Science in healthcare: Delivering the NHS Long Term Plan

The Chief Scientific Officer's strategy

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NHS England and NHS Improvement

Contents

Foreword

We are currently experiencing, and will continue to see, an exponential pace of change in scientific and technological advances, coupled with an ability to compare and interrogate large datasets. These developments have the potential to revolutionise many areas of healthcare delivery and benefit patients through more personalised and evidenced based interventions.

These advances are happening at a time when the health system is facing a number of challenges. For example, obesity and mental health problems are rising, especially among children and young adults. More needs to be done to manage health inequality, remove unwarranted variation and meet the health needs of people with a learning disability or autism. Frailty in our older population requires careful management to prevent unnecessary hospital admissions or treatments. Cardiovascular disease, respiratory conditions and cancer remain leading causes of premature death in England and long-term ill health for many.

We have the opportunity to better use science and technology to address these challenges, and shape technological advances to help people live happier and healthier lives. The NHS healthcare science workforce use science and their technical skills to help prevent, diagnose and treat diseases. They are in a unique position as a highly trained scientific workforce, working as part of an integrated health system, to drive transformational change and deliver technological and scientific advances, such as genomics, which help fundamentally change the NHS and healthcare around the world.

Digital health and technology are at the heart of the NHS Long Term Plan. This healthcare science strategy for England, developed with the healthcare science profession and system partners, outlines how we can help deliver that plan. Our ambition is to provide scientific leadership within the system, encourage and attract research and innovation, embrace digital advances and technology in NHS services and work in collaboration with stakeholders, patients and partners to deliver this ambition.

To succeed we must work together as scientific leaders, supporting and empowering our workforce, building on our successes as a profession over the last decade and working in partnership to ensure that the NHS continues to operate at the limit of science to deliver the best possible outcomes for patients and the diverse population it serves.

Professor Dame Sue Hill DBE
Chief Scientific Officer for England

Our strategy at a glance

Our ambition over the next 10 years is:

To use the latest scientific and technological innovations to embed novel ways of delivering scientific services to improve patient care; delivered by a digitally enabled and intelligence-led healthcare science profession driving change.

We will achieve this by focusing on four priorities:

- **Delivering transformation in scientifically led services**
- **Attracting and supporting research and innovation in healthcare science**
- **Providing scientific leadership across an integrated health and social care system**
- **Partnering to improve information and knowledge**

We will know when we have succeeded when:

- Innovative models of delivering scientific and diagnostic services have been embedded to improve outcomes for patients and provide cost effective care.
- Healthcare science research capacity and capability is strengthened, and the entire scientific workforce fully embrace innovation.
- Healthcare science is fully integrated across health and social care, and routes exist for healthcare scientists to be decision makers across the system.
- Strong and diverse healthcare science partnerships exist that deliver visible impact and improve public understanding of healthcare science.
- This technology and data literate healthcare science workforce feels valued, well-led and part of the wider healthcare team.

For patients this will mean:

- The right test at the right time in the right place.
- Support for earlier prevention and treatment.
- More non-invasive tests and better targeted therapy with fewer side effects.
- Better disease management strategies.
- Improved access to test results and services closer to where they live.
- Assurance of quality and safety.
- More opportunity for self-care and increased patient choice.

Healthcare science

Healthcare is entering the era of personalised medicine and prevention. Patient care is improving through maximising use of new technology and digital innovations, provision of diagnostics, and treatment closer to the patient. Digital advances, medical technology and diagnostic innovations will continue to change pathways and improve outcomes, with the potential to completely transform how we deliver care.

Innovation in diagnostics and scientific services has revolutionised care over the years, from the first vaccine, to in-vitro fertilisation, to the advanced imaging that underpins many of today's clinical services. NHS scientific services are at the heart of this innovation; services that deliver changes to help patients and keep the NHS at the forefront of health innovation.

Our ambition is to use the latest digital and technological innovations to embed new ways of delivering scientific services to improve patient care; delivered by a digitally enabled and intelligence-led healthcare science profession driving change.

1.1 Integral role of the healthcare science workforce in improving patient outcomes

The healthcare science workforce is a unique, diverse and specialised community within the NHS who use their knowledge and expertise to develop, design and deliver transformative patient care. There are over 56,000 people that make up this healthcare science workforce, working in the NHS in over 150 service areas across pathology and laboratory science, physiological sciences, data science and bioinformatics, and in medical physics and clinical engineering (see Appendix for an overview of healthcare science specialisms).

Diagnostic and scientific investigations and interventions can accurately detect health risk and disease at earlier stages. They are crucial in providing earlier access to treatments, disease management, as well as reducing subsequent health problems and their associated costs. These investigations and interventions serve a key role within the health service by influencing the quality of patient care, health outcomes and downstream resource requirements.

The healthcare science workforce delivering these services is fundamental to clinical decision-making and providing patients with timely, high quality, state of the art care. They collectively underpin the delivery of over a billion diagnostic and scientific investigations and treatment interventions a year, including pioneering whole genome sequencing, proton beam and chimeric antigen receptor T-cell (CAR-T) therapy. They ensure the equipment and protocols used are safe, effective and evidence based.

Their specialist scientific training and service skills – delivering services in over 150 discrete areas – make them ideally placed to lead the integration of the latest scientific and technological advances into clinical practice, and develop in-house innovations and models of transformative care.

The value of scientific information

Scientific information affects healthcare decision-making along the patient journey: its value extends well beyond detecting and diagnosing disease.

Scientific investigations from blood tests and multi-modality imaging to specialist interventions and diagnostics, including whole genome sequencing, proton beam and CAR-T therapy, will enable clinicians, patients and their carers to:

- assess disease risk sooner
- screen for disease before symptoms occur
- identify health or environmental threats before infection spreads
- use more preventative and less invasive treatment options
- make timely decisions on admission to or discharge from hospital
- access health interventions earlier to minimise or stop disease progression
- select appropriate treatments that reduce patient risk and increase effectiveness
- better predict patient prognosis and manage treatment
- integrate data at a population level for better prevention and planning.

1.2 Emerging technology trends that will shape healthcare science

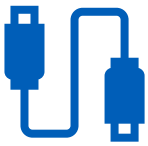
Advances in technology will have a significant impact on the future delivery of healthcare science. What makes these opportunities so powerful is that once these different types of technology are available in the NHS, they can be used in various combinations to tailor solutions to the needs of patients, their carers and clinicians.

Horizon scanning of emerging technologies by the Office of the Chief Scientific Officer has identified key technology trends. These illustrate how technology convergence will shape healthcare science services over the next 20 years, and play a role in driving improvement across the whole patient journey and in patient outcomes.

Genomics and personalised care: The 'omics' technologies – genomics, epigenomics, transcriptomics, proteomics, metabolomics, radiomics – offer personalised prevention, screening, monitoring and medicines optimisation (pharmacogenomics). These technologies can be used in conjunction with, for example, digital tools, regenerative medicine, 3D printing and machine learning, to personalise patient care.

Technology supported self-management: Mobile health apps on smart phones and wearable biometric health technologies, underpinned by advances in other digital technologies, will empower patients to better prevent, manage and understand their conditions and support behavioural change.

Remote care: Improving access to point-of-care testing and remote monitoring by bringing measurement closer to the patient via self-testing, testing in the community or social care. Building on advances in bioengineering and assistive technology will provide innovative ways of working that ensure patients' needs can be addressed as early as possible.



Digital evolution: Exploiting the full range of digital tools and technologies – mobile health, artificial intelligence, robotic platforms, machine learning, blockchain, internet-based technology – will increase analytical and data interpretation capacity for diagnosing diseases, more effectively triaging patients and improving health system logistics and data security.

Biomedical innovation: Cutting-edge technologies will allow diagnosis and treatment to be more personalised to the patient and their disease. Examples range from those in reproductive medicine to the latest cancer treatments, such as CAR-T, and regenerative medicine.

Healthcare science and the NHS Long Term Plan

The NHS Long Term Plan[1] signals a new era for the NHS, setting out a roadmap for a scientifically driven, digitally and data enabled, sustainable health system that is 'fit for the future'. It sets out ambitious improvements required to enhance patient care over the next 10 years, and outlines how the NHS can overcome the challenges it faces, such as staff shortages and growing demand, by:

- **Doing things differently:** providing more control for people over their own health, encouraging collaboration through primary care networks and working through integrated care systems (ICSs).
- **Preventing illness and health inequalities:** enhancing preventative approaches to combat major causes of ill health.
- **Backing the workforce:** improving recruitment, retention, training, development and staff experience.
- **Making better use of data and digital technology:** providing more convenient access to services and information, and better use of digital tools and data.
- **Getting the most out of investment in the NHS:** improving efficiency, getting it right first time for every patient and minimising adverse effects.

The Long Term Plan identifies clinical priorities for the population's health and wellbeing and outlines service measures to significantly improve patient care in these areas. These priorities include cancer, cardiovascular disease, maternity and neonatal health, mental health, stroke, diabetes and respiratory care; with a strong focus on children and young people's health throughout. The role of technology and the healthcare science workforce within the scientific diagnostic, interventional and therapeutic services that deliver these advances are integral to ensuring the improved outcomes have widespread population impact.

Innovative models of service delivery and joined-up care, such as integrated multidisciplinary care teams within primary care networks and increased access to

out-of-hospital care, will require new ways of delivering diagnostics and therapeutic services in community settings. This will make sure the most appropriate intervention is made and most appropriate equipment is used.

Bringing healthcare science services closer to the patient in this way will help transform the wider ICSs to better support people in their own homes, in care homes, and across the mental health system. Building on the benefits of a digitally enabled infrastructure, healthcare science services will also contribute to this transformation. Alongside NHS strengths in clinical engineering and bioinformatics, advances in biometric technology can now support the use of home-based and wearable monitoring equipment. Within the community, this will improve prediction and prevention of events leading to hospital admission.

Advances in health technology are also closing the gap between diagnostics and therapy. Healthcare science services can diagnose, screen, monitor and support therapeutic decisions with more accuracy, while also combining and sharing data. Interventions are earlier and less invasive, and patients experience fewer side effects.

Scientific services are already working towards an enabled and integrated data infrastructure and individualised models where patients are enabled to lead their own care. This can already be seen in healthcare science-led service transformation such as genomics and proton beam therapy and with the integration of wearable and assistive technologies in rehabilitation pathways.

The extension of molecular diagnostics and the routine use of genomic testing in cancer services puts the UK at the forefront of personalised cancer therapy; patients, especially children, are now more likely to receive their optimum treatment.

Increased investment in Radiotherapy equipment, such as new computer tomography (CT) and magnetic resonance imaging (MRI) scanners, commissioning of proton beam therapy, provision of specialist interventions such as CAR-T therapy and regenerative medicine, all help meet the need for expanded scientific and diagnostic services. Building capacity and capability will be major drivers of the requirements of this workforce, as articulated in the Interim NHS People Plan[2].

Earlier diagnosis of cancer will be supported by new faster diagnostic standards and facilitated by rapid diagnostic centres. By expanding whole genome sequencing,

molecular testing in the diagnosis of cancers, screening services for bowel cancer, human papillomavirus (HPV) testing for cervical cancer and mobile lung cancer screening, healthcare science services will increase the opportunities for earlier diagnosis and prevention of a wide range of cancers.

Expanding the availability of preventive measures is also a key area for action in cardiovascular disease. This will be achieved through access to healthcare science services within the community and within primary care networks (PCNs); for example, testing for atrial fibrillation, high-blood pressure, high cholesterol and other risk factors. Increased genetic testing for familial hypercholesterolemia will facilitate diagnosis and management of those at risk of early heart disease. For patients with heart failure, increasing access to physiological services such as echocardiography in the community will further support equitable access to healthcare science services, reducing unnecessary hospital appointments and improving the overall patient experience.

Initiatives for earlier detection of chronic obstructive pulmonary disease (COPD) and other respiratory issues in the community, with a reduction in the variation in spirometry testing and interpretation, will enable better support of patients with respiratory disease. Improved outcomes will also be realised through optimised prescribing and medication use, along with more specific medication support for asthma patients, eg using smart inhalers.

For people with learning disabilities, autism or both, the Long Term Plan outlines ambitions to improve uptake of an annual health check, specific to the person's needs. Hearing and vision investigations are examples of physical health checks that can be improved for this population group. ICSs need to consider how they can use healthcare science services within the community to help improve health and wellbeing in this group.

Integrated models of primary and community care will support patients with mental health needs, ensuring they have the same access to healthcare services as those with physical health needs – aka 'parity of esteem'. Patients with mental health issues often miss out on screening, such as for cancer, and so are often diagnosed with later stage cancer. We plan to expand point-of-care testing (POCT) and support colleagues providing mental health services with quicker, easier, more efficient and effective physical health checks and access to screening where appropriate.

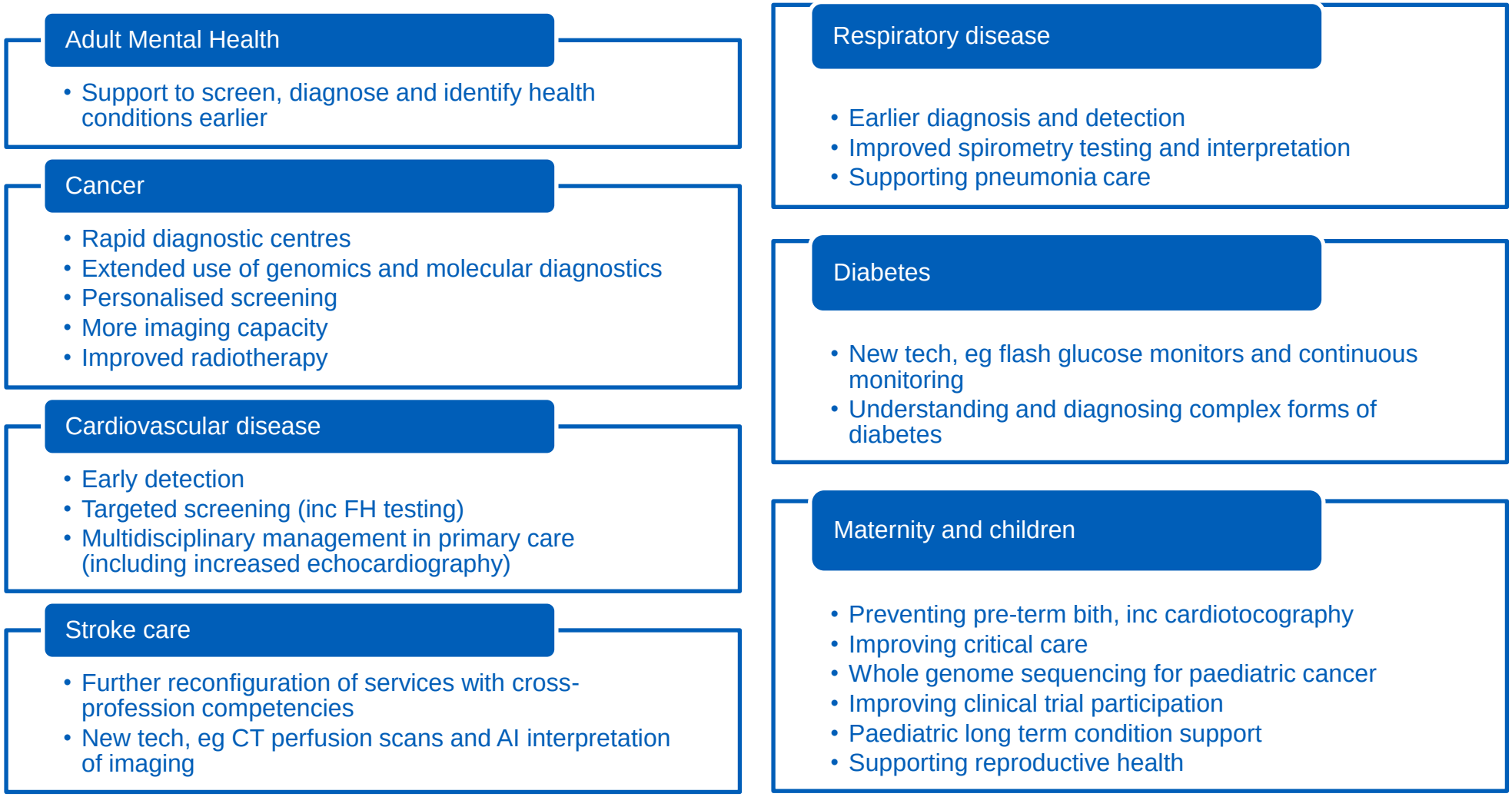
All of this will be facilitated by investments in innovations such as POCT diagnostics across a broad range of diagnostic and scientific service areas delivered in the community, with support in interpretation of results from experts in NHS secondary care provider organisations working as networks of hub and spoke points. As part of the programme for bringing different ways of exploring and testing innovation into healthcare, innovations around remote monitoring and an expansion of ‘test beds’ will help support the delivery of care to people with complex and long-term mental health needs closer to where they live.

Diagnostic and scientific services are integral to delivering high quality care across the patient journey. As the model of healthcare delivery continues to shift towards prevention, anticipatory care and supported self-management, the integrated use of diagnostic and scientific investigations and interventions at the correct point in the patient journey are fundamental to targeting effective healthcare treatment and improving patient outcomes and reducing the burden on outpatient services.

For the clinical priorities outlined in the Long Term Plan, the healthcare science workforce has an opportunity not just to bring new technologies into clinical practice, but also to enable system-wide change in how care is delivered and to promote both understanding of and engagement with innovation.

Exploring patient pathways in more detail and using examples of advances in technology and innovation in healthcare science services will be an integral role of the healthcare science workforce. This will support the delivery of new service models, where there are more care options, better support and enhanced ‘joined up’ care, at the right time, safely and in the optimal care setting.

Figure 1: Recognising the impact of HCS in the Long Term Plan



The command centre of a technology enabled NHS

The healthcare science workforce in England comprises more than 56,000 people who:

- deliver over 150 highly specialist or sub-specialist scientific services
- collectively underpin the delivery of over a billion diagnostic and scientific investigations and treatment interventions a year, with demand increasing at an annual rate of 6%; this encompasses 80% of the total diagnostics carried out in the NHS
- are critical to delivery of specialist interventions such as radiotherapy and CAR-T therapy
- impact three in four of all clinical decisions made in the NHS.

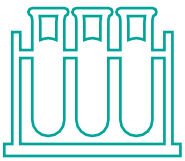
Over 15% of recruits embarking on a healthcare science career in the NHS already possess a research qualification such as an MSc or PhD and are sufficiently enabled to deliver innovative technology in diagnostics.

We will focus on four priorities to deliver our ambition

In order to understand and maximise the potential of emerging technologies a radical change in healthcare science services is needed. By unlocking the benefits through innovation, research, scientific leadership and collaboration, the potential value to the continuum of health and social care, from early detection to health outcomes, is enormous.

In order to deliver this ambition, we will focus on four priorities where healthcare science will play a central role in embedding research and innovation in the NHS and transforming the way we deliver scientific and diagnostic services in the future.

We will **deliver transformation in scientifically-led services** by translating advances in technology to transform healthcare science service models across the care continuum for patient benefit.



We will **attract and support research and innovation** in healthcare science by further developing the research capacity and capability of the workforce, as well as supporting the development and the implementation of technological and service innovation.

We will **provide scientific leadership for transformational change** by developing, recognising and embedding leadership in healthcare science.

We will **partner to improve and integrate information and knowledge** in collaboration with academia, industry, charities, the health and social care system and government departments.

Priority: Delivering transformation in scientifically-led services

Patients receive better care when they have access to high quality scientific and diagnostic services and when research is carried out in their hospitals. Delays in accessing the right test or the right image at the right time creates a bottleneck in patient care. Unnecessary cost is also added to the system by repeating tests or scans and by using tests or imaging processes that are outdated. An additional challenge for the system is that demand for diagnostics has increased by 26% in the last five years (HES data 2014 to 2018), and an average yearly increase of 8% is predicted (Health Education England (HEE) workforce data) as the population ages and non-communicable diseases, such as cancer and heart disease, rise.

As the NHS moves to a new service model in which patients get more choice, better support and appropriately integrated care, healthcare science service models are evolving to ensure high quality scientific and diagnostic services can meet this demand. They will need to continue to triage patients effectively and efficiently to ensure the most applicable diagnostic approach is used at the right time in the optimal setting.

Making radical changes to the healthcare science service delivery model is complex, takes time, and requires strong leadership and adequate resource. Relationships need to be built with patients, the healthcare science workforce and other health and social care professionals and communities. Service transformation is already happening in genomics, pathology, imaging and radiotherapy, creating new networks that will help deliver the ambitions of the Long Term Plan.

Networked provision will become increasingly important as the focus of care shifts to primary care and community integration, providing responsive service models of care closer to the patient; for example, implementing measures to prevent and diagnose cardiovascular and respiratory disease.

Building on past successes the healthcare science workforce is in an excellent position to support the health system scientifically, take advantage of increasing knowledge on service development and lead service transformation.

By using data and new technology to more effectively target resource to where it is best utilised, diagnostic and scientific services will support population-based plans and screening and prevention approaches, for earlier diagnosis and more effective therapy.

This opportunity extends to enabling whole system change, engaging the wider clinical workforce to increase the spread of knowledge and achieve greater use and impact of evidence-based interventions.

We will need to consider new versatile and flexible roles, working on new care models to showcase how diagnostics will be delivered closer to the patient and in our communities, and how new innovative technologies will help achieve these goals. This will also be supported by a new flexible education and career framework.

NHS genomic medicine service

The NHS will be the first national healthcare system to offer whole genome sequencing as part of routine care. The new NHS genomic medicine service will cover the use of all genomic testing technologies from single gene to whole genome sequencing, operating to national standards under a single testing directory.

This builds on the legacy of the ground-breaking 100,000 genomes project[3], a unique partnership between Genomics England and the NHS. This project is already delivering results for patients, with early indications that at least one in four people suffering from a rare disease and one in two with cancer will now get a diagnosis they may not previously have received.

For further information on the NHS genomic medicine service see www.england.nhs.uk/genomics/nhs-genomic-med-service/

3.1 Develop integrated models of care

Work is ongoing to create a networked provision of pathology and imaging services across England to reduce unwarranted variation, reduce unnecessary tests and imaging, and improve the quality and productivity of service models.

Continuing to build on a hub and spoke network model for healthcare science services (such as pathology, genomics and imaging) will ensure advanced technology can benefit all population groups.

3.2 Increase services in primary and community settings

The health system's ability to provide rapid diagnostics in the community reduces delays in patient care. This is especially important in diseases such as cancer where the Long Term Plan includes a package of measures to extend screening and expand diagnostic services with the aim of identifying 75% of cancers at stages 1 or 2 by 2028 through earlier and faster diagnoses.

This also includes expansion of screening services to detect cancer in asymptomatic patients including cascade screening of family members where appropriate.

Working with PCNs, we will develop new versatile and flexible healthcare science roles to enable earlier and faster diagnostics closer to the patient, building diagnostic capacity in the community. This demand and timely access will also be supported by the creation of more diagnostic hubs and networks, for example in physiological measurement, mirroring those for pathology and genomics, which will enhance local provision of care.

Recent advances in point-of-care technologies provide the opportunity for universal access to affordable, quality-assured tests. This has the potential to transform patient management and control of many diseases such as infectious diseases, diabetes, hearing loss and COPD.

In addition, advances in home-based assisted technologies and wearable monitoring equipment are opening opportunities for the healthcare science workforce, such as physiologists and clinical engineers, to use this advanced technology to predict and prevent events that could otherwise lead to a hospital admission. A good example of

this is falls prevention: using motion analysis technologies installed in a patient's home or care home, their way of walking (gait) can be monitored to predict a fall.

Mobile hearing aid apps on smart phones are enabling people with hearing loss to self-manage their hearing and communication difficulties, with remote support from clinicians. This has reduced the need for patients to travel to hospital.

These changes have helped to refine the self-management phone apps and develop self-learning hearing aid technology, reducing the need for costly audiology appointments and providing better patient satisfaction and improved clinical outcomes.

However, if local scientific services are not involved with the planning, implementation, scale-up and quality assurance strategies for local delivery, decentralisation of testing can increase the risk of loss of quality and lack of accredited testing practice being used.

To ensure the continued high quality in diagnostic and scientific services, we will embed UK Accreditation Services (UKAS) ISO standards in new contracting arrangements for scientific service models and ensure quality assurance and quality standards are matched across acute and community settings.

To ensure an effective patient–laboratory–clinic interface the new models of care being developed will need to provide an integrated infrastructure. Here the secondary care laboratories will act as the command centre, providing the expertise, assessment calibration and assurance for new technology introduction in community settings.

The healthcare science workforce, working with PCN colleagues, is in a unique position to bring high quality diagnostic and scientific investigations closer to the patient and enhance all elements of the patient journey from end to end.

Innovative echocardiogram imaging

The healthcare science workforce from University Hospital South Manchester have redesigned a patient pathway in collaboration with a GP practice to enable an innovative care delivery model of echocardiogram imaging by cardiac physiologists within the GP surgery rather than in the hospital setting.

If concerning pathology is identified, the healthcare scientist promptly refers the patient into secondary care.

Those patients that can be safely treated in the community do not need to be sent to hospital, saving GPs' time and reducing delays for patients accessing hospital appointments.

The innovative service model means that patients will have access to high quality primary care diagnostics delivered by the healthcare science workforce closer to their home and reduces the necessity of repeat diagnostic testing at outpatient clinics, if the patient needs an onward referral into hospital[4].

3.3 Create digitally-enabled and data-led services

The Long Term Plan contains wide-ranging programmes, some of which have been linked to funding sources, such as the upgrade of imaging technology and digitally enabled care across the NHS.

Artificial intelligence will be used to support decision-making and, by securely linking (eg with cyber-secure and blockchain technology) clinical, genomic and other data, technology will support new medical breakthroughs and consistent quality of care.

These ambitions present opportunities to further strengthen the role of the healthcare science workforce, as information and data specialists who can collaborate with those patients who know their disorder so well they have become 'expert patients'.

Building on significant advances already achieved by scientific services, the healthcare science workforce can lead the way in the use of digital technology to

support analysis of patient data, while ensuring patient information is kept safe and secure.

These skills will become more important as the delivery of care extends into more diverse community settings and data is collected from a varied range of sources, including phone apps, wearables and mobile health technologies.

An example of this is work that has been undertaken with the NHS and wider voluntary sector, where developers and individuals have co-created a range of phone apps to support health related conditions, eg 'The HeLP App', which is an evidence based, self-directed, self-management application programme for those newly diagnosed with diabetes.

The delivery of new models of care and a reduction in the duplication of tests relies on digitally integrated service infrastructure underpinned by robust data quality standards and regulation.

Achieving this will also provide a strong foundation for the future adoption of technological advances involving artificial intelligence, which will also require the development of specialised skills in data analytics.

These innovations can also help to create an effective platform for the delivery of telemedicine and remote interpretation of medical data as well as machine learning for better clinical decision-making.

3.4 Provide an integrated patient journey

The data generated in scientific investigations can be extensive. Healthcare science services are data rich, and with staff trained in data interpretation there are valuable opportunities to compare data between populations, unlocking and integrating information across different specialisms, something that currently only happens in environments active in research.

The integration of services and personalisation of care will provide the ideal foundation for this to become 'business as usual' in clinical environments, providing further resource for mobile applications, such as the NHS mobile phone app (NHS App).

An integrated health informatics journey and the ability to successfully link datasets that can be accessed by clinicians and the patient, across primary, secondary and community care, empowers individuals in their own care. It can enable a more effective prevention approach, identify unmet need and support activities to address health inequalities.

The healthcare science workforce is in a unique position to enable this as their services span across all medical specialisms, and provides 80% of patient diagnostics and specialist interventions, all of which is rich in data.

Lab in a bag

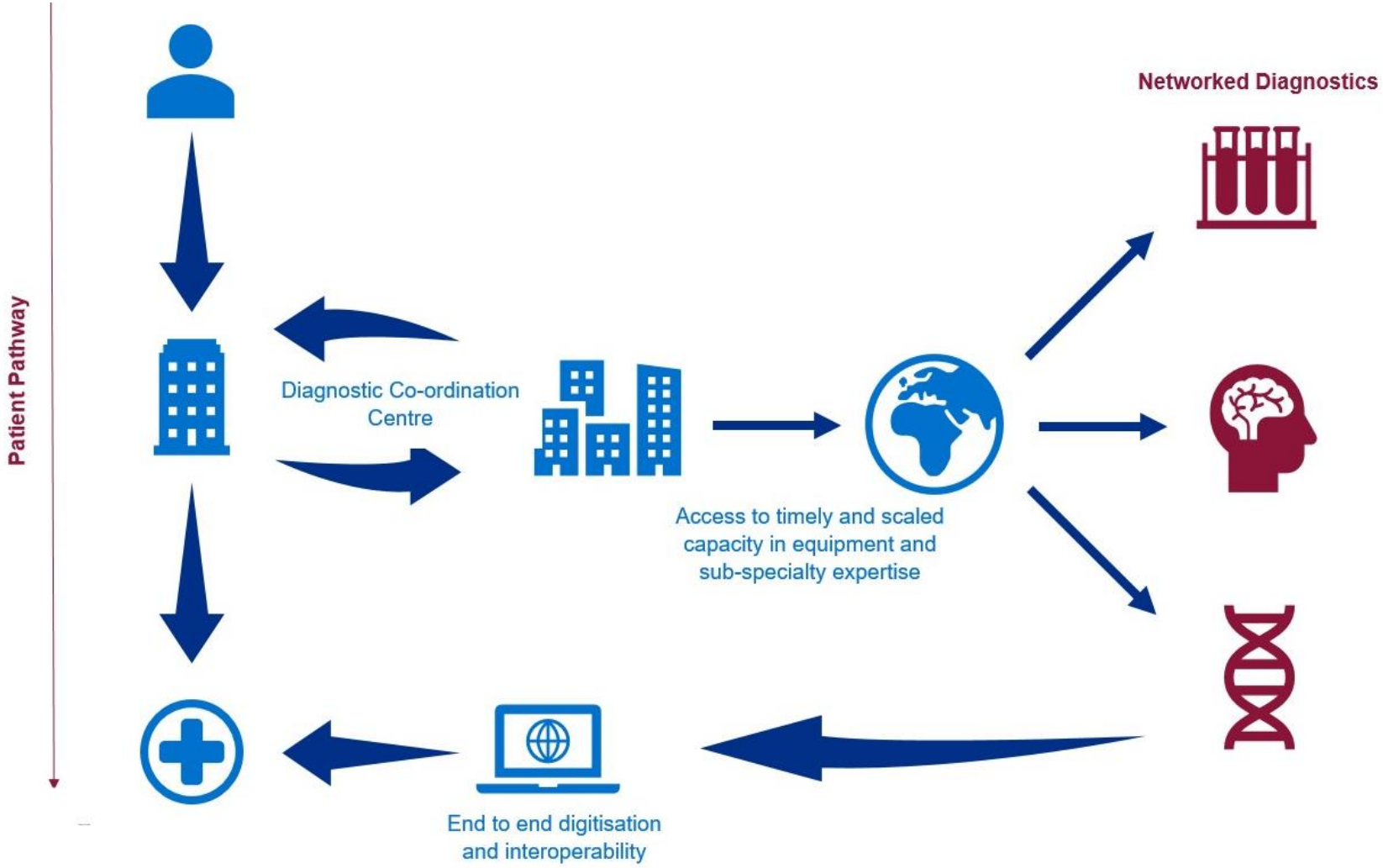
A multidisciplinary collaboration between the University of Sunderland and NHS England, led by an NHS consultant clinical scientist, has created innovative care pathways to deliver **'lab in a bag' diagnostics to people with a learning disability**.

People with a learning disability have increased risk of chronic conditions. However, they also experience inequity of access to healthcare assessment and can suffer anxiety in response to interventions, such as having their blood taken.

The new care pathway delivers point-of-care diagnostic and screening tests at day centres and community events for people with a learning disability and their carers.

This innovation has given clinicians the opportunity to offer health checks and advice and increase healthcare accessibility to a vulnerable patient group outside the traditional healthcare setting.

Figure 2: Summary of delivering innovation in scientifically-led services



3.5 Delivery steps for priority: Delivering innovation in scientifically-led services

	Priority: **Delivering innovation in scientifically-led services**
New models of care delivery	Keep the NHS at the cutting edge of science in healthcare ensuring large datasets are used to improve the discovery and targeting of therapies, so that patients obtain more precise and useful diagnostic information in a range of disorders.
	Embed UKAS accreditation in new contracting arrangements for scientific service models and ensure quality assurance and quality standards in community settings match those in acute settings.
	Support new models of specialist testing and screening in highly complex services such as paediatric pathology, cancer screening and cardiovascular services.
Diagnostics in primary care networks and the community	Support HEE and the National School for Healthcare Science (NSHCS) to provide fully integrated community-based diagnostic healthcare by creating new versatile workforce roles in multidisciplinary community and primary care networks, through a new education and career framework.
	Enhance health in care homes to reduce unnecessary, unplanned and avoidable admissions to hospital.
	Understand current use of point-of-care technologies and wearables to support a remote testing and monitoring agenda, and work with partners and pilot sites to ensure an appropriate quality framework for their use.

Digitally enabled and data led services	Work with NHS Digital and system partners to review digital and artificial intelligence solutions and establish next steps for digitally-enabled scientific services, underpinned by robust data standards.
	Appoint a national digital lead for healthcare science to support regions in fulfilling the integrated agenda.
	Work with the UK's Industrial Strategy-funded digital pathology and imaging centres, Genomic Medicine Services and NHS data hubs to test and speed up adoption of artificial intelligence and machine learning solutions in real-world settings.
Provide an integrated patient journey	Develop an integrated 'health informatics journey' by linking and correlating healthcare science service datasets to identify diagnostic patterns, predict future ill-health, identify advanced treatment options and support population data analysis.

Priority: Attracting and supporting research and innovation in healthcare science

Over the past 70 years the NHS has been built on science, clinical research and innovation. Each has made important contributions to improving patient care by developing more effective and efficient treatments and tools, and through enabling the workforce to innovate to develop improvements to clinical care.

The healthcare science workforce is unique in the NHS in having both scientific training in a range of areas from life sciences and bioinformatics to physiological science, medical physics and clinical engineering, as well as clinical expertise. They have a key role in supporting and creating innovation pathways and a recent clinical academic careers review suggests that this 'research-active' workforce is underutilised in clinical research and innovation, despite 'research active' hospitals having lower mortality rates and benefits for patients beyond those participating in research[5].

An example of the healthcare science workforce working at the cutting edge of science is the 100,000 Genome Project. This links and correlates genomics, clinical data and data from patients to provide routes to new treatments, identify diagnostic patterns and give patients better information on which to base decisions about their care.

Many NHS laboratories and departments do currently support research efforts and have established links to clinical research networks, academic health science networks (AHSNs), higher education institutes and industry. The healthcare science workforce is already working in partnership with these organisations, some leading research and innovation in healthcare science. There are also integrated clinical academic (ICA) opportunities provided through HEE and the National Institute for

Health Research (NIHR), offering dedicated funding routes to enable the healthcare science workforce to lead research, whether full time or part time.

A strong healthcare science research agenda can give the healthcare science workforce greater opportunity to lead scientific research, making best use of their unique combination of skills in creative product development, strong analytical skills as well as the clinical expertise to contextualise how innovation will fit into the wider health system.

To increase the generation, spread and adoption of innovation in the NHS, our approach is to develop an environment conducive to clinical research and trials. This will be enabled by mechanisms allowing healthcare science services to collaborate and benefit from academic and commercial partnerships and shape research. This will address clinical need and enable the creation and testing of new innovations in real-world scenarios. We will produce a research, development and innovation framework to support the healthcare science workforce in this endeavour.

Maximising a research-ready professional community

A recent **review on clinical academic careers for the healthcare science workforce** highlighted the achievements of the healthcare science workforce in combining patient-centred innovation with clinical practice.

It describes a highly motivated, scientifically trained, research literate clinical community that frequently embeds and creates innovation as part of their core practice.

A significant proportion hold advanced research qualifications. Targeted funding – such as that provided through the HEE/NIHR ICA pathway – role models and mentors, as well as a supportive environment in which to work or train, are needed to maximise the contribution this workforce can make to driving outcomes improvement, through research and innovation[6].

4.1 Provide access to leading scientific research

The NHS research and innovation agenda is critical to the scientific service transformation required to meet future demands on the health system. Career pathways such as, but not exclusively, clinical academic careers are key to translating new ideas into patient care.

Healthcare science departments are focusing on a range of research areas, from scientific training, data measurement, analysis, critical evaluation and research, while also actively applying for NIHR backfilled fellowships, a programme which allows individuals to undertake PhDs on a part time basis. This enables the healthcare science workforce to take the lead in stimulating innovation and contribute to this research rich environment, as demonstrated by the healthcare science workforce who are already involved in knowledge transfer partnerships[7] with industry and research collaboratives.

There is continuing scope to strengthen clinical academic career training, clinical research and research delivery opportunities. These initiatives will support delivery of the Long Term Plan in improving care and contribute to the vibrant life science sector in the UK by increasing the pipeline of high value affordable innovations, supporting economic growth and the Life Sciences Sector Deal[8].

4.2 Enable better clinical research and trials for patient care

A strong clinical research environment is important for patient care as it enables innovations to be tried in the context of current care pathways and can also involve patients in the process of bringing innovations into the clinics, wards and operating theatres. It is well established that patients have better outcomes in research active hospitals.

To increase research delivery there are opportunities to use the expertise of the healthcare science workforce in advising, supporting and designing clinical trials. NHS England will need to work more closely with the NIHR to support, for example, pharma-related research that could provide changes to excess treatment costs. This will involve the support of commercial trials through NHS England's *12 actions to support and apply research in the NHS*[9].

To achieve this, we will need to explore research delivery roles for scientific services and the healthcare science workforce. We will therefore produce a research, development and innovation framework for the healthcare science workforce to underpin this requirement.

Earlier detection and treatment of breast cancer

Earlier detection and treatment of breast cancer can lead to better patient outcomes, but accurately detecting and diagnosing disease earlier through mammography screening remains challenging.

Thousands of cases are missed each year and 90% of women referred for biopsy do not have the disease.

To tackle this, healthcare scientists at the Royal Surrey County Hospital NHS Foundation Trust are working with world leaders in artificial intelligence (AI) from Google DeepMind. They are developing an innovative 'virtual clinical trial' to evalute commercial breast cancer screening technologies using an AI-powered computer model.

Early indications suggest this new technology improves the accuracy of mammogram screening analysis, improving early breast cancer detection while reducing the number of women unnecessarily receiving invasive biopsy.

4.3 Test and evaluate innovation in current clinical settings

To ensure innovation fits seamlessly into care pathways it needs to be tested in real-world scenarios. This helps ensure that the innovation works within the boundaries of the clinical service, and that it also integrates effectively into wider clinical pathways and meets the clinical need for which it has been developed.

Established networks of healthcare science expertise and knowledge transfer partnerships[7] offer avenues through which the healthcare science workforce can support the evaluation and subsequent adoption of new diagnostic and technological advances within the NHS and lead the research agenda.

The exchange of clinical expertise and innovation through European and global networks, and the multiple roles the healthcare science workforce play in leading and advising on international measurement standards, provide a platform on which to build stronger links through initiatives such as the NHS Export Catalyst with Healthcare UK[10].

National innovation programmes such as Clinical Entrepreneurs and NHS Innovation Accelerator and the Chief Scientific Officer's (CSO) Knowledge Transfer Partnership programme[7] offer further opportunities to expand collaboration with academic and industry partners. The CSO scheme is bespoke to the healthcare science workforce.

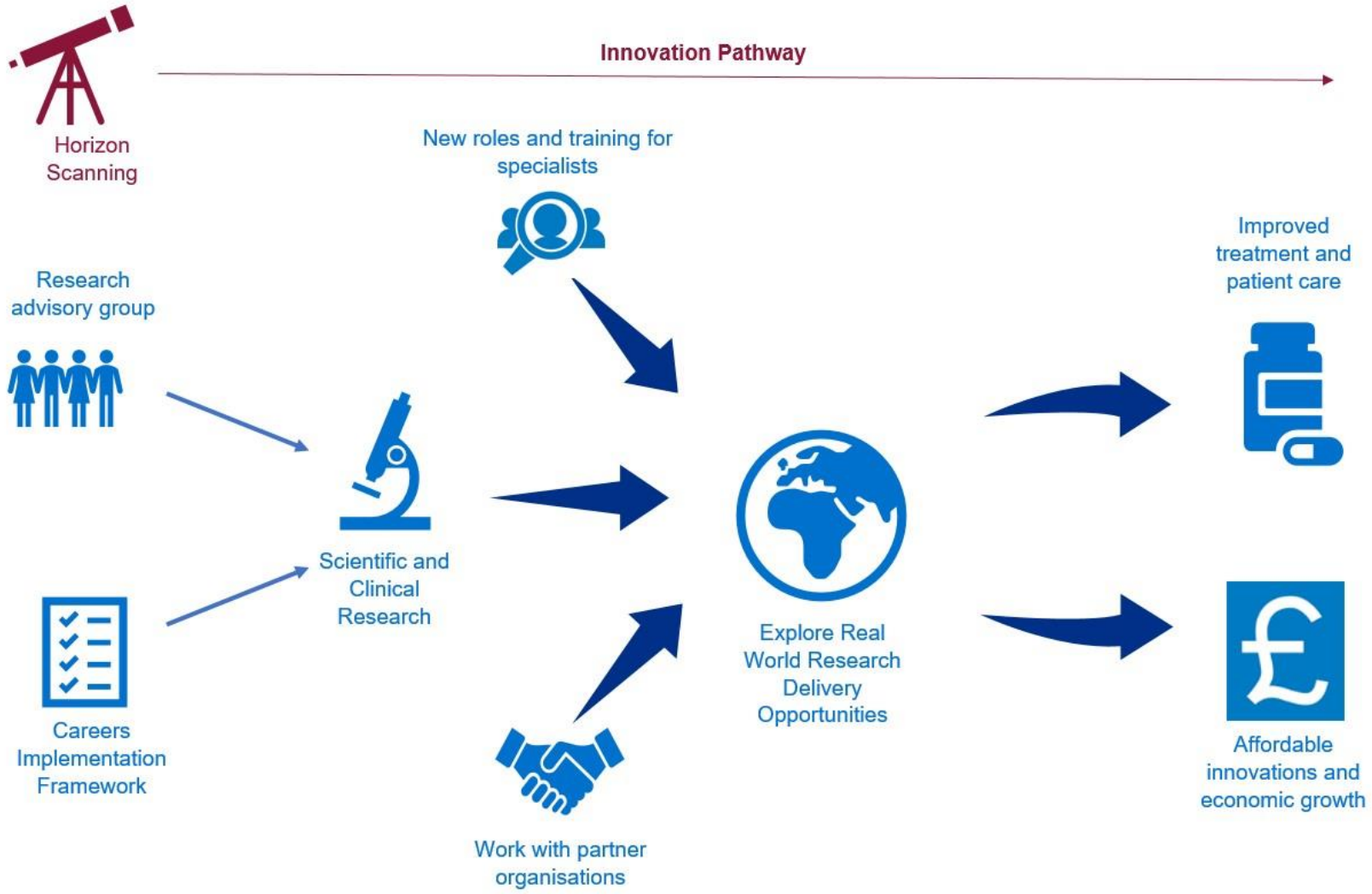
4.4 Integrate future intelligence and technology adoption

Horizon scanning future research provides valuable intelligence on the innovations which are developing rapidly and which the scientific services should be preparing to engage with and explore the implementation of.

This process can also identify areas where development is happening more slowly, and which could benefit from support to speed up clinical implementation; or other areas of diagnostic need that would benefit from further clinical research activity. The healthcare science workforce is well-placed to support and lead this process and provide insight in terms of how research fits into a clinical context, looking ahead to which technologies will be relevant in the future and considering the impact of these technologies on service providers and the health system as a whole (summarised in Figure 3).

The pivotal role of the healthcare science workforce in adopting large-scale technological advances is seen in many NHS-led service transformation projects. To ensure the NHS operates at the forefront of science, specialist roles for the healthcare science workforce in technology adoption will be explored in the new framework.

Figure 3: Summary of attracting and supporting research and innovation in healthcare science



4.5 Delivery steps for priority: Attracting and supporting research and innovation in healthcare science

	Priority: Attracting and supporting research and innovation in healthcare science
Provide access to leading scientific research	Establish a research advisory group to take forward the recommendations of the Healthcare Science Clinical Academic Career (CAC) Review.
	Construct an implementation support mechanism for the HEE non-medical CAC framework to enhance healthcare science career pathways and increase options for integrated clinical academic funding, joint appointments with higher education institutes and research leadership programmes.
Enable better clinical trials for patient care	Develop a strategic approach to enable the healthcare science workforce and scientific services to support clinical research and access clinical trials
Test and evaluate innovation in a real-world setting	Work in partnership with academia, industry, charities and other scientific organisations to support real-world testing and evaluation of technology in a clinical setting. Work with the Medicines and Healthcare products Regulatory Agency (MHRA) to develop and evaluate a regulatory pathway in line with In-Vitro Diagnostic (IVD) regulations.
	Expand relationships with funders to shape funding calls and develop more clinically integrated opportunities.
Ensure the NHS operates at the limits of science	Scope new roles and training routes for technology adoption specialists, bioinformaticians and data scientists.
	Enable a joined-up approach to conduct, communicate and act on horizon scanning for future innovations across healthcare science services.

Priority: Building a workforce to lead transformational change

The healthcare science workforce is unique, specialised and fundamental to clinical decision-making. We will develop a comprehensive healthcare science workforce programme, overseen by a Healthcare Science Workforce Partnership Board and chaired by the Chief Scientific Officer (CSO), working in collaboration with key partners to support implementation of the NHS Long Term Plan and expand the frontiers of clinical science and innovation.

The programme will work to model and plan the workforce, introducing flexible entry routes, better careers, new roles and ways of working and competency-based development frameworks underpinned by the most suitable regulatory framework. These will underpin flexible and responsive systems of education, training and leadership and build on good practice in the system. The programme of work will strengthen multiprofessional partnerships across education, training and workforce development to support transferability of skills and knowledge, supporting high quality outcomes and a culture of valuing the workforce.

Through the programme, we will better recognise the valuable and essential work of the healthcare science workforce and allow their unique knowledge, skills and expertise in science, technology, engineering and mathematics (STEM) to be employed more effectively and efficiently. This will be achieved through effective, evidence-based mobilisation of this scientifically trained, flexible and versatile workforce, ensuring we more rapidly adopt, develop and scale up proven advances in technology and innovation to improve patient care and health outcomes.

The development of new models of integrated care and service transformation has been driven by those in leadership roles, and by a strong appreciation of the central role of clinical networks of expertise, communities of practice and multiprofessional collaboration in accelerating adoption. To realise national service transformation and the ambitions of the Long Term Plan, the provision of specialist advice by leaders distributed throughout the health and social care system is increasingly important,

especially against a backdrop of regional and cross-system integration of services and new care model structures signalled in the Long Term Plan.

The healthcare science workforce is uniquely placed as innovation leaders to shape population-based health planning and advise on new technologies across systems. This is due to their scientific and technological training and expertise, data analysis and interpretation skills, experience in ensuring services work safely and effectively within the wider health system, and cross-sector collaboration.

Despite this, the healthcare science workforce remains a largely untapped resource for leaders. Few hold senior leadership roles on NHS trust executive boards, in regional infrastructure or in the advisory structures for sustainability and transformation partnerships (STPs) and integrated care systems (ICSs).

We will work to address the leadership challenges within the workforce and establish a local leadership approach to enable intelligent feedback from regional and local organisational structures to inform national planning, commissioning and service development.

5.1 Workforce leading change to deliver carbon footprint

Almost 30% of preventable deaths in England are due to non-communicable diseases specifically attributed to air pollution. More than 2,000 GP practices and 200 hospitals are in areas affected by toxic air. In 2017, 3.5% (9.5 billion miles) of all road travel in England was related to patients, visitors, staff and suppliers to the NHS. At least 90% of the NHS fleet will use low-emissions engines (including 25% ultra-low emissions) by 2028, and primary heating from coal and oil fuel in NHS sites will be fully phased out[2].

The healthcare science workforce can help the NHS to reduce its carbon footprint in line with the Climate Change Act[11] (34% by 2020, 51% by 2025 compared with the 2007 baseline).

The NHS healthcare science workforce is working with national partners to review opportunities to reduce carbon, waste and water use in line with these targets, and supporting the development of national programmes to drive progress in three key areas:

- shifting to appropriate use of lower carbon inhalers across the NHS
- reducing use of single-use plastic, based on best practice
- reducing the amount of staff commute and visitor and patient travel.

Additional information to support systems to respond to the sustainable development targets for carbon reduction, air pollution and reduction in use of single-use plastic will be published by 2020. In the summer of 2019, the NHS Healthy New Town Principles – *Putting health into place*[12] – was published. Any geography with planned housing growth should use these principles as a guide for collaboration between local authorities, NHS services and developers in ensuring that new developments plan, design and build healthier environments. A 'Healthy New Towns Standard' will be developed in 2020, which will include further incentives to build health and wellbeing into any new developments.

To ensure the expertise of the healthcare science workforce is utilised to its full potential our approach is to identify clear and direct routes to influence and inform NHS provider trust boards and wider integration discussions in this area through our organisational lead scientists.

Access to healthcare science services underpins the efficiency and care quality of many patient pathways. As the NHS moves to a 'triple integration' of primary and specialist care, physical and mental health services, and health with social care, we will outline steps to ensure scientific leadership is embedded in decision-making, from the Office of the CSO, through regional lead scientists, to organisational lead scientists, working through networks across the system, including any decisions and actions that need to be undertaken with respect to climate change.

5.2 Increase strategic leadership across systems and integrated care

Healthcare science services are an integral component of modern health and social care and using the right test at the right time ensures an efficient patient journey with the best possible outcomes. It is therefore critical that scientific leadership and advice should be visible, accessible, diverse and embedded across a health and social care system that is evolving to integrated care models. This will ensure patient pathway transformation aligns with diagnostic and scientific service transformation.

To facilitate this interface, the regional healthcare science leadership infrastructure will be strengthened, working closely with regional medical directors to provide

dedicated advice to support service transformation activities and population health planning. These regional healthcare science leaders will work closely with regional healthcare science networks and organisational lead scientists encompassing the breath of specialist diagnostic and scientific service.

Creating clinical diversity and leadership roles

Evidence suggests that professionally diverse teams and clinicians at all levels increases the likelihood of meeting the increasingly complex and strategic problems facing healthcare organisations.

The 2019 NHS Long Term Plan and NHS Interim People Plan confirmed the importance to the NHS of sustained and effective leadership in order to deliver high quality care and outstanding performance in a complex, changing and demanding environment. The King's Fund[13] and the Foundation for Medical Leadership and Management[14] reinforced the need to engage a diverse group of clinical staff in leadership at all levels, if the health system is to innovate and adapt for the future.

From data collected on ESR in 2019, 69% of the HCS workforce identified themselves as female and 31% as male, but at Agenda for Change Band 9 only 38% of the workforce were female. In addition, only 17% of the HCS workforce identified themselves as Black Minority Ethnic (BME) staff, with only 11% occupying a Band 8d or 9 post. There is clearly work that needs to be done to address the diversity in this workforce.

The training and insights of healthcare scientists have much to offer to improve the diversity and decision making capability of senior leadership teams as the complexity, technical sophistication and interdependence of NHS services grows. However, there are significant barriers to overcome to realise their contribution including a lack of formal Board level posts and of professional leads at regional or area level. Those healthcare scientists in such roles have got there more by serendipity than by planning.

NHS Improvement's recent guide for senior leaders on developing professional diversity at board level, *Clinical leadership; a framework for action*[15], identifies the barriers hindering those with clinical backgrounds, such as the healthcare science workforce, in gaining senior leadership roles and provides a framework for overcoming these barriers.

The NHS Leadership Academy provides leadership development for people of all backgrounds and experiences across health and care. The Academy offers 10 different programmes catering for all levels, aimed at anyone who is interested in leadership with a range of tools, models, programmes and expertise to support individuals, organisations and local partners to develop leaders,

On 1 April 2019, the NHS Leadership Academy moved to NHS England and NHS Improvement, in order to directly support the leadership and talent management requirements of the NHS Long Term plan, this is a resource very much underutilised by the Healthcare Science workforce. We will work with the Leadership Academy to raise awareness of this resource with our workforce.

An accessible network of healthcare science expertise

There currently exist a very small number of national leadership roles providing close working with regional medical directors and across integrated care systems. This is very sporadic and needs to be more robustly facilitated across all regions.

There also exist organisational lead healthcare scientists in many NHS provider trusts in England, although not in all, currently 74% of NHS provider organisations have an organisational lead scientist. Again, this needs to be addressed to enable the formation of local and regional networks of scientific expertise and communities of practice, collaborating as a national lead healthcare science network, enabling provision of scientific and diagnostic expertise into the system.

5.3 Nurture the next generation of leaders

It will be important to nurture a cadre of scientific leaders to bolster leadership at a regional and organisational level and continue to build upon existing leadership training programmes to ensure we are equipping the workforce with the leadership skills required to work in an increasingly complex environment and lead transformational change (summarised in Figure 4).

We will create opportunities and more clearly defined routes for the healthcare science workforce to be decision makers, and to have influence at all levels. While leadership is a core part of healthcare science training pathways, such as the NHS Higher Specialist Scientist Training (HSST)[16], the healthcare science workforce needs support to access leadership and management opportunities that use their skills in technology adoption and data analysis.

A strategic approach to supporting the scientific leaders of the future

Through dedicated scientific leadership programmes, designed in partnership with other scientific sectors such as the National Measurement System and Woman in Science and Engineering (WISE), shared learning and best practice in leadership between industry, academia, the third sector and the NHS have resulted in the successful Knowledge Transfer Partnership (KTP) programme and the WISE Fellowships.

Both these endeavours provide a strong foundation to strengthen the pipeline of versatile and innovative leaders for the future[17].

5.4 Create capacity to evolve roles to meet system needs

Service transformation and new technology create a need for new roles and offer opportunities to create a long-term workforce plan that addresses recruitment, retention, education and training to provide a strong healthcare science profession for the 21st century.

Core skill sets, versatility in roles and training development will need to be built into career pathways for the healthcare science workforce, as well as new and evolved roles and working within a multidisciplinary environment. This will provide an opportunity for the healthcare science workforce to contribute their evaluative, analytical and critical thinking skill sets to address wider challenges.

These new roles will include technology prescribers, data interpreters and more patient-centred community based healthcare scientists.

5.5 Increase professional diversity at executive levels

The healthcare science workforce has a critical role in supporting the NHS to stay abreast of new technologies. This includes working with providers to know when to acquire and effectively deploy new technologies and innovative medical devices, equipment and diagnostics.

Clear lines of accountability and leadership will be necessary to ensure the effective management and adoption of new technologies, encourage clinical diversity in leadership and reduce the risk of adverse events.

To achieve this, it will be important to provide the healthcare science workforce with clear and direct routes to influence and inform board level discussions and influence across ICSs. We will support our healthcare science leaders and provide them with the underpinning talent management and leadership development framework to enable them to deliver these important roles across the system.

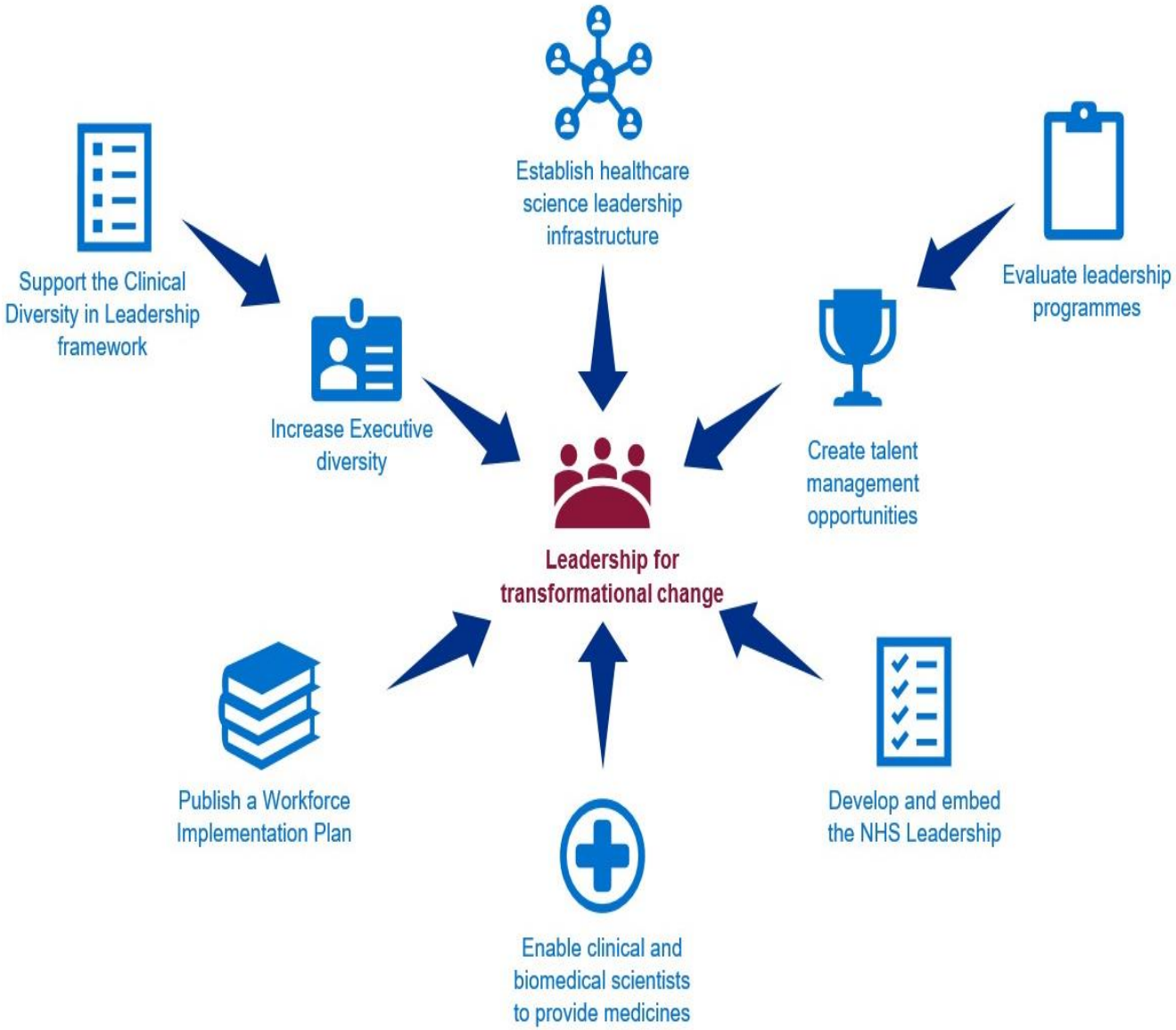
Preparing the healthcare workforce to deliver the digital future

The Topol Review[18] provides advice on how healthcare technologies, such as genomics, digital medicine, artificial intelligence and robotics, will change clinical roles; how the workforce can be prepared for that change, and therefore the changes required in the education and training of all staff.

It sets out how healthcare technologies will be able to speed up clinical processes like diagnostics, for example, providing patients with quicker, better treatment and freeing up clinical time for care.

It makes recommendations on the steps needed to continue the development of staff for a future in which the implementation of revolutionary technologies will consistently allow the NHS to provide the best care and treatment possible.

Figure 4: Summary of delivering leadership for transformation change



5.6 Delivery steps for priority: Leadership for transformational change

	**Priority:** **Leadership for transformational change**
Strategic leadership across systems and integrated care	Establish a healthcare science leadership infrastructure across arm's length bodies and other national system architecture, supported by regional scientific advisors to lead the healthcare science workforce networks mapped to regions, STP and ICS footprints.
Nurture leadership development	Create talent management opportunities across the leadership pipeline based on existing and ongoing evaluation of current healthcare science leadership programmes such as the those offered by the Leadership Academy
Create capacity to evolve roles to meet system needs	Support the Long Term Plan's development of and embed, the NHS Leadership Compact highlighted in the Interim People Plan, setting out core cultural values and leadership behaviour.
	Work with NHS England and NHS Improvement and HEE as part of the cross-sector national workforce group to publish a workforce implementation plan (National People Plan) in 2020.
	Seek to amend regulations so clinical scientists and biomedical scientists can supply and administer medicines where appropriate.
Increase professional diversity at executive level	Work with the lead healthcare science network to support the implementation of a more diverse clinical leadership framework for provider trusts and increase opportunities for routes to senior leadership positions for females and the BME workforce.

Priority: Partnering to improve and integrate information and knowledge

Partnerships create new ideas, transfer expertise, mobilise knowledge and resources across professional and organisational boundaries and provide greater integration and better value for public funding. They offer opportunities to draw on knowledge and expertise from other sectors, create more innovative approaches and develop new ways of thinking.

The interpretation and effective application of scientific investigations requires considered analysis and communication within a multidisciplinary environment. This coupled with academic and educational roles for the healthcare science workforce creates a collaborative environment.

The healthcare science workforce already creates partnerships to innovate, communicate and share expertise to improve patient care. Academic and industry partnerships are common, as are close links to charities and other patient groups.

To successfully realise the new service models, the clinical research and scientific leadership ambitions of our healthcare science profession, alongside the Long Term Plan and Interim NHS People Plan[2] for the future, relies on this workforce working within and between sectors, in collaboration and partnership with patients, providers, academia, industry and the third sector.

Our approach will include a high-level coordinated effort to ensure the healthcare science workforce has the tools they need to access and assimilate knowledge on emerging science and innovation and are embedded within an integrated infrastructure to consider and communicate the next steps to implementing new technologies and care pathways working with a wide range of partners.

The power of healthcare science partnership

The Perfect Patient Pathway Test Bed programme, hosted by Sheffield Teaching Hospitals NHS Foundation Trust, was launched to benefit patients with multiple long-term conditions.

The programme sought to combine and integrate innovative digital technologies and service redesign to keep patients well and independent, and to avoid crisis points which often result in hospital admission, intensive rehabilitation and a high level of social care support.

The programme also sought to build the infrastructure and networks within the region, working with industry partners to test, refine and scale-up innovation and to establish the effectiveness of this type of programme for identifying, implementing and evaluating the use of digital health.

This work highlights the importance of collaboration with industry partners and patients[19].

6.1 Partnership to share scientific and technical expertise

Disruptive technologies underpinning transformational change are more likely to arise from innovative partnerships. Adoption and diffusion can accelerate when these technologies have been co-created by the health system, where the healthcare science workforce and partners such as the pharmaceutical, biotechnology industry or academia work together.

The success of current healthcare science knowledge transfer partnerships[7] has provided opportunities for the healthcare science workforce to collaborate more closely with science-based sectors to identify and apply high value, high impact, new approaches, to improving patient outcomes.

These projects invest in science research and provide the healthcare science workforce with opportunities to increase effectiveness and the efficiency of the care they provide and to explore how new innovations and ways of working can benefit patients.

6.2 Partnering to innovate

There are also opportunities to develop stronger relationships with health and medical research funders to shape funding calls, and opportunities to work closer with industry partners to accelerate the adoption of new innovations into the NHS, through closer working with the AHSNs.

This will also be supported by building on the universal language of science and expanding partnerships across other scientific sectors including academia, industry and public sector charities, in support of the Life Sciences Sector Deal[8]. By expanding links with the innovation architecture including the NIHR Community, Healthcare MedTech and In Vitro Diagnostic Cooperatives (MICs), vanguards and test beds, our healthcare science workforce can support the development, adoption and spread of innovations in their services.

In addition, building on the international expertise and advisory role of the healthcare science workforce within international networks and professional bodies offers even greater possibilities to expand the ambassadorial role of the healthcare science workforce in supporting wider initiatives to address the global impact of healthcare in combating disease burden.

Antimicrobial resistance diagnostics

Antimicrobial resistance (AMR) poses a significant risk to health. By 2050 it is estimated that AMR will kill 10 million people per year[20], which is more than cancer and diabetes combined.

The right diagnostics are critical to the appropriate use of antimicrobials. In collaboration with cross-system partners the UK Antimicrobial Resistance Diagnostics Collaborative (UK ADC) was established under the leadership of the Office of the Chief Scientific Officer to ensure opportunities for precise and timely diagnosis and effective prescribing decisions, through rapid point of care diagnostics, are maximised.

This work will continue through a newly formed AMR Diagnostics Partnership Board, again led by the Office of the Chief Scientific Officer, to deliver the priorities of the Long Term Plan.

6.3 Partnering to support integrated care

Optimising the health and economic value of scientific investigations will require collaboration between multiple stakeholders involved in health delivery and commissioning.

The healthcare science workforce is well placed to facilitate these collaborative cross-disciplinary efforts and address wider system challenges; their work in diagnostics spans organisations and disciplines including primary and secondary care, social care and public health.

The opportunities to create large scale and effective pathway transformation through closer collaboration between scientific services and regional integrated care plans is significant and currently underutilised. This is especially true in primary care and across community based settings such as social care, where, for example, with diagnostics closer to the community, the identification of a urinary tract infection in the community can support the care of patients closer to their home, keeping them out of hospital.

Similarly, the diagnosis of diminished hearing in a care home which could increase the risk of a fall, can make an enormous impact to the quality of a patient's life. The healthcare science workforce working more closely with clinical colleagues in primary care networks could bring significant benefits to patient care and a reduction in hospital admissions.

As care continues to move closer to the community, and the use of biometric sensors and monitoring in the patient's home becomes more prevalent, co-production of innovative solutions will become increasingly important.

The ability to design solutions for a real-world environment will rely on the ability of the healthcare science workforce to effectively partner and collaborate with colleagues and patients across the health and social care system.

Implementing wearable technology for more effective fall protection

The Falls Prevention Project**,** a collaborative project led by the Sheffield Telehealth team with both NHS and external industry partners, aims to reduce falls in at-risk populations.

These can cause significant damage to physical health; however, many people are often only introduced to falls prevention services after having suffered an initial fall.

The team established the use of the Kinesis Quantitative Timed Up and Go (QTUGTM) mobile device for earlier assessment of falls risk. The device is worn by the participant as they undertake a short walking exercise to objectively assess their gait.

The new method was well-received by patients, worked effectively in busy clinical settings as well as in the community, and was cost-saving compared to paper based assessment. These findings could lead to service transformation in assessing risk of falls[21].

For more information on falls improvement collaboratives see: https://improvement.nhs.uk/resources/falls-improvement-collaborative-provider-stories/

6.4 Partnering to understand public and patient needs

The implementation and adoption of new technologies, particularly digital technologies, will require effort to inform the health system, patients and the public about how they work and their impact on users. This is an area that the healthcare science workforce can support through their healthcare science networks.

New technologies present an opportunity to further reduce inequalities between patients in access to, and outcomes from, healthcare services and to ensure services are provided in an integrated way.

The healthcare science workforce has been working in partnership with '*Sense about Science'* to facilitate public discussions on advances in technology, such as big data, machine learning and artificial intelligence.

Efforts such as these build patient and public trust in technologies, not only giving them confidence in interacting with the technology but also that the information generated by such technologies will be used and safeguarded appropriately.

This is particularly important with assistive digital technologies. Building on advances in bioengineering, assistive technologists can support patients and the public to take more of an active role in their own care, using self-monitoring tools and devices, phone apps and wearables.

In order to improve the communication of complex aspects of healthcare science to patients and the public and to facilitate the democratisation of data and patient access to test results, partnerships with science communication organisations, such as 'Sense about Science' and 'Pint of Science' and co-creating solutions with patient organisations such as the Alzheimer's Society, Age UK and the British Heart Foundation, will be critical.

We will work towards more patients and the public being involved in the designing and testing of new technologies, involving more patients in clinical trials and research, and in the design of new care pathways through patient forums and patient involvement events alongside healthcare professionals.

Continuing to engage with stakeholders, staff, patients and partner organisations will also provide ongoing opportunity to refine and innovate scientific and diagnostic services and ensure future programmes of work are aligned to meet patient and public needs (Figure 5).

Innovating with patients: The care home red bag

Audiologists and patients have been working together to integrate sensory awareness to the ‘Care Home Red Bag’ initiative.

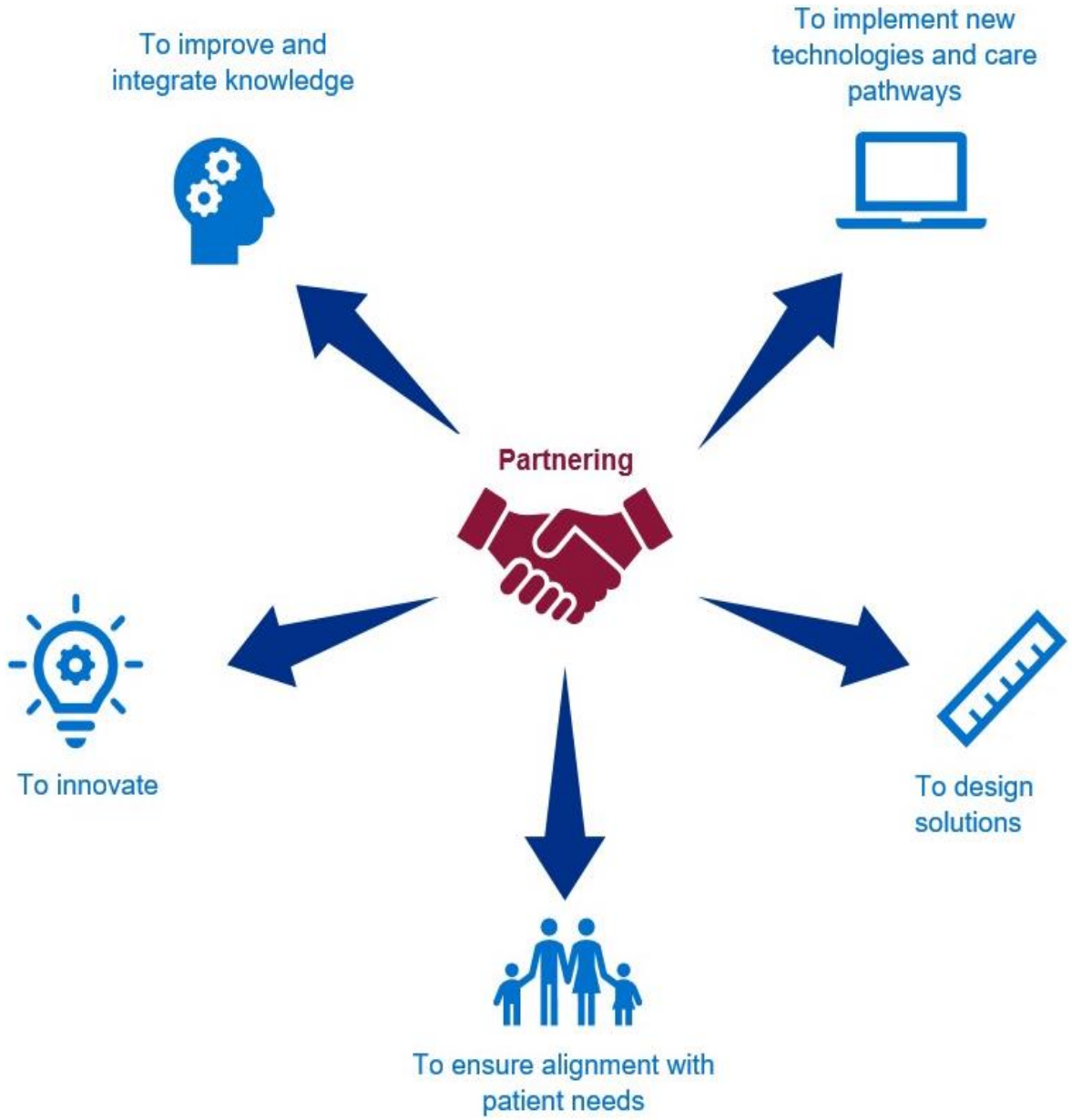
The 'Red Bag' initiative is making a big difference to the transfer of patients between local care homes and NHS hospitals. Formally known as the Hospital Transfer Pathway (HTP), the initiative involves a red bag being given to every care home resident.

The bag contains medical records, discharge details and space for the patient's personal belongings, and has been developed to increase collaboration between care homes and NHS hospitals, and make the admission/discharge process between the two, much more efficient.

Incorporating sensory awareness into this initiative is allowing the bag to be more applicable to those patients with hearing impairment and therefore improving the experience and care of patients with hearing loss.

For more information on this initiative, please visit:
www.england.nhs.uk/publication/redbag/

Figure 5. Summarising partnering to improve information and knowledge



6.5 Delivery steps for priority: Partnering to improve information and knowledge

	**Priority 4: Partnering to improve information and knowledge**
Partner to improve and integrate knowledge	The healthcare science workforce will partner with industry, academia and third sector patient groups to assimilate knowledge on emerging science and innovation through programmes such as the Chief Scientific Officer Knowledge Transfer Partnership.
Partner to implement new technologies and new care pathways	Align regional healthcare science leadership within an integrated infrastructure to consider and communicate the next steps towards implementing new technologies and care pathways working through integrated care systems and primary care networks.
Partner with industry to innovate	Expand links with the organisations, including industry partners, driving innovation and supporting senior healthcare scientists to work directly with AHSNs, MICs, vanguards and industry partners to lead innovation through, for example, primary care test beds.
Partner to design solutions	The healthcare science workforce will work with primary care networks to design solutions for a real-world environment across the health and social care system, moving diagnostics (where needed) particularly in areas such as cardiac and respiratory closer to the community, through new ways of working.
Partner with patients	Work with lead healthcare scientists to build communication and engagement with patients and patient partner organisations to provide ongoing opportunities to refine and innovate scientific and diagnostic services and ensure future programmes of work are aligned to meet patient needs.

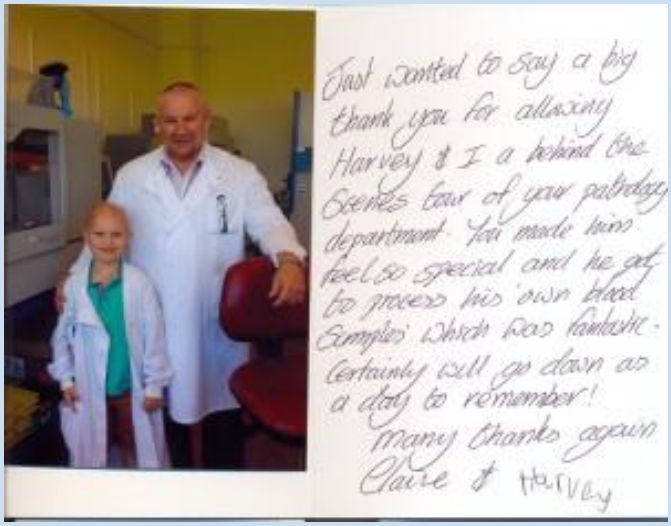
6.6 What this strategy means for patients

- Patients will receive better care as a result of high quality scientific and diagnostics services.
- Patients will receive the right diagnostic test at the right time in the right place.
- Patients will benefit from networked expertise and services closer to their homes and those of their carers.
- Patient safety and outcomes will be improved.
- Patients will receive preventative interventions and earlier treatment.
- Patients will have access to more non-invasive tests and better targeted therapy with fewer side effects.
- Providers will implement better disease management strategies.
- Test results will be easier to access; diagnostic services will be available closer to where patients live; and their quality, safety and equity of access will be assured.
- Patient pathways will be streamlined to give patients a better experience.
- There will be a reduction in patient ‘odysseys’, from identification of symptoms to diagnosis, especially in rare diseases
- Patients will always undergo scientific and diagnostic investigations and interventions the equipment and protocols used will be safe, effective and evidenced based.

Harvey's story

A simple request from a paediatric patient about where his blood went when it was tested has led to an international initiative established by the healthcare science workforce to increase the involvement and knowledge of patients and their families in the laboratory aspects of their transfusion treatment.

'Harvey's Gang' was set up in memory of leukaemia patient Harvey, who was curious about why the hospital staff needed blood samples and how they used them to help plan his treatment.



Malcolm Robinson, chief biomedical scientist at the Haematology and Blood Transfusion Laboratory at Worthing Hospital, Western Sussex NHS Trust, and colleagues invited Harvey and his family to the laboratory and gave him a tour as a 'trainee scientist' (pictured), showing him how his blood samples were processed and what the equipment in the laboratory was used for.

Harvey's Gang is now available in at least nine hospital trusts, supporting children and giving them the opportunity to meet scientists, ask questions and demystify their treatment.

6.7 Achieving our ambition together

This **Science in Healthcare Strategy** has been created through a combination of data, evidence and stakeholder consultation, alongside the development of the Long Term Plan and the NHS Interim People Plan. This involved:

- a review of national policy documents and publications
- a horizon scan of technology
- engagement and involvement from senior leaders across the system
- a thematic analysis of the engagement activities to gather contributions from patients, carers, the public, professional bodies and health and care staff and in particular the healthcare science workforce.

This is a plan for how we intend to take the ambitions and commitments of the Long Term Plan and the forthcoming NHS People Plan and work together to turn them into local action to improve services and the health and well-being of the communities we serve.

We will continue to engage with patients and the public so that together we can transition to a new model for scientific services as the command centre at the heart of the patient journey.

6.8 Call to action and next steps

1. To ensure our services are fit for the future we will need to secure the workforce that will be required for current and future supply, we will need to work with HEE (NSHCS) to review current healthcare science education and training programmes and create new education and career frameworks.

   To ensure we keep pace with technology advances and meet the needs of the Long Term Plan we will undertake the following actions:

   a. Explore with HEE a modular and digitally accessible approach to support flexible learning and portfolio careers for the healthcare science workforce and other professional groups.
   b. Initiate an impact assessment of tapered funding for scientific training programmes and alternative approaches to supporting trainees and create a new funding model.

c. Ensure funding flows to employers via the Local Development Agreement (LDA), identifying funding to support healthcare science placements as part of multi-professional workforce commissioning funding.

d. Review the current provision of practice based education and training and explore innovative training approaches such as a clinical educator, which is a model to reduce pressure on current training and service capacity constraints, modelled on areas of expansion, such as genomics.

e. Further develop the advanced clinical practice model and opportunities for the healthcare science workforce in histopathology, microbiology and other specialisms.

f. Scope a strategy to guide continued professional development (CPD) and upskill investment underpinned by digitally accessible platforms to back the healthcare science workforce and continue to reform education and training programmes and quality assurance and assess training capacity and CPD requirements.

g. Work with higher education partners including HEE, Universities UK (UUK) and the Department of Education (DofE) to review undergraduate training routes into HCS careers and to identify sustainable supply solutions including funding to ensure a strong UK STEM pipeline in line with the broader life sciences strategy.

h. Strengthen supply routes and professional reputation by working closely with schools to inspire young people to pursue a career in STEM.

i. Review the healthcare science career framework and initiate strategic expansion of credentialing, competency based skill-mix and apprenticeship routes, and develop plans to increase flexibility.

j. Bring together new service models with workforce commitments and financial plans.

k. Explore new service models and versatile roles to support primary and community care working closely with primary care networks.

2. We will redesign our services and the workforce to meet the needs of the future NHS, with the establishment of a healthcare science workforce partnership board in collaboration with HEE, the professional bodies, royal colleges and other stakeholders to:

a. Guide a review of the healthcare science career framework and agree strategic plans to ensure healthcare science training is more flexible, agile, permissive and addresses changing service needs.

b. Design, agree and implement workforce testbeds of new roles to support emerging and new Long Term Plan models of care, including rapid diagnostics in primary care networks and community care.

c. Begin initiation of recommendations from the career framework review, embedding approaches with other professional groups within the educational framework.

3. We will work with pharmacy system partners to reduce antimicrobial resistance, ensuring opportunities for precise and timely diagnosis and effective prescribing and decision-making are supported and maximised through rapid point of care diagnostics.

4. We will develop a research, development and innovation framework and review options for strengthening and enabling the healthcare science workforce to develop, deliver and support NHS research and innovation. We will access clinical academic career pathways to ensure advances in science and technology are developed, tested and adopted at pace and scale to address patient need.

5. We will scope the current regulatory infrastructure, in particular how it may impact new and advancing practice roles and work with regulators to ensure that professional regulation supports and facilitates current and future practice.

6. We will identify and develop formal advanced clinical practice training programmes to integrate working with medical pathologists, releasing time for care and in addition to this initiate deployment of skill-mix and adoption of digital technologies to address urgent pathology workforce gaps. We will establish a portal of innovative case studies to build an evidence-base for leveraging change.

7. To support growing and changing services we will undertake workforce planning and develop accurate workforce analysis with insight into affordability. We will establish a national workforce analytics function and review and improve electronic staff records (ESR) coding and other data sources to reach a clearly identified, single trusted national workforce data set for healthcare science.

   This will be used in 2020 and beyond to identify workforce gaps and opportunities in the Long Term Plan priority areas and inform strategic plans for service

redesign, linked to appropriate education, training and workforce transformation that will be needed in these areas.

To enable this, we will:

a. Work with HEE and NHS Digital to embed changes to ESR coding that enables dynamic modelling of the workforce more accurately.
b. Model supply and demand, benchmark good practice and link workforce commissioning with service delivery requirements for the Long Term Plan and new care models in Primary Care Networks, ICS and STP diagnostic and scientific service models.
c. Undertake robust predictive analytics to capture impact and return of investment on new ways of working.
d. Provide a strategic workforce analysis aligned with horizon scanning to understand current and future needs and risks, and to provide guidance to STPs and ICSs in completing their operating models.
e. Develop and provide tools for workforce profiling and benchmarking to support operational efficiency, productivity and where relevant, consolidation. This will be aligned with priority areas of critical shortage including genomics, radiotherapy and pathology and underpinned by national and international models of best practice.

8. To release time for care, we will support workforce engagement and publish a strategic approach for healthcare scientists to deliver the ambitions of the Long Term Plan.

   We will also embed a strategic narrative on the value and contribution of the healthcare science workforce for the wider system and contextualise workforce priorities within the broader ambition of system integration, clinical leadership and new models of care.

   We will release time for care by:

   a. Working closely with ICS/STPs and other NHS system partners to positively demonstrate the value and contribution of the healthcare science workforce and support the development of a systematic and sustainable recruitment and employment programme for this specialist workforce.
   b. Scoping options to support integrated portfolio working across primary, secondary and community care through approaches such as passporting.

c. Working with HEE, NHS Employers, NHS Providers and others to develop robust plans for recruitment, retention and support for the healthcare science workforce, inclusive of resilience models, to ensure the NHS remains the best place to work.

d. Ensuring there is a strategic programme for cross cutting HCS specialty leadership development, embedding HCS leadership in NHS Provider Trusts, primary care networks, ICSs and regions to provide the forward thinking scientific leadership needed to deliver new models of care.

9. We will work with national partners to review opportunities to reduce carbon, waste and water use in line with the national targets from the *Climate Change Act 2008* and support the development of national programmes to drive progress in three key areas:

    a. shifting to appropriate use of lower carbon inhalers across the NHS

    b. reducing use of single-use plastic, based on best practice

    c. reduce the amount of staff commute and visitor and patient travel.

10. We will provide scientific leadership for transformational change by developing, recognising, through talent management, and embedding leadership in healthcare science. We will further improve healthcare science leadership at all levels, including at provider trusts and supporting regions, ICSs and STPs, through a bespoke leadership framework aligned to appropriate regulation.

Conclusion

The NHS healthcare science workforce is a digitally enabled, intelligence-led workforce that uses science and their technical skills to help prevent, diagnose and treat diseases. They are a unique workforce that has led transformational change, such as genomics, that has been world leading. With digital health and technology at the heart of our NHS Long Term Plan for the future, the healthcare science workforce can help deliver that plan.

To succeed we will work together with our scientific leaders, supporting and empowering our workforce, building on our successes as a profession over the last decade and working in partnership to ensure the NHS continues to operate at the limits of science.

As the biggest employer of scientists, and related scientific staff, we will ensure the NHS continues to be the best place for scientists to work and through this strategy our healthcare science workforce will deliver the ambitions and commitments of the Long Term Plan and the People Plan and continue to provide the best possible care for patients and our communities.

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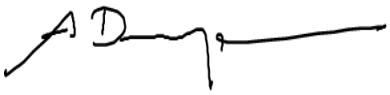

Angela Douglas MBE
Deputy Chief Scientific Officer
NHS England and NHS Improvement

References

1. NHS (2019) *NHS Long Term Plan.* www.longtermplan.nhs.uk/publication/nhs-long-term-plan/ .

2. NHS (2019) *Interim NHS People Plan.* www.longtermplan.nhs.uk/publication/interim-nhs-people-plan/

3. Genomics England (2018) *100,000 Genomes Project.* www.genomicsengland.co.uk/

4. Potter A, Pearce K, Hilmy N (2019) *The benefits of echocardiography in primary care*. British Journal of General Practice; 69(684): 358-9.

5. Aldemir BA, Karthikesalingam A, Sinha S, et al (2015) Research activity and the association with mortality. *PLoS One* 2015; 10(2): e0118253.

6. Clinical Academic Careers Framework: A framework for optimising clinical academic careers across healthcare professions www.hee.nhs.uk/sites/default/files/documents/HEE_Clinical_Academic_Careers_Framework.pdf

7. Knowledge Transfer Partnerships. www.gov.uk/guidance/knowledge-transfer-partnerships-what-they-are-and-how-to-apply

8. Department for Business, Energy and Industrial Stategy; Life Sciences Organisation; Office for Life Sciences (2017) *Life Sciences Sector Deal 1.* www.gov.uk/government/publications/life-sciences-sector-deal/life-sciences-sector-deal

9. NHS England and the National Institute for Health Research (2017) *12 Actions to support and apply research in the NHS.* www.england.nhs.uk/publication/12-actions-to-support-and-apply-research-in-the-nhs/

10. NHS Export Catalyst. www.gov.uk/government/news/government-export-support-to-help-nhs-profit-by-sharing-expertise

11. Climate Change Act 2008 www.legislation.gov.uk/ukpga/2008/27/contents

12. NHS England, Public Health England, The King's Fund, The Young Foundation (2018) *Putting health into place: Introducing NHS England's healthy new towns programme.* www.england.nhs.uk/publication/putting-health-into-place/

13. Leadership in today's NHS: delivering the impossible, King's Fund, 2018

14. Barriers and enablers for clinicians moving into senior leadership roles: Review report, FMLM, 2018

15. Clinical leadership – a framework for action. https://improvement.nhs.uk/documents/3702/Clinical_leadership_-_framework_Jan2019.pdf

16. Higher Specialist Scientist Training. https://nshcs.hee.nhs.uk/programmes/hsst/

17. WISE Campaign (2019) *The CSOWISE Healthcare Science Leadership Development Programe.* www.wisecampaign.org.uk/what-we-do/wise-projects/the-csowise-healthcare-science-leadership-development-programme/

18. Dr Eric Topol, on behalf of the Secretary of State for Health and Social Care (2019) *The Topol Review NHS Health Education England.* https://topol.hee.nhs.uk/

19. Perfect Patient Pathway Test Bed Programme 2018. www.england.nhs.uk/ourwork/innovation/test-beds/

20. House of Commons Health and Social Care Committee (2019) *House of Commons Health and Social Care Committee Antimicrobial resistance Eleventh report of session 2017-2019*

21. Falls Prevention Project 2017. www.health.org.uk/improvement-projects/the-fallsafe-project

Appendix

Healthcare science specialisms

Laboratory (life) sciences

Roles in the life sciences can be divided into three areas:

1. **Pathology** — investigating the causes of illness and how it progresses; carrying out tests on tissue, blood and other samples from patients. Pathology plays a crucial role in guiding decisions on the best type of treatment and interventions for patients, and monitoring effectiveness.
2. **Genetics** — understanding the genetic components of illnesses, both inherited and acquired. Genetic testing – sometimes called genomic testing – finds changes in genes that can cause health problems. It is used to diagnose rare and inherited health conditions and cancers.
3. **Reproductive science** — a rapidly developing field, creating life and providing other solutions to infertility. Reproductive science concerns the male and female reproductive systems. It encompasses a variety of reproductive conditions, their prevention and assessment, as well as their subsequent treatment and prognosis

Healthcare science teams in life sciences work in hospital laboratories – including clinical pathology laboratories, and laboratories in specialist hospitals – community and primary care clinics, and in organisations such as NHS Blood and Transplant and Public Health England.

Specialisms include:

- analytical toxicology
- anatomical pathology
- blood transfusion science/transplantation
- clinical biochemistry, including paediatric metabolic biochemistry
- clinical genetics/genetic science
- genetic counselling
- clinical embryology and reproductive science
- clinical immunology
- cytopathology, including cervical cytology
- electron microscopy
- external quality assurance
- haematology
- haemostasis and thrombosis
- clinical immunology
- histocompatibility and immunogenetics
- histopathology
- microbiology
- molecular pathology of acquired disease
- phlebotomy
- tissue banking.

Physiological sciences

Healthcare science staff who work in the physiological sciences use specialist equipment, advanced technologies and a range of different procedures to:

- evaluate the functioning of different body systems
- diagnose abnormalities
- direct – and in some cases provide – therapeutic intervention and long-term management and care.

The work involves direct interaction with patients in a range of areas. Most healthcare science staff in physiological sciences work in hospital clinics and departments, or as part of a surgical team. Some work in the community, visiting patients in their homes or in schools.

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Specialisms include:

- audiology
- autonomic neurovascular function
- cardiac physiology
- clinical perfusion science
- critical care science
- gastrointestinal physiology
- neurophysiology
- ophthalmic and vision science
- respiratory physiology
- urodynamic science
- vascular science.

Physical sciences and biomedical engineering

Healthcare science staff in this area develop methods of measuring what is happening in the body, devise new ways of diagnosing and treating disease, and ensure that equipment is functioning safely and effectively.

They support, develop and apply physical techniques such as ultrasound, radioactivity, radiation, magnetic resonance, electromagnetism and optical imaging to explore or record the workings of the body for diagnosis, monitoring and treatment.

Most healthcare science staff working in physical sciences and biomedical engineering are based in hospitals and specialist departments. Some will work in patients' homes.

Specialisms include:

- assistive technology
- biomechanical engineering
- clinical measurement and development
- clinical pharmaceutical science
- clinical photography
- diagnostic radiology and magnetic resonance physics
- equipment management and clinical engineering
- medical electronics and instrumentation
- medical engineering design
- nuclear medicine
- radiation protection and monitoring
- radiotherapy physics
- reconstructive science
- rehabilitation engineering
- renal dialysis technology
- ultrasound and non-ionising radiation.

Bioinformatics

Bioinformatics combines computing science with information science, biology and medicine.

Bioinformaticians and health informaticians provide support to ensure that bioinformatics data is used efficiently and to required standards. Connecting computing science, information science, biology and medicine is one of the fastest growing areas of development within healthcare.

Vast amounts of data and information are generated, and bioinformatics resources are used in healthcare. The NHS is using advances in this area in diagnostic testing and management to provide the highest quality patient care and outcomes.

Specialisms include:

- clinical data science
- genomics and clinical bioinformatics
- health informatics
- pathology informatics.

Acronyms

Academic Health Science Network	AHSN
Antimicrobial resistance	AMR
Antimicrobial resistance diagnostic collaborative	ADC
Artificial intelligence	AI
Chief Scientific Officer	CSO
Chimeric antigen receptor T-cell therapy	CAR-T therapy
Chronic obstructive pulmonary disease	COPD
Circulating tumour DNA	ctDNA
Clinical academic career	CAC
Computer tomography	CT
Deoxyribonucleic acid	DNA
Fluorescence in-situ hybridisation	FISH
General practitioner	GP
Health Education England	HEE
Healthy Living for People (with Type 2 diabetes)	HeLP
Hospital transfer pathway	HTP
Human Papillomavirus	HPV
Immunohistochemistry	IHC
In-situ hybridisation	ISH
Integrated care system	ICS
Integrated clinical academic	(NIHR) ICA
Kinesis quantitative timed up and go	QTUGTM
Knowledge Transfer Partnership	KTP
Magnetic resonance imaging	MRI
Medical technology and in vitro diagnostic co-operative	MIC
Medicines and Healthcare products Regulatory Agency	MHRA
National Health Service	NHS
National Institute for Health and Research	NIHR
National School of Healthcare Science	NSHCS
Non-small cell lung cancer	NSCLC
Point of care testing	POCT
Preparation of ethical special education leaders	PSEL
Sustainability and transformation partnership	STP
United Kingdom Accreditation Service	UKAS
Women in science and engineering	WISE

Contact us:

NHS England and NHS Improvement
Skipton House
80 London Road
London
SE1 6LH

0300 123 2257
enquiries@improvement.nhs.uk
improvement.nhs.uk

@NHSEngland

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