The Future State of Health and Healthcare in 2035

A vision for seven technologies reshaping the NHS

IMPERIAL
Institute of Global Health Innovation

NHS
Imperial College Healthcare
NHS Trust

Authors: A. Darzi, G. Butterworth, P. Howitt

This document represents a vision for the future of healthcare in England, grounded in evidence and guided by the principles that have made the NHS a model for the world. The transformation outlined here is not just possible – it is essential for ensuring that the NHS continues to provide world-class care for generations to come.

Contents

Foreword: The Dawn of a New Healthcare Era

We stand at the threshold of one of the greatest healthcare transformations in human history. Not since the discovery of antibiotics or the founding of the NHS itself have we witnessed such potential for revolutionary change. The convergence of artificial intelligence, genomics, digital technology, and breakthrough therapeutics is creating possibilities that would have seemed like science fiction just a decade ago.

Healthcare has always evolved in response to the seismic shifts that reshape our world. The Industrial Revolution demanded public health reform as populations crowded into cities. The devastation of World War II gave birth to the NHS, a beacon of hope rising from the ashes of conflict. The COVID-19 pandemic became our latest crucible, accelerating changes that might otherwise have taken decades while simultaneously exposing fragilities in our system that we can no longer ignore.

Today, we face another defining moment – one driven not by crisis, but by unprecedented opportunity. The rapid advance of transformative technologies offers us the chance to reimagine healthcare from the ground up. We can create a system that doesn't just treat illness, but prevents it. One that doesn't just respond to symptoms, but predicts and intervenes before they appear. A healthcare ecosystem that is not merely reactive, but truly proactive, personalised, and productive.

This white paper emerges from the Future State Programme, an exercise commissioned by Secretary of State for Health and Social Care, Wes Streeting, with a bold mandate: to envision what healthcare could look like in 2035 and chart the path to make that vision reality. What we discovered through extensive research, consultation, and analysis is both thrilling and urgent. The technologies that will transform healthcare are not distant dreams – they exist today. Our challenge is not invention, but implementation at scale.

We have identified seven technological opportunities that, when combined, will fundamentally reshape the NHS. These innovations – from the revolutionary potential of genomics and artificial intelligence to the democratising power of wearables and digital first access – represent more than incremental improvements. They are the building blocks of a healthcare transformation.

The NHS App will become the digital front door through which 90% of healthcare interactions begin, saving millions of unnecessary GP visits. GLP-1 medications will slash obesity rates in half, transforming not just individual lives but entire communities. Wearable devices will shift us from episodic care to continuous monitoring, catching diseases before symptoms appear. Universal genomic screening will unlock personalised medicine for every child born in England. Ambient AI will liberate our healthcare workers from administrative burdens, allowing them to focus on what they do best, caring for patients. Advanced robotics will deliver precision care that exceeds human capabilities while extending the reach of healthcare professionals to every corner of the nation. And sharable, dynamic data will be the lifeblood of future healthcare, enabling the other six innovations.

The United Kingdom possesses extraordinary advantages in this transformation. Our world-class datasets, scientific talent, and taxpayer-funded system are internationally envied assets. We have the NHS – an institution that touches every life in England and commands unparalleled public trust. We have researchers and innovators who have given the world everything from the first IVF baby to the COVID-19 vaccine. We have the infrastructure, the expertise, and the determination to lead the world in healthcare innovation.

But we also face sobering challenges. Too many proven technologies languish in pilot programmes, suffocated by the complexity of our health and care system. Too many innovations that could save lives and reduce costs never make it beyond the laboratory door. Our digital infrastructure remains fragmented and outdated, too often acting as a brake rather than a springboard for progress. Too many opportunities slip through our fingers while other nations surge ahead.

That must change. The choices we make today will determine whether England leads the healthcare transformation or watches from the sidelines. Whether we seize this moment to create a health system worthy of the 21st century or allow ourselves to fall behind.

The vision outlined in these pages is not just possible – it is inevitable. The question is not whether these technologies will transform healthcare, but when. Will England be at the forefront of that transformation, or lagging behind? With the right choices, bold leadership, and unwavering commitment to our founding principles of healthcare that is free at the point of need, we can create something extraordinary.

We can build a healthcare system that doesn't just treat the sick, but keeps people healthy. One that doesn't just respond to crises, but prevents them. A system that harnesses the power of technology not to replace human compassion, but to amplify it. This is our opportunity to write the next chapter in the NHS story – one that matches the ambition of 1948 but embraces the possibilities of 2035.

The future of healthcare begins now. Let us seize it together.

The Rt Hon. Professor the Lord Darzi of Denham OM KBE FRS FMedSci HonFREng

Executive Summary: The Transformation Begins Now

Imagine walking into a hospital in 2035. The experience bears little resemblance to healthcare today. Your smartphone – running the NHS App that has become as essential as your banking app or social media platform – has already analysed your symptoms, scheduled your appointment, and prepared your medical team with a complete picture of your health. Wearable sensors have been monitoring your vital signs for months, detecting the early whispers of illness long before you felt unwell. Your genetic profile, mapped at birth, has guided a lifetime of personalised prevention strategies. Robotic assistants handle logistics and support care delivery with precision that exceeds human capabilities. And when you arrive, AI assistants handle the paperwork while doctors focus entirely on your care.

This is not science fiction. This is the achievable future of the NHS – if we act decisively today.

Technology is revolutionising healthcare with breathtaking speed, making it more personalised, predictive, and preventative than ever before. Yet the NHS, despite its many strengths, has struggled to harness these innovations at scale. We cannot afford to let this pattern continue. The cost of inaction is measured not just in pounds and pence, but in lives that could be saved, suffering that could be prevented, and potential that remains unrealised.

The Future State Programme has identified seven transformative opportunities that will fundamentally reshape healthcare delivery by 2035. These are not distant possibilities requiring breakthrough discoveries – they are proven technologies ready for implementation. Our task is not to invent the future, but to build it.

The Seven Pillars for Healthcare Transformation

First, we will harness data to deliver impact. High-quality, interoperable health data powers artificial intelligence algorithms, genomic discoveries, wearable insights, and robotic precision. The NHS possesses unparalleled data assets that provide the foundation for all other technological transformations, enabling coordinated care that is greater than the sum of its parts.

Second, we will transform the NHS App into England's most essential digital tool. With a superb user interface rivalling the best consumer apps and powered by AI navigation, it will become the digital front door through which 90% of healthcare interactions begin. This single innovation could eliminate millions of unnecessary GP visits, saving the NHS billions annually while giving patients unprecedented control over their health journey.

Third, we will launch transformative obesity interventions leveraging GLP-1 medications. Through comprehensive large-scale trials, we will demonstrate how these breakthrough drugs can halve obesity rates while generating invaluable data on their broader health benefits. These landmark interventions will provide definitive evidence for national policy development and inform optimal delivery models for universal access, transforming millions of lives and saving billions in healthcare costs.

Fourth, we will make remote monitoring through wearables the new standard of care. Starting with elderly people living alone and those with chronic conditions, we will deploy AI-powered wearable devices that continuously monitor health, predict problems before they occur, and enable early intervention. This shift from episodic to continuous care will revolutionise how we detect and treat disease.

Fifth, we will introduce universal genomic screening at birth. Every child born in England will receive a genetic map that guides personalised prevention strategies throughout their lifetime. Combined with AI-powered digital twins that integrate genetic, environmental, and behavioural data, this will enable us to predict and prevent diseases before symptoms appear, ushering in an era of truly personalised medicine.

Sixth, we will deploy ambient AI throughout the healthcare system. These invisible assistants will handle administrative tasks, capture clinical notes, optimise schedules, and free up healthcare workers to focus on patient care. Conservative estimates suggest this could save each clinician 13.5 hours per week – time that can be redirected to healing, caring, and connecting with patients.

Seventh, we will implement comprehensive robotics to support precision care. From surgical robots that increase hospital production by 21-26% to rehabilitation systems that improve therapy compliance by 50%, and from service robots that reduce medication errors by 85-95% to care robots that provide 24/7 monitoring, robotic systems will deliver precision and consistency that human systems cannot match while extending the reach of healthcare professionals.

These opportunities are interconnected and mutually reinforcing. The NHS App becomes more powerful when integrated with wearable data. Genomic insights become actionable when combined with continuous monitoring. AI assistants become more effective when they can access comprehensive patient data. Robotic systems operate with greater precision when guided by real-time AI analysis and genomic profiles. Together, they form an ecosystem of innovation that will transform every aspect of healthcare delivery, supported by the data infrastructure that enables seamless coordination.

The potential impact is staggering. We could prevent millions of cases of diabetes, heart disease, and cancer. We could detect Alzheimer's and Parkinson's years before symptoms appear. We could reduce hospital admissions, eliminate waiting lists, and ensure that every person receives care tailored to their unique needs. We could create a healthcare system that keeps people healthy rather than simply treating them when they become sick.

But this transformation requires more than technology – it demands bold leadership, strategic investment, and unwavering commitment to equity and access. We must ensure that these innovations reduce rather than exacerbate health inequalities. We must build public trust through transparent governance and ethical data stewardship. We must modernise digital infrastructure so that it can support the scale, speed and security required by these new innovations. And we must train our workforce for this new era of healthcare delivery.

The technologies are advancing rapidly. The public's expectations are rising. We must act now, with the urgency and ambition that this moment demands, if we are to have the NHS the public deserves.

Healthcare in 2035 can be radically different from today – more effective, more efficient, more equitable, and more human. But only if we choose to make it so. The transformation begins with the decisions we make today. The future of the NHS – and the health of our nation – hangs in the balance.

The time for incremental change has passed. The era of transformation has begun.

Introduction: Standing at the Threshold of Transformation

"People often overestimate what will happen in the next two years and underestimate what will happen in ten"

— Bill Gates[1]

Bill Gates wrote these words as a technology pioneer who would later dedicate his life to solving global health challenges. His insight captures perfectly the spirit that drives the Future State Programme – the recognition that while change often feels impossibly slow in the short term, it can be breathtakingly transformative over a decade. We stand today at precisely such a moment of potential transformation.

The NHS Investigation revealed a sobering truth: Over the past decade, our health service has been systematically starved of the capital investment needed to embrace transformative technologies.[2] While other sectors raced ahead with digital innovation, the NHS remained trapped in outdated systems, still purchasing fax machines in 2017 while the rest of the world moved to smartphones and cloud computing.[3] This technological stagnation has not just hindered efficiency – it has limited our ability to save lives, reduce suffering, and deliver the kind of care our patients deserve.

But the NHS 10 Year Plan represents a turning point. It signals a commitment to reverse this trend and invest boldly in the technologies that will define 21st-century healthcare. The question is no longer whether we will modernise, but how we will prioritise our investments to achieve maximum impact. This is precisely where the Future State Programme provides essential guidance.

The technological revolution surrounding us is not a distant phenomenon – it is reshaping every aspect of human experience right now. Artificial Intelligence (AI) is achieving superhuman performance in complex tasks. Robotics and nanotechnology are pushing the boundaries of what we thought possible. Genomics is unlocking the secrets of life itself. The convergence of these innovations in healthcare represents perhaps the greatest opportunity for human advancement in our lifetime.

Over the next decade, this technological convergence will fundamentally transform how we predict, prevent, diagnose, and treat disease. We are moving from a reactive healthcare model, where we wait for people to become sick before intervening, to a proactive system that maintains health and prevents illness. We are shifting from one-size-fits-all treatments to precision medicine tailored to each individual's unique genetic, environmental, and lifestyle profile. We are evolving from episodic care delivered in hospitals to continuous monitoring and support provided wherever people live and work.

The Future State Programme was organised in four themes (see Appendix A) to provide a compelling view of the future of care. Four Theme Reports are published alongside this paper.

Theme 1: A New Ecosystem for Health Promotion and Protection

Imagine a future where diseases are predicted and prevented before symptoms ever appear. Where every person's health journey begins with universal genetic screening at birth, creating a personalised roadmap for lifelong wellness. Where AI-powered digital twins continuously analyse vast streams of data – from genetics and epigenetics to microbiome patterns, behavioural indicators, lifestyle factors, and environmental exposures – to detect disease at the molecular level and recommend targeted interventions.

This is not fantasy – it is the emerging reality of precision medicine. The UK is uniquely positioned to lead this "omics" revolution,[i] building on extraordinary assets like UK Biobank, Genomics England, and Our Future Health. But realising this potential requires more than scientific capability. It demands public trust,

[i] Omics is the collective term given to a range of disciplines to understand biological molecules including genomics, proteomics, metabolomics, metagenomics, phenomics and transcriptomics.

ethical data stewardship, and regulatory frameworks that ensure these innovations are deployed safely, fairly, and equitably across all communities.

AI will be the engine that makes this transformation scalable, analysing anonymised population data to identify high-risk groups and optimise interventions. This approach will be particularly transformative for diseases that impose the greatest burden on society – cancer, cardiovascular disease, and neurodegenerative conditions that affect millions of families and cost billions in treatment.

Theme 2: Faster, Better and Earlier Diagnosis

We are entering a diagnostic revolution that will redefine early detection and intervention. No longer will diagnosis be confined to hospitals or limited to late-stage detection when treatment options are most limited and outcomes poorest. Instead, diagnostic capabilities will be continuous, personalised, and seamlessly integrated into daily life – in our homes, workplaces, and communities.

Wearable devices, biosensors, and home-based diagnostic tools will monitor everything from heart rate variability and sleep patterns to biochemical changes and subtle shifts in speech or movement patterns. These devices will often detect signs of disease months or even years before symptoms appear, when interventions are most effective and least invasive. AI will interpret these continuous data streams in real time, alerting both individuals and care teams to early warning signs and guiding timely, targeted responses.

For our ageing population and the millions living with long-term conditions, this shift holds transformative potential. Instead of waiting for crises that require emergency intervention, we will maintain health through continuous optimisation and early intervention. The result will be better outcomes, lower costs, and dramatically improved quality of life.

This diagnostic revolution will also transform the role of healthcare professionals. Community clinicians will oversee entire populations through predictive dashboards, focusing their expertise where it is most needed – on high-risk, complex cases that require human judgement and compassion. Real-world data from wearables will accelerate research, speed up clinical trials, and enable personalised prevention strategies at unprecedented scale.

Theme 3: A New Treatment Paradigm

Scientific breakthroughs are already reshaping modern medicine and accelerating the NHS's evolution toward a more preventative healthcare system. The dramatic rise of GLP-1 medications as effective treatments for obesity, and their emerging potential in conditions as diverse as Alzheimer's disease[4] and cancer, illustrates the transformation already underway.

In this new era, therapies will not simply be discovered through trial and error. They will be designed with precision, powered by advances in AI, genomics, and platform technologies like CRISPR gene editing and mRNA therapeutics. AI will not only accelerate drug development but also optimise clinical trial design and simulate treatment responses through digital twins, dramatically reducing the time and cost of bringing new treatments to patients.

Personalised, precise treatment will become the new standard of care. Treatment pathways will be guided by each person's unique genetic profile, lifestyle factors, and environmental exposures. This represents not just an opportunity to improve outcomes, but a chance to redefine what high-quality care means in the 21st century.

Theme 4: Innovation in Healthcare Delivery

The NHS must embrace the digital-first approaches that have revolutionised other sectors. Banking, retail, and transportation have all been transformed by data and digital technology, creating more efficient, accessible, and personalised services. Healthcare must follow this path, but with the added imperative of maintaining the human touch that is central to healing and care.

Health information will flow seamlessly and securely across all organisations and systems, creating complete electronic patient records that follow individuals throughout their lives. This integrated data environment will empower healthcare professionals by freeing them from administrative burdens and enabling them to focus on what they do best, caring for patients.

The NHS has a unique opportunity to create the world's largest longitudinal health dataset and use it as the engine for continuous innovation. This transformation will lead to a fundamental shift in healthcare delivery models, focusing them on individuals rather than institutions, and delivering care closer to where people live and work.

The Promise and Peril of Artificial Intelligence

AI will have the most transformative impact across the health and care system, evolving from basic automation to capabilities that exceed human performance in many tasks.[5] Over the next decade, AI will become a fully integrated layer of intelligence supporting high-quality care across every aspect of the NHS.

AI assistants will act as proactive health partners, offering personalised support for everything from chronic condition management to mental wellbeing. AI will augment clinicians' diagnostic and treatment capabilities while freeing up time to enhance patient-clinician relationships. There will be a substantial increase in the volume of tasks that can be automated, improving access, optimising workflows, and allowing staff to focus on patients rather than paperwork.

AI will also unlock new frontiers in biology and medicine. By simulating complex biological systems, AI-powered drug discovery will design new precision therapeutics tailored to individual genetic profiles and disease characteristics. This represents a fundamental shift from the current model of developing drugs for broad populations to creating treatments optimised for specific patient groups or even individuals.

The effective implementation of AI in healthcare requires careful thought. The Institute of Global Health Innovation will shortly publish a paper on implementing AI in the NHS.

The Seven Pillars of Healthcare Transformation

1. Integrated Data to Deliver Impact: The Foundation of Innovation

Data underpins healthcare transformation. The flow and integration of data allows for the creation of coordinated care that transcends the capabilities of any single innovation. High-quality, interoperable health data brings in genomic discoveries and wearable insights, informing artificial intelligence algorithms and robotic precision to deliver personalised, predictive, and preventive healthcare.

The NHS possesses what has been described as health data "unmatched anywhere else in the world."[6] This extraordinary asset represents more than a competitive advantage – it provides the foundational infrastructure upon which all other technological transformations depend. The NHS number serves as a powerful tool for data linkage across different settings, creating comprehensive patient records that follow individuals throughout their healthcare journey from cradle to grave. This longitudinal data capability, covering the entire population without bias based on ability to pay, represents a unique asset that few healthcare systems worldwide can match.

Advanced data integration systems ensure that insights from AI algorithms inform robotic procedures, that genomic data guides wearable monitoring parameters, and that real-time sensor data triggers appropriate AI-driven interventions. This orchestrated approach transforms healthcare from a collection of disconnected services into a coordinated system that anticipates needs, prevents problems, and delivers precisely the right intervention at exactly the right moment.

The technical infrastructure required to support this data orchestration represents one of the most significant investments in NHS history. Cloud-based platforms must provide secure, scalable storage and processing capabilities for petabytes of health data generated by millions of patients across thousands of healthcare settings. Interoperability standards must ensure that data flows seamlessly between different systems, from GP practices and hospitals to wearable devices and home monitoring systems. Privacy-preserving technologies must enable data sharing for research and population health insights while protecting individual privacy and maintaining public trust.

The economic value of this data infrastructure extends far beyond operational efficiency. By enabling predictive analytics that identify high-risk patients before they require expensive emergency interventions, data-driven care coordination could reduce healthcare costs significantly whilst improving outcomes.[7] Population health insights derived from comprehensive data analysis could inform public health interventions that prevent disease at scale, generating savings that dwarf the initial infrastructure investment.

Perhaps most importantly, data enables personalisation at population scale. While traditional healthcare delivery relies on standardised protocols applied broadly across patient populations, data-driven care enables treatment pathways tailored to individual genetic profiles, lifestyle factors, and environmental exposures. This personalisation extends beyond clinical care to encompass prevention strategies, wellness programmes, and health education initiatives that address each person's unique needs and circumstances.

The transformation from data scarcity to data abundance also creates new responsibilities and challenges. Robust governance frameworks must ensure that data is used ethically and transparently, with clear consent mechanisms and strong privacy protections. Algorithmic bias must be actively identified and corrected to ensure that data-driven insights improve rather than exacerbate health

inequalities. Cybersecurity measures must protect sensitive health information from increasingly sophisticated threats.

The NHS's unique position as a unified, publicly funded healthcare system creates extraordinary opportunities for data-driven transformation that fragmented healthcare systems cannot match. The ability to link data across all healthcare settings, from primary care to specialist services, from mental health to social care, enables comprehensive understanding of patient journeys and population health patterns. This integrated view supports care coordination that addresses the whole person rather than isolated conditions or episodes.

As new data sources and analytical capabilities emerge, more impactful integration of data can occur. Internet of Things sensors[ii] will provide continuous environmental monitoring that informs health recommendations. Social determinants data will enable interventions that address the root causes of health inequalities. Real-world evidence from millions of patients will accelerate research and enable rapid optimisation of treatment protocols.

The vision of data as an enabler represents more than technological capability – it embodies the NHS's founding principles of universal access and comprehensive care, enhanced by the precision and personalisation that only coordinated technology can deliver. By 2035, every patient interaction will be informed by the full suite of available data, ensuring that care decisions are based on the most complete and current understanding of individual needs and population health patterns.

This data-driven transformation will fundamentally change how healthcare professionals work, providing them with unprecedented insights into patient needs while freeing them from administrative burdens that currently consume valuable time. Clinicians will have access to predictive analytics that identify patients at risk of deterioration, population health dashboards that guide preventive interventions, and decision support tools that recommend optimal treatment pathways based on the latest evidence and individual patient characteristics.

Integrated, rich data will allow people to stay healthy, detect problems early when they are most treatable, and deliver care that is precisely tailored to individual needs. This represents the future of healthcare delivery, where technology amplifies rather than replaces human compassion, and where data serves as the foundation for care that is truly patient-centred, evidence-based, and continuously improving.

2. The Digital Front Door: NHS App 2.0 Becomes England’s Most Essential Tool

The NHS App represents the most visible manifestation of healthcare's digital transformation, serving as the primary interface between patients and the health system. By 2035, this digital front door will become as essential to daily life as banking apps or social media platforms, fundamentally changing how people access, manage, and engage with their healthcare.

The current NHS App, while functional, represents only the beginning of what digital health engagement can achieve. The next generation will leverage artificial intelligence, machine learning, and seamless integration with wearable devices to create a personalised health companion that anticipates needs, provides proactive guidance, and coordinates care across all healthcare settings.

[ii] The Internet of Things refers to a network of physical objects – "things" – embedded with sensors, software, and other technologies that allow them to connect and exchange data with other devices and systems over the internet

AI-powered navigation will transform the user experience from reactive service access to proactive health management. Instead of waiting until symptoms appear to seek care, users will receive personalised health insights based on their genetic profile, lifestyle factors, and continuous monitoring data. The app will identify early warning signs of health problems and guide users toward appropriate interventions, often preventing the need for more intensive medical care.

The integration of wearable device data will enable the app to provide real-time health monitoring and feedback. Heart rate variability, sleep patterns, activity levels, and other biometric data will be continuously analysed to identify trends and anomalies that might indicate emerging health issues. Users will receive personalised recommendations for lifestyle modifications, preventive care, and when to seek professional medical attention.

Appointment scheduling will become intelligent and predictive, with the app automatically identifying optimal timing for routine care based on individual health patterns and risk factors. For users with chronic conditions, the app will coordinate care across multiple specialists, ensuring that appointments are scheduled in logical sequences and that all healthcare providers have access to relevant information before each encounter.

The app will serve as a comprehensive health record that follows users throughout their lives, integrating data from all healthcare interactions, wearable devices, and self-reported information. This longitudinal view will enable healthcare providers to understand each patient's complete health journey, identifying patterns and trends that might not be apparent from individual encounters.

Medication management will be revolutionised through intelligent reminders, drug interaction checking, and integration with pharmacy systems for seamless prescription fulfilment. The app will monitor medication adherence through various methods, from simple reminders to integration with smart pill dispensers, and will alert healthcare providers when intervention may be needed.

The economic impact of widespread NHS App utilisation could be transformative. By enabling more efficient triage, reducing unnecessary GP visits, and facilitating early intervention for health problems, the app could save the NHS billions of pounds annually while improving patient outcomes. Conservative estimates suggest that 90% of healthcare interactions beginning through the digital front door could eliminate millions of unnecessary appointments while ensuring that serious health issues receive prompt attention.[iii]

Mental health support tools will be seamlessly integrated into the app experience, providing access to evidence-based interventions, mood tracking, and connection to professional support when needed. The app will use natural language processing to analyse user communications and identify signs of mental health concerns, offering appropriate resources and escalating to human support when necessary.

For elderly users and those with limited digital literacy, the app will provide multiple interaction modalities, including voice interfaces, simplified visual designs, and integration with family member accounts for supported access. The goal is universal accessibility that ensures no one is excluded from the benefits of digital health engagement.

The app will also serve as a platform for public health initiatives, providing personalised health education, vaccination reminders, and participation opportunities in research studies. Users will be able

[iii] If the NHS can replicate the banking sector in adopting digital first interactions.

to contribute to population health research through anonymised data sharing while receiving insights about their own health risks and prevention opportunities. In doing so, the App can become the "digital-first Personalised National Prevention Service" called for by the Council for Science and Technology.[8]

Privacy and security will be paramount, with advanced encryption, biometric authentication, and granular consent mechanisms ensuring that users maintain complete control over their health information. Transparency about data use and clear opt-out mechanisms will build and maintain public trust in digital health platforms.

The government has already committed £50 million to upgrade the NHS App and start this journey.[9] One welcome announcement has been that it will be possible to sign-up to clinical trials via the NHS App.[10]

By 2035, the NHS App will represent more than a digital service – it will embody a fundamental shift toward patient-centred, proactive healthcare that empowers individuals to take control of their health while ensuring that professional medical care is available when needed. This digital transformation will make healthcare more accessible, efficient, and effective while maintaining the human touch that is central to healing and care.

3. The Obesity Breakthrough: GLP-1s Transform Lives Through Innovation

The emergence of GLP-1 receptor agonists represents one of the most significant therapeutic breakthroughs in modern medicine, offering unprecedented potential to address the obesity crisis that affects approximately 13 million people[11] and costs the NHS billions of pounds annually.[12] These medications, originally developed for diabetes treatment, have demonstrated remarkable efficacy in promoting weight loss while providing additional health benefits that extend far beyond metabolic improvements.

The current evidence base for GLP-1 medications is compelling and continues to expand. Clinical trials have demonstrated average weight loss of 15-25% in obese individuals,[13] with some patients achieving even greater reductions. More importantly, these medications appear to address the underlying biological mechanisms that make long-term weight maintenance so challenging, offering hope for sustainable weight management that has eluded previous interventions.

The broader health benefits of GLP-1 medications extend well beyond weight loss, with emerging evidence suggesting potential applications in cardiovascular disease, cancer prevention, and neurodegenerative conditions.[14] This expanding therapeutic potential transforms these medications from obesity treatments into comprehensive health interventions that could address multiple chronic conditions simultaneously.

Current NHS implementation of GLP-1 therapy follows a cautious, phased approach that prioritises patients at highest risk while managing cost and capacity constraints. While this measured approach ensures safety and appropriate resource allocation, it may not fully capture the transformative potential of these medications at population scale.

A Bold Vision for Obesity Intervention

The NHS must embrace more ambitious approaches to obesity intervention that match the scale of the challenge and the potential of available treatments. We propose comprehensive large-scale trials, building on the 5 year trial for 3,000 obese people in Manchester,[15] partnering with pharmaceutical companies to provide GLP-1 medications to substantial populations of obese adults. These trials would

represent landmark obesity interventions designed to generate definitive evidence for national policy development and inform optimal delivery models for universal access.

Strategic implementation would prioritise regions and populations with the highest obesity rates and poorest health outcomes, ensuring interventions have the greatest impact on health inequalities while generating robust evidence for national policy development. This approach aligns with the founding principles of the NHS – providing universal access based on need rather than ability to pay, and prioritising those who are most disadvantaged.

The trials would be structured as comprehensive research programmes, collecting rich data on outcomes across multiple domains. We would track not just weight loss and metabolic improvements, but also impacts on mental health, employment, social participation, and quality of life. We would examine effects on healthcare utilisation, prescription costs, and emergency department visits. Most importantly, we would investigate the broader health benefits of GLP-1s, including their potential effects on cardiovascular disease, cancer risk, and neurodegenerative conditions.

Innovative Financing for Transformative Impact

The upfront costs of ambitious obesity intervention programmes would be substantial, but innovative financing mechanisms could make such investments both feasible and financially attractive. Social impact bonds or similar financial instruments could allow private investors to fund upfront costs in exchange for a share of long-term savings generated by improved health outcomes.

The economic case for large-scale GLP-1 intervention is compelling. If trials achieved even modest success – reducing obesity-related healthcare costs by 20% in target populations – the savings would exceed initial investments within five years. When broader economic benefits including increased productivity, reduced absenteeism, and improved quality of life are included, the return on investment becomes even more attractive. For instance, a study presented at the European Obesity Congress calculated potential savings of £4.5 billion through people with obesity being able to do more paid and unpaid work.[16]

Large-scale provision would provide significant negotiating leverage with pharmaceutical companies, justifying substantial price reductions and making interventions more cost-effective than current market rates suggest. The prospect of treating substantial populations would create economies of scale that benefit both the NHS and pharmaceutical partners.

Beyond Individual Transformation

Large-scale obesity interventions would demonstrate the potential for medical intervention to transform not just individual lives, but entire communities. As obesity rates decline, we would expect to see cascading effects throughout target regions. Healthcare systems would experience reduced demand for diabetes care, cardiovascular interventions, and obesity-related surgeries.

The psychological and social benefits could be equally transformative. As people lose weight and regain health, they often experience improved self-esteem, increased social participation, and greater optimism about the future. These changes can ripple through families and communities, creating positive feedback loops that extend far beyond direct treatment recipients.

Large-scale trials would also provide invaluable insights into optimal delivery of GLP-1 therapy. We would learn about the most effective dosing regimens, the importance of lifestyle support programmes, and the role of digital health tools in improving adherence and outcomes. This knowledge would inform

national rollout and ensure that when these medications become widely available, they are delivered in the most effective and cost-efficient manner possible.

The Path to National Implementation

Successful large-scale trials would pave the way for national rollout of GLP-1 therapy. By 2035, the goal should be universal access for all obese individuals and those with a BMI over 27 with obesity-related comorbidities. This would represent a fundamental shift in how we approach obesity – from a condition that people are expected to manage through willpower alone to one that receives comprehensive medical treatment.

Several factors will support this expansion. Drug delivery methods are rapidly improving, with oral formulations showing promise in clinical trials and likely to be available within the next few years.[17] This will improve convenience and adherence while potentially reducing costs. Patent expiration for current GLP-1 medications will occur in the early 2030s, leading to generic competition and substantial price reductions.

Perhaps most importantly, the evidence base for GLP-1 therapy continues to expand. Ongoing research is revealing benefits for conditions ranging from addiction and mental health to cancer and neurodegenerative disease. As these broader benefits become established, the economic case for widespread use becomes even more compelling.

A Comprehensive Approach to Obesity Prevention

GLP-1 therapy, however transformative, cannot address obesity in isolation. The widespread use of these medications must be complemented by regulatory interventions that address the obesogenic environment contributing to weight gain. This includes restrictions on advertising of unhealthy foods, improved food labelling, and policies that make healthy choices more accessible and affordable.

The integration of GLP-1 therapy with digital health tools, wearable monitoring, and AI-powered lifestyle interventions will create comprehensive obesity management programmes that address both biological and behavioural factors contributing to weight gain. This holistic approach recognises that sustainable weight management requires addressing multiple factors simultaneously.

By 2035, the combination of effective medications, supportive technology, and environmental interventions could fundamentally transform the obesity landscape in England. We have the opportunity to become the first nation to effectively address obesity at population scale, creating a model that other countries can follow while improving the health and wellbeing of millions of our citizens.

The obesity breakthrough represents more than a medical intervention – it embodies the potential for evidence-based medicine to address complex health challenges that have resisted previous solutions. By embracing ambitious approaches to obesity intervention, we can demonstrate the NHS's capacity for innovation while delivering transformative benefits for individual patients and society as a whole.

4. The Wearable Revolution: When Your Watch Becomes Your Doctor

The transformation of consumer wearable devices from fitness trackers to sophisticated medical monitoring systems represents one of the most democratising forces in healthcare technology. By 2035, wearable devices will serve as continuous health guardians, providing real-time monitoring, early warning systems, and personalised health guidance that fundamentally changes the relationship between patients and their health. Third party wearables will be fully integrated into the NHS data landscape.

Current wearable technology already demonstrates remarkable capabilities, with devices capable of monitoring heart rate, detecting irregular rhythms, measuring blood oxygen levels, and tracking sleep patterns.[18] The next generation of wearables will incorporate advanced sensors capable of monitoring blood glucose levels, blood pressure, hydration status, and even biomarkers associated with inflammation and infection.

The integration of artificial intelligence with wearable monitoring creates capabilities that exceed traditional clinical assessment in many areas. AI algorithms can detect subtle patterns in physiological data that might indicate emerging health problems days or weeks before symptoms appear. This early detection capability is particularly valuable for chronic conditions like diabetes, heart disease, and respiratory disorders, where early intervention can prevent serious complications.

For elderly individuals living independently, wearable devices provide continuous safety monitoring that enables independent living while ensuring rapid response to medical emergencies. Fall detection, irregular heart rhythm alerts, and medication reminders help maintain autonomy while providing family members and healthcare providers with peace of mind.

The shift from episodic to continuous care represents a fundamental change in healthcare delivery models. Instead of waiting for patients to develop symptoms and seek care, healthcare providers will monitor populations continuously, identifying individuals who require intervention before they become acutely ill. This proactive approach could reduce A&E attendances by 30% and hospital admission days by 15% while improving outcomes through earlier intervention.[19]

Wearable devices will also revolutionise chronic disease management by providing objective data about treatment effectiveness and disease progression. Patients with diabetes will receive real-time feedback about how their lifestyle choices affect blood glucose levels. Individuals with heart conditions will have continuous monitoring that detects early signs of deterioration. Those with respiratory conditions will receive alerts about environmental factors that might trigger symptoms.

The integration of wearable data with electronic health records creates comprehensive patient profiles that inform clinical decision-making. Healthcare providers will have access to weeks or months of continuous monitoring data before each patient encounter, enabling more informed discussions about treatment effectiveness and necessary adjustments.

Mental health monitoring represents an emerging application of wearable technology, with devices capable of detecting changes in sleep patterns, activity levels, and physiological markers associated with depression and anxiety. This objective monitoring can complement traditional mental health assessments and provide early warning signs of mental health crises.

The economic impact of widespread wearable adoption could be substantial, with reduced healthcare utilisation, earlier intervention for chronic conditions, and improved medication adherence generating significant cost savings.[20] The ability to monitor treatment effectiveness in real-time could also accelerate clinical research and enable more rapid optimisation of treatment protocols.

Privacy and data security remain critical considerations for wearable health monitoring. Robust encryption, secure data transmission, and clear consent mechanisms must ensure that users maintain control over their health information while enabling appropriate sharing with healthcare providers when needed.

The democratisation of health monitoring through wearable devices will empower individuals to take greater control over their health while ensuring that professional medical care is available when needed. This shift toward patient-centred, continuous care represents a fundamental evolution in healthcare delivery that aligns with the NHS's founding principles, while embracing the possibilities of modern technology.

5. The Genetic Gateway: Universal Genomic Screening Unlocks Personalised Medicine

The completion of the Human Genome Project marked the beginning of a new era in medicine, one where understanding individual genetic variations enables personalised prevention, diagnosis, and treatment strategies. By 2035, universal genomic screening at birth will provide every child born in England with a genetic roadmap that guides healthcare decisions throughout their lifetime.

Current genomic medicine focuses primarily on rare genetic disorders and cancer treatment, but the next decade will see expansion into common diseases like diabetes, heart disease, and mental health conditions.[21] Polygenic risk scores, which combine information from multiple genetic variants, will enable prediction of disease risk decades before symptoms appear, allowing for targeted prevention strategies that could prevent millions of cases of chronic disease.

The NHS's unique position as a unified healthcare system provides extraordinary advantages for genomic medicine implementation. The ability to link genetic information with comprehensive health records spanning entire lifetimes will enable research insights that fragmented healthcare systems cannot achieve. This integrated approach will accelerate the development of new treatments while ensuring that genomic insights translate into improved patient care.[22]

Universal genomic screening will enable personalised prevention strategies that address each individual's unique risk profile. For instance, children identified as having high genetic risk for diabetes could receive targeted lifestyle interventions and monitoring to prevent or delay disease onset. Those with genetic variants associated with adverse drug reactions will receive personalised medication recommendations that improve safety and effectiveness.

The integration of genomic data with AI-powered digital twins will create sophisticated models that predict how individuals will respond to different treatments and lifestyle interventions. These digital representations will enable healthcare providers to test different approaches virtually before implementing them in real patients, optimising outcomes while minimising risks.

Pharmacogenomics, the study of how genetic variations affect drug responses, will revolutionise medication prescribing by 2035. Instead of the current trial-and-error approach to finding effective medications, healthcare providers will have genetic information that predicts which drugs are most likely to be effective and safe for each individual patient.[23]

The economic benefits of genomic medicine extend beyond improved health outcomes to include reduced healthcare costs through more effective treatments and prevention strategies. Early intervention based on genetic risk assessment could prevent expensive complications and reduce the need for intensive medical care later in life.

Ethical considerations around genomic screening require careful attention to privacy, consent, and potential discrimination. Robust legal protections must ensure that genetic information cannot be used

to deny insurance coverage or employment opportunities, while clear consent mechanisms must give individuals control over how their genetic information is used.

The integration of genomic data with other health technologies creates synergistic effects that enhance the value of each individual innovation. Wearable devices can provide personalised monitoring based on genetic risk factors. AI algorithms can incorporate genetic information to improve diagnostic accuracy. Robotic systems can deliver treatments optimised for individual genetic profiles.

By 2035, genomic medicine will transform healthcare from a reactive system that treats disease after it occurs to a proactive system that prevents disease before it develops. This shift toward personalised, predictive medicine represents the fulfilment of genomic medicine's promise to improve health outcomes while reducing healthcare costs.

6. AI to Drive Patient Power and Productivity: The Invisible Assistant Liberates Healthcare Workers

Artificial intelligence represents the most transformative force in healthcare technology, with the potential to augment human capabilities, automate routine tasks, and enable new forms of care delivery that were previously impossible.[24] By 2035, AI will be seamlessly integrated throughout the NHS, serving as an invisible assistant that enhances rather than replaces human healthcare providers.

The current applications of AI in healthcare focus primarily on diagnostic imaging and clinical decision support, but the next decade will see expansion into virtually every aspect of healthcare delivery. Natural language processing will enable AI systems to automatically generate clinical notes from patient encounters, freeing healthcare providers from time-consuming documentation tasks. Predictive analytics will identify patients at risk of deterioration, enabling proactive interventions that prevent complications.

Administrative automation represents one of the most immediate opportunities for AI implementation, with the potential to save each clinician 13.5 hours per week currently spent on paperwork and administrative tasks.[25] The time savings could be redirected toward direct patient care, improving both job satisfaction for healthcare workers and care quality for patients.

AI-powered scheduling optimisation will revolutionise healthcare operations by intelligently matching patient needs with provider availability and expertise. Machine learning algorithms will analyse historical patterns, patient preferences, and clinical requirements to create schedules that maximise efficiency while ensuring appropriate care delivery.

Clinical decision support systems will provide healthcare providers with real-time access to the latest evidence-based guidelines, drug interaction checking, and personalised treatment recommendations based on individual patient characteristics. These systems will augment clinical expertise rather than replacing clinical judgment, ensuring that AI enhances rather than diminishes the human elements of healthcare.

The integration of AI with robotic systems creates capabilities that neither technology could achieve independently. AI enables robots to adapt to changing circumstances, learn from experience, and make complex decisions in real-time. This combination is particularly powerful in healthcare, where variability in patient conditions and clinical scenarios requires systems that can respond intelligently to unexpected situations.

AI will also revolutionise medical research by analysing vast datasets to identify new treatment targets, predict drug effectiveness, and optimise clinical trial design.[26] Machine learning algorithms can process information from millions of patients to identify patterns that would be impossible for human researchers to detect, accelerating the development of new treatments and improving existing therapies.

Patient engagement will be enhanced through AI-powered chatbots and virtual assistants that provide 24/7 access to health information and support. These systems will use natural language processing to understand patient concerns and provide appropriate guidance, escalating to human healthcare providers when necessary.

The economic impact of AI implementation could be transformative, with productivity improvements, reduced errors, and more efficient resource utilisation generating billions of pounds in savings annually. The ability to automate routine tasks while augmenting complex decision-making will enable the NHS to deliver higher quality care with existing resources.

Ethical considerations around AI implementation require careful attention to algorithmic bias, transparency, and accountability. AI systems must be designed and trained to ensure equitable outcomes across all patient populations, with clear mechanisms for understanding and correcting biased decisions.[27]

The integration of AI throughout the healthcare system will fundamentally change how healthcare providers work, enabling them to focus on the uniquely human aspects of care while leveraging AI capabilities to enhance their effectiveness. This human-AI collaboration represents the future of healthcare delivery, where technology amplifies rather than replaces human compassion and expertise.

7. Robotics to Support Precision: The Physical Transformation of Healthcare

Healthcare robotics represents the physical manifestation of technological transformation, delivering precision, consistency, and capabilities that exceed human performance while extending the reach of healthcare professionals to every corner of the nation. By 2035, robotic systems will be seamlessly integrated throughout the NHS, from surgical suites to rehabilitation centres, from hospital logistics to home care delivery.

The evidence for robotics transformation in healthcare is compelling and immediate. Studies analysing robotic surgery implementation across the English NHS demonstrate that robotic techniques increase total hospital production by 21-26% while improving labour productivity by 29%.[28] These are not theoretical projections but measured outcomes from actual NHS implementations, proving that robotics can deliver the productivity gains necessary to address current capacity constraints while improving patient outcomes.

Surgical Robotics: Precision Beyond Human Capabilities

Surgical robotics has evolved from experimental technology to proven systems that enhance surgeon capabilities and improve patient outcomes. The da Vinci platform, having performed nearly 17 million procedures worldwide,[29] represents the mature foundation of surgical robotics, while newer systems like the Versius Surgical Robotic System offer enhanced modularity and portability that make robotic surgery accessible to smaller hospitals.[30]

The integration of artificial intelligence with surgical robotics creates capabilities that neither technology could achieve independently. AI-powered surgical planning systems analyse patient imaging

data to optimise surgical approaches, while real-time AI guidance enables robots to adapt to unexpected anatomical variations during procedures. This combination of robotic precision and AI intelligence reduces surgical complications by 15-25% while enabling minimally invasive approaches that accelerate patient recovery.[31]

By 2035, surgical robotics will extend beyond current applications in urology, gynaecology, and general surgery to encompass cardiac procedures, neurosurgery, and microsurgery applications that require precision beyond human capabilities. The integration of haptic feedback systems (using vibrations to simulate touch) will enable surgeons to feel tissue characteristics through robotic instruments, combining the precision of robotic movement with the tactile sensitivity that surgeons rely upon.

Remote surgery capabilities will enable specialist surgeons to perform procedures on patients in distant locations, addressing geographic disparities in access to specialised care. High-speed, low-latency communication networks will enable real-time control of robotic systems, bringing expert surgical care to rural and underserved communities.

Rehabilitation Robotics: Restoring Function and Independence

Current rehabilitation faces a fundamental challenge that robotics can address: less than 40% of patients complete their prescribed rehabilitation exercises, limiting recovery outcomes and increasing long-term disability costs.[32] Rehabilitation robotics provides consistent, personalised therapy programmes that adapt to individual patient needs and progress while providing objective measurement of improvement.

Exoskeleton systems enable paralysed individuals to walk again while providing intensive gait training that promotes neuroplasticity and functional recovery. These systems use AI algorithms to adapt assistance levels based on patient capabilities, gradually reducing support as strength and coordination improve. The psychological benefits of regaining mobility, even with robotic assistance, can be transformative for patients and families.

Therapy robots deliver consistent rehabilitation programmes for stroke recovery, spinal cord injury, and musculoskeletal conditions. Unlike human therapists who may vary in their approach or availability, robotic systems provide standardised, evidence-based interventions that can operate for extended periods without fatigue. AI integration enables these systems to adapt exercise parameters based on real-time patient performance and fatigue levels.

The economic impact of rehabilitation robotics extends beyond direct therapy costs. By improving therapy compliance by over 50% and reducing rehabilitation costs by 30%, these systems enable more patients to achieve functional independence, reducing long-term care costs and improving quality of life.[33] The integration of rehabilitation robotics with wearable monitoring systems creates comprehensive recovery programmes that continue beyond formal therapy sessions.

Service Robotics: The Invisible Backbone of Healthcare Operations

Service robotics represents the invisible backbone of healthcare transformation, automating logistical and operational tasks that are essential to healthcare delivery but do not require direct patient interaction. These systems operate 24/7 with precision and reliability that humans cannot match, addressing both efficiency and safety challenges in healthcare operations.

Pharmacy automation systems reduce medication errors by 85-95%[34] while achieving productivity gains of 20-300% depending on application. These systems can prepare thousands of medication doses with perfect accuracy, eliminating human errors that can have serious consequences for patient safety.

Integration with electronic prescribing systems enables automated verification of drug interactions and dosing appropriateness.

Hospital logistics robots transport supplies, medications, and specimens with 60-80% greater efficiency than traditional methods.[35] These autonomous systems navigate hospital corridors using advanced sensors and mapping technology, delivering materials precisely when and where they are needed. The COVID-19 pandemic demonstrated the importance of reducing human contact in certain healthcare scenarios, making robotic logistics essential for infection control and staff safety.

Laboratory automation processes thousands of samples with greater consistency and accuracy than manual methods, reducing processing times and eliminating human error in routine testing procedures. Robotic systems can work continuously, processing samples around the clock to reduce turnaround times for critical test results.

Cleaning and disinfection robots provide consistent environmental hygiene that exceeds human capabilities. These systems use ultraviolet light, hydrogen peroxide vapor, or other disinfection methods to eliminate pathogens from patient rooms and operating theatres. The ability to operate in contaminated environments without risk of infection transmission makes these systems particularly valuable for infection control.

Care and Telepresence Robotics: Extending Human Touch

Care robotics addresses the human elements of healthcare delivery while extending the reach of healthcare professionals to address geographic disparities and workforce shortages. These systems combine advanced technology with careful attention to the emotional and social needs of patients, particularly elderly individuals and those with chronic conditions.

Telepresence robots enable specialist consultations in remote locations, bringing expert care to patients who would otherwise face significant travel burdens or delays in accessing specialised services. High-definition video and audio systems provide clear communication, while robotic mobility enables specialists to move through patient environments and examine patients remotely.

Companion robots provide 24/7 monitoring and social engagement for elderly patients, addressing both clinical monitoring needs and social isolation challenges that affect health outcomes. These systems can detect falls, monitor vital signs, remind patients to take medications, and provide social interaction that supports mental health and cognitive function.

The integration of AI with care robotics enables systems to learn individual patient preferences and adapt their interactions accordingly. Advanced natural language processing allows robots to engage in meaningful conversations, while emotion recognition capabilities enable appropriate responses to patient distress or confusion.

Economic Impact and Implementation Strategy

It is projected that for the NHS comprehensive robotics implementation could deliver annual cost savings of £5 billion by 2035 while reducing medical errors by 60-70%.[36] This economic impact justifies the substantial investment required for robotics transformation, particularly when combined with the previous government's £3.4 billion commitment for NHS technology transformation.[37]

The recommended implementation follows a three-phase timeline spanning ten years. Phase 1 focuses on surgical and service robotics deployment in major hospitals, building on existing successful implementations. Phase 2 expands robotic integration across all NHS trusts while introducing

rehabilitation and care robotics programmes. Phase 3 achieves autonomous robotic healthcare systems with full AI integration and comprehensive coverage across all healthcare settings.

Success requires more than technological capability and financial investment. Strategic leadership must prioritise robotic integration, comprehensive workforce development must prepare staff for human-robot collaboration, and robust governance frameworks must ensure robotic systems enhance rather than replace the human elements of healthcare that patients value most.

Integration of Robotics with Other Technologies

Like the other six pillars, robotics will be most effective when integrated, rather than acting as an isolated capability. Under the guidance of the data conductor, surgical robots benefit from AI-powered planning and genomic data that informs personalised surgical approaches. Rehabilitation robots integrate with wearable monitoring systems to provide comprehensive recovery programmes that continue beyond formal therapy sessions. Service robots operate within digital ecosystems that optimise logistics and supply chain management based on real-time demand and predictive analytics.

This integrated approach reflects the reality that healthcare transformation requires coordinated implementation of multiple technologies rather than isolated deployment of individual systems.

The robotics revolution in healthcare represents both an unprecedented opportunity and a fundamental challenge for the NHS. The evidence demonstrates that robotic systems are not futuristic possibilities but practical tools that are already delivering measurable benefits in healthcare systems worldwide. The question is not whether the NHS should embrace healthcare robotics, but how quickly and effectively it can implement these transformative technologies while maintaining the compassionate, patient-centred care that defines excellent healthcare.

By 2035, the combination of surgical precision, rehabilitation effectiveness, operational efficiency, and extended care reach provided by robotic systems will fundamentally transform how healthcare is delivered. Patients will receive more precise treatments, more effective rehabilitation, and more consistent care, while healthcare professionals will be freed from routine tasks to focus on the uniquely human aspects of healing and care. This robotic transformation, conducted by the data infrastructure that coordinates all healthcare technologies, represents the physical manifestation of the NHS's evolution into a truly 21st-century healthcare system.

Enabling the Vision: Building Tomorrow's Healthcare Infrastructure

Digital Infrastructure

The transformation of healthcare delivery through advanced technologies requires more than individual innovations – it demands comprehensive infrastructure that enables seamless integration, secure data sharing, and coordinated care delivery. By 2035, the NHS will use digital infrastructure that rivals the most advanced technology companies while maintaining the security, reliability, and accessibility that healthcare demands.

The technical infrastructure required to support healthcare transformation represents one of the most significant investments in NHS history. Cloud-based platforms must provide secure, scalable storage and processing capabilities for petabytes of health data generated by millions of patients across thousands of healthcare settings. This infrastructure must support real-time analytics, machine learning workloads, and seamless integration between diverse systems and devices.

Interoperability standards will ensure that data flows seamlessly between different systems, from GP practices and hospitals to wearable devices and home monitoring systems. The adoption of international standards like FHIR (Fast Healthcare Interoperability Resources) will enable different systems to communicate effectively while maintaining data integrity and security.[38]

Network infrastructure must provide high-speed, low-latency connectivity that enables real-time applications like remote surgery, telepresence consultations, and continuous monitoring. The rollout of 5G networks will be particularly important for mobile health applications and remote care delivery in rural areas.[39]

Cybersecurity and Privacy Protection

The increasing digitisation of healthcare creates new vulnerabilities that must be addressed through comprehensive cybersecurity measures. Advanced threat detection systems will monitor network traffic for signs of malicious activity, while encryption technologies will protect sensitive health information both in transit and at rest.

Zero-trust security architectures will ensure that every access request is verified and authorised, regardless of the user's location or device. This approach is particularly important in healthcare, where staff may access patient information from various locations and devices throughout their workday.

Privacy-preserving technologies will enable data sharing for research and population health insights while protecting individual privacy. Techniques like differential privacy and federated learning will allow researchers to gain insights from large datasets without accessing individual patient records.[40]

Workforce Development and Training

The successful implementation of healthcare technologies requires comprehensive workforce development that prepares staff for new roles and responsibilities. Training programmes must address both technical skills and the human factors involved in working with advanced technologies.

There is appetite for this, as 67% of medics and dentists look forward to using AI as part of their job, but at present the evidence is that AI is currently used by less than 10% of healthcare practitioners.[41]

Healthcare professionals will need to develop new competencies in data interpretation, human-robot collaboration, and technology-mediated patient care. Medical education curricula must evolve to include training on AI systems, robotic technologies, and digital health tools. The emphasis should be on how technology enables and empowers clinicians to achieve more, rather than replacing them.

Support staff will require training on new systems and processes, while new roles may emerge that bridge the gap between technology and patient care. These roles might include AI specialists, robotics technicians, and digital health coordinators who ensure that technology enhances rather than complicates care delivery.

Regulatory Framework and Governance

The rapid pace of technological change requires adaptive regulatory frameworks that can keep pace with innovation while ensuring patient safety and data protection. Regulatory agencies must develop new approaches to evaluating AI systems, robotic devices, and digital health tools that consider their unique characteristics and risks.

Governance structures must ensure that technology implementation aligns with NHS values and priorities. Clinical governance committees will need to include technology experts, while technology governance must include clinical representation to ensure that clinical needs remain central to decision-making.

Ethical frameworks must guide the development and deployment of healthcare technologies, addressing issues like algorithmic bias, consent for data use, and the appropriate balance between automation and human oversight.

Financial Sustainability and Investment

The transformation of healthcare through technology requires substantial upfront investment, but the long-term benefits justify these costs. The £3.4 billion commitment for NHS technology transformation made by the previous government provides the foundation for this investment,[42] but additional funding sources are likely to be needed in the short-term to achieve the full vision.

Public-private partnerships can leverage private sector expertise and investment while ensuring that public interests are protected. These partnerships must be structured to ensure that the NHS retains control over critical systems and data while benefiting from private sector innovation and efficiency.

Return on investment calculations must consider both direct cost savings and broader benefits like improved health outcomes, reduced disability, and increased productivity. The economic benefits of preventing disease through early intervention often exceed the costs of treatment, making prevention-focused technologies particularly attractive investments.

International Collaboration and Leadership

The UK has the opportunity to lead global healthcare transformation by demonstrating how advanced technologies can be implemented at scale while maintaining universal access and high-quality care. International collaboration can accelerate innovation while sharing costs and risks across multiple healthcare systems.

Research partnerships with other countries can provide larger datasets for AI training and validation, while technology sharing agreements can reduce development costs and accelerate implementation. The UK's leadership in areas like genomics and AI provides a strong foundation for international collaboration.

Standards development and best practice sharing can help other countries implement similar transformations while ensuring that UK innovations reach global markets. This international leadership can generate economic benefits while advancing global health outcomes.

Public-led Innovation

The implementation of the seven technology innovations will create a healthcare system that is more personalised, with people more in control of their own health and clinicians having more time to dedicate to their patients. Technology will make healthcare more human.

Implementation of the innovations must be done in partnership with patient representatives and organisations. It will be important to ensure that health literacy resources complement the use of more technology[43] as otherwise there is a danger that the more educated and digitally literate will disproportionately benefit, exacerbating health inequalities.

Conclusion: Technology Making Healthcare More Human

As we stand at the threshold of healthcare transformation, the vision of 2035 comes into sharp focus. Data will be the lifeblood that underpins the promise of artificial intelligence, genomics, wearables, robotics, pharmaceuticals and digital platforms to create coordinated care that transcends the capabilities of any single technology.

This connected approach represents more than technological advancement – it embodies the NHS's founding principles of universal access and comprehensive care, enhanced by the precision and personalisation that only coordinated technology can deliver. Every patient interaction will be informed by the full symphony of available data, ensuring that care decisions are based on the most complete and current understanding of individual needs and population health patterns.

The transformation from today's fragmented, reactive healthcare system to tomorrow's integrated, proactive system will touch every aspect of healthcare delivery. Patients will experience care that anticipates their needs, prevents problems before they occur, and delivers treatments precisely tailored to their unique characteristics. Healthcare professionals will be freed from administrative burdens to focus on the uniquely human aspects of healing and care, supported by AI assistants and robotic systems that enhance their capabilities.

The economic benefits of this transformation will be substantial, with productivity improvements, reduced errors, and more effective prevention strategies generating billions of pounds in savings annually. More importantly, the human benefits – lives saved, suffering prevented, and quality of life improved – will justify the investment and effort required to achieve this vision.

The path forward requires sustained commitment, strategic investment, and careful attention to the human factors that make healthcare transformation successful. Technology must enhance rather than replace the compassion, empathy, and clinical judgment that define excellent healthcare. The goal is not to create a system dominated by machines, but to create a system where technology amplifies human capabilities and enables care that is more personal, more effective, and more accessible than ever before. Technology can make healthcare more human and allow a universal NHS that is personal to all.

The NHS of 2035 will demonstrate that universal healthcare and technological innovation are not competing priorities but complementary forces that together can create a healthcare system worthy of the 21st century. This vision is not just possible – it is inevitable. The question is not whether these technologies will transform healthcare, but whether the UK will lead that transformation.

Appendix A: Our Journey to Discovery

The Future State Programme represents the most comprehensive examination of healthcare technology potential ever undertaken for the NHS. Four Theme Groups were established, each with an institutional, industry and knowledge partner. The knowledge partners were chosen through a call for expressions of interest.

Our methodology combined literature review, expert interviews, international case studies, and economic modelling to identify the most promising opportunities for healthcare transformation by 2035. We consulted with clinicians, researchers, technology companies and policy experts to ensure that our recommendations reflect both technological possibilities and practical implementation realities.

Acknowledgements

We extend our sincere gratitude to all the organisations, institutions, and individuals who contributed to this report through their expertise, insights, and collaboration. All of those acknowledged here freely gave their time to help improve the NHS.

Hosting Partners

Imperial College Healthcare NHS Trust and Imperial College London
We are particularly grateful to Imperial College Healthcare NHS Trust and Imperial College London for their leadership and support throughout this initiative.

Theme Working Groups and Partner Organisations

We thank the following organisations for their valuable contributions to the Theme Working Groups

	Theme 1 - health promotion and protection	**Theme 2 – faster, better, earlier diagnosis**	**Theme 3 - new treatment paradigm**	**Theme 4 - innovation in health care delivery**
Institution partner	Royal Society	Imperial	Wellcome	Nesta
Industry partner	Google	Siemens UK	GSK	Narayana Health
Knowledge partner	Deloitte	BCG	RAND-Europe	CF

Expert Interviews and Discussions

We are deeply grateful to the following distinguished experts who generously shared their time and insights through interviews and discussions.

Healthcare Leadership and Policy:

- Eric Topol, Founder & Director, Executive Vice President – Scripps Research Translational Institute and Professor of Molecular Medicine
- Victor Dzau, President of the National Academy of Medicine of the United States National Academy of Sciences, Vice Chair of National Research Council
- Mandy Cohen, former CDC Director
- David Probert, Deputy CEO, NHS England
- Professor Patrick Chinnery, Executive Chairman of the Medical Research Council

Technology and AI Innovation:

- Chris Bishop, Director of Microsoft Research AI for Science
- Dom King, VP Health, Microsoft AI
- Peter Hames, VP Health, Microsoft AI
- Bay Gross, VP Health, Microsoft AI
- Christopher Kelly, Partner, Microsoft AI
- Pushmeet Kohli, Vice President, Science & Strategic Initiatives, Google DeepMind
- Susan Thomas, Health Director, Google
- Anna Koivuniemi, Head of Google DeepMind Impact Accelerator, Google DeepMind
- Joelle Barral, Research & Engineering Senior Director, Google DeepMind
- Raj Panjabi, Senior Partner, Preemptive Health and Medicine, Flagship Pioneering; former White House Senior Director for Global Health Security and Biodefense and adviser to the U.S. President.
- Noubar Afeyan, CEO of Flagship pioneering and Founder of Moderna.
- Junaid Bajwa, Senior Partner at Flagship Pioneering
- Matthew Davis, Senior Partner, Head of Pioneering Intelligence Global AI Strategy, Flagship Pioneering
- Chris Bischoff, Managing Director, General Catalyst

Academic and Research Excellence:

- Peter Lee, Professor of Applied Ethics and Associate Dean for Research (Interim), University of Portsmouth Faculty of Humanities and Social Sciences
- Prof Stephen O'Rahilly, University of Cambridge
- Prof Patrick Maxwell, Regius Professor of Physic and Head of the School of Clinical Medicine at the University of Cambridge
- Professor David Sharp, Director of Care Research & Technology Centre, UK Dementia Research Institute

Healthcare Innovation and Delivery:

- Kedar Mate, Founder & Chief Medical Officer, Qualified Health
- Asaf Bitton, Executive Director, Ariadne Labs
- Esther Krofah, Executive Vice President, Health, Milken Institute
- Simon Radford, Director for Policy and Programming, Milken Institute in Europe

Industry and Investment:

- Daniel Freeman, General Partner, Dorilton Ventures
- Dr Maksim Sipos, CausaLens
- Michael Ferro, Chairman at Merrick Ventures LLC
- Sir Harpal Kumar, President of International Business and BioPharma, GRAIL

Healthcare Technology Entrepreneurs:

- Jacob Haddad, CEO, Accurx
- Neil Daly, CEO, Skin Analytics
- Martin Ratz, Co-founder, Doccla
- Tom Whicher, CEO, DrDoctor
- Ivan Beckley, CEO, Suvera
- Molly Gilmartin, VC, Albion Ventures
- Nadine Hachach Haram, BEM, CEO Proximie, NHS Surgeon, Director Centre of Innovation, Transformation & Improvement GSTT, Co-Managing Partner Meridian Health Ventures
- Harry Leeming, CEO, Visible

We also want to thank Tom Kibasi, for his significant contribution to this report. With thanks to Amish Acharya, Rachel Davies and Victoria Murphy at the Institute of Global Health Innovation.

The insights and recommendations contained within this report reflect the collective wisdom and expertise of all these contributors, while the responsibility for the final analysis and conclusions rests with the authors.

About the Authors

Lord Ara Darzi holds the Paul Hamlyn chair of surgery at Imperial College London, the Royal Marsden Hospital and the Institute of Cancer Research. He is the Co-director of the Institute of Global Health Innovation, Imperial College London, the Chair of Pre-emptive Health and Medicine at Flagship Pioneering and a Member of the House of Lords.

Georgia Butterworth is Senior Strategy Advisor to Lord Darzi.

Peter Howitt is the Managing Director of the Centre for Health Policy and the Climates Cares Centre, Institute of Global Health Innovation, Imperial College London.

References

[1] Bill Gates, *The Road Ahead*, "Afterword" (1996 ed.)
[2] A. Darzi, *Independent investigation of the NHS in England*, September 2024
[3] DeepMind Health Independent Review Panel Annual Report, July 2017, available here.
[4] ClinicalTrials.gov. A Research Study Investigating Semaglutide in People With Early Alzheimer's Disease (EVOKE). https://clinicaltrials.gov/ct2/show/NCT04777396.
[5] Bajwa J, Munir U, Nori A, Williams B. Artificial intelligence in healthcare: transforming the practice of medicine. *Future Healthc J*. 2021 Jul;8(2):e188-e194.
[6] NHS England, *How data is used to improve health and care*, Accessed June 2025, available here.
[7] The Academy of Medical Sciences, *Our data-driven future in healthcare*, November 2018
[8] CST advice on improving the nation's health through primary prevention, June 2025, available here.
[9] Harry Stedman, NHS app to become new 'front door' for appointments, screenings and test results, *The Independent*, 7 June 2025.
[10] Michael Savage, Ministers plan to use NHS app to expand clinical trials as part of UK-wide drive, *The Guardian*, 16 June 2025
[11] Frontier Economics, *Estimating the full cost of obesity*, Jan 2022. Available here.
[12] UK Government, *Obesity Healthcare Goals*, June 2025. Available here.
[13] A. Reiss, Weight Reduction with GLP-1 Agonists and Paths for Discontinuation While Maintaining Weight Loss, *Biomolecules*, 2025 Mar 13;15(3):408
[14] Zheng, Z., Zong, Y., Ma, Y. *et al.* Glucagon-like peptide-1 receptor: mechanisms and advances in therapy. *Sig Transduct Target Ther* **9**, 234 (2024).
[15] University of Manchester, *New study to deepen understanding of a weight loss medication*, 14 October 2024, accessed June 2025.
[16] Anna Bawden, Giving weight loss jabs could bolster UK economy by £4.5bn a year, study says, *The Guardian*, 9 May 2025
[17] S Wharton et al., Daily Oral GLP-1 Receptor Agonist Orforglipron for Adults with Obesity, *N Engl J Med* 2023;389:877-888,
[18] Ben Horner et al., *Faster, Better and Earlier Diagnosis*, June 2025
[19] ibid.
[20] Gioacchino D. De Sario Velasquez et al., Economic Perspective of the Use of Wearables in Health Care: A Systematic Review, *Mayo Clinic Proceedings: Digital Health* Volume 2, Issue 3, September 2024, Pages 299-317
[21] Hui Ding et al., Shared genetics of psychiatric disorders and type 2 diabetes:a large-scale genome-wide cross-trait analysis, *Journal of Psychiatric Research*, Volume 159, 2023, Pages 185-195
[22] Sonja Marjanovic et al., *Better and more efficient NHS care through innovative approaches to treatment*, RAND-Europe, June 2025
[23] Pirmohamed, M. Pharmacogenomics: current status and future perspectives. *Nat Rev Genet* 24, 350–362 (2023).
[24] Maleki Varnosfaderani S, Forouzanfar M. The Role of AI in Hospitals and Clinics: Transforming Healthcare in the 21st Century. *Bioengineering* (Basel). 2024 Mar 29;11(4):337.
[25] CF, Narayana Health, Nesta, *Future State Programme*: *The impact of data, digital and AI in healthcare*, June 2025*, p. 60*
[26] Ara Darzi & Anna Koivuniemi, Harnessing Artificial Intelligence to Tackle Antimicrobial Resistance, January 2025. Available here.
[27] N. O'Brien et al., *Addressing Racial and Ethnic Inequities in Data-driven Health Technologies*, Institute of Global Health Innovation, 2022
[28] Maynou, Laia, Alistair McGuire, and Victoria Serra-Sastre. "Efficiency and Productivity Gains of Robotic Surgery: The Case of the English National Health Service." *Health economics.* 33.8 (2024): 1831–1856. Web.
[29] Intuitive, Annual Report 2024, Available here.
[30] Gussago S, Balaphas A, Liot E, Meurette G, Toso C, Ris F, Meyer J. Applicability and results of the versius surgical robotic system in colorectal surgery: a systematic review of the literature. *J Robot Surg.* 2025 Apr 28;19(1):182.
[31] Wah JNK. The rise of robotics and AI-assisted surgery in modern healthcare. J Robot Surg. 2025 Jun 20;19(1):311
[32] Peek K, Carey M, Mackenzie L, et al. Patient adherence to an exercise program for chronic low back pain measured by patient-report, physiotherapist-perception and observational data. *Physiother Theory Pract*. 2019;35(12):1304–13.
[33] Gareth Francis, *6 ways that robotics are transforming healthcare*, World Economic Forum, June 12 2025, available here.

[34] Bettina Wulff Risør, Marianne Lisby, Jan Sørensen, Complex automated medication systems reduce medication administration errors in a Danish acute medical unit, *International Journal for Quality in Health Care*, Volume 30, Issue 6, July 2018, Pages 457–465,

[35] Tushar Dasgupta. Supply chain automation in healthcare: Transforming logistics for enhanced patient care. World Journal of Advanced Research and Reviews, 2025, 26(01), 1493-1500.

[36] Based on projections from NHS England, *Millions to Benefit from NHS Robot Drive*, 11 June 2025, available here.

[37] HM Treasury, *Budget for Long Term Growth*, 6 March 2024, available here.

[38] NHS England, FHIR (Fast Healthcare Interoperability Resources), accessed June 2025, available at https://digital.nhs.uk/services/fhir-apis

[39] Adam Clark, *5G in the UK*, Commons Library Research Briefing, 8 March 2024

[40] M Adnan, et al., Federated learning and differential privacy for medical image analysis. *Sci Rep* **12**, 1953 (2022).

[41] CF, Narayana Health, Nesta, Future State Programme: The impact of data, digital and AI in healthcare, June 2025, p.50

[42] P. Mistry, *With a return to basics, is the spring Budget a game changer for NHS technology?,* The King's Fund, 5 April 2024

[43] Deloitte, Google and the Royal Society, *The shift to prevention: A new ecosystem of health promotion and protection*, June 2025