While I see isolated examples in all these areas, the burning platform that now exists is a huge opportunity for innovation to come to the fore. Crises generate a step change in innovation, such as the rapid treatment for Ebola as the risks from that outbreak escalated. In this country, there are examples of where we have made significant improvements in our response. Citizen-led demand and activism can speed up progress, as we have seen in the fight against HIV, stroke and breast cancer. Today, there are some green shoots in this area, for example the significant activity that we are seeing around dementia. Through social movements, it is possible to harness public feeling and create a strong momentum to make things happen. It is the partnership between the public and health professionals that is such a potent force for change.







Data ethics and machine learning

As machine learning for medical research and healthcare takes hold, the ethics of data sharing and handling need to be explored by clinicians, citizens, commercial companies and law-makers.

Many clinicians say that, while data laws are complex, it is their duty to find ways of mining patient data for the benefit of patients and to advance research and treatments. We need to use the power of vast data combined with machine learning to advance healthcare for the benefit of all and continue to position UK plc at centre of academic research. Yet the legal frameworks and precedents for using patient data are complex and could hamper medical progress.

Much of medicine's most pioneering work is done in partnership with private sector companies who have the scale and resources that are needed. In today's world, this involves close interactions between clinicians, hardware and software, and data: all are necessary to make progress. The field of machine learning itself has a culture of openness and free exchange, with open source software and sharing of learning. There is an ethos around the public collection of data and a move towards more transparency and open government that will in turn lead to better services and economic advance. Yet when it comes to patient data, the picture is more complicated.

Most citizens are happy to have their anonymised data used for the purposes of research. However, research has found evidence of much lower levels of support for data to be shared with private companies. Yet with the private sector critical to research, this creates an issue. Making data available to all companies is one answer, but there are risks. Firstly, making the data available to all destroys its commercial value; secondly, there may be problems with anonymising data completely (even if you remove identifiers, data may be identifiable with enough effort). In general, people depend on the ethics of researchers and also the strong likelihood that they are not at all interested in individuals. But perhaps a legal framework needs to be in place – not just for anonymity but for gaining consent.

These issues are critical to resolve because the collective good will not be served if pioneers are not given access to valuable data. Like so many of the social and ethical challenges of new technologies, these questions need the attention of government and society. Ultimately, this is about individual citizens knowing that their data will be protected and used for real benefit. Public engagement is now key so that citizens understand what is at stake and can be involved in making the decisions.



Shifting focus to enable better care



It's well documented that in terms of patient outcomes and experience, the NHS and local authorities must become more integrated around delivery of health and social care, with GPs as the first port of call.

For elderly people and those with long-term conditions, unless there is a critical episode, much of what is needed is preventative and requires monitoring in the best environment – ideally at home. As well as patients and clinicians, it's about integrating with families and other carers to bring together a whole health ecosystem along the patient journey.

While the benefits and opportunities of more joined-up services may be clear, some major cultural shifts and a refocusing of attention are needed in key areas. I'd like here to focus on just four.

Give patients more power and choice

As the CIO of a high-profile trust recently pointed out to me, when patients leave hospital, they get services as consumers (with tools at their fingertips to book a taxi, shop and bank online). Yet while they are in hospital, things are very different. People need access to the right information about themselves and their treatment, at the right time and in the right format; it's the difference between good and poor care. The technologies, of course, exist. This is about making a cultural shift towards treating patients as consumers of health and care services.

There is a direct parallel here with early digital banking. Just as those services started slowly – initially by sharing just account balances and top-level information – there is an opportunity to start slowly in healthcare, to break down cultural barriers, prove what's possible and then evolve it in line with what patients want.

Giving patients choice is crucial and links directly to integrated care by tailoring interactions for individuals. For example, appropriate test reports could be sent to patients (who opt in) at the same time they are sent to GPs. The benefits are significant: patients own results with advice on next steps delivered by text, email or app, freeing-up GP capacity by eliminating a GP visit. This report could trigger an action in the clinical pathway; for example, a positive BNP result (indicating possible heart failure) would generate an appointment for an echocardiogram, or a positive pre-op MRSA result would trigger a prescription for an appropriate antibiotic. The key here, and the shift in culture, is to give patients choices, thereby driving more personalised care plans for all.

Provide GPs with better tools

Long-term conditions account for around 50% of all GP appointments. Freeing up even 10% of that time by better joining up and targeting patient services would make a huge difference. Apart from severe cases, the last thing many people with problems such as diabetes or a heart condition want to do is attend their GP surgery in person. Proactive information and reminders keep all of us healthier – and can stop people with long-term or short-term conditions going to the GP or to A&E.

The NHS intakes thousands of junior doctors every year who tend to be very open to informing the patient experience via digital tools. There is an evolving culture in the NHS, with clinicians and others entering the workplace as digital natives for whom technology is not a cost-saver or a bolt-on, but an essential and integral fact of everyday life.

Many patients will be open to using technology apps, texts, Skype, email and other messaging tools to manage their own care (because that's what we do in just about every other area of our lives). Giving GPs these same tools will free up their time at surgeries, refocusing that time to spend face to face with, say, the 20% most urgent cases and looking after the other 80% more proactively by making smarter use of digital tools.

Be more open to collaboration

Increasingly, private companies are joining forces to drive out potential from digital transformation. The private sector brings the expertise, the experience, the capabilities, the technologies, the innovation and the funds to redefine business models, services and new ways of delivering outcomes.

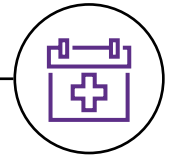
The NHS and the rest of the UK health economy is now at a pivotal point to also be able to leverage technology, investment and lessons learned from other sectors in order to redesign services and become more collaborative. We live in an age where the public and private fiscal relationship is transparent and even allows direct investment from private companies to support innovation. These conditions, and more, enable organisations to facilitate collaboration, foster trust, promote and enable a culture of openness, and develop mutually beneficial partnerships.

Maintain the privileged clinician/patient relationship

The privileged relationship between the patient and their doctor must maintain its privilege as it is transformed through technology. As patient data is enriched and consolidated, and moves into off-site storage vehicles such as cloud technology and mobile devices, attention must be focused on how data must be protected from mis-use, corruption or loss. Once more, a shift of focus is needed. Of course data has to be secure: citizens expect and trust no less. Vast amounts of personal data are already being used responsibly in sectors such as banking. Compromised security is not an argument for poorer or less targeted consumer care; steering clear of digital is not the answer. The way forward is to invest in cyber security and data and analytics, and to engage closely with clinicians to ensure they take ownership of delivering services in new ways across multiple channels.



The Business Services Association



Business services and the digital transformation of health



When harnessed effectively, digitisation can help reduce hospital admissions, improve patient experience and boost efficiency. Business services companies already deliver a wide range of innovative cutting-edge technologies to the NHS and health providers across the globe. The BSA recognises that realising a digital vision for the delivery of healthcare and services isn't simply a matter of technology. We can see the need for gradual yet significant cultural change. The prize of successful, well-implemented digital transformation is health outcomes and services that are more readily accessible and understood by the user and a more sustainable health service overall.

Digital transformation of health services doesn't always require change on a large scale. Often small measures can have a significant impact, such as enabling patients to order meals on an easy-to-read computer tablet. Changes such as these can both save staff time and improve patient experience. Business services companies are at the forefront of delivering technological innovation, helping keep patients out of hospital through pioneering telehealth solutions and the improved collection and use of data. As the NHS begins the process of implementing sustainability and transformation plans, its ability to successfully incorporate digital transformation will prove increasingly essential.

The Business Services Association is a policy and research organisation. It brings together all those who are interested in delivering efficient, flexible and cost-effective service and infrastructure projects across the private and public sectors.

Digital transformation at University College London Hospitals NHS Foundation Trust

Atos was selected as Digital Transformation Partner to the University College London Hospitals NHS Foundation Trust (UCLH), supporting UCLH on its mission to deliver high-quality patient care, excellent education and world-class research.

As part of this ten-year partnership, Atos is primary Information and Communication Technology (ICT) contractor and systems integrator, delivering the Trust's foundation ICT services while at the same time helping to realise the Trust's digital transformation agenda.

UCLH is the 'Intelligent Customer', working with Atos to achieve a step change in the quality of services while also delivering savings. As well as ensuring that core services are delivered, the key objective is to introduce innovative technologies that support the Trust's strategic objectives. An evolutionary journey of digital transformation is focused on delivering better and more agile ICT services for clinicians, patients and staff.

“

Neil Griffiths, Deputy Chief Executive, UCLH said:

This is an important step to create a digitally enabled, exemplar organisation that provides staff and patients with access to the right systems, in the right place, at the right time to enable the delivery of high-quality, efficient and effective patient care.

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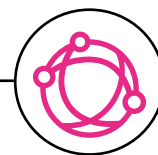
'Right people, right place, right equipment' saves lives



Within the NHS, supply chain management has been a relatively a niche concept. Yet across the healthcare system, clinical and non-clinical teams use systems and processes to order supplies, carry out health checks, dispense medications, perform operations, sterilise instruments, identify medical devices, and the list goes on. Collectively this forms a supply chain. And today, the way that supply chain is managed is fast evolving: partly because of digital technologies, and partly because of the NHS' new strategic focus.

Traditionally, the task of managing the supply chain was seen as a 'back-office' function with the main objective of reducing costs. Today, while cost reduction is still important, the key priority – the *raison d'être* of the supply chain – is better patient care. And as Trusts and others embrace digital, a more integrated, strategically driven, better-connected supply chain becomes possible.

Too often, treatment of patients has been hampered by not having the right people available at the right time, with the right equipment in the right place: and that's exactly where supply chain management is so powerful. Take just one example: up to 20% of nurses' time can be taken up just looking for dressings, sutures and equipment – time that could be re-directed to frontline patient care. The impact of inefficiencies was underlined in Lord Carter's 2016 report, Operational productivity and performance in English NHS acute hospitals: Unwarranted variations. As that study pointed out, the potential is vast. Eliminating unwarranted variations in non-specialist acute hospitals is worth £5 billion a year. Strategic supply chain management directly addresses these variations by driving quality, value and innovation – all aimed at delivering better, more consistent, more targeted care.



New standards have been mandated

Modern supply chain management best practices are key. Catalogue management (a procurement industry best practice) speeds up supply significantly. Leaner inventory management not only increases efficiency but can also release physical space (such as a new facility for families recently created at one Trust by reducing its storage requirements). Better use of transparent, common, accurate data is also essential, together with supply chain analytics, for example to better understand, target and predict spend, supply and demand. Modern supply and contract management techniques leverage more innovation and responsiveness from suppliers. And digital information exchange between Trusts and suppliers is vital to underpin the local, regional and national collaboration that the Carter report says is so vital.

One challenge has been the lack of a common NHS language for identifying patients, clinicians, suppliers, products, locations, assets and documents. That's where GS1 and PEPPOL come in. GS1 is a set of global standards and barcodes for the clear and unique identification of People, Places and Products. PEPPOL (Pan European Public Procurement Online) is a set of messaging standards for the electronic exchange of procurement-related documents. Both have been mandated by the Department of Health for use throughout the healthcare sector by 2020, with six Trusts chosen as demonstrator sites (some of whom Atos has been supporting). This will help NHS Trusts to improve patient outcomes, reduce errors and increase efficiency by having a standard way to identify and track equipment, patients, medication and locations on each patient's journey.

The supply chain is breaking new ground

So much is possible with the emergence of new standards and technologies. In response, Trusts need to implement a robust digital supply chain, all underpinned by GS1 and PEPPOL. There is the risk that some Trusts may be approaching this piecemeal. What's needed is a clear unifying vision and digital supply chain strategy, with a sufficiently robust roadmap to implementation and the programme management capabilities to deliver it. This is ground-breaking in a few ways. Firstly, the concept of an integrated digital roadmap and operating model is still relatively new, enabling the fundamental digital transformation that is essential.

Secondly, digital supply chain management is shifting its positioning within Trusts. In the past, it may have been viewed as secondary in comparison to electronic patient records and administration. This is changing, with an awareness that the technology needs to evolve away from finance-centric systems (focusing on financial control, accountability and audit) towards people-centric technology. Supply chain management can provide an overview of contract management across the organisation, moving it out from finance into a strategy function and integrating it with the broader digital strategy piece. There are also moves to position supply chain management as a commercial function alongside other revenue-generating activities, such as negotiating franchises and supporting bids to CCGs. Critically, the new standards and digital enablement will produce a rich set of new integrated data that can be used to better inform clinical and management decision-making.

And as in many other sectors, the power of digital and the changing of supply chain management is affecting the role and function of supply chain professionals within organisations. Skillsets need to adjust; professionals need to upskill away from just cost reduction towards creating better long-term relationships with suppliers, driving innovation and performance, and becoming internal advisors. In Scotland, supply chain management has already been evolved to be more closely aligned with patient pathways to reduce risk and improve performance. Supply chain management is an important vanguard for efficiency and improvement of patient outcomes across the health and social care system. If the supply chain is digitally enabled, connected and efficient, then frontline care and patient outcomes are significantly impacted and improved.





Health at every level: why interoperability is so crucial

Interoperability – the ability to easily share data across primary, secondary and social care – is now critical to advance new models of care. techUK is working with NHS England and NHS Digital through our commitment to the Interoperability Charter and, through our members, to improve data access for citizens.

With the introduction of the 44 Sustainability and Transformation Plans, we are seeing a focus on interoperability. To ensure sustainability, new models are beginning to use more real-time data to better 'predict and prevent' as well as 'diagnose and treat.' Whilst predicting the needs of the population is not new, the use of Big Data to predict and monitor outcomes is relatively new, and could well influence commissioning plans and tariffs in the medium term.

Health at local level

There are a number of initiatives underway at a local level, such as the Cheshire Care Record that brings together information for direct care, as well as counties such as Kent and Leicestershire that are linking information to provide intelligence and pathway analysis. The target architecture is about showing how more of these kinds of activities can be brought together into an overall managed framework to improve the delivery of care to the citizen.

Health in our hands

There is also an increase in the use of apps, for example, to monitor diabetes and asthma and the remote monitoring of people in their own homes. In this domain, we are beginning to see a drive towards behavioural changes using game theory. For example, the mySugr app that was conceived by Fredrik Debong who was diagnosed with type 1 diabetes as a child. Fredrik's love for gaming and struggles to overcome diabetes burnout led him to launch the app in which players monitor their diabetes and earn points by 'taming' their diabetes 'monster'. This approach to managing long-term conditions has proven extremely popular with younger users. The app has more than 250,000 registered users and raised almost \$5m in seed funding in 2015.

One area where we see particular opportunities is building digital solutions (available 24x7) for people suffering from poor mental health, such as bipolar disorders, eating disorders and problems that are the result of abuse. This is yet another area where the digital revolution could make a significant change in healthcare provision.

International health services

Scotland

Atos designs, builds and operates mission-critical systems that support NHSScotland in delivering improved patient care for the people of Scotland. Transforming healthcare through partnership is key to meeting all NHSScotland's eHealth needs now and in the future.

- Over 185,000 healthcare professionals in Scotland rely on systems supported by Atos.
- Each year, on behalf of NHSScotland, our technology processes over 24 million health screening invitations
- Each year, our technology also processes and despatches over 10 million child health reports and immunisation mailers for schools and pre-school, 15 million ophthalmic and dental payment records, and one million influenza vaccination reminder mailers.
- We work in partnership with NHSScotland to manage the Scottish Government's ePharmacy Programme, including the electronic transmission of over 60 million prescriptions each year.
- Over 180 million patient results are made available across Scotland through the Scottish Care Information Store application.
- The Emergency Care Summary IT system is available 24 hours a day and is accessed more than 53 million times a year by Scottish clinicians and NHSScotland employees.
- We have helped to achieve a 50% reduction in the cost of outpatients' letters through our Patient eCommunications system.
- By introducing a new eReporting service, we have helped NHSScotland achieve sustainability targets of over £1 million savings by reducing the number of items physically printed by 10 million pages across a number of key customer services.

Spain

Atos has worked on healthcare technology-related projects at national, regional and local level in Spain for over 20 years. We have worked for the Madrid Regional Health Administration since 2008, which is responsible for healthcare provision to 6.3 million citizens. Work has included Digital Hospital and Electronic Health Record deployments across hospitals in Madrid.

Atos is also at the forefront of Genomics research, combining high performance computing with world-leading analytics. We've already helped over 20 research centres, hospitals, genomics production centres across five countries.

- For Spain's National Centre of Genomics Analysis, we have helped extend sequencing capacity through a High Performance Data Analytics Platform.
- For the Spanish Cancer Research Centre, we designed the architecture to conduct molecular-dynamic simulation, dramatically changing the way research is done. Results are now available in less than a month (an improvement of over 83%), supporting ground-breaking studies for more potent cancer treatments.
- For a hospital in Spain, Atos has implemented a high performance computing cluster to make Genomics testing more efficient.

In Spain, we have developed a Pocket Health Proof of Concept application which is, in effect, a patient held digital care record.

Switzerland

In Switzerland, Zurich's Triemli Hospital opened Switzerland's most modern inpatient facility featuring touchscreen multimedia Patient Universal Terminals available at each bed.

Based on the OpenScape Health Connect communications suite from Atos company Unify, the Terminals are integrated with the hospital information systems. As well as catering and entertainment facilities for patients, doctors can identify themselves at the Terminal to retrieve and share patient records and discuss treatments with their patients. The Patient Universal Terminal is a key enabler for digital transformation that delivers a new kind of patient experience while helping to streamline processes and free up clinicians' time. Key to the success was the close collaboration between all parties involved including Swisscom, Unify, the specialised IT partner aibIT together with Triemli's IT team and key staff.



France

In France, we deliver Electronic Medical Records systems, helping to put patients truly at the heart of delivery. We're helping to realise significant improvements across the patient journey, from reception to ward to pharmacy.

Over the period 2005-2017, Atos provided a team of consultants to support and maintain the implementation of the Cristal-Net®/Easily® Electronic Medical Record (EMR) solution in over 30 hospitals (covering over 40,000 beds), including the large 1,000+ bedded hospitals including four major University Hospitals such as Paris (AP-HP), Grenoble, Saint-Etienne, Reims, and regional hospitals such as CHR Orleans, Hopitaux Civils de Colmar and Hopital Simone Veil at Eaubonne on the outskirts of Paris.

Netherlands

In the Netherlands, Atos helped Orbis to become one of the country's leading hospitals and Europe's first paperless hospital.

We're part of pioneering work introducing a new generation of robotics into health settings. These robotics are optimising efficiencies in hospitals, enhancing patients' experience and aiding their recovery. The Dutch Ministry of Health has shown particular interest in the Zora robot, the world's first social robot to be widely used in healthcare, pioneered with the Lyvore Elderly Care, Soest, The Netherlands. Also at Lyvore, we are involved in a 'Magic Table' pilot project, designed to improve the physical and mental wellbeing of elderly patients suffering from dementia.

USA

Atos company, Anthelio Healthcare Solutions is the largest independent provider of healthcare technology solutions in North America.

Atos serves 500 healthcare organisations across the US with scalable, comprehensive technology solutions and deep healthcare expertise. Key offerings include multi-vendor Electronic Health Records, Revenue Cycle Management, Analytics, Data, and Patient Engagement. Our services cover 475,000 healthcare professionals, 60 million patients, 74,000 beds and 63,000 physicians and nurses.

Towards a truly paperless NHS



Many organisations have an aspiration to become paperless. There are huge benefits: for the environment, for efficiency and, these days, for the benefit of service users. When things are paperless, they are generally better, cheaper and faster to use.

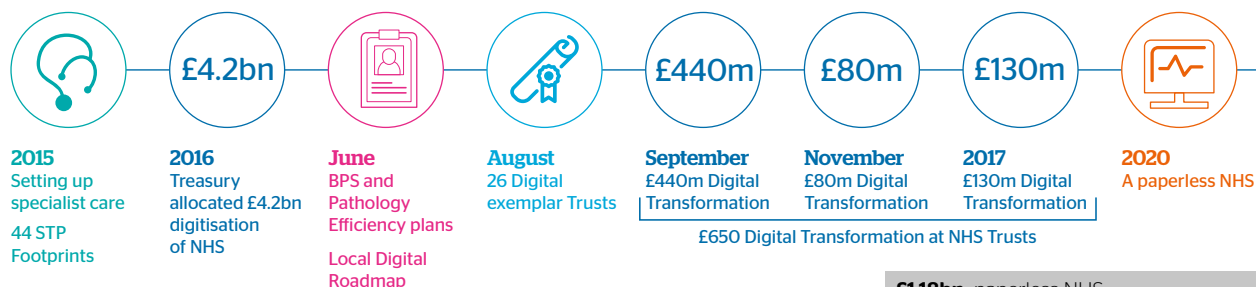
Today, there are a combination of reasons for me to believe that the NHS is truly on its way to achieving its vision to be a paperless organisation. Firstly, it's now policy. The Five Year Forward View published in 2014 clearly states the ambition for the NHS to be paperless by 2020. The second driver is user demand. Increasingly, patients want to book appointments, check information and communicate with their GPs using digital tools: channels such as Skype, text and screens that give me a real-time view of appointments at my GP's surgery all help me to better use and plan my time. There is also the huge issue of growing clinical demand. With wearables, data analytics and other digital solutions, we can achieve more proactive management of patients. Checking insulin levels, for example, or monitoring breathing or heart problems remotely all prevent problems escalating and requiring significant NHS resources.

This year, we're going to see funding restrictions of £2.5 billion. There is a need to make improvements financially and operationally, the urgency of which was set out in Lord Carter's 2015 review, Productivity in NHS hospitals. By implementing digital solutions such as cloud, the digital workplace and data analytics, we expect to see major impacts on operational process efficiency. Re-engineering business processes through digital transformation frees up clinicians' time for frontline patient care – plus, of course, a better patient experience.

In 2015, the NHS set up Specialist Care Vanguards around key specialisms (cancer, A&E and so on) to remove fragmentation and better target resources. There are also Sustainability and Transformation Plans, with 44 footprints that bring together health and social care and consolidate 'back-office' functions such as Procurement, Finance and so on, to drive efficiencies. Then, at beginning of 2016, the Treasury allocated a total of £4.2 billion funding: £1.8 billion to spend on a paperless NHS; £1 billion on cyber security (because you can't digitise the NHS without addressing cyber-security and data challenges); £750 million on digitising emergency and social care; £400 million on the NHS website, apps, and wifi for patients in hospitals; and £250 million on outcomes and research. This is real, major investment.



Is the NHS following up on its vision?



£1.18bn: paperless NHS
£1bn: Cyber security and data consent
£750m: Digital social care and emergency care
£400m: New website nhs.uk, wifi, apps
£250m: Outcomes and research

And finally, funding for digital transformation is now allocated locally. There are 16 Global Digital Exemplar Trusts, who each have £20 million to deliver their digital agendas, with a further 20 National Digital Exemplars with a total of £10 million each; plus the £120-130 million for mental health Trusts to digitise their services as global exemplars. Instead of the national initiatives of the past, the NHS is giving accountability, ownership and control to local Trusts. For these reasons, I believe that the NHS paperless digital vision is truly exciting, with momentum and structures for change that I've never before seen in my career.

So, what part does the private sector have to play in all of this? Firstly, we are getting closer to our customer's customer: the people employed across the NHS and anyone who accesses health services. Digital transformation is an enabler across the health ecosystem. At Atos, we see four main pillars to drive the fundamental transformation that is now needed:

- **Integrated care:** using digital services to better understand the health economy and deliver more integrated health and social care and improve patient satisfaction

- **Collaborative care:** using infrastructure and services so that there is collaboration not just within the health and social care economy, but also with patients and their carers
- **Mobile care:** giving patients ownership and access to their own care plans and records in a way that is convenient for them; and using mobile technologies in care settings to better understand, patient needs and increase clinical resource productivity
- **Care analytics:** harnessing healthcare data and information to support better-informed clinical decisions, plus wider information on lifestyle and health data to enable clinicians proactively to offer earlier interventions and care.

It is through these drivers that the private sector can work in partnership with clinicians, NHS managers and other partners. Together we can direct and focus resources and expertise to enable the NHS to become a truly paperless organisation that delivers better experiences and outcomes for the 65 million people in the UK who are beneficiaries of its services.

On the journey to creating the UK's first digital hospital



The Royal Free London NHS Foundation Trust is one of the largest in the UK, with over a million patients every year and around 10,000 staff. Like every NHS Trust, it faces major pressures: a growing and ageing population; unwarranted clinical variations and health inequality; severe and intensifying cost pressures; and demand for more patient-centric services.

NHS England's national Vanguard programme was established to help deliver its Five Year Forward View and support the improvement and integration of clinical services. As one of only four national Acute Care Collaboration Vanguard Trusts, the Royal Free's ambitions are to develop a world-leading Hospital Group, to be a world-class digital innovator, and to achieve a major strategic shift towards four key value areas (below).

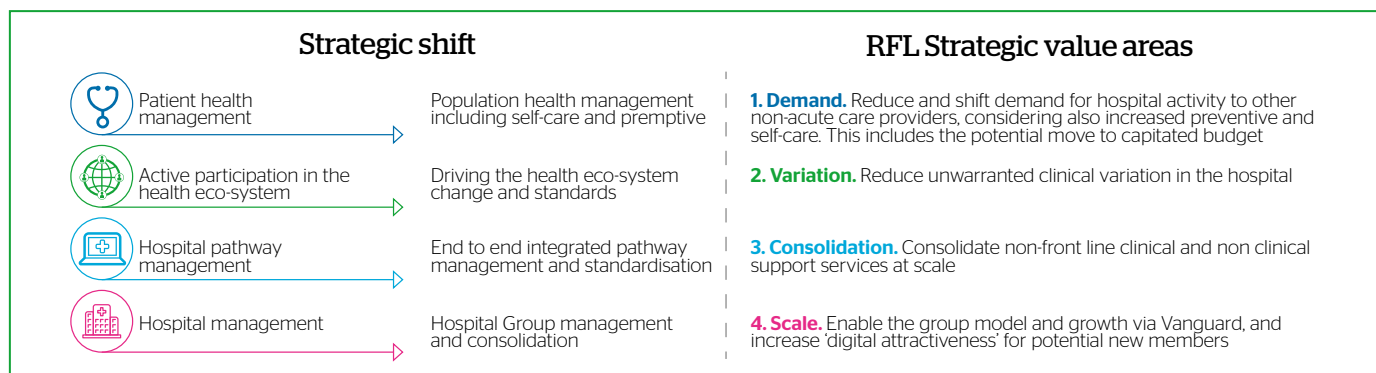
In March 2016, with legacy IT systems holding it back, the Royal Free set out to develop a complete end-to-end Digital Strategy for the Hospital Group.

Devising a Group Digital Strategy

The Royal Free commissioned Atos to support the development of its first comprehensive Digital Strategy.

In consultation with senior managers and clinicians, the Trust prioritised 54 major digital opportunities to achieve the strategic shift, which were grouped into six themes. With a huge step change required in the Group's digital capability, the Royal Free agreed a Digital Strategy to:

- **Transform through a series of business transition states** leveraging multi-speed delivery to trial new digital technologies
- **Create and proactively manage a Group-wide digital portfolio** to remove silos and halt any items not aligned to strategy
- **Implement a complete new Digital Operating Model** with fully enhanced digital capabilities and process automation
- **Create a 'plug-and-play' platform** for real-time data, omni-channel experiences, system independence and smart devices.





The team also designed a fully integrated digital healthcare experience for patients and clinicians at the hospital (with solutions carefully selected for degree of impact, ease of implementation and return on investment). This gives the Royal Free a blueprint for a digital hospital setting. Relevant, timely and reliable information is available in actionable form, underpinning high-quality, efficient care based on best evidence, resulting in:

- **Connected patients:** remote self-monitoring, virtual consulting, real-time health data, fully integrated records available anywhere, any time
- **Connected clinicians:** able to access information irrespective of location in a paperless environment, with the same clinical interface irrespective of hospital or system, decision-support systems, time freed-up for patient care, systems capturing metrics which matter most to patients and providers, and datasets providing rich substrates for clinical research.

The Trust also has a detailed delivery roadmap for the next five years and a business case that identifies benefits, costs and savings over five years for the prioritised solutions, with exponential further benefit to be realised from full strategy implementation.

Reducing clinical variation

As a first demonstration of the value of the Digital Strategy, the Trust implemented a 'proof of value' for Analytics to support its strategic objective to reduce unwarranted clinical variation.

Based on a review of global best practice, including at Intermountain (US) and the Kings Fund (UK), the team developed a leading approach to measuring clinical variations in the Maternity department. This used advanced analytics to establish the extent of variation in clinical processes driven by demand (patient needs) and supply (consultant, site). The findings proved strategically important to the Trust's clinical and managerial leadership because the Trust had demonstrated that it could:

- Use the data available to quantify clinical variation
- Enhance the quality of care and reduce costs through actionable insights from analytics.

This was a milestone on the Trust's journey to standardise clinical care and reduce unwarranted variation.

The Royal Free London NHS Foundation Trust now has an all-encompassing digital model that is enabling a strategic shift away from

focusing on efficient yet reactive treatment to more proactive, strategic population health management. It has developed a comprehensive clarification of what digital means in a hospital setting (learning that can be shared with the rest of the NHS) – plus proof that the Trust can enhance the quality of care and reduce costs through actionable insights from analytics.

Since then, the Trust has been selected by NHS England as a Global Digital Exemplar (GDE) to release new funding and momentum to advance its digital ambitions. This new status is accelerating delivery of the Trust's ambitions to transform healthcare:

- Among the highest-priority 100 clinical pathways, the Trust is standardising and integrating care across 20 in the first two years
- Across the Trust care processes are expected to move from 20-40% reliability to over 90%, driving step changes in patient outcomes and value.

The Trust's new Digital Hospital at Chase Farm is opening in 2018. This will be the first completely digital NHS hospital in England, fully embodying the Trust's world-leading digital model. Experience will be shared with the rest of the NHS.

"Our digital strategy was a critical component of our successful Global Digital Exemplar application, which has secured additional digital investment from NHS England over the next two years and which will be matched by our own funds to accelerate our digital journey."

The analytics proof of value in maternity services practically demonstrated how we can use data to drive predictive health models and reduce clinical variation. This was a major step forward for us on our journey to standardise clinical care and reduce unwarranted variation."

Professor Stephen Powis, Medical Director and Digital Lead, Royal Free London NHS Foundation Trust

A world first: organ donation supported in the cloud

Among the responsibilities of the NHS Blood and Transplant service is managing the supply of blood to hospitals in England and the matching and offering of organs in the UK. With around two million donations of blood and 3,500 organs a year, the service saves countless lives. Yet still there are over 6,500 people on the organ transplant waiting list.

Why move to cloud?

Technology underpins all the service's processes for managing blood, organ and tissue – not least the vital, time-critical search and allocation of organs. Over the years, a diverse, bespoke and siloed legacy estate had built up. This meant it was difficult to share processes and information and the service was locked into fixed technology that was expensive to maintain.

In 2014, knowing that digital technologies would offer much greater agility and better ways of working, the service made the strategic decision to move to the cloud. What was needed was a modern Cloud-First strategy together with a process to safely migrate all core services to become cloud-based. Atos was brought on board to support the migration in an agile way, help develop the strategy, produce a full business case and choose vendors for any new software that was needed.

As much mindset as technology

Part of the process was to shape and implement clear design principles for the future IT landscape. Operational security and safety of data and systems is paramount. All solutions must enhance the experience of donors and other stakeholders. IT must be delivered against a much-simplified technology landscape, using agile and cloud to deliver a step change in business performance.

Yet the journey to cloud has been as much about a change in mindset as technology. The project had to take everyone – from the Board members, to the business managers, to the IT department – along on the journey. Agile is a completely different way of working, especially for such a safety-critical organisation. Naturally, there had been a very well-established, highly controlled waterfall approach to project delivery up and down the chain of command. With agile on the other hand, you need to work together across organisational hierarchies and silos. It's a huge testament to the service's vision and readiness to change, not just technologically but culturally, that the project stayed on track.

Proving cloud

At the same time, an important key principle of cloud is to be strict about standardisation and using generic solutions and processes. Understandably, there were real concerns that such advanced clinical needs would be too intricate to be replicated with off-the-shelf software. For instance, the rules that manage the heart application require 2,000 lines of code dedicated to matching blood group, height, weight and more complex data like blood- and tissue-matching. There were questions as to whether an off-the-shelf platform could handle this level of multi-factor complexity. As part of the project, agile teams successfully unpicked the decision-tree logic that is inherent in matching and allocating a heart. On 29 October 2016, the team reached a critical milestone with the first organ transplant allocated using a cloud-hosted scheme using IBM's cloud-based Business Process Management and Operational Decision Support solutions to allocate organs. This was the first cloud-based solution for urgent heart transplants in the world.

NHS Blood and Transplant:

- Promotes blood, tissue and organ donation to the public
- Manages the supply of blood to hospitals in England
- Manages organ transplantation in the UK
- Manages the British Bone Marrow Register
- Works with hospital colleagues to promote the safe and appropriate use of blood
- Provides a range of tissues and other services to hospitals
- Provides a wide range of diagnostic services



The service now has a strong, stable, future-proof platform that supports its emerging digital vision. This is also aligned with the aims of the National Information Board Personalised Health and Care 2020 Framework in promoting patient-centred care. What's particularly exciting is the potential for new self-learning digital environments. The new cloud platform and systems enable the service to continually improve and hone the organ donation process, refining rules and providing the platform for an intelligent allocation system.



“NHS Blood and Transplant is using the very latest technologies to improve the services we offer to our donors, patients, hospitals and staff. Our various digital services are used regularly by over one million people. We are using the capacity and flexibility of cloud services, alongside the intelligent capabilities of new and emerging software to analyse what we do and ensure that we do it in the best possible way. Our digital journey is all about being more connected – inside and outside the organisation – and personalising the services we offer. Ultimately, being digital enables us to save and improve more lives.”

Aaron Powell, Chief Digital Officer, NHS Blood and Transplant



Derek Hussey, Business Development Director, Horsebridge Network Systems Ltd



Joining together to make change happen

Pre-hospital information monitoring system (PRIME)

PRIME is a mobile health information and monitoring platform. It was first developed as a way of more accurately directing patients to the most appropriate care pre-hospital. Too often, patients were arriving at the wrong healthcare facility based on incomplete or inaccurate information, pushing up unnecessary admissions and creating unnecessary delays for patients with more serious conditions.

How PRIME works

PRIME collects vital information from a number of different sources in a way that is easy for people to understand and take action on. It features intuitive and rich patient electronic forms (eForms) that can be integrated with real-time continuous recordings of patients' vital signs and multimedia (written and audio notes, images and high-definition video). eForms can be seamlessly shared with telehealth specialists to intervene early, accurately assess patients' conditions, and decide on treatment. Notes and data can be recorded, communicated and made available in a variety of media. Videos can be transmitted over mobile communication networks to get a picture of how the patient is doing in any number of clinical and non-clinical settings.

PRIME can be used to aid decision-making and care by paramedics, within hospitals, in elderly care settings, to name but a few. And with increased use, the system builds up a history and can use intelligent algorithms to enable more predictive care and personalised interventions.

PRIME benefits

PRIME brings major potential improvements in care and efficiency. In pre-hospital healthcare, it can help to sustainably develop ambulance services as their role evolves. There are obvious improvements in terms of patient experience, as well as direct cost savings, all the benefits of a paperless system and a contribution to more integrated and responsive care models.

There are plans to develop PRIME so that it integrates with other NHS databases, providing clinical teams with a patient's medical history, again more effectively targeting and enhancing the care that patients receive in non-clinical or clinical settings.

SME Harbour

Digital transformation depends on working with a mix of partners to make disruptive change possible. So in 2012, Atos created the SME Harbour programme as a framework for working more widely and closely with smaller companies for the benefit of clients in health and other sectors.

SME Harbour promotes, supports and enables deeper and wider engagement with the SME community. Through the programme, healthcare organisations can access agile solutions, niche capabilities and innovation that small players offer. It means that selected SMEs can access Atos' large and diverse client base, together with support and governance for working with larger enterprises. And it helps Atos to stay agile and focused on what our clients need.

Horsebridge Network Systems was founded in 2000 and provides world-class communication network and security infrastructure solutions. Within the SME Harbour, Horsebridge works in collaboration with Atos - and in partnership with health specialist Rinicare - to deploy wireless technologies that connect patients to clinical services in real time.

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With mobile communications and wireless technologies, the possibilities are almost boundless. Making progress is about thinking laterally, being innovative and joining together the right pieces to create the right solution. The technologies exist: the real challenge is about working together to make necessary changes happen.

Derek Hussey, Business Development Director,
Horsebridge Network Systems Ltd

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Identifying people in a heartbeat



Evidian Enterprise Single Sign On is a prime example of how effective cyber security can be an enabler for wider digital transformation and cost-efficiency - especially with electronic patient records. Used in over 80 hospitals across Europe, it supports half a million clinicians and employees and over five million protected identities.

Instead of clinical and admin staff having to remember multiple passwords, they have one single sign-on to all the applications they need. All this is done with inherent enforcement of each provider's strict security policies and profiles built in. It means that security policies are more easily enforceable, and hospitals can better comply with laws and regulations on patient confidentiality while improving efficiency and quality of care.

Atos recently introduced the Nymi Band, an authentication wristband based on a person's heartbeat, to enable what's now called Always On Authentication™. It means that staff can authenticate themselves using their Nymi Band and then stay authenticated, completely hands-free via a wireless connection.

It's a step on from conventional security measures such as biometric identification at terminals, chips or card readers. Clinicians, doctors and nursing staff can easily access their data while maintaining complete security for patients, without using their hands or having to remember a PIN or a password. And it's a major advance for sectors like health, the pharmaceutical industry and research labs because it's a simplified, ultra-protected experience, even in the most sensitive of settings.



Andrew Jackson, Chief Executive, ProReal Ltd



Virtual worlds as a tool for mental health and wellbeing

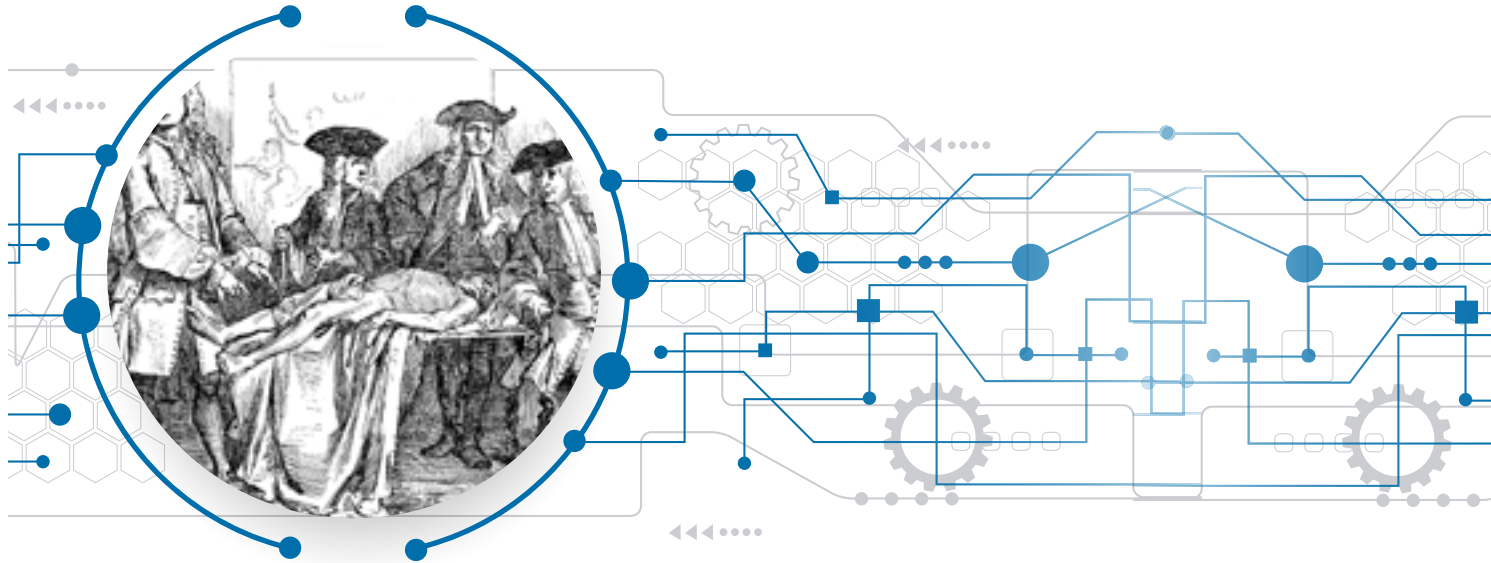


ProReal is a technology platform that delivers an immersive virtual-world experience. Users can populate their own secure online environment to describe what's going on in their inner and outer worlds. Using avatars and props, people can represent how they experience their world, explore different perspectives and then visualise other options and futures. By making what may have been difficult experiences more accessible, this virtual environment can help people find new insights, supporting resilience and aiding recovery.

Launched in 2013 by British company ProReal Ltd, the software brings 3D gaming and immersive technologies into the mainstream. Based on extensive research and evidence-based practice, it's used in a wide range of corporate and healthcare settings. ProReal Ltd - a strategic partner of Atos - has developed the software for use with touch-screen tablets as part of its strategy to bring this secure, immersive technology to low-cost, accessible devices.

In Summer 2016, ProReal completed a major study funded by NHS England's Small Business Research Initiative for Healthcare initiative, involving 54 young people in eight secondary schools. The research, led by Professor Mick Cooper, found that ProReal helps reduce psychological distress and could be a useful tool in supporting therapeutic work with a range of clients, particularly young men and clients who may find verbal expression difficult. A number of clinical pilots are now underway, including a research collaboration in Bethlem Royal Hospital and Oxford Health with the support and steer of Professor Chris Hollis and Dr Caroline Falconer (NIHR MindTech HTC), Dr Paul Moran and Professor Paul Stallard.

It's surgery...but not as we know it

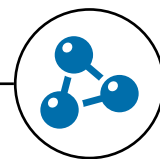


In the Renaissance, anatomy was scrutinised and dissected by artists; in the age of enlightenment, self-trained medics drained bodies, carried out dissections and performed autopsies with the public looking on. These gruesome spectacles, viewed with suspicion and abhorrence by many, helped surgeons to understand our workings from the insides out. Even today, we have an uncomfortable relationship with what lies beneath our skin. Such grim fascination has been underlined by the extraordinary success of Dr Gunther von Hagens' 'Bodyworlds' exhibition that's been travelling the world to give visitors a graphic look at exactly what makes us all.

This long journey to understanding our bodies has been essential in the build-up of knowledge needed for surgeons to remove or fix things that are not performing. It has been remarkable what humans have been able to understand and improve. But we are on the cusp of a miraculous change in how we as human beings respond to medical problems. As anyone who's interested in technology knows,

it's riveting to look at how science fiction can so often turn into science fact. Take Star Trek, with its 50-year saga in films and television and its pioneering ideas of how future mankind will live and how technology will play its part. They might not have got the fashions right, but Star Trek predicted a lot of technology in the 50 years that they have been setting the trend. The crew's hand-held communications devices pre-empted mobile phones. Devices such as the VISOR and Hypospray have manifested in some form in real-world medical science.

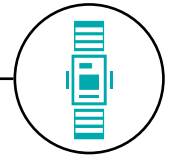
Which takes me to a news report I saw at the end of 2016, where doctors in London used sound waves to successfully operate deep inside the brain. They treated a 52-year-old man who had suffered from uncontrollable tremors in his right hand. The condition, called 'essential tremors', affects a staggering one in 25 people over 40. It can sometimes be treated with a cocktail of drugs that come with serious side effects, or with brain surgery that carries the risk of stroke and infection - not to mention the long road to recovery. In the report, the



team at St Mary's hospital had used MRI-guided focused ultrasound to destroy the tissue that was causing the mis-timed electrical signals that were sent to the muscles to cause the tremors. The result was remarkable and immediate: the tremors in the man's right hand completely disappeared and he was able to write his name for the first time in years. The fact that someone can enter an MRI scanner and emerge asymptomatic is a modern-day miracle.

The digital surgery of the future will not be about a scalpel and stitches, but about lasers and scanners – even augmented reality that enables the surgeon to take virtual tours of the human body. The implications of this are magnificent, in terms of fundamentally minimising the impact on the patient, reducing recovery time to be almost negligible, decreasing the cost of helping the patient to fully recover and fundamentally transforming the entire experience of dealing with any number of conditions.

I don't speak as a medical expert, but as someone who is observing not just how technology can help to manage hospitals better, improve data and the supply chain, but how the point of a scalpel gets replaced by the point of a laser, and how surgeons become medical scientists with digital lasers as their tool of choice. The excitement and awe I feel about this medical step change brings me back to Star Trek. For many generations, we have been on one direction of travel when it comes to surgery and the human body – albeit with startling progress and invention. But we are now entering a totally different realm that is much closer to sci-fi than to the operating tables of even a few years ago. As Dr 'Bones' McCoy discovered in the 1986 movie, Star Trek IV: The Voyage Home, medicine of the 20th and even the 21st centuries will surely be seen as primitive in the not-too-distant future: we are in the Dark Ages in comparison to what is yet to come.



A millennial's view: The future of healthcare



My wearables have been measuring my sleep, temperature, heart rate as well as my eating habits and exercise performance. Through comparing this data against the now freely available NHS data base and my past performance, it has noticed a downward trend and a slight temperature increase. When I wake up in the morning, my phone suggests that I could be coming down with an illness and so it opens my NHS dashboard app and asks me some questions on other symptoms; are you suffering from a headache? Are you finding it difficult to concentrate? From this, my phone can now say with a reasonable amount of certainty I am going to be ill. In fact, some of the answers I have given suggest it could be more serious than just the flu.

My phone automatically books me in with a specialist in the particular illness it believes I have, sends my health information that has been tracked over a number of weeks and my responses to the earlier

questions so that the doctor is as informed as possible. It then gives its own intermediate recommendation of paracetamol and rest. A few minutes later, my phone rings on video call and I answer to the specialist who already knows all my details, history and current stats. The specialist is able to make a very quick diagnostic and signs off on the prescription, I then pay via fingerprint identification on my phone and it will arrive by drone to my drop box within a few hours.

I am not yet feeling many symptoms but I have the correct treatment to pre-empt my illness. I haven't yet had a call from my manager to ask where I am as my phone has already blocked out my diary and informed my work, which is now verified with a digital doctors note. I haven't needed to fill a GP waiting room, I haven't let a minor illness become chronic and more costly to fix, I haven't even thought about A&E.



A millennial's view: A trip to A&E



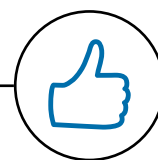
A&E is now reserved for its sole purpose of serving emergencies and the customer journey is quite different. On the way there, either I or someone with me enters the reason I am going, which is very quickly screened along with my wearable data and will recommend quicker and more suitable alternatives if these are more appropriate. If A&E is still the best place for me it will tell me where to park, which entrance to use and generate an identification number for my phone's location data.

As I walk in to the hospital it logs where I am and what I am there for. I then arrive exactly where I need to be and the doctor knows I'm there. He comes out very shortly after I arrive as there is little to no queue. He has come with porters who have brought my bed, because he already knew this is what I would need based on my answers. They take me to the ward where I am seen by the specialists and they recommend an x-ray. The porter takes me to x-ray straight away and I am seen by a radiographer. When the radiographer is done a porter comes and takes me back to the ward. Due to the location data on my

phone the doctors, porters and radiographers have known where I am throughout my time in the hospital and thus no time has been wasted searching for me.

My x-ray goes straight to the doctor's tablet and he is able to look at this on the way to my bed. When he gets there he has already recommended a small surgery to fix my problem. The best surgeon for my particular issue is based in a different part of the country and will do my operation in the next half an hour via a robot surgeon which he will control, they just need to 3D print a piece of bone first.

Once the bone is finished, I am wheeled to meet it in the operating room, the porter leaves and the robot performs precision surgery with minimal invasion. When the surgery is finished, the porter comes and wheels me out, I am booked into physio and given a download on how to best recover from my injury. So the only thing left to do is book an Uber to take me home.



Acknowledgements

We would like to thank the following contributors. If you wish to send feedback, please tweet using **#DVfHealth** or email: **AtosDigitalVisions@atos.net**

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Andrew Jackson	Chief Executive, ProReal Ltd
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Isaac Swanton	Business Consultant, Atos
Christopher Joynson	Business Consultant, Atos

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Digital Transformation will be the legacy of today's leaders in health. Developing real-time personalised tools to empower citizens in optimising their health and wellbeing is a key focus. Making the transition from the current operating model to a digital operating model will require committed leadership to the digital quest, belief in the benefits of digital and creativity in securing the required skills and resources.

Elaine Bennett, Partner - Health, Business & Platform Solutions, Atos UK&I

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About Atos

Atos SE (Societas Europaea) is a leader in digital transformation with circa 100,000 employees in 72 countries and pro forma annual revenue of circa € 12 billion. Serving a global client base, the Group is the European leader in Big Data, Cybersecurity, Digital Workplace and provides Cloud services, Infrastructure & Data Management, Business & Platform solutions, as well as transactional services through Worldline, the European leader in the payment industry. With its cutting edge technologies, digital expertise and industry knowledge, the Group supports the digital transformation of its clients across different business sectors: Defense, Financial Services, Health, Manufacturing, Media, Utilities, Public sector, Retail, Telecommunications, and Transportation. The Group is the Worldwide Information Technology Partner for the Olympic & Paralympic Games and is listed on the Euronext Paris market. Atos operates under the brands Atos, Atos Consulting, Atos Worldgrid, Bull, Canopy, Unify and Worldline.

Find out more about us

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Let's start a discussion together



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