HEALTHCARE SOLUTIONS: IMPROVING TECHNOLOGY ADOPTION.

Institution of MECHANICAL ENGINEERS

Improving the world through engineering

The last decade saw great technological progress in the healthcare sector. It also saw the democratisation of some aspects of healthcare with high-end equipment being re-engineered for adoption in developing economies.

This new decade is expected to be nothing short of amazing. We will see an increase in multidisciplinary technology entering the sector, including personalised medicine and miniature robotics which will herald a new wave of surgical innovation.

To optimise clinical outcomes, patient experience and the adoption of effective technology, a close partnership needs to be developed between engineering and healthcare professionals at all levels of care.

Dr Sylvain Jamais CEng FIMechE
Chair, Biomedical Engineering Division
Institution of Mechanical Engineers

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Executive Summary

Healthcare technology has developed rapidly over the past decade, with the pace of change expected to accelerate as a consequence of the current pandemic. The development of medical technology that has enabled previously intractable conditions to be treated has also triggered greater demand for innovation.

Despite this progress, healthcare services across the globe will continue to suffer from mounting pressures, driven by ageing populations, lifestyle conditions and the impact of poverty in poorer countries. The medical technology revolution is being driven by health data analytics and the digitisation of patient care pathways. This level of rapid change will require comprehensive strategies from Governments, regulatory authorities and healthcare providers to allow for timely development, evaluation, implementation and regulation of technology.

In the UK, the NHS has created a "Long-Term Implementation Framework"[1] to improve overall care for patients, which includes a drive to 'digitally-enable' service provision over the next 10 years. Alongside this, the Government has launched its 'Tech Vision'[2] outlining plans to introduce technical standards that digital services and IT systems in the NHS will have to meet. While this digital transformation will address some of the connectivity and data management issues facing the UK's health service, it falls short in looking at ways to improve medical device and equipment procurement and adoption in the long-term[3].

Technology innovation in the NHS is often a time consuming and costly process even if the innovation is relatively simple. Uptake of technology in the UK has been slow[4,5] often due to inconsistent approaches to innovation and poor specification by NHS Trusts. In some cases, technology is being incorrectly used or disposed of because it fails to meet the needs of the clinicians and patients[6].

This is not a phenomenon unique to the UK. Similar challenges to technology adoption exist across many of the world's healthcare systems.

A new approach is needed. The Institution of Mechanical Engineers believes that to deliver safe and affordable care in a fast-changing healthcare environment, Governments and healthcare providers need to look at implementing National 'Complete Lifecycle' technology adoption strategies. This approach would ensure equipment is correctly specified so it is fit for purpose and delivers the expected patient benefits, within budget. Healthcare engineers are already well placed to carry out this role but the benefits of their involvement will only be realised if a more consistent and coherent approach to their work is implemented.

Engineers across the healthcare sector must be empowered to take greater ownership of the procurement and implementation processes. This would include being directly involved in the design, selection, purchasing, maintenance, and decommissioning of medical equipment; adapting it to local environments to ensure it is fit for purpose, sustainable and cost effective.

To help achieve this, we are calling in a parallel report, 'Healthcare Solutions: Elevating the Engineering Workforce' for the creation of two new healthcare engineering roles. These are board-level Chief Engineers in hospitals and Patient-Enablement Engineers and Technicians in social care.

In the area of technology, the Institution has identified two areas which would offer the most widespread opportunity and significantly benefit from complete lifecycle technology adoption strategies:

Remote Monitoring of Patient Care

Remote monitoring is becoming increasingly important for managing the impact of conditions such as obesity and diabetes, ageing conditions such as Alzheimer's and frailty, as well as end-of-life palliative care. Effective management and support of remote monitoring systems and home diagnostics applications in social care settings will need both technically and clinically-trained professionals.

In 2017 the Institution called for the creation of a national Remote Health Monitoring (RHM) network[7], this was reiterated in its 2018 policy on Intelligent Assistive Technologies[8]. An RHM network that integrates acute and social care sectors using data analytics, wearables and sensors could revolutionise healthcare provision by easing logistical pressures and supporting care initiatives for patients outside hospital. A key element is the standardisation of RHM equipment that enables patients' information and care needs to be accessed anywhere in the healthcare network.

Advanced GP Surgeries

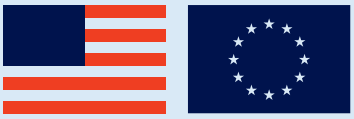
With many countries shifting healthcare focus to prevention rather than just cure, greater pressure is being placed on primary care services. There is an opportunity to establish national technology procurement and adoption strategies specifically aimed at GP surgeries to enable holistic prevention programmes to be supported. These 'Advanced GP Surgeries' would contain in-house early diagnostic technologies for liver, lung and bowel cancer for example, as well as blood testing, analysis and other preventative technologies. By enabling patients to be tested locally, waiting times and referrals could be reduced to days not weeks, saving thousands of pounds per patient and billions of pounds in long-term acute care costs.

The MedTech Industry

The medical technology industry is predicted to overtake pharmaceuticals in size and value **within the next 5 years**.

Conservatively, the global market was estimated at over **£356bn** in 2019[14].

The WHO estimates the average increase in global healthcare spend to be between **4%** and **6%** per year. At this rate of growth, it is expected as a society, we will spend over **£8tn on healthcare products and services by 2022**.



The US and EU are the two largest exporters of medtech, with markets worth **£130bn** and **£97.7bn** respectively.

There are more than **500,000** pieces of CE Marked medical equipment available for hospitals and social care settings across Europe alone[15].

The UK medical technology sector is made up of approx. **3,000** SMEs, employing over **100,000** people in core technology and **30,000** in Service & Supply, with an estimated annual turnover of about **£18bn**.

Around **6.6k** GP practices (~97%) are now enabled to accept appointment bookings from other NHS organisations

In March 2020 registrations to use the NHS App increased by **111%**

Introduction

Healthcare services across the globe are under growing pressure both demographically and technologically. The next decade will see further transformation in the way healthcare is delivered, including an increase in technology entering the sector. This ranges from personalised medicine delivery to autonomous surgical robotics.

Governments face the continuing challenge of supporting rapidly ageing populations with limited national financial and material resources. In the case of the UK, the structure of the NHS has yielded significant challenges, particularly in terms of development and delivery of technology to the front line. With its mix of centralised authority and regional self-governance, the route to technology adoption within the NHS can be an arduous one. As an organisation, the NHS is often resistant to innovation which does not deliver an immediate tangible benefit to patient care or cost saving, stifling medium and long term healthcare innovation strategies[9,3].

An isolated approach to procurement and inconsistent distribution of innovation within and between NHS trusts, in part due to suboptimal operational management processes, is a key reason for the slow uptake of technology in the UK[4,5]. Entrenched approaches to innovation have often resulted in unsuitable or poorly specified devices. In some cases, technology is being incorrectly used or disposed of because it fails to meet the needs of the clinicians and patients[6].

The adoption of technology will be affected further as this equipment becomes more complex and multidisciplinary with greater interconnectivity, integration, interoperability and interdependence. It is likely that if steps are not taken now to create sustainable strategies for complete lifecycle technology adoption and greater engagement with the engineering specialists who oversee it, the NHS may be unable to propagate a coherent and cost-effective approach to patient care.

Technology Adoption for Better Care

The adoption of technologies that can transform healthcare providers' ability to meet patient needs, rather than just solve immediate problems[3], is the ultimate goal for all medtech designers and suppliers. The reality is it can take on average 10 years for a new device to be adopted into the NHS.

This is in part due to the sheer volume of evidence needed to demonstrate the efficacy of the technology, such as wider impact on treatment, cost reduction and lessening in care interventions[3]. It is also a result of the complex nature of the NHS, which means there are not enough opportunities for sharing innovation between Trusts and across the healthcare service at large[10]. While challenging, the complexity of technology adoption within the NHS offers new opportunities for better, safer and more universally accessible care, which the Institution of Mechanical Engineers believes can be realised with greater intervention from the engineering community, alongside their clinical counterparts[11].

According to the World Health Organisation (WHO), progress in adopting technology varies widely from country to country. However, successful national technology adoption often goes beyond patient need and funding and requires the engagement of all healthcare stakeholders to deliver successful uptake[9]. In order to address the growing demands for more healthcare, and the technology to support patient care, an additional workforce is needed that can advocate and implement technology at a speed and scale that the NHS feels comfortable with. To achieve the level of technology adoption in the coming decades engineers will have to have a greater presence across the NHS to interact with and interpret clinicians' needs, understand the care pathway and be able to validate the devices in question[3].

Strengthening Existing Routes to Adoption

Going forward, the success of device adoption will depend on the route by which the intervention is delivered. While technology is a key enabler to successful patient outcomes it relies heavily on advocates who can create adoption opportunities. Organisations such as NHSX, a Government unit with responsibility for setting national policy and developing best practice for NHS technology, and the Accelerated Access Collaborative (AAC) have been playing an important role in connecting and promoting innovation across the NHS for several years.

The Academic Health Science Networks (AHSNs) are also connecting innovators with unmet patient needs, through learning collaboratives and developing actionable data to support improvements. However, progress remains patchy across the UK. By producing more accessible guidance and improving communication with medtech manufacturers, the National Institute for Health and Care Excellence (NICE) is hoping to further streamline and speed up time-to-market of new technology. NICE found that devices introduced under a nationally managed scheme showed more rapid and complete uptake than devices which were not part of a national programme. This does not mean that all new technologies should be mandated nationally but highlights the need for improved routes to adoption and the need for a robust infrastructure and the expertise of trained professionals to achieve it[9]. Both the Innovation Unit and Health Foundation have called for dedicated organisations to promote new technologies more widely across the NHS[3], however the engineering workforce within the NHS (known as Clinical Engineers) are already well placed to carry out this role.

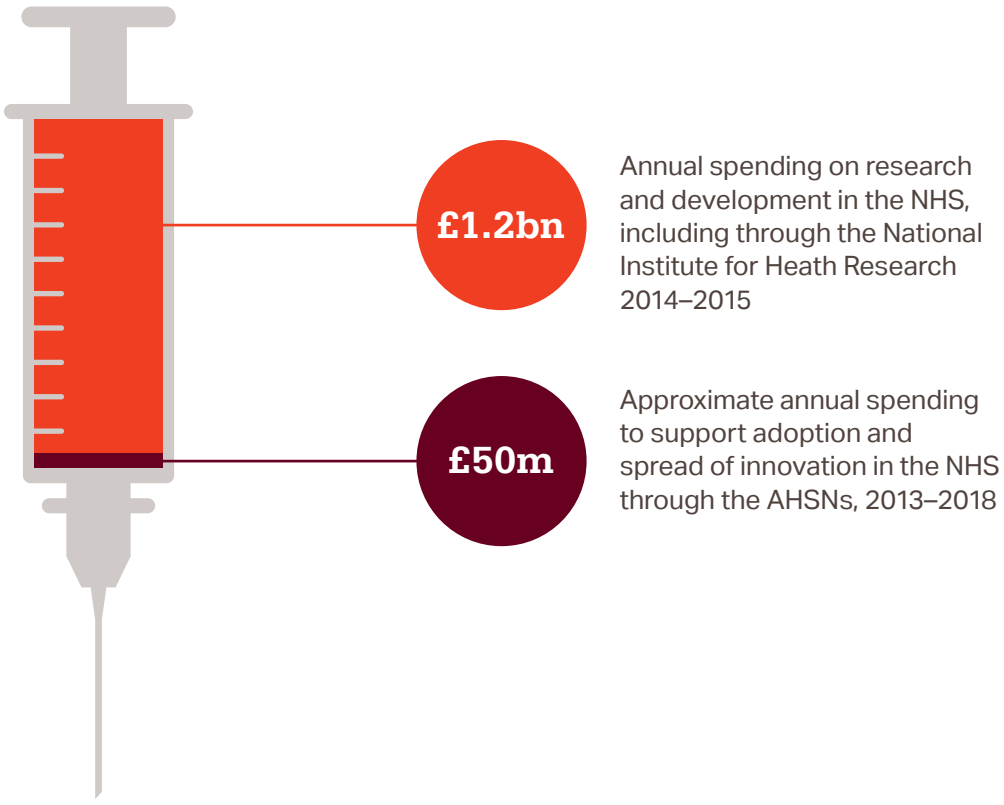
Time to Recognise the Value of Adoption

There remains a mismatch in the UK's health service between the money invested in developing technology versus the investment to adopt and spread that technology at scale. The NHS set aside less than 0.1% per year (£50m) of available resources between 2013 and 2018 for the adoption and spread of innovation compared to the £1.2bn it invested in R&D. Hesitancy in recognising the value of national technology adoption opportunities over the next five years could result in the NHS missing the opportunity to improve patient outcomes.

The role of GPs, social services, pharmacists and family carers must not be overlooked when considering how technology will be adopted. Empowering patients to play a more active role in their own care for example through remote health monitoring (RHM) or regular local testing at GP surgeries, could drive greater acceptance, compliance and adoption of technology[10].

Here lies an opportunity to create a national strategy to address care within the community, based on regional need, which could yield significant technology uptake. This would be managed through a nationwide network of engineers dedicated to patient enablement and providing patients with access to the right devices.

Figure 1: Comparison of spend on innovation and on adoption and spread of innovation in the NHS



What Are Medical Technologies?

Medical technologies provide life-changing solutions to many health problems, such as pacemakers and hip replacements. They also tackle issues such as the logistics of delayed patient transfer or improved health monitoring in the home. Medical technologies can be products, services or solutions which cover prevention, diagnosis and cure. There are three main categories:

- Medical devices that prevent, diagnose, monitor, treat and care for human beings by physical means.
- In-vitro diagnostics (IVDs), non-invasive tests used on biological samples such as blood, urine or tissue to determine the status of a person's health.
- Digital Healthcare which includes tools and services that use information and communication technologies to improve prevention, diagnosis, treatment, monitoring and management of health and lifestyle.[12]

Future medical devices will incorporate a myriad techniques and protocols to enable doctors to monitor and treat patients anywhere. Healthcare engineers continue to develop the capabilities of this technology; adapting existing solutions today to develop new devices and protocols for tomorrow, in a continuing effort to address global healthcare challenges.

Personalised Treatment

Advances in genomics will allow an individual's personal genome to be read, identifying disease risks even before any symptoms appear. Medicines and lifestyle regimes will be tailored to suit each person's profile.

Big Data Analytics & AI

The ability to process enormous amounts of data will allow connections to be made about people's health that might otherwise not have been noticed. Personal medical records will be instantly accessible whenever needed, without the delays and errors associated with sharing hard copy notes and images, enabling rare disorders to be identified and linked or hotspots of disease to be pinpointed.

Nanomedicine

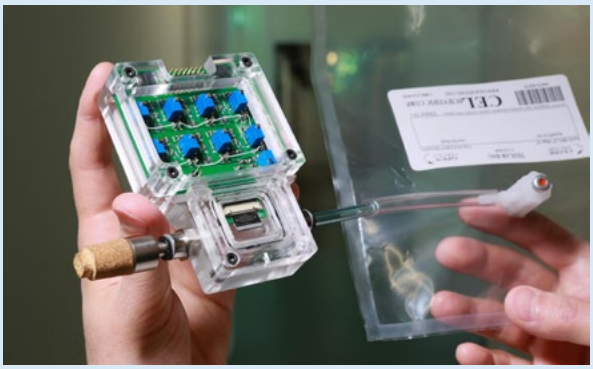
The development of micro- and nano-scale sensors and materials will create new methods of drug delivery, diagnosis and treatment. Such techniques will avoid the risks and complications of traditional surgery and will allow even complex interventions to be treated as day cases.

Remote Diagnosis and Treatment

The development of smart phone apps and body-worn measurement systems for healthcare will be combined with more sophisticated systems for assisting in the monitoring and control of diabetes, heart disease and management of medication. These remote monitoring systems will put the patient in direct control of their own health, with access to expert support when needed.

Digital Twins

The creation of digital replicas of a patient's organs to test procedures such as cardiac synchrosation therapy and drug therapies, are being assessed on biophysical numerical models to speed up implementation or avoid resorting to animal testing.



CANCER

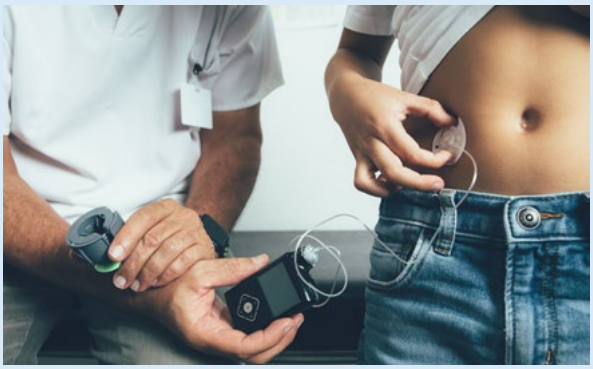
Globally, about 1 in 6 deaths are due to cancer; an estimated 9.6 million deaths in 2018. The most common is lung cancer (1.76 million deaths per year)

A breath tester for detecting oesophageal cancer has the potential to detect early stage throat cancers and can be used in a GP surgery. It uses a chemical reaction in the nanoparticles embedded in the detector to create an electrical signal which corresponds to the percentage of cancer cells.

MENTAL HEALTH

1 in 4 people in the world are affected by mental or neurological disorders. By 2030, the global cost of all mental health could amount to $16tn[13]

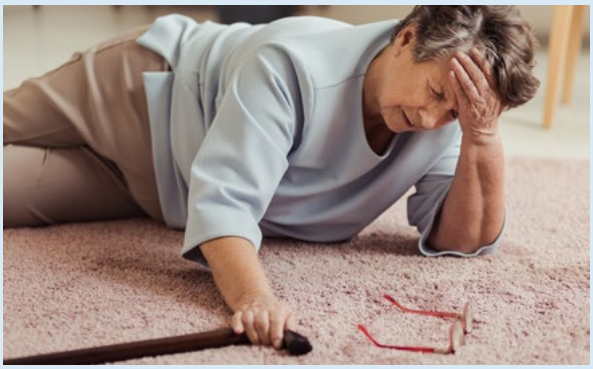
Wearable technology can detect emotions, breathing patterns and other physiological signs. Once detected, the device sends a signal or a text notification with suggestions on how to relax or other wellness tips needed to improve your mood.



DIABETES

Diabetes is costing the NHS around 10% of its annual budget; that's nearly £10bn a year, or £1m every hour (4m people by 2025).

In 2016, the world's first artificial pancreas was approved for use. The device monitors blood sugar and supplies insulin automatically. It can be monitored remotely via a smartphone and be set to give the right doses of insulin when needed.



AGEING

Falls are the number one cause of injury and death among older adults and the number one reason for hospital admissions for trauma.

Technology that can detect subtle changes in an older person's gait can alert a doctor or caregiver of the increased likelihood of a fall before it happens. Smart carpet has been developed with plastic optical fibres in the underlay to track walking patterns in real-time. It is designed to detect the changes in gait that can precede a fall.

Technology Lifecycle Strategy

It is the Institution's opinion that systematic and sustainable medical technology adoption, with emphasis on the full lifecycle of that technology, will be key to ensuring the delivery of safe, affordable care not just in the UK but on a global scale. Failure to act on these obligations will place increased risk on patients' health in the long term. Adoption of technology needs to be considered as a service improvement and incorporated as such, rather than trying to squeeze new technology into existing, and often technology-saturated environments[10].

Technology adoption and the lifecycle strategies that support it, will only be realised if healthcare providers implement a more consistent and coherent approach to the role of engineering; particularly healthcare engineers who span both the clinical and technical worlds. National strategies could be achieved by empowering these engineers to take greater ownership of the procurement and implementation processes, including the design, selection, purchasing, maintenance and decommissioning of these devices through a nationwide network.

The importance of experienced healthcare engineers, who could provide practical validation of technology and help healthcare providers to adapt nationally available innovations in a local context, should not be underestimated. Transferring some of the strategic decision-making and national regulatory requirements to a network of board-level Chief Engineers for example, would accelerate the spread of innovation and develop new processes by which technology is adopted [7,10].

Conclusion

The Institution of Mechanical Engineers is committed to ensuring that performance, safety and ethical standards are maintained across the profession when creating transformative technology such as that used in the healthcare sector.

The Institution is well-placed to support healthcare engineers to provide workable and cost-effective solutions that will inform decision-making at all levels of Government and care provision. This will ensure the highest levels of care and safety for patients and that where technology and services are being implemented, they are the right tools for the job.

In ever more technical surroundings, we need engineers to ensure our healthcare providers are able to make the best decisions possible regarding medical equipment, which can facilitate early diagnosis and provide better and more cost-effective treatment for patients. In response to international healthcare challenges, the Institution urges all healthcare engineers across the globe to establish and share strategies and best practice processes for technology adoption through engineering communities and networks.

Innovation cannot be expected to spread passively. It requires insight into the application, awareness of the clinical setting and an in-depth knowledge of the function of the technology, to ensure active acceptance.

The realistic and long-term adoption of technology can no longer be the sole responsibility of the clinician but must include healthcare engineers who are able to implement innovations and adapt them to the local environments; ensuring they are fit for purpose.

To initiate a national technology lifecycle strategy the Institution recommends focusing on two key areas of care provision: remote monitoring of patients in the community and the provision of primary care services through GP surgeries. These offer the best and most widespread opportunity for technology adoption.

Remote Monitoring of Patients

A technology adoption strategy to address the management and support of medical devices used in social care settings, such as remote patient monitoring and home diagnostics applications, will be fundamental to addressing lifestyle disease such as obesity and diabetes, ageing conditions such as Alzheimer's and frailty as well as end-of-life palliative care.

The creation of national remote health monitoring (RHM) networks which integrate acute and social care sectors could revolutionise healthcare provision by easing logistical pressures and supporting care initiatives for patients outside hospital. A key element will be standardisation of RHM technology that enables patient data to be accessed anywhere in the network.

Advanced GP Surgeries

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Institution of Mechanical Engineers

1 Birdcage Walk
Westminster
London SW1H 9JJ

T +44 (0)20 7973 1293
F +44 (0)20 7222 8553

media@imeche.org
imeche.org