# More Time to Care
Automation, Digitisation and the Workforce

Beamtree®

## About Beamtree

A leading provider of decision support and data insights solutions, Beamtree supports healthcare providers globally. They believe in creating a better future for health by turning data into insights and action through automation. They believe it starts with better data and ends in better care – and that better has no limit.

## About the Global Impact Committee

The Global Impact Committee provides advice on strategies and policies, promotes best practice and innovation in health data, and advances the Beamtree mission to create a better future for health. It leads thought leadership programmes to promote the priority of quality in healthcare and oversees schemes to empower global comparison of health outcomes.

## Disclaimer

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# Foreword

Globally, we know that productivity in healthcare is both slow and sluggish. While it is fiendishly hard to calculate, and nearly always contested, our best estimate is around 0.9% per year, worldwide. Other sectors and industries have vastly superior productivity levels, some averaging around 12% to 15% each year.

Recently, in the Harvard Business Review[1], in an article 'What the Most Productive Companies Do Differently', the authors pointed to four factors that drive superior performance: capturing value from digitisation; investing in intangibles like research & development, developing a future-ready digital workforce and adopting a total systems approach. These elements can readily be applied to health, but require a different leadership mindset – one which views the interplay between people, process and technology in a much more agile and connected fashion.

As I have argued elsewhere in my book 'Human: solving the global workforce crisis in healthcare' there are good reasons that healthcare productivity is lower, as it is highly labour intensive. However, this does not account for variations between health systems, nor the chasm between healthcare and other sectors. With the global healthcare workforce shortage projected to reach 18 million by 2030, doing more with the same and doing things differently will become a vital necessity and not just a nicety.

We know clinical staff can waste a great deal of their valuable time on unproductive tasks yet we also know there are some stunning, if isolated, examples of automation and digitisation making patient care safer, quicker and more efficient.

Our new global report, *More Time to Care*, highlights the enormous potential of automation and digitisation in healthcare. With demand for care increasing and our workforce facing burnout and attrition, the question for healthcare leaders is why hasn't automation been put front and centre in meeting the needs of the patients and communities we serve?

Our report points to the many success stories that can be found across the world. Additionally, our report critically looks at the barriers and obstacles health faces and often puts in its own way. We suggest new public-private partnerships and alliances at scale to break this impasse and note the new type of health leaders that will be required if the enormous potential of automation and new technologies is to be harnessed.

I wish to thank our Global Impact Committee members drawn from around the world, along with the organisations who have kindly agreed to be featured here.

**Prof Mark Britnell**
Chair, Global Impact Committee

# Executive Summary

1. Automation is a powerful tool in the pursuit of error-free healthcare, higher productivity and a better patient experience.

2. Automation enhances, rather than diminishes, the humanity of care by freeing clinicians to focus their time, intellect and emotional energy on the patient.

3. We train people as doctors and nurses and make them work as clerks. Automation liberates the talents of highly skilled staff.

4. The consequence of the failure to exploit automation is patient harm on a massive scale.

5. The failure to pursue big productivity increases will seriously impede the ability of health systems to cope with growing and ageing populations. Low productivity care on a massive scale inflicts significant economic harm.

6. Other industries, such as aviation, are leaving healthcare behind.

7. The technology trinity which will transform care in the 21st century is electronic health records (EHRs), automation and connected devices (the Internet of Medical Things).

8. In decades to come the healthcare mantra should be digital first, home first.

9. Automation has three big advantages over entirely human systems – it can learn from big data, it can perform defined tasks with higher precision and it can carry out the same task continuously without compromising its performance – unlike a human it never suffers from burnout or loss of concentration.

10. Automation has the potential to drive quality and productivity across the entire spectrum of healthcare activities, both clinical and nonclinical.

11. Individual institutions do not have the capacity to evaluate this vast array of tools, so automation needs to be driven from the centre.

12. Regulators should champion proven innovations and push the system to adopt them at scale.

13. Automation empowers patients with more choices, better care and more freedom to get on with their lives.

14. Much of the research, innovation, manufacturing and delivery will be in private sector hands. Public/private partnerships to deliver automation need to work for patients, taxpayers and healthcare providers.

15. Automation is primarily a human, not a technological, undertaking which needs to be championed and led by the people who will use it. Imposing technology on an unwilling workforce is setting it up to fail.

# Introduction – the case for automation

Automation is a powerful tool in the pursuit of error-free healthcare, higher productivity and a better patient experience. It has already demonstrated its ability to transform care by delivering big improvements in outcomes and efficiency while liberating the talents and time of highly skilled staff.

But few if any healthcare systems see automation as central to their future, clinicians are ill-prepared for exploiting the potential of intelligent machines, vast amounts of doctors' time is wasted on basic tasks that should be automated, and resources are consumed in routine back-office functions that divert money and time from care.

The consequence of the failure to exploit automation is patient harm on a massive scale. Some of this is through errors in diagnosis and treatment that would have been avoided with the support of automated systems, but the hidden harm is people who are unable to access care – disproportionally from poorer communities – because services are inefficient and often overwhelmed. Inevitably, when healthcare systems are overstretched and access is compromised, it is the poorest and most disadvantaged who suffer most.

> *"Hospital information systems, devices and AI are the trinity that will change the game in how we deliver healthcare."*
>
> Dr Sangita Reddy (India)

Automation can make a major contribution to addressing the healthcare workforce crisis. But with healthcare systems in many countries, from the wealthiest to the poorest, struggling to recover from the COVID-19 pandemic and a global shortage of healthcare workers which before the pandemic was heading for 18 million[2] – around one in five of those needed – the failure to automate is ultimately costing lives.

Automation is the creation and application of technologies which minimise human input by controlling and monitoring the production and delivery of products and services.[3] There are many ways of classifying it, but it includes:

- Basic automation – automating simple tasks. This includes robotic process automation (RPA), also known as software robotics, which carries out back-office tasks such as extracting data, filling in forms and collating and sending files.[4] (Robots are perhaps best described as machines that can execute specific tasks with little or no human intervention and with speed and precision.)[5]

- Process automation – typically applications which manage processes to ensure uniformity. This includes the robotic systems used in pathology laboratories and systems for scheduling appointments and managing supply chains.

- Artificial intelligence (AI) automation – AI can be programmed with logic and rules to mimic human decision-making, or use machine learning to teach itself and then make decisions based on situations it has encountered and analysed.[6]

When it comes to how automation is used, it broadly falls into three groups:

- Fully automated, which could be everything from a simple rules-based program to an AI-driven system which makes a diagnosis without human intervention.

- Fully assistive, such as surgical robots.

- Hybrid systems combining automated and human activity, such as a clinical decision support tool.

The bedrock of automation is an electronic health record (EHR) system. The technology trinity which will transform care in the 21st century is EHRs, automation and connected devices in hospitals, people's homes and on or even in people's bodies, sometimes known as the Internet of Medical Things (IoMT).

# Introduction – the case for automation

While much of the early focus of automation is on hospitals, the development of home and body-worn devices is growing rapidly. While health systems across the world are currently characterised by staff shortages and overwhelmed hospitals, in decades to come the mantra should be digital first, home first.

The intense public and media interest in the ChatGPT (Chat Generative Pre-trained Transformer) bot developed by OpenAI using natural language processing (NLP) shows how acceptance of automation and excitement about its potential is growing. By January 2023 ChatGPT had had 100 million users.[7] The Lancet has already discussed its potential for generating discharge summaries.[8]

*"A key challenge is using automation to enhance the humanity of care."*

**Prof Sir Bruce Keogh (United Kingdom)**

## The moral case for automation

There is a strong moral case for adopting this transformative technology at scale and pace. Failure to exploit systems for which there is robust evidence wastes healthcare resources and, when it comes to clinical services, means patients suffer harm either through lack of access to care or poorer outcomes. Having highly trained clinicians waste time and intellect on tasks that can be automated is unacceptable when health systems across the world are under immense strain and suffering severe staff shortages. Automation does not need to be perfect, it just needs to be better – or just as good at lower cost – than current ways of working.

## Enhancing the humanity of care

Automation enhances, rather than diminishes, the humanity of care. By freeing clinicians of the burden of repetitive tasks and enhancing their ability to secure good outcomes and a good experience for the people in their care, automation allows staff to deliver better treatment while focusing their time, intellect and emotional energy on the patient.

## The danger of two-speed healthcare

An automation gulf is opening up both within and between countries' health systems. If governments and system leaders do not ensure the widespread adoption of automation, the benefits will be confined to small population pockets around the leading hospitals, largely in major cities of wealthier countries. Meanwhile, the inverse care law will prevail, with deprived populations and poor countries having to make do with inefficient and relatively poor quality healthcare. The urgent need to address workforce shortages in developing countries means they could reap even greater benefits than the world's wealthier nations if they were able to automate.

## The leadership challenge

Automation at scale presents a huge leadership challenge if the full range of benefits – care quality, productivity and workforce sustainability – are to be achieved. The cultural change required is formidable, and design, training, testing, implementation, analysis and improvement require considerable long-term resources. But the prize is high-quality, affordable care for all.

*"As healthcare leaders we have a responsibility to look under the bonnet and challenge what is possible. How many of us can say we are really doing this every day?"*

**Jim Birch (Australia)**

# The transformative potential of automating healthcare

Automation in healthcare has three big advantages over entirely human systems – it can learn from big data, such as thousands of images, it can perform defined tasks with higher precision and it can carry out the same task continuously without compromising its performance – unlike a human it never suffers from burnout or loss of concentration.[9]

In pursuit of value in all its forms – better patient safety, better outcomes, reduced workload and stress, improved human performance, improved productivity and less waste – healthcare organisations should be seeking opportunities for automation right across their clinical and nonclinical operations.[10]

Automation has the potential to drive quality and productivity across the entire spectrum of healthcare activities. Hospitals are like small cities – there's a finance district, a manufacturing district, a food services district, maintenance and security. Automation can improve the productivity of all of them. Piecemeal reforms are better than nothing, but the big prize of a step change in performance which will free up hundreds of staff in each hospital to improve care will come from automating clinical and nonclinical systems across the organisation, for example:

- Automation of business processes – accounting and financial management such as handling of bills and wages, HR tasks, supply chain management. The NHS in England employs around 103,000 full-time equivalent (FTE) staff in clerical and administrative roles in "central functions".[11] Significant automation would improve speed and accuracy and free up money to hire more patient-facing staff.

- Automation of control and allocation of resources – coding of clinical activity is time-consuming, laborious and riddled with inaccuracies. Automation of the coding itself and the auditing would give payers and system leaders an accurate picture of activity, enabling resources to be allocated to where they are most needed. This is much more than an administrative exercise, with important implications for equity of care between different populations in the community.

- Automation of legal services – several AI systems have emerged which can ingest proposed contracts, analyse them using natural language processing and determine which parts are acceptable and which are problematic. Major companies such as Salesforce and eBay are already using AI-powered contract review programs.[12]

- Automation of collecting and processing data and reports, including real-time performance monitoring and quality assurance, and managing documents.

- Automation of medical image analysis – among a rapidly growing list of examples of machine learning improving the speed and quality of analysis, a collaboration between Moorfields Eye Hospital in the United Kingdom, DeepMind and University College London Institute of Ophthalmology used thousands of eye scans to train a system which was then able to recommend the correct referral decision for over 50 eye diseases with 94% accuracy, matching world leading eye experts.[13]

- Automated scheduling of patients, staff, equipment and beds to deliver maximum productivity – patient appointments, staff rotas, patient flow through the hospital, theatre bookings, management of beds and equipment and more can all be automated.

### Real-time paramedic management in Victoria, Australia[14]

Ambulance Victoria provides emergency response to over 5.8 million people in an area of more than 227,000 square kilometres, roughly the size of Romania. It uses machine learning, predictive analytics, root cause analysis and data mining to give paramedics real-time information.

Healthcare data is combined with information such as weather and traffic patterns to provide contextual data to determine where resources are best allocated and the routes paramedics should take. Having reached the patient, they are told the best hospital to go to, considering issues such as drive time, hospital congestion and patient needs.

# The transformative potential of automating healthcare

- Automation of monitoring vital signs on wards – patients can be monitored in real-time for signs such as pulse, blood pressure and temperature, saving hours of nurses' time every day on every ward to focus on patient care. Staff will be alerted to deterioration sometimes hours earlier than clinical staff using traditional techniques. Automated monitoring of the signs of sepsis can drastically reduce mortality in a disease where hours and minutes count, by identifying the deterioration and recommending a course of action.

- Precision medicine – the delivery of treatment at a patient-specific molecular level – will be able to fulfil its potential because of the power of automation, particularly AI. They are seen as converging technologies.[15] Among many applications in precision medicine, automation enables whole genome sequencing and other genetic tests to be performed and interpreted at a speed, scale, accuracy and cost to be a practical proposition for routine healthcare, while robotics enables medicines to be manufactured for individual patients.[16]

- Automation of medicines management – full digitisation of medicines processes at University Hospitals Coventry and Warwickshire NHS Trust in the West Midlands of England, including automated ordering on wards and automated box filling and dispensing in the pharmacy, will remove two million manual pharmacy transactions each year and release 40 nurses and pharmacy support staff for direct patient care.[17]

- Automation of laboratories – ordering of tests and supplies and automation of testing and reporting increases productivity, delivers more effective management of reagents and materials and reduces errors through standardisation. Reductions in error rates of 70% have been reported.[18]

- Clinical decision support systems – these are typically point-of-care tools which analyse the characteristics of an individual patient and present recommendations to help the clinician in reaching a decision. Benefits include reducing adverse drug interactions and inappropriate dosages, increasing adherence to clinical guidelines and reducing length of stay.[19]

- Automation of discharge summaries – one summary can typically take a junior doctor around 19 minutes, often totalling several hours a week across a ward. The work is tedious and the information sent is often late and incomplete.[20] Hospitals are already automating this process, delivering significant improvements in speed and accuracy.[21] A review for the United Kingdom government found that the proportion of a clinician's time spent on administration varied between 15 and 70%, so automating parts of that work would deliver substantial capacity gains.[22]

Clinicians spend up to
## 70%
of time on administration

- Monitoring of vital signs outside the hospital – heart function, blood pressure, blood oxygen levels and other signs can be monitored remotely in real-time by simple devices which allow people to get on with their daily lives. This reduces pressure on hospitals by reducing admissions and enabling earlier discharge.

- Analysing population health data – with its ability to process vast amounts of data, AI has almost limitless applications for generating population health insights. These include identifying factors which influence health outcomes, predicting the progression of infectious disease outbreaks, identifying the causes and effects of health inequalities, allocating resources across populations and disease groups and modelling the impact of health improvement interventions.

- Automated answering of questions – during the pandemic chatbots were used in countries such as Australia, Austria, Estonia, India, Japan, Singapore, the United Kingdom and the United States of America to answer questions as varied as employment rights, care options and symptoms, as well as carrying out tasks such as booking appointments.[23] In Singapore its public sector chatbot *Ask Jamie* was estimated to have reduced enquiries to call centres by 50%.[24]

*"Vast amounts of our junior doctors' time is taken up with administrative tasks. We have a responsibility to clinicians and patients to reduce this burden."*

Prof Keith McNeil (Australia)

# The transformative potential of automating healthcare

But despite the vast array of evidence supporting many of these systems, from clinical trials to months and years of live running, progress is slow, patchy and uncoordinated. If system leaders sit back and wait for each hospital and clinic to come to its own conclusions on the efficacy of these approaches, too little will change, not least because individual institutions simply do not have the capacity to evaluate this vast array of tools. This needs to be driven from the centre.

The proven effectiveness of automation of clinical systems needs to be treated in exactly the same way as any other innovation which drastically improves outcomes, such as by reducing error rates. It needs to be adopted as standard practice by regulators and medical institutions and system leaders need to enforce adoption. It is a moral issue – healthcare providers do not have the right to perpetuate the use of substandard practices which harm patients.

### Diagnosing lung disease in India

With India's cumulative COVID-19 infections reaching two million by early August 2020 and over 10 million by the end of that year,[25] clinical services were swamped, including imaging departments, where chest x-rays provided first-line screening. The stress and tedium of manually examining huge numbers of x-rays made timely and accurate diagnosis difficult.

Apollo Hospitals India implemented Red Dot, an AI platform for diagnosing CT scans and x-rays to detect conditions such as lung cancer and stroke. A pilot scheme was established in collaboration with Amazon Web Services (AWS) to speed up diagnosis by classifying x-rays as either normal or abnormal. In the 19 months from May 2020, it analysed over 82,000 x-rays and classified around 62,000 as abnormal.

To evaluate the algorithm's performance, around 1300 x-rays were labelled by consultant radiologists and compared with the classification generated by the algorithm. Red Dot showed an AUC of 0.91 in the classification of abnormal images.[26] (AUC is Area Under Curve, an aggregate performance measure ranging from 0 to 1.)

In a trial at Somerset NHS Foundation Trust in the United Kingdom to support the diagnosis of lung cancer, Red Dot more than halved the time between initial x-ray screening and a CT scan – the gold standard for detecting lung cancer – from seven to three days. The average time for the algorithm to return a result was 15.7 seconds.[27]

# Other industries are leaving healthcare behind

Compared with other industries, healthcare is far off the pace when it comes to automation, and it is falling further behind. Automation across industries such as aviation and automotive has improved safety, increased productivity, enabled the creation of new services and products and enhanced value for consumers.[28]

## Aviation shows the way

A review for the United States government of healthcare automation showed how the digitisation and automation of aviation set the path for healthcare to follow.[29] The advent of digital data inside the cockpit, along with automation of plane communication systems, ensured pilots could make informed decisions based on information about the aircraft and its environment. Now the aviation industry is exploring partial and full automation using AI and other methods to relieve the pilot of the burden of many of the tasks involved in flying the plane, while retaining an appropriate degree of direct pilot control to maximise safety.

Like pilots, clinicians use a range of technologies and devices to ensure safety and generate information to enable them to make quick and appropriate decisions, while the serious consequences of error – by either humans or automation design – create an imperative to carefully balance full and partial automation.

Beyond the cockpit, there are obvious parallels between airlines and healthcare, such as data being shared with central hubs to monitor performance, safety and outcomes. Airlines have long automated the scheduling and booking of crews, customers and facilities, which provides a better experience for staff and passengers, saves money and enables airlines to respond quickly to disruptions such as a delayed flight. Yet many healthcare providers still use cumbersome, human-driven systems to carry out routine, rules-based work such as producing staff rotas and booking patient appointments and operating theatre slots which could easily be performed quicker and with fewer errors through automation.

The automotive industry has had to automate to keep costs down and improve specification and reliability to meet consumer demand. The result is cars with far higher specifications and greater safety and reliability produced at a lower cost. Home computing companies use machines to build machines with constantly improving specifications, performance and reliability at a lower cost.

In the United States, vanguard industries such as computer manufacturing and wireless telecommunications have been delivering annual productivity growth of around 12 to 15%.[30] Meanwhile the productivity of the NHS across the United Kingdom was growing at around 0.9% a year before the pandemic,[31] while productivity in Australian hospitals was growing by an average of 0.5% a year.[32] This indicates that the productivity of the fastest-moving industries is growing at roughly 16 to 30 times the productivity of healthcare in major economies. One way or another, the burden of this poor productivity growth falls on patients and payers. The automation revolution in health is long overdue.

> "Automation is how we build sustainability for our future. We have to respond differently if we want health systems that support us in five, 10 and 50 years' time."
>
> **Prof Walter Ricciardi (Italy)**

# Other industries are leaving healthcare behind

## Low productivity care is unsustainable

Sooner rather than later this failure to pursue big productivity increases will seriously impede the ability of health systems to cope with growing and ageing populations. Across the world, healthcare is consuming an ever greater proportion of national wealth, a trend at least temporarily accelerated by the response to the COVID-19 pandemic.[33] Driving up costs to deliver low-productivity care on a massive scale inflicts significant economic harm. Productivity gains through automation will be essential to maintaining the long-term sustainability of healthcare spending.

## 36%
### Activities that could be automated
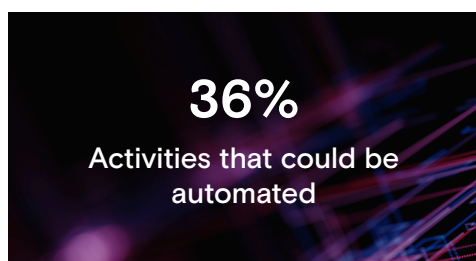
The slow pace of productivity gains is often excused by arguing that healthcare is a human contact industry, but this only provides part of the explanation. It is being held back by a failure to automate. Consultancy McKinsey & Company estimates that about 36% of activities in the health and social care sector could be automated, particularly around processing data.[34]

Automation feels like a cottage industry, with little planning across systems to exploit its potential. Crucially, it is not being integrated with workforce planning, recruitment and training.
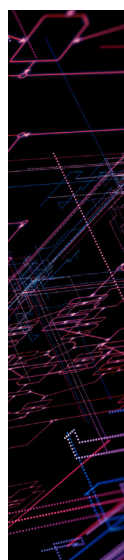
### Using AI to slash disability among stroke patients in the United Kingdom

The NHS has been trialling an AI system which has increased the number of patients recovering from stroke with little or no disability from 16% to 48%.[35]

The Brainomix e-Stroke system has been used for 111,000 people with suspected stroke across 11 stroke networks in England. Early analysis indicates that it reduces the time between diagnosis and treatment from 140 to 79 minutes, by providing real-time decision support to doctors in interpreting brain scans. This allows more patients to receive the right treatment promptly.

The system also works remotely, allowing stroke specialists to access images across the integrated stroke delivery networks.

## Chapter 4:
# Liberating the workforce through automation

With a global health workforce shortage of many millions, it is clear even the wealthiest economies cannot buy their way out of trouble, while the workforce crisis is threatening progress towards universal healthcare in the world's poorest countries.[36] In every country, including the richest, it is rural, remote and impoverished communities who suffer the worst shortages.

In England, about 10% of NHS posts are unfilled, around 133,000 roles. This includes 12% of nurses and 6.2% of medical posts, with particularly serious shortages in mental health.[37] Australia is expected to be short of more than 100,000 nurses by 2025 and 123,000 by 2030.[38] Its shortage of GPs is expected to exceed 10,000 by 2031.[39] In Canada, around 6.4% of healthcare and social assistance posts are vacant, totalling 152,000 staff.[40]

> *"How can we use automation to replace lower level work, to enable our experts to operate at the top of their skills set?"*
>
> Don Rucker (United States of America)

Automation is about reducing the enormous workforce gaps by taking on the heavy lifting for many tasks. It is not about replacing clinical staff. Radiologists will not be replaced by AI, but it will profoundly change their role by taking over much of the routine assessment of medical images, and doing it at a lower error rate, freeing the radiologist to focus on interpreting and responding to the results, building relationships with patients and managing their care.[41]

### 10%
Nursing activities that could be automated

It will be the most powerful tool for filling the chasm between the demand for treatment and the supply of clinicians. The sustained real terms growth in healthcare spending and the global shortage of healthcare staff all point to automation freeing time rather than replacing posts. For example, global projections indicate a 39% increase in nursing roles by 2030, while around 10% of nursing activities could be automated.[42] Automation takes on routine and repetitive tasks while freeing clinicians to focus on care, and supplies them with faster and more accurate data and diagnostics.

In a global survey addressing the growing problem of staff retention among nurses, "doing meaningful work" was a key reason to stay.[43] But we train people as doctors and nurses and make them work as clerks. According to OECD research, around three-quarters of doctors and nurses reported performing tasks for which they were overqualified.[44] [45] In the United Kingdom, the Royal College of Nursing estimates around 18% of nurses' time is spent on "non-essential" paperwork, while the British Medical Association says more than 13.5 million hours of doctors' time is being lost each year in England due to inadequate technology – the equivalent of almost 8000 doctors.[46] This shows that even quite simple steps to get clinicians the right information at the right time and automate routine paperwork would drastically reduce stress, frustration and burnout. Automation removes drudgery and repetition. It's not a threat to clinicians, it's a liberation.

Taking a conservative estimate that around 15% of current work hours in healthcare could be automated, McKinsey estimated the proportion of hours that could be freed by automation by 2030 across France, Germany, Hungary, Italy, Portugal, Sweden and the United Kingdom.[47] Estimates included: 29% of the time of pharmacy, medical and clinical laboratory technicians; 26% for dental assistants; 23% for pharmacists and medical records technicians; 21% for radiation therapists and medical and clinical laboratory technologists; 19% for dieticians and nutritionists; 17% of audiologists; 16% for nurse anaesthetists and ophthalmic medical technicians; 13% for MRI technologists; 12% for GPs; 11% for obstetricians and gynaecologists and 10% for anaesthetists.

Chapter 4:
# Liberating the workforce through automation

When identifying priorities for automation, leading contenders should include services most impacted by staff shortages. This may well be hospital wards. Automation on wards could play a major role in reducing emergencies and mortality while saving nurses from the tedium of routine checks. Monitoring protocols on wards typically consist of intermittent spot checks by a nurse every four to eight hours. A major European study found around three-quarters of patients who died in hospital after surgery were not in intensive care at any stage, demonstrating the importance of identifying deterioration and life-threatening complications on general wards.[48]

### Identifying deteriorating patients earlier using AI

Two doctors at Sydney Adventist Hospital built an algorithm using machine learning that could pick up signs of patient deterioration on a ward before they would be identified by staff. The Ainsoff Deterioration Index™ can predict that a patient will deteriorate before an adverse event, and sometimes hours earlier compared with traditional monitoring and alert systems.

The deterioration prediction model was developed using patient demographics, ward-based observations, laboratory values and trend analysis. The model's outputs were converted to a deterioration index that was successfully integrated into a live hospital EHR.[49]

## Using AI to reimagine job roles

The hardest part of automation is reimagining and redesigning human systems. Automation is not something to be layered on top of existing professional silos and hierarchies, but requires new ways of training, developing and interacting. Only a fraction of the extraordinary potential of automation will be realised if it is simply used to free up time.

Health services need to move away from old-fashioned job descriptions for old-fashioned jobs, and instead map skills to tasks. Automation enables us to demystify the care process by analysing what work needs to be done, not what work is described by professional silos and job descriptions. Companies such as Faethm in Australia are using AI to break down processes into their constituent parts, identify where similar tasks are being performed across the organisation and highlight where they can be automated. It also matches people to the tasks and looks at the skills and training required to enable people to work with automated systems.[50]

Using AI to identify the optimum workflow and optimal patient journey, eliminating duplications, overlaps and unnecessary hand-offs, increases quality and productivity and avoids falling into the trap of automating unreconstructed, inefficient systems. This creates much more agility and fluidity between professional silos, empowering highly skilled staff to use their talents to the full.

*"We must trust and empower our workforce to identify what they would value automating. Let's give them the tools to help them do their jobs."*

**Prof Andy Hardy (United Kingdom)**

# Liberating the workforce through automation

But the insights of the team doing the work are vital as well. One of the 13 pillars of the famous Toyota Production System is kaizen – empowering individual staff to identify areas for improvement and suggest practical solutions.[51] It is based on the idea that those who do the work know the work, and those who know it can improve it. If clinicians are convinced that automation will enable them to focus on more fulfilling work rather than make them redundant, they will identify where improvements can be made.

Automation and AI will become part of the recruitment process, sifting CVs, running online tests and identifying desirable attributes. As clinicians increasingly work in a world of digitally driven healthcare, the desirable traits are likely to tilt from knowledge and experience to demonstrating skills such as solving problems, thinking creatively and adapting to new environments.[52] Every time a vacancy arises, employers need to look for opportunities to automate, so that recruits can focus on more valuable work.
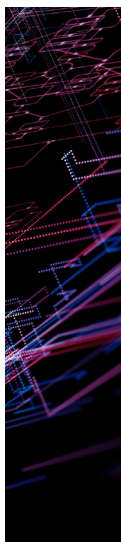
### Reducing deaths from sepsis in Cambridge, United Kingdom

Cambridge University Hospitals NHS Foundation Trust has drastically improved the diagnosis and treatment of sepsis, saving at least 64 lives in one year.[53]

Every year around 250,000 people are affected by sepsis in the United Kingdom and 44,000 die, more than bowel, breast and prostate cancer combined.

Electronic prompts in the Epic EHR alert clinicians if a patient's clinical observations indicate the possibility of sepsis, and guide the actions and tests needed to diagnose it quickly. It also recommends the dose and frequency of antibiotics.

It has resulted in a 70% increase in the proportion of patients diagnosed with sepsis receiving antibiotics within the recommended time.

Similar approaches at the Royal Berkshire NHS Foundation Trust and Royal Liverpool and Broadgreen University Hospitals NHS Trust achieved comparable improvements.[54]

# Empowering patients and building trust

Healthcare systems all over the world talk about 'empowering patients', but until recently little has changed in the power balance between clinician and patient. Automation is finally beginning to make a difference. Greater use of machines will empower the humans who depend on healthcare. Empowerment means people gain control over decisions that affect their health.[55] Technology such as smartphone apps linked to devices is enabling patients to become active partners in their care, which is particularly powerful in the management of long-term conditions. Examples include wearable technology for diabetes and Parkinson's disease and digital tools for mental health support. These tools can have a transformative impact – freeing patients from repeated hospital visits, engendering a greater sense of personal responsibility for managing conditions and allowing people freedom to simply get on with their lives. A striking example is helping patients maintain their quality-of-life by using smartphone apps to ensure they take critical medication. A study of one company's AI-driven program indicated that treatment adherence in patients with schizophrenia improved from 50% to 90% over six months.[56] Patient empowerment through automation can be highly cost-effective, as it replaces clinician activity with patient activity. By reducing avoidable consultations, it also allows staff to focus on the patients with the greatest need.

## Liberating patients through virtual care

In a major development, the NHS is pushing the potential for digitisation and automation to new levels by aiming to establish around 24,000 'virtual ward beds' by December 2023. Several thousand are already in operation. Initially, the service is focused on the frail elderly and people with acute respiratory infections, although local areas are working on other pathways such as COPD. It builds on the success of virtual care models during the pandemic. Virtual wards support patients who would otherwise be in hospital to receive in their own home the acute care, monitoring and treatment they need. This includes either preventing avoidable admissions into hospital or supporting early discharge. The wards typically have their own clinical teams across the hospital and the community, and often involve voluntary organisations. Virtual ward technology includes devices, often wearables, to monitor signs such as oxygen saturation, temperature, pulse, weight, blood sugar and blood pressure, with the readings usually transmitted automatically to clinicians and algorithms alerting clinicians if a threshold is breached. Virtual wards are liberating for patients because they keep them out of hospital and encourage people to manage their own conditions. Better evidence is needed on how to maximise their effectiveness in terms of patient outcomes, but their transformative potential is obvious.

## Opening up care quality to professional and public evaluation

People who provide health care have a moral, professional and societal duty to know how good they are. Despite some progress in publishing outcome and mortality data over the last 25 years, there is little meaningful information provided to patients and the public, and far too little benchmarking by individuals and organisations so that they are able to judge their performance against the best, and improve the quality of their work. Every healthcare provider should be a learning system. This lack of transparency disempowers patients by depriving them of the opportunity to make informed choices about who provides their care, and undermines trust in the healthcare system by failing to be open about the drivers of quality. People have a right to know, and transparency and openness are powerful engines for improvement. The speed and standardisation of data associated with automation can finally open the performance records of healthcare providers and individual clinicians to professional, public and patient scrutiny.

## Would you like a machine today or a doctor next month?

AI-driven chatbots are already beginning to provide medical consultations,[57] empowering patients with the choice of speed and convenience over waiting for a human. But this choice could be pushed much further. With so many patients globally waiting for cancer diagnoses, many of which are time critical, if they were given a choice of having their scans read, analysed, diagnosed and reported back by machine in 24 hours, or in a fortnight via a doctor, which would they choose? It would be an extraordinarily powerful test of public appetite for putting diagnostic power in the hands of machines.

> *"Let's take away the pain of ward-based daily tasks and give people time to care."*
>
> Shane Kelly (Australia)

# Chapter 6:
# Overcoming barriers to automation

Despite its extraordinary potential for improving quality and cutting costs, automation is proving slow to catch on. Among the challenges to be overcome to achieve widespread adoption are:

## Improving digital infrastructure

The upfront investment in digital infrastructure is substantial. As well as the EHR, it needs digital connectivity such as hardwiring, wireless and Bluetooth, alongside other critical systems such as cyber security and data governance. Installing 5G across a concrete and steel hospital is a big undertaking. The long-term benefits and savings will be substantial, but the return on investment will take years to come to fruition.

## Providing better evidence

While evidence requirements around clinical trials for new drugs are clearly understood, the protocols for testing and approving automated systems are far less clear and still evolving. For example, early proof of performance is typically undertaken using historical data, but that does not equate to a randomised controlled trial. There has been growing concern that new machine learning models are being released and put into use after preliminary validation studies without being tested against this gold standard.[58]

Since automated systems are inherently opaque in their design, robust evidence is vital for patient safety and clinician confidence. But a review in 2022 found that, despite the large number of medical, machine learning-based algorithms in development, few randomised trials were being conducted. Of the randomised trials which had been published, most did not adhere to accepted reporting guidelines and frequently revealed basic errors such as underrepresenting minority groups.[59]

As well as being tested in randomised trials, performance needs to be measured against traditional human systems to identify whether the benefits justify the costs. One review of 82 studies of deep learning systems used to diagnose various diseases from medical images found only 14 of them compared the performance with that of health professionals.[60] (Deep learning is an AI method that teaches computers to process data in a way that is inspired by the human brain. Deep learning models recognise complex patterns in pictures, text, sounds and other data to produce accurate insights and predictions, enabling the automation of tasks that typically require human intelligence.)[61]

**Comparing the performance of a deep learning system and human experts in identifying diabetic retinopathy and related eye diseases among diabetics.[62]**

An international group led by a team in Singapore evaluated the performance of a deep learning system in detecting diabetic retinopathy, possible glaucoma and age-related macular degeneration (AMD) among a multi-ethnic population with diabetes.

The global potential for such a system is immense. It is projected that by 2040 around 600 million people will have diabetes, and 200 million of them will suffer from diabetic retinopathy.[63]

After the system had been trained with massive numbers of retinal images – such as 125,000 for possible glaucoma – the diagnostic performance of the system was evaluated using 495,000 retinal images. This revealed that the system had high sensitivity (few false negative results) and specificity (few false positive results) for identifying diabetic retinopathy and related eye diseases.

This performance was compared with the standard approach of assessment by two trained senior non-medical professional graders, with reference to a retinal specialist. The deep learning system was comparable with the current approach, and the automated system's performance was consistent across images of varying quality, different camera types and patients with varying glycaemic control.

# Overcoming barriers to automation

Robust evidence needs to take account of factors such as the varying quality of input data. For example, evidence obtained from an automated system using scans from the latest equipment may be a poor indicator of how it would perform using much older kit in a developing country.

One of the big advantages of automated systems is that once they are live they can be monitored and analysed in real time, so the evidence from clinical trials will quickly be overtaken by real-world evidence, enabling further improvements But evidence is useless unless it is acted upon. Healthcare providers have a duty to their patients to adopt proven systems.

## Improving regulation

Regulators across the world are grappling with how to regulate automated systems for healthcare. Dilemmas include: whether regulators need to understand every detail of the algorithm – the so-called 'black box problem'; whether the automated system has to demonstrate significantly superior performance to humans working alone, or whether simply matching performance at a lower cost is acceptable; and whether AI programs have to be subjected to fully randomised controlled trials.

By definition, regulation will always be running to catch up with technological developments. But at a time when health systems are under exceptional strain as they try to recover from the pandemic, many developers and clinicians feel regulators are being too risk averse. Concerns include regulators having expectations of perfection far beyond existing human systems, and failing to identify and fast track automation which could significantly improve safety and productivity.

There is also a feeling that the entire regulatory process is far too slow, with the sheer volume of digital devices swamping the capacity of regulators to analyse them for safety and performance. For start-ups and small companies, months waiting for approval can be enough to kill them off and is a significant disincentive to enter the healthcare market.

Developers and healthcare organisations need a system which is clear about the process and evidence requirements, transparent, proportionate and quick. Regulators should be supporting companies who have great ideas for meeting big healthcare challenges, turning regulation from being an obstacle to overcome to being an active and supportive part of the development process. It is not enough simply to facilitate innovation by not getting in the way. Regulators should be driving the change by championing proven innovations and pushing the system to adopt them at scale.

*"Regulators need to ask themselves: 'How are my regulations enabling the adoption of useful technology?"*

**Roger Taylor (United Kingdom)**

# Overcoming barriers to automation
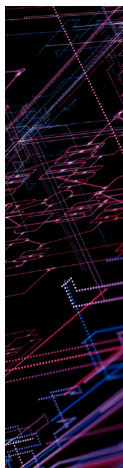
**Using regulation to stimulate innovation in Germany**[64]

In 2019 Germany reformed the regulation of digital health to stimulate digital transformation. The Digital Health Care Act (known as the DVG) created a fast track regulatory process for companies to take their applications to market.

Following a streamlined review by the Federal Institute for Drugs and Medical Devices (BfArM), which looks at issues such as interoperability, data protection and preliminary data on benefits, an app can be added to a central register of apps that can be prescribed and – crucially – have to be paid for by insurers. Early examples include support for conditions such as obesity, osteoarthritis and tinnitus.

Innovation by smaller companies and start-ups is encouraged by granting some apps 12 months to provide full data on the benefits, which often helps companies attract funding at this crucial stage to perform large-scale clinical evaluation and work through the regulatory process.

## Overcoming professional resistance

A study of the views of doctors on the ethics of AI highlights the range of attitudes to automation.[65] Analysing the views of doctors in Portugal, the Netherlands and the United States, the researchers identified four attitudes:

- AI is a helpful tool which lets physicians do what they were trained for – these doctors see AI as a positive development which replaces boring work with time for more intellectually challenging tasks. They aren't overly concerned about the 'black box' aspects of AI and do not subscribe to the idea that AI will lead to overtesting, overdiagnosis and overtreatment. They see embracing AI as essential to developing their practice.

- Rules and regulations are crucial, and private companies only think about money – these doctors distrust companies involved in developing AI tools and feel the tech industry is poorly aligned with healthcare values. They have serious concerns about companies owning medical data and the potential harm this can inflict on the patient–physician relationship. Rules and regulations are needed to keep these corporations in check and stop patients being put at risk. They believe AI health products should be tested in randomised trials.

- Ethics is enough: private companies can be trusted – these doctors take a far more relaxed approach to companies working in healthcare and feel healthcare staff are already heavily dependent on technology. They don't think AI will increase discrimination and therefore don't see improving equity as being a high priority in the way AI is developed.

- Learning about AI tools is necessary and inevitable – these doctors believe that to reap the benefits of AI, they must understand and lead the technological progress. They think it's important that they know how AI medical tools work, and clinicians should only use them if they understand how decisions are made.

This study highlights the diverse and often contradictory views that doctors hold. It is important for system leaders to stimulate debate and discussion so that issues are surfaced and addressed.

It is striking in this research that excessive acceptance – such as being too relaxed about data governance and biases – could prove just as much of a problem for automation as people who oppose it.

> "Automation is a force for good for our workforce. Let's harness it to liberate them and create trust, so they can devote more time to what matters."

Janet Davison (Canada)

# Overcoming barriers to automation

## Improving clinicians' digital skills

Poor digital skills and confidence among clinicians are major barriers to adopting EHRs, the bedrock of clinical automation, and undermines their effectiveness once they are introduced.[66] When implementing a new system, healthcare organisations should provide staff with frequent opportunities to become familiar with it before it goes live through a variety of training channels – such as one-on-one and classroom and online training – and provide plenty of support before and after launch, particularly for older staff.[67] Professional bodies and employers need to see the development of digital skills as a core part of personal and professional development.

## Addressing the perception and reality of biases

Like any other part of healthcare, automation has the power to redress or exacerbate health inequalities. They can be worsened through biased assumptions, differing impacts – such as skin pigmentation affecting a pulse oximeter's ability to accurately measure oxygen saturation[68] – or unequal access to the technology. Care must be taken to understand the risks of biases in the designing and training of algorithms. For example, it is now widely recognised that the dominance of people of European ancestry in genetic databases can affect the diagnosis and treatment of people with African ancestry.[69] But as well as getting the technology right, developers and health organisations need to actively demonstrate that they have addressed the potential for biases in design and development. The fact that many developers still fail to take even basic steps around the heterogeneity of source data shows that clinicians and the public are justified in wanting robust evidence that automation is not introducing new biases.

## Exploiting the talents and drive of digital natives from ward to board

The transformation of healthcare cannot wait until digital natives reach the most senior positions. Their talent and drive need to be harnessed now to make the change happen. This might include appointing relatively young staff to positions such as chief clinical information officer (CCIO), developing the skills of younger people in fields such as medical Informatics, and ensuring digital natives are represented on boards in executive and non-executive positions. The lack of digital talent on boards is a major inhibitor to transformation. Getting digital skills around the table needs to be a key board development goal, and digital needs to be an integral part of all discussions, such as patient safety, workforce development, productivity and resource management.

### Using AI to overcome human biases

AI can be used to correct biases already embedded in healthcare. University Hospitals Coventry and Warwickshire NHS Trust in the United Kingdom realised there was an inherent problem in dealing with the backlog of elective care by treating those who have been waiting the longest first, because it fails to take into account how and when people managed to get on the waiting list.[70 71]

Patients from deprived groups find it more difficult to get onto waiting lists. Factors include being more likely to struggle to access primary care – the inverse care law – and finding it more difficult to attend appointments. So exclusively focusing on waiting times when selecting patients for treatment fuels health inequalities.

To address this, the trust developed its Health Equity And Referral To Treatment Tool (HEARTT), a clinically-led elective care scheduling program which builds upon clinical data to take account of factors which drive, or are proxy markers for, inequality.

This was a detailed and sophisticated piece of work which took account of different outcomes for different services. For example, ethnicity was indicated as a factor in outcomes for diabetes but not for spinal discectomy, so the program follows the evidence. Crucially, it does not overrule clinical prioritisation. Public consultation, including detailed market research and structured debates, has informed the entire process.

# Overcoming barriers to automation
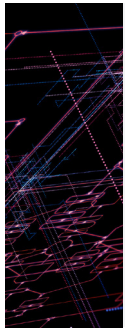
### Using AI to identify algorithmic bias

To guard against the introduction or amplification of biases in machine learning systems, the University of Chicago is developing a range of approaches to detect and mitigate them.

It is developing governance approaches including the Algorithmic Bias Playbook and other checklists and open source toolkits to audit machine learning algorithms for bias in clinical applications. It aims to scale the audit process so that a health system can assess an entire portfolio of algorithms. The goal is to make significant strides in reducing health disparities among vulnerable populations.

## Securing public trust with transparent public–private partnerships

There is widespread public suspicion about the use of their medical data by tech companies in general, and overseas tech giants in particular. In the United Kingdom an impressive collaboration between London's Royal Free Hospital and Google subsidiary DeepMind on diagnosing acute kidney injury was overshadowed by breaches of data protection legislation, when the records of 1.6 million patients were handed to the company for processing.[72]

In a review for the United Kingdom government of how to deliver digital care, American clinical researcher Prof Eric Topol called for AI-driven tools to be governed by a binding code of conduct and a transparent framework of information governance to support the analysis of anonymised patient data by industry.[73]

As well as following clear rules, healthcare organisations and their private sector partners need to do a far better job of earning public trust by explaining the benefits to patient care of such partnerships and how patient confidentiality is being maintained. If attitudes in the United Kingdom are anything to go by, the public are more likely to accept collaborations with the private sector if data stays in the country, is handled by local companies and remains in the ownership of the healthcare provider.

Getting the triangular relationship between the public and private sectors and citizens on the right footing is key to the technological transformation of healthcare. The reality is that much of the research, innovation, manufacturing and delivery will be in private sector hands, but this needs to work for patients, taxpayers and healthcare providers.

*"The COVID-19 pandemic was a game change.  Now we must seize on this to put automation solutions at the centre of modern healthcare."*

Tony O'Brien (Republic of Ireland)

# How to make automation a success

## Find solutions to real problems

Automation should be used to tackle problems identified by staff and service users. Work with users to understand their needs and then collaborate with them in prototyping, testing and improving solutions.[74]

A survey of AI developments in the NHS found diagnostics to provide accurate and early detection of disease was by far the most common use, with radiology and dermatology cited as examples. [75]

The second most important area was administrative systems such as routine clinical and managerial tasks including document management, paperwork and scheduling.

Tasks that are more difficult to automate include those which involve knowledge which is difficult to represent as clear and consistent rules, such as discussions which involve consultations between stakeholders within a multidisciplinary team, or some mental health diagnoses. It should be noted, however, that automation is already entering areas of diagnosis which might instinctively feel a uniquely human domain. A speech recognition application developed with NHS mental health staff which exploits natural language processing supports mental health triage by analysing text and voice inputs for emotion and suicidal ideation.[76] The bot replicates existing clinical practice and meets NICE guidelines. The aim is for this program to become part of the Improving Access to Psychological Therapies (IAPT) triage across London.

It is important not to automate the human interactions between staff and patients that build trust and are at the heart of the healthcare experience. Receiving a routine test result through an app may well be simple, quick and convenient for all concerned, while a patient will have vastly different expectations for receiving a diagnosis of a serious illness.

Automation of administration has the attraction of improving productivity while enabling healthcare systems to develop their understanding of automation without the risks and complexities of clinical decisions. This should not be an alternative to automating clinical systems, but preparation for it.

> *"Automation, done ethically will be the key driver to narrow health inequity and shift delivery towards ambulatory care and keeping people out of hospital."*
>
> Thomas Jackiewicz (United States of America)

## Make the investment case

The benefits of investing in automation are likely to be seen first in improved quality, such as lower error rates, fewer transfers to ICU, lower readmission rates and higher productivity. In the longer term, financial benefits such as lower administration costs will become apparent.

The return on investment needs to be sufficient to justify the time, money and disruption involved. For example, if a system works quickly and points the clinician to the appropriate decision, it has the potential to deliver significant improvements in productivity and quality. But if automation only improves the error rate by 2%, such marginal gains could well be achieved by improvements to the existing pathway without the expense and disruption of moving to a new way of working.

The investment case needs to make a realistic assessment of the cost of resources and time to support implementation, including training and culture change among the people who will be using it.

One impediment to healthcare automation is the high degree of autonomy enjoyed by many providers. While the drive for a national or international retailer or manufacturer to automate its processes is obvious, the benefits for a standalone hospital or a small group of clinics are less clear-cut, with a relatively high investment of time and resources to make the change. Collaboration across healthcare systems can help manage costs but makes implementation more complicated.

# How to make automation a success

In the United Kingdom, the NHS reflects the low productivity growth in the wider economy. Both the NHS and the United Kingdom in general have relatively low levels of capital investment, and instead rely on a higher proportion of low-wage labour, such as administration staff. Countries known for their innovative use of technology such as Singapore, South Korea and Israel have far higher levels of capital investment.
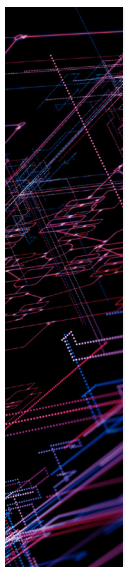
**Improving resource management by using AI for clinical coding**

Most countries don't have a clear idea of the allocation of resources across their public health systems because the underlying data is inaccurate. The inaccuracy has two causes – the absence or inaccuracy of clinical documentation, and human errors introduced in the process of classification. Beamtree in Australia has developed technology which automates the audits of clinical classification, which drastically reduces the error rate and therefore improves resource allocation in individual providers and across the wider system.

The next step is automating the coding itself. In Germany, around 400 hospitals are using coding software developed by Tiplu to automatically code and bill for treatment, reducing errors and addressing the problem caused by an acute shortage of coding staff.[77]

Problems with clinical coding highlight another advantage of the airline industry over healthcare – it has standard ways of describing things internationally, which enhances safety and supports data comparisons and sharing. Tiplu's program is designed for Germany's coding system, and cannot be readily applied elsewhere.

## Start small, win confidence and trust, then build

Introducing the latest clinical decision support tools may not be the best place to start. Focusing on saving time spent on routine, relatively simple, rules-based tasks has more chance of feeling like a liberation rather than a threat. Simple systems with fewer risks provide an opportunity for everyone involved to learn. Prototyping, testing and improving, with the staff who will be using the system closely involved at every stage, is the way forward.

## Create a culture of openness and transparency

Clear governance structures are needed to guide decisions and build trust, underpinned by an ethical framework capturing issues such as transparency in the development of algorithms.[78] A strong ethical framework is essential for securing and maintaining the trust of staff and the public.

There needs to be openness about how data is cleaned and structured for use, as this requires subjective decisions which will have an impact on the output of the algorithms, such as introducing or accentuating biases.[79]

Clinicians need clear guidelines for how they should be interacting with automated tools and must understand their ultimate responsibility for clinical decisions.

## Build clinician trust and leadership

Automation is primarily a human, not a technological, undertaking which needs to be sponsored, championed and led by the people who will use it. Imposing technology on an unwilling workforce is setting it up to fail.
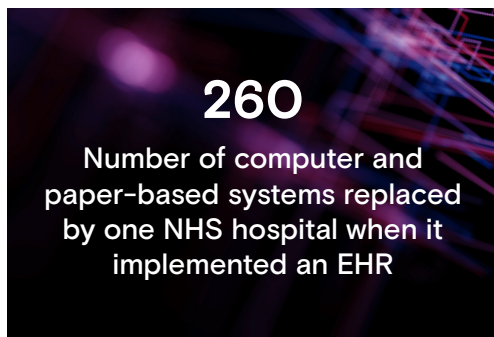
Clinicians need to be immersed in every aspect of development and delivery. Early and consistent engagement will maximise the chances of a smooth introduction and long-term success. As well as clinical champions to explain the benefits for staff and patients and promote a new way of working, changes need board-level leadership and oversight.

The need for clinician involvement from the beginning is still not understood by many in the medtech industry. According to a survey in 2020, only 14% of start-up executives felt that the input of healthcare professionals was critical in the early design phase, while healthcare professionals described the private sector's role in upskilling staff as "minimal or non-existent".[80] As automation moves from carrying out repetitive, well-defined, rules-based tasks to guiding clinical decisions using intelligent systems that are evolving and learning, clinician trust becomes ever more vital.

As a starting point, winning the support of clinicians means providing them with systems that can be shown to improve patient outcomes, that are safe and that are easy and intuitive to use.[81] It is supposed to simplify processes rather than complicate them. According to a study for the NHS, four conditions have to be met for clinicians to get the maximum benefit from automation: having the time and willingness to adopt new technology; having an understanding of the technology; having well-designed technology which meets their needs: and having workplace support to maximise the benefits.[82] It is important not to oversell the technology. The excitement around the use of AI among its enthusiasts can lead to excessive hype which leaves clinicians feeling alienated and threatened. At its heart, it is just another algorithm in a software program.

While a lack of trust in intelligent systems is a barrier, excessive trust can also impede implementation. If a clinician accepts without question all the recommendations of a decision support tool, then the combined performance of the human and the AI system will be no better than the system alone. This is why AI experts talk about "optimal trust", in which AI applications and humans each retain a level of scepticism regarding the other's decision-making, because both can make mistakes.[83] So part of implementing AI is establishing a level of trust that matches the capability of the machine.

## 260

Number of computer and paper-based systems replaced by one NHS hospital when it implemented an EHR

### Build high-quality data

To maximise the potential of automation, different information systems, devices and applications need to be able to seamlessly access, exchange and integrate data which has been entered in a structured, consistent form.[84]

The difficulties that healthcare organisations routinely experience when introducing an EHR are symptomatic of the extraordinary variety of data and codings which can arise over years of uncoordinated development of manual and digital systems. When Frimley Health NHS Foundation Trust in England went live with Epic in June 2022 in a contract worth £108 million (USD$133 million) it replaced 260 computer and paper-based systems.[85]

Cleaning up dirty data, standardising it and digitising it are important basic tasks. Automation will become synonymous with interoperability and open standards. Building this in from the beginning will reduce costs, improve safety and care and promote digitisation. Open standards are essential for unlocking the potential of smartphone apps and wearables. Using cloud technology to store and share data encourages the use of open standards.

At the heart of data standardisation is the Fast Healthcare Interoperability Resources (FHIR) standard. It allows developers to build standardised 'browser' applications that will enable access to data no matter which health record operating system underpins the user's infrastructure. FHIR, therefore, allows access to data held and shared in a standard format rather than different parts of the healthcare system having to exchange documents.[86]

As always, clear frameworks defining issues such as who owns the data, and how it can be shared, are essential. This includes carefully defining the role of private companies and developers. Data collection processes will need to be improved, including accuracy, completeness and timeliness.[87]

## Build foundations of security and resilience

The ransomware attack on the NHS[88] and the theft of hundreds of thousands of customer records from Australian health insurer Medibank,[89] both in 2022, underscore how healthcare systems need to protect themselves against cyberattacks. As well as installing and constantly improving cyber security, healthcare organisations need to ensure they are resilient to an attack by establishing robust business continuity procedures that are tested, and understood by the people who would need to use them.

# How to make automation a success

*"We can't just rely on digitising an existing workflow, we need to improve or re-engineer it first."*

Associate Prof Cheng Ooi Low (Singapore)

## Deconstruct and rebuild the workflow

The objective for automation is not to automate the current process, but to deconstruct and redesign the workflow to maximise quality and productivity. The starting point is mapping the existing workflow – including all the mental, as well as the physical, tasks – and then analysing it to identify resources, information needs, dependencies and constraints.[90] As always, the most valuable insights will come from the people who are already doing the work. Then the workflow needs to be redesigned, and the potential for any automation identified. Then suitable technologies should be sourced or developed to meet these needs. While much of the focus of the automation discussion is on headline-grabbing examples of AI diagnostics, there are many opportunities for automating different parts of clinical pathways with much simpler programs, including some developed in-house. A key benefit of involving clinical staff from the beginning of the project is to ensure that the system has a user-centric design which works as seamlessly as possible with the rest of the workflow. Anything which disrupts, rather than simplifies, the working day will struggle to be adopted.

## Invest in staff, training and culture change

Staff cannot be passive recipients of automation. They need a good understanding of issues such as data governance, the risk of biases, how to judge the performance of automated systems, how to understand the evidence and how to reconstruct pathways and workforce processes to maximise the benefit of the new way of working. Staff will need to be able to critically appraise digital technologies, which means having a reasonable understanding of how they work.[91] Clinicians and managers should have a basic appreciation of automation and concepts such as AI, and many will need a detailed understanding of issues such as user-driven design and change management. Transparency with staff is crucial, in everything from the eventual benefits to the practical difficulties during implementation. Engaging the staff fully in discussions with the process redesign engineers and then the development, testing and reviewing will improve the quality of delivery, identify difficulties earlier and engender a team spirit in overcoming the inevitable problems. Health systems need to recruit and train far more people specialising in disciplines such as computer science and data science. This is a highly competitive global market, so pay and conditions need to be attractive.

## Ensure clear board leadership of digital transformation and public/private partnerships

Boards, armed with the right digital talent in executive and non-executive positions, need to provide clear leadership for digital transformation. They need to ensure a shared understanding across the organisation of what they mean by digital transformation, build support among staff and service users and ensure there are sufficient resources to deliver the cultural as well as the technological changes to ensure success. Boards also need to lead the partnerships with the private sector, which means having board members with first-hand experience of working in the private sector. The board needs to establish a clear and shared understanding of the goals and the responsibilities of each partner, notably around the management of costs and risks. Partnership working means ensuring a good outcome for everyone, not simply trying to drive the hardest bargain.

*"One of the biggest barriers to change is the digital skills of our clinicians. How do we take people on a journey of improvement and empowerment?"*

Martin Bowles (Australia)

# Conclusion

Health systems must constantly evolve and shape themselves to changing economic, social and human imperatives. They must embrace the power of data to help them learn and to take advantage of new technologies to deliver high quality, sustainable care.

More than twenty years ago, I was one of many making the case for more comprehensive and transparent use of data to illuminate ways in which unwarranted variation in health outcomes might be reduced. The argument then, as it is now, was that high quality care is also better value care. The variation, however, continues – despite much good work in the intervening years – and remains a blight on modern healthcare. The quality and safety of patient care is uncertain, while the misallocation of resources as the demand for care increases threatens the solvency of many health systems.

The term 'automation' conjures up images of cold and impersonal machines, but it is the way to liberate the talents of healthcare staff to achieve a truly user-centred, personalised health service. Machine learning and Artificial Intelligence technologies offer immediate opportunities to free care givers and those who support them from time-consuming routine tasks, to devote their energies and expertise to more complex care. Patients will spend less time in hospital, have a better experience and secure better outcomes from diagnostics, treatment and monitoring tailored to their specific needs.

Healthcare must become a learning system where real-time analysis of performance and outcomes will facilitate constant improvements in quality and experience. Automation will enable healthcare systems to meet the triple challenge of rapidly ageing populations, a global shortage of millions of healthcare staff and healthcare budgets which are consuming an increasing proportion of GDP. The alternative is unsustainable levels of low productivity spending, overwhelmed hospitals and staff and poor outcomes. Automation is the key to high quality, sustainable healthcare for all.

This report by the Beamtree Global Impact Committee provides a blueprint for how automation can be integral to the foundations of modern, productive, digital, learning healthcare systems. It highlights some bright innovations, but it also serves as a call to action. Recent international initiatives like the Global Digital Health Partnership support health services to share best practice, but many patients continue to encounter health systems which operate on paper and fax machines.

I am grateful for Prof Britnell and the committee for showing us what is possible, and encourage all international healthcare system leaders to make automation the reality of the next few years, enabling our clinical colleagues to do what they do best. Better has no limit.

**Tim Kelsey**
CEO, Beamtree

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*Global healthcare policy expert*

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