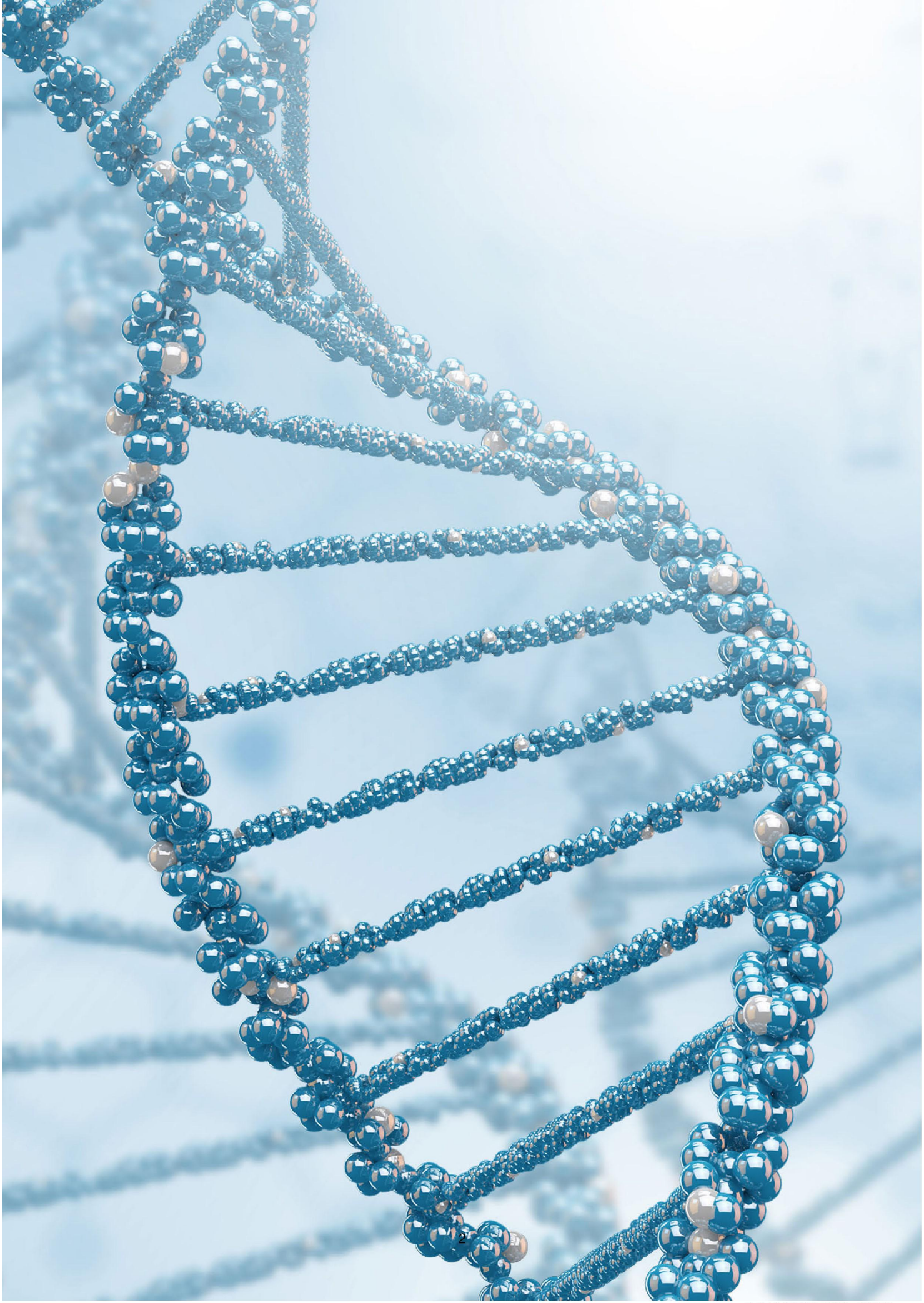
UK Health Security Agency

UKHSA Science Strategy 2023 to 2033

Securing health and prosperity



About UKHSA

The UK Health Security Agency (UKHSA) was launched on 1 October 2021 to ensure the UK is ready for future health hazards, and to drive innovation in health protection and life sciences in partnership with academia and industry.

UKHSA is the UK's permanent standing capacity to prepare for, prevent and respond to health security hazards and is the nation's expert health security agency.

UKHSA is an Executive Agency of the Department of Health and Social Care (DHSC), providing specialist and expert policy advice as part of delivering the Secretary of State for Health and Social Care's statutory duty to protect the nation's health. The agency is accountable to the public through ministers and Parliament.

UKHSA has some UK-wide responsibilities and delivers health security in England in partnership with national and local actors. Responsibility for most of the health protection matters in Scotland, Wales and Northern Ireland rests with the devolved governments (with UKHSA responsible for these issues in England). In specific areas where responsibility rests with the UK government, UKHSA's remit extends to the whole of the UK, for example when it deploys specialist capabilities in areas such as radiation alongside other system leaders.

Colindale containment level 2 laboratory

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Foreword

Dame Jenny Harries
Chief Executive of UKHSA

Ian Peters
Chair, UKHSA

The UK Health Security Agency (UKHSA) protects our communities from infectious diseases and the impact of chemical, radiological and other environmental health hazards. Our work depends on generating and applying the best scientific evidence.

The UK faces a wide range of health security threats. These include new and emerging infectious diseases, the public health risks posed by climate change, and the growing menace of antimicrobial resistance. UKHSA's mission is to prepare for and respond to these threats by building health security capacity at local, national, and global levels.

Science is fundamental to achieving these goals. The day-to-day work of our scientists underpins health protection decisions and activity. It informs the strategic policy advice we provide to the highest levels of government. Indeed, the scientific evidence we generate is used around the world because of its quality.

Our science spans varied disciplines and relies on close collaboration with research centres in industry, academia, the NHS, and government partners. This partnership approach will help us secure the best health outcomes and greater prosperity.

The Science strategy for health security

Health is necessary for a prosperous society. By identifying and addressing threats rapidly we will not only protect health but livelihoods too and prevent the costs associated with major outbreaks and incidents including the burden on NHS services.

We will protect health and livelihoods from the serious health threats we face now and we will face in the coming years: new and emerging infections, climate and environmental change, antimicrobial resistance, air pollution and chemical and radiological incidents.

Reducing sickness is fundamental to UKHSA. Our science supports this by controlling the spread of infection and developing tools and evidence to reduce the burden on and costs to the NHS.

We will strengthen our scientific capabilities and help deliver the government's ambition for the UK to be a science superpower: working in partnership with industry and academia to save more lives and contribute to prosperity.

Our science will be fully aligned to our health security mission. It will underpin our work to protect health in the UK and globally, including our efforts to reduce inequalities and protect the most vulnerable.

Science is the foundation of our work, underpinning everything we do. UKHSA's scientists generate new knowledge and evidence and provide a broad range of scientific services. As one of the leading global expert bodies on health, we bring together operational capabilities, data analytics and world-leading science.

We will use these capabilities to secure major public health victories (such as the measles, polio, hepatitis C and HIV elimination targets), and spearhead the UK's efforts to tackle the health security challenges for this decade.

Assets, capabilities and ambitions

This Science Strategy provides the vision and high-level ambition for UKHSA's science over the coming decade. UKHSA possesses a breadth of scientific disciplines and unique physical and data assets. Over the next decade our ambition is to build on these and maximise their public benefit.

With the development of new modern facilities we will build UKHSA's presence in one of the UK's growing life sciences innovation corridors and catalyse a collaborative health security campus through new partnerships. We will transform our surveillance accelerating pathogen genomics and artificial intelligence applications.

Our genomic transformation

Genomics has been at the core of the COVID-19 response, facilitating the rapid identification and characterisation of new variants. UKHSA is building on the legacy from the pandemic to strengthen our genomics surveillance further.

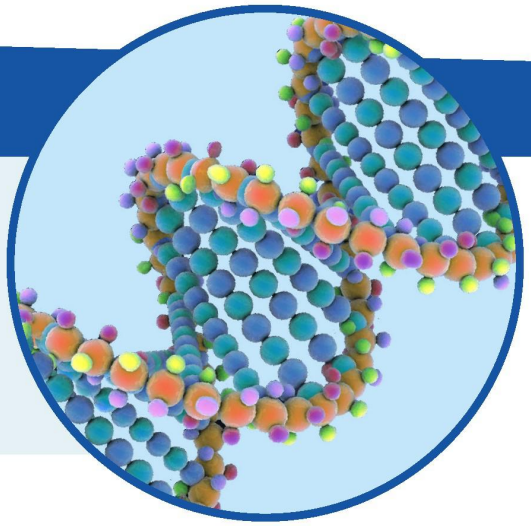
The application of pathogen genomics to surveillance and outbreak investigation has already delivered major benefits for public health. It has enabled much faster diagnosis of tuberculosis (TB), including the detection of antibiotic resistance. In the case of gastrointestinal infections, it has improved the sensitivity of our surveillance and enabled us to detect more outbreaks and their sources.

Evidence indicates that pathogen genomics will help us in our efforts to reduce hospital acquired infections, reduce the transmission of infections such as TB and sexually transmitted infections, and more rapid and accurate targeting of infections with the most effective treatments.

We will invest in our laboratory-based services to ensure that we have the tools that we need to protect health. Through science-driven, data-enabled research platforms and technologies we will make the most of data as an asset for health security.

By focusing on areas where UKHSA has a competitive advantage (summarised on the following pages) we will take the cutting edge to the front line of health security.

Genomics



UKHSA is a world leader in pathogen genomics, a powerful approach providing detailed information for use in the investigation and management of infectious diseases. UKHSA possesses considerable genomics expertise including:

- an accredited clinical service for tuberculosis (TB) and other key pathogens
- identification and resistance prediction for gastrointestinal pathogens
- outbreak investigation
- surveillance
- vaccine and therapeutic effectiveness
- global capacity strengthening
- variant characterisation
- access to data for international sharing and research purposes

Data

Data collection and analysis are important steps in the scientific process, providing evidence to test and validate hypotheses. UKHSA collects and generates valuable data as part of its health protection activities. Our data is used internationally because of its quality.

Capabilities encompass:

- access to data through secure and interoperable systems, enabling sharing with international, national, local, and academic partners
- advanced modelling capabilities
- world-class insights gained through analytics and data science
- our science-driven, data-enabled approach underpins all our work

High-containment

UKHSA has unique expertise in containment microbiology. Our level 4 facilities can undertake work at the highest categorisation of human and animal pathogens – supporting clinical response needs, delivering research programmes and supporting in vivo programmes of work.

- the UK's largest capability for handling dangerous human pathogens and animal models to investigate infectious diseases
- in vitro and in vivo laboratory facilities rated at biosafety level (BSL) 3 and 4
- management of a wide range of species, from rodents to farm animals and macaques
- maintenance of rhesus and cynomolgus macaque breeding colonies
- a flexible laboratory complex for housing animals and performing procedures

Biosafety and environment

UKHSA has particular expertise and capabilities for the investigation of the role of the built environment in the transmission of infection – including a mock hospital ward created for this purpose.

- characterisation of environmental (air, surface) stability of emerging pathogens
- air and surface sampling for pathogenic agents in all environments
- support to outbreak investigations involving the built environment
- a full scale research ward to assess mitigations to prevent transmission of healthcare associated infections
- UKHSA Porton is a WHO Collaborating Centre for Applied Biosafety and Training

Innovation in diagnostics

UKHSA offers a single expert solution for development, testing and assurance of assays used to diagnose infectious diseases in the UK for application in the NHS and beyond.

Examples of innovation in diagnostics include:

- rapid evaluation of commercial assays
- development, validation and verification of assays to ensure in vitro diagnostic devices conform to standards, including UKCA (UK Conformity Assessed) and CE (European Conformity) markings
- research and development of new diagnostic technologies and innovative platforms
- real time development and evaluation of isolates from relevant clinical samples
- inactivation of pathogens by X-ray irradiation
- provision of standardised external quality assessment schemes

Culture collections

UKHSA is the custodian of 4 unique collections that consist of expertly preserved, authenticated cell lines and microbial strains of known provenance for use in medical science and laboratory healthcare.

Culture collections activity encompasses:

- oversight of UKHSA's Biological Resource Centres (BRCs) to provide authenticated biological reference materials to the global scientific community
- unique expertise in shipping and dispatch of restricted pathogens
- recognised International Depositing Authority for Scientific Patents

Radiation protection

UKHSA has a full range of capabilities that ensure that the public are protected from the risks of exposure to all forms of radiation while benefiting from its uses, such as x-rays in medical practice.

- an accredited radiation protection service
- personal radiation dosimetry services
- patient safety science – in the context of medical and dental exposures
- radon measurements in homes and workplaces
- radiation monitor calibration, testing and site delicensing
- environmental surveys – electromagnetic fields, optical and ionising radiation
- experimental research for ionising and optical radiation effects (in vivo disease models, cell culture models, gene expression quantification)

Toxicology

UKHSA's capabilities for the identification and assessment of exposure to and risk from chemical substances inform the use and regulation of such substances to minimise risk, enhance benefits, determine other risk factors and design treatments.

- analysis for chemicals and metals in clinical and environmental samples
- air exposure for cells, animals (whole body and nose) with aerosol generation and analysis
- air sampling for bioaerosols and analysis using eukaryote and prokaryote sequencing
- development and validation of cell-based new approach methods (NAMs) for regulatory application
- molecular toxicology for application in regulation, incidents and policy development
- risk assessment to translate evidence to intervention and policy
- chemicals regulation support nationally and internationally

Medical entomology

UKHSA has a unique role in preventing and controlling endemic and emerging vector-borne disease threats in a changing climate and environment including:

- invasive mosquito detection and control
- native mosquito and arbovirus detection
- nationwide tick surveillance
- ecology studies on tick-borne bacteria transmission
- application of genomics to vector pathogen and host studies
- vector data capture and analysis

Vaccine development and evaluation

We are building on our expertise in this area by creating a Vaccine Development and Evaluation Centre (VDEC) securing the legacy from the COVID-19 pandemic and bringing together UKHSA's laboratory-based activity, expertise and leadership in vaccine discovery, development and evaluation.

- discovery (virus isolation, in vivo studies, analytical method development and antigen discovery)
- pre-clinical development (assay qualification, in vivo studies and supporting regulatory submission)
- clinical evaluation (Phases I to III in assay validation, testing and supporting regulatory submission)
- delivery (procurement, stockpiling and deployment of vaccines)
- post-licensure (Phase IV study support, sero-surveillance, molecular surveillance and batch release)


EJ16 CYA

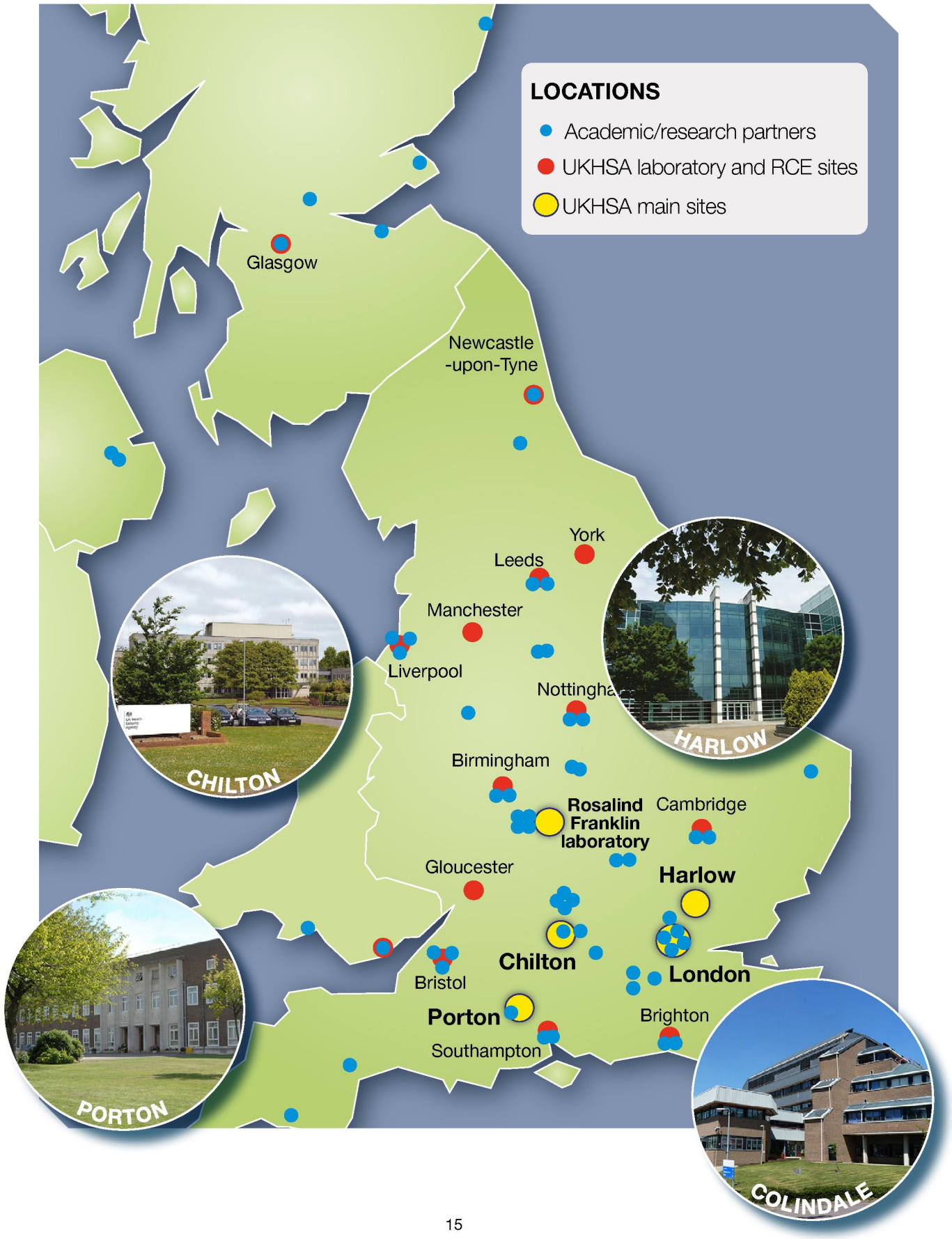
One of our many strengths is the multidisciplinary nature of our scientific workforce geographically dispersed across the UK in our scientific centres of excellence, local health protection teams and network of laboratories and specialist facilities.

Our scientific work takes places in our sites and a wide geographic spread of partners across the UK and beyond. Our formal contractual partnerships with the National Institute of Health Research (NIHR) Health Protection Research Units (HPRUs) is complemented by ever-evolving R&D collaborations, alongside funded PhDs at a number of universities. As the map on the following page shows, our science has a broad base and is future facing

For more information on our most important partnerships see Our partnerships and Our research and access to external scientific expertise in the Our enablers section below.

Our scientific disciplines

UKHSA and partner locations



Contexts

We are living in a world with increasing risk of pandemics and other threats to health because of climate and environmental change and other global factors. The relationships between the environment, wildlife, domestic animals and humans are part of a complex social-ecological system. As part of a 'One Health' approach, we work across sectors and borders to protect health.

International context

The COVID-19 pandemic is just one example of the major challenges to health security we face. Since the 1940s more than 330 new and emerging infectious diseases have been identified, of which 60% were zoonotic[1]. The risk of emergence of pathogens able to cross species is increasing. The last 2 decades have seen major global outbreaks of infectious diseases occur regularly, including SARS, H1N1, MERS and COVID-19. We have also seen major outbreaks of Ebola and most recently an epidemic of mpox. The likelihood of new and emerging threats spreading rapidly is increasing due to rapid global travel and trade, population movement, environmental change, and changes in human behaviour.

Our changing climate has already exacerbated more than 200 infectious diseases and dozens of non-transmissible conditions[2]. Its wider adverse health impacts are profound, unevenly distributed and increasingly having a direct effect within the UK, with record high temperatures linked to around 3,000 excess deaths in 2022[3]. Other environmental hazards continue to impact our lives every day, with air pollution a major contributor to chronic respiratory conditions.

Global events are also exposing vulnerabilities in our health protection systems and highlighting areas in need of development in those systems. New and emerging threats from a number of areas pose challenges to the meticulous operations that keep us safe and emphasise the need for continuous improvement. Meanwhile, antimicrobial resistance (AMR) is growing and currently claims at least 50,000 lives each year across Europe and the United States alone[4].

Biobank laboratory training in Lagos

These trends all threaten the health of the public, and the economic activity that depends on it, yet our awareness of such health threats is still predominantly retrospective. Medical science made incredible progress during the 20th century, with technologies such as sanitation and antibiotics achieving dramatic reductions in mortality. But these advances increasingly look assailable, and unequal — health insecurity often has the greatest impact on the most deprived both across the globe and within the UK.

National context

We are committed to working across sectors to deliver the UK Biological Security Strategy[5]. We will lead efforts to provide timely, safe and effective diagnostics, vaccines and therapeutics against known high consequence infectious diseases once a new pandemic threat is detected. The Centre for Pandemic Preparedness is at the core of UKHSA's commitment to future countermeasure platforms as part of the delivery of the 100 Days Mission[6]. Much of our work will be driven by and aligned with the apparatus of the National Risk Register and the Integrated Review.

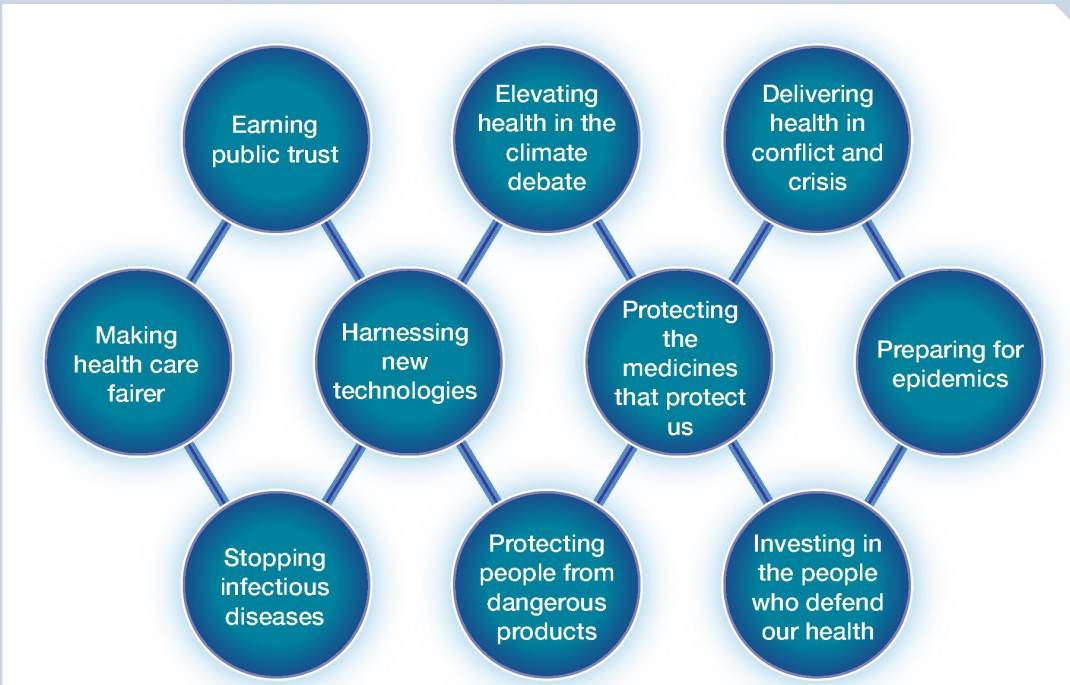
UKHSA is a Public Sector Research Establishment (PSRE) with operational autonomy. UKHSA has a remit that is predominantly England-only, but on so-called reserved health matters our responsibilities cover the whole of the UK. We work in partnership with authorities in Scotland, Wales and Northern Ireland through various scientific collaborations for the benefit of the public's health.

UKHSA is working together across the 4 nations to identify specific areas of expertise and opportunities for collaboration in implementing the ambition in this Strategy.

Global challenges

UKHSA will lead the UK's efforts to tackle the WHO's urgent health challenges for this decade, which encompass some of the most pressing health security threats that we face. Infectious diseases, climate and environmental threats do not respect national borders. Global collaboration is paramount to guard against shared threats.

UKHSA addressing WHO urgent health challenges



The 2023 World Economic Forum Global Risk Report[7] highlights how these urgent health challenges will see the "risk of a rise in 'syndemics': a set of concurrent, mutually enhancing health problems that impact the overall health status of a population". Over the 10-year perspective in the WEF Report, 6 of the 10 most severe risks are environmental in nature. The Report notes the negative effects that climate change will have on chronic health conditions.

As such it will be vital to have robust feedback mechanisms that support place-based responses through data and evidence availability. There are major gaps in our understanding of the impact of these threats and effective interventions to secure health from them. We will build effective systems to identify research priorities, strengthen evaluation science, and enable dissemination. This will improve our ability to translate evidence into public health policy and practice.

Learning from the COVID-19 pandemic

Our experience during the pandemic demonstrates the enormous potential for UKHSA's science to protect the public's health. For example, UKHSA's scientific teams played an important role in the pre-clinical and clinical development of COVID-19 vaccines, including the Oxford/AstraZeneca (ChAdOx1-S) and Beta vaccine (ADZ2816) COVID-19 vaccine. In 2021 and 2022 our teams generated data to inform vaccination policy, working in partnership with academia and industry[8].

The UK's COVID-19 vaccination programme has prevented over 100,000 deaths and enabled the relaxation of other control measures, facilitating socio-economic recovery. It is estimated that, globally, vaccines prevented 14.4 million deaths between December 2020 and December 2021[9].

These vaccines were developed and delivered in record time, using innovative scientific approaches and highly effective partnerships between industry, academia, funders, regulators and public sector organisations including UKHSA. This was enabled through the dynamic and innovative approach of the Vaccines Task Force (VTF), which has strengthened relationships with industry.

UKHSA also used its genomic surveillance capabilities to rapidly characterise emerging SARS-CoV-2 variants, undertaking in vitro and in vivo analysis to help understand the risks associated with all new variants. These risks included the pathogenicity of the variants, and their potential impacts on the effectiveness of vaccines and diagnostics. We are committed to detecting and assessing pandemic threats early, building our surveillance capability, including genomic data, is key to this. UKHSA regularly publishes variant surveillance analyses and risk assessments, along with other technical briefings containing up-to-date scientific evidence that are a model of best practice globally[10].

But the fight is not over yet, and the UK has fully committed to the 100 Days Mission to reduce the impact of future pandemics. This global collaboration aims to make diagnostics, therapeutics and vaccines available within 100 days of the emergence of a new pandemic threat. UKHSA is proud to act as the domestic secretariat for the 100 Days Mission, to contribute to the development and evaluation of diagnostics, vaccines and therapeutics and to be a partner in global efforts to build resilience to health threats.

Through this strategy we are securing learning from the pandemic such as strengthening scientific capabilities outside of incidents. The pandemic showed how the pace of translating scientific advancement into health interventions deployed at population level can be accelerated. We are building capabilities to enable this across diagnostics, vaccines and where appropriate therapeutics.

There is a need to establish greater awareness of our scientific work and capabilities outside of emergency response to build preparedness. The next major health incident may or may not be similar to the last one. As such we are building capability across a range of health security scenarios from a new pathogen X to a radiological incident. This capability building includes improving scientific career progression through new relationships across government and with industry.

Our values: Inclusive, Insightful, Impactful

Domestically and globally, we will pursue our mission aligned to our values:

Inclusive

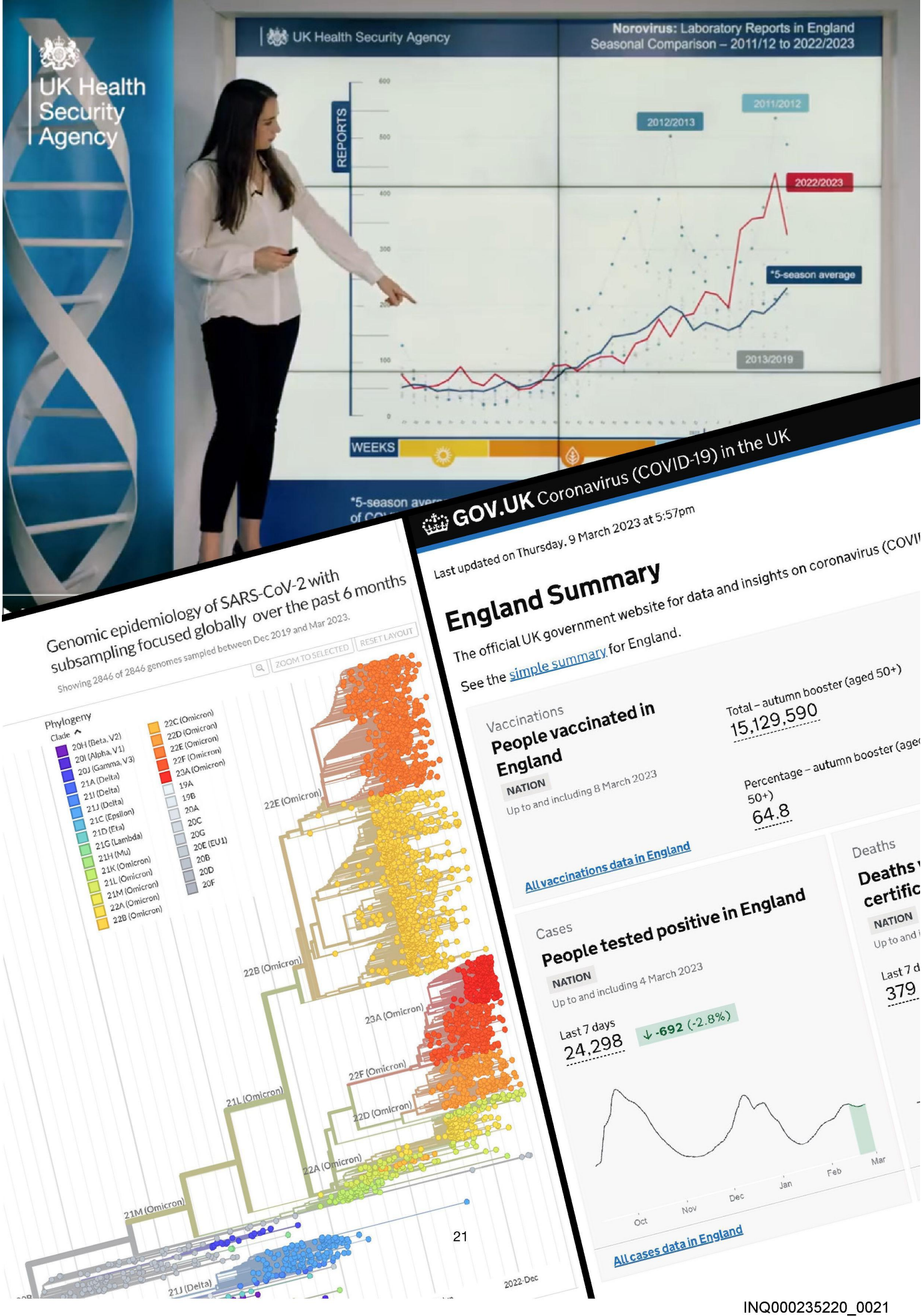
- we will attract and develop the scientific leaders of the future
- we will create the ecosystem for a thriving multidisciplinary community of scientists and analysts where everyone's contribution is valued
- we will be an open and collaborative organisation working in partnership across sectors

Insightful

- we will generate timely and high-quality scientific evidence to inform policy
- we will excel in the communication of scientific knowledge and health risks to the public
- we will maximise the value of surveillance data to generate new insights to protect health

Impactful

- we will find solutions to public health problems and accelerate their implementation
- we will harness the power of scientific research, data and technology to prevent and control threats to health
- we will apply our scientific activity to underpin efforts to protect health, responding to urgent issues and fighting threats before they reach the UK


UK Health Security Agency
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Norovirus: Laboratory Reports in England
Seasonal Comparison – 2011/12 to 2022/2023
REPORTS
WEEKS
2011/2012
2012/2013
2022/2023
*5-season average
2013/2019
Genomic epidemiology of SARS-CoV-2 with subsampling focused globally over the past 6 months
Showing 2846 of 2846 genomes sampled between Dec 2019 and Mar 2023.
ZOOM TO SELECTED
RESET LAYOUT
Phylogeny
Clade
20H (Beta, V2)
20I (Alpha, V1)
20J (Gamma, V3)
21A (Delta)
21I (Delta)
21J (Delta)
21C (Epsilon)
21D (Eta)
21G (Lambda)
21H (Mu)
21K (Omicron)
21L (Omicron)
21M (Omicron)
22A (Omicron)
22B (Omicron)
22C (Omicron)
22D (Omicron)
22E (Omicron)
22F (Omicron)
23A (Omicron)
19A
19B
20A
20C
20G
20E (EU1)
20B
20D
20F
22E (Omicron)
22B (Omicron)
23A (Omicron)
22F (Omicron)
22D (Omicron)
21L (Omicron)
22A (Omicron)
21M (Omicron)
21J (Delta)
2022-Dec
GOV.UK Coronavirus (COVID-19) in the UK
Last updated on Thursday, 9 March 2023 at 5:57pm
England Summary
The official UK government website for data and insights on coronavirus (COVI
See the simple summary for England.
Vaccinations
People vaccinated in England
NATION
Up to and including 8 March 2023
Total – autumn booster (aged 50+)
15,129,590
Percentage – autumn booster (age
50+)
64.8
All vaccinations data in England
Cases
People tested positive in England
NATION
Up to and including 4 March 2023
Last 7 days
24,298
↓ -692 (-2.8%)
Oct
Nov
Dec
Jan
Feb
Mar
All cases data in England
Deaths
Deaths
certific
NATION
Last 7 d
379

Vision and strategic goals

Our vision is that through our science we will secure health and prosperity.

Our ambition is to save more lives, secure major public health victories and contribute to the Life Sciences Vision which sees the UK as a global science superpower[11].

This strategy for our science is framed by UKHSA's overarching strategic goals:

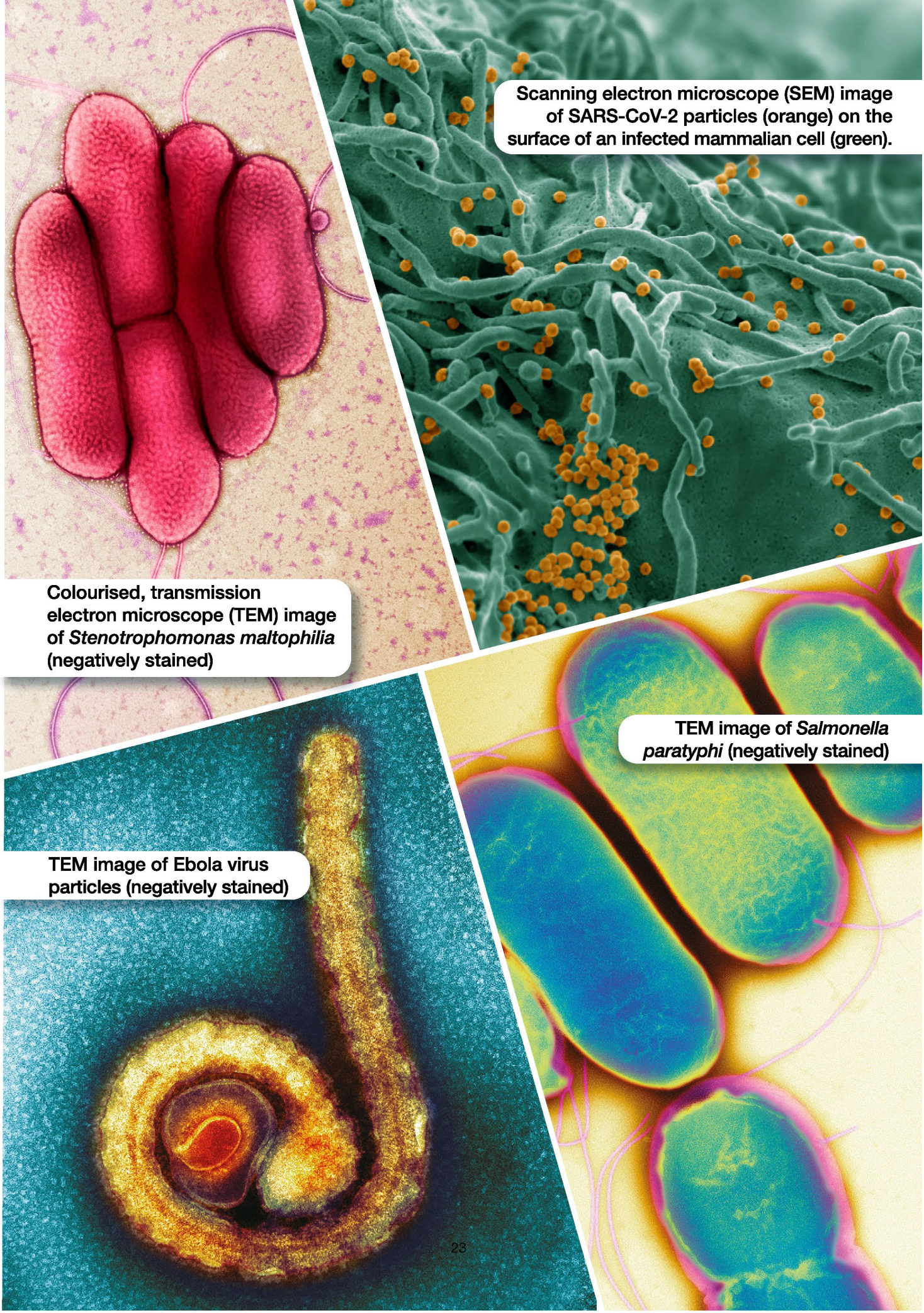
- **Prepare** for future health security hazards
- **Respond** to health security threats to save lives and reduce harm
- **Build** the UK's health security capacity

The health security challenges that we face are great, but the harms they cause are largely avoidable. There are major public health gains within our grasp if we harness the power of science. Through our scientific work, we will be able to protect people more effectively from health threats, saving more lives and securing better health outcomes. Our research will help us to understand and anticipate these threats before they have a major impact on health and make more rapid progress towards our objectives. This work will also generate scientific advancements that will contribute to the nation's economic prosperity.

To achieve these organisational goals, our science will:

- predict and anticipate health threats
- create a more secure environment
- reduce and eliminate health threats
- act on the scientific evidence
- unlock the potential of our assets

In the following sections we provide illustrative examples of how UKHSA science will achieve these 5 themes to deliver health security nationally and internationally. The full examples of how UKHSA will deploy science in defence of health security will be outlined in our corporate strategy and operational plans which will be periodically updated.



Scanning electron microscope (SEM) image of SARS-CoV-2 particles (orange) on the surface of an infected mammalian cell (green).

Colourised, transmission electron microscope (TEM) image of *Stenotrophomonas maltophilia* (negatively stained)

TEM image of *Salmonella paratyphi* (negatively stained)

TEM image of Ebola virus particles (negatively stained)

Prepare

Our scientific work will enable us to identify and understand new health threats rapidly. This will ensure effective control, before these threats have a major impact on health and society.

UKHSA will **predict and anticipate health threats** through investing in genomics, data science and surveillance, including vector surveillance.

UKHSA will embed genomics in its surveillance and outbreak response activities, building on the legacy of our COVID-19 work by expanding and transforming our pathogen genomics capabilities (see 'Genomic Transformation'). We will maximise and consolidate our assets, such as specialised technology and data analysis, to generate targeted scientific knowledge. Our work will follow a 'One Health' approach that brings together human, animal and environmental genomic information. We will also work with experts in the NHS and universities to understand how the genetics of the human host may influence the course of their infection. We will strengthen our vector surveillance to ensure that we identify as early as possible new threats arriving in this country.

We will continue to improve our systems to support data linkage and the sharing of data internally and externally. We will enhance the value of our data by creating a powerful central data and analytics platform, and by reforming surveillance systems. By reducing 'data latency' — the time lag between data collection, analysis and synthesis — we will bring clinicians, scientists, analysts and policy makers closer together. This will enable a more efficient and effective response to our future health security priorities. It will help us to identify threat trends in collaboration with other government departments and other partners. For example, advanced data science and innovative analytics should allow us to detect outbreaks of infectious diseases, or identify environmental health threats through geospatial modelling.

Medical Entomology and Zoonoses Ecology group

UKHSA will work closely with partners to carry out scientific foresight horizon scanning. This will help us to maintain a networked understanding of health security threats and how they might be met through new and emerging technologies. We will also use our resources to analyse the health threats to different groups within our population, enabling a greater focus on reducing health inequalities. UKHSA's health equity strategy supports the Core20PLUS approach to reducing healthcare inequalities[12]. This approach focusses on the most deprived 20% of the national population as identified by the national Index of Multiple Deprivation (IMD). UKHSA's Behavioural Science and Insights Unit offers new ways to target health security at this group, which will also include PLUS population groups identified at a local level.

UKHSA **will create a more secure environment** for all by enhancing our understanding of threats in the environment and building scientific defences against these hazards.

As a first priority in the implementation of its Science Strategy, UKHSA has already established a new Centre for Climate and Health Security that brings together multidisciplinary skills and expertise from teams across UKHSA and partner organisations. Its goal is to ensure that we can protect health in the context of a changing climate and environment. This centre will lead the way to improve our understanding of the impact of the climate crisis on health, and deliver effective interventions that will secure our health from the adverse impacts of climate change. The centre will be a focus for partnership including local, national and international organisations. By linking research, scientific analysis, surveillance and scientific policy advice in this way, we will achieve a step change in the impact of our work to secure health from the consequences of climate change, ensuring better adapted and more resilient communities.

UKHSA will work to improve our understanding of the environmental transmission of pathogens. This will inform infection prevention and control strategies; support strategies to reduce AMR; and accelerate progress towards the elimination of infectious diseases such as hepatitis C and HIV/AIDS. Ultimately, this will allow us to build resilience in population health groups that are disproportionately affected by these threats.

By strengthening the public health microbiology service to ensure it is consistent in every part of the country, we will detect infection threats rapidly and effectively. This service will deploy diagnostics against new infections in a timely manner, and provide surge capacity to meet public health needs.

We will deploy our scientific capabilities to strengthen global health security. This will include genomic surveillance through the New Variant Assessment Programme (NVAP) and involve partnerships with our WHO collaborating centres and laboratories. We will also build capabilities such as the programme to strengthen compliance with International Health Regulations.

Respond

We will ensure that we have the scientific capabilities to respond to the broad range of health security threats that we face. We will deploy our scientific capabilities rapidly and effectively to protect health.

UKHSA will **reduce and eliminate health threats** by strengthening the scientific evidence underpinning our health protection programmes, both domestically and internationally. One of our key ambitions is to strengthen our contribution to global health security. This Science Strategy will underpin these efforts.

We will enhance our radiation and chemical hazards functions to ensure that we can respond most effectively to chemical, radiological and nuclear incidents. We will invest in improved exposure assessment tools, analytical chemical capabilities, environmental monitoring and dispersion modelling, and integrate these data with geospatial information.

We will establish an evidence hub on health equity and health security. This will address gaps around health threats that disproportionately affect particular populations. Working in partnership with patient, public, and community groups, we will ensure that science underpins health equity with a focus on populations that face the highest risks.

UKHSA will ensure that all our health protection programmes and activities are informed by the best scientific evidence, by working in partnership with National Institute for Health and Care Research (NIHR) Health Protection Research Units, other academic colleagues, NHS, local authorities and other partners. We will systematically identify gaps in evidence and work with research funders and other partners to ensure that these are addressed.

UKHSA will **act on the scientific evidence** generated by our teams and our partners. This will involve translating data, knowledge and insights into practical actions that prioritise the protection of people and places most at risk, along with quick and consistent assessments of how different threats impact different population groups. We will do this by developing further UKHSA's capabilities in behavioural, social and implementation science, which will support effective and targeted delivery through multi-disciplinary endeavours. We will work with NHS, local authorities, devolved administrations, and local communities to inform the development of public health guidance and policy.

We will evaluate the UK's health protection interventions and policies by working with partners across academia and the health protection system. We will also strengthen our capabilities to undertake rapid research and evaluation in emergencies to inform the public health response.

Build

We will secure and develop the health protection scientific workforce of the future. By investing in our infrastructure and facilities, we will ensure that we are ready to respond to future threats. We will maximise the public benefits of our assets and enhance our contribution to economic prosperity by helping to deliver the government's Life Sciences Vision, and support its ambition for the UK to be a science superpower.

UKHSA has a unique combination of scientific assets. Our national and local infrastructure gives us rare capabilities, including high containment microbiology, biological models, medical entomology, radiation protection, and toxicology. Our workforce has a broad range of multidisciplinary skills and expertise, strengthened by our partnerships and collaborations. Our health protection activities generate vital data, which enhance our ability to translate science into action. UKHSA will **unlock the potential of these assets** in a range of different ways.

We are establishing a Vaccine Development and Evaluation Centre that builds on the legacy of the COVID-19 pandemic. This will help ensure that we have the tools we need to protect health and support the delivery of the 100 Days Mission to respond to future pandemic threats. We will work with industry and academic partners to ensure that health security research priorities are addressed, and will generate and apply world-leading scientific evidence to inform and optimise vaccination programmes.

Through research, development and evaluation, we will support innovation in diagnostics. Building on our expertise in diagnostic development and evaluation, we will work with industry and academia to accelerate the diagnostics pipeline. We will also provide independent reviews of assay performance, working with the Medicines and Healthcare products Regulatory Agency (MHRA) to ensure assays are fit for purpose before sale or implementation.

UKHSA will maximise the value of our data, strengthening data science and taking advantage of new technologies such as artificial intelligence to further UKHSA's mission. Strengthening our modelling and analytical capabilities to provide the best possible insights on which to base our public health advice is a core aspect of the ambition in this Science Strategy. This will support the generation of world-class evidence gained through analytics and data science, and ensure that our science-driven, data-enabled approach underpins all our work.

These activities will be supported by a strategic commercial framework that facilitates and develops a range of engagements with industry and academia. This framework will offer a full spectrum of options for engaging UKHSA skills and assets.

Our enablers

To achieve these ambitions, we will depend on the solid foundation provided by 4 crucial building blocks, our enablers:

- our people
- our facilities
- our partnerships
- our research and scientific activity

Our people

If we are to succeed in our mission, we need to retain, attract and develop the scientific leaders and workforce of the future. We will create the ecosystem for a thriving multidisciplinary community of scientists, analysts and experts (see 'Our Scientific Disciplines'). They will have access to facilities, resources, high quality data and technology that help them to deliver our strategic needs and make important scientific advances.

UKHSA needs to recruit and retain scientists in a competitive market. To overcome difficulties in scientists moving between UKHSA and partner organisations, we will:

- take action to ensure UKHSA is an attractive destination for scientists, where they can develop successful and rewarding careers
- develop flexible approaches including fellowships, joint appointments and secondments with academia, industry, the NHS and PSREs
- strengthen our formal and informal training opportunities, including PhDs
- value diversity and create an inclusive scientific environment in which everyone's contributions are appreciated

Our facilities

UKHSA's success often relies on our ability to analyse samples rapidly and accurately – so our scientists need access to laboratory facilities and technologies that are modern and safe. UKHSA's laboratories are among the organisation's key assets, central to the delivery of its health security mission.

UKHSA's facilities span a geographic network around the UK. Our research laboratories at Porton Down, Wiltshire, adjoining the Defence Science and Technology Laboratory, deliver much of our work on vaccine development and evaluation alongside pioneering work on diagnostics.

Our new Centre for Climate and Health Security is based here and at our Harwell Campus where our specialist radiation protection and toxicology work is centred, alongside our Radiation, Chemical and Environmental Hazard laboratories in Glasgow and Leeds. Our scientific campus at Colindale leads our surveillance work.

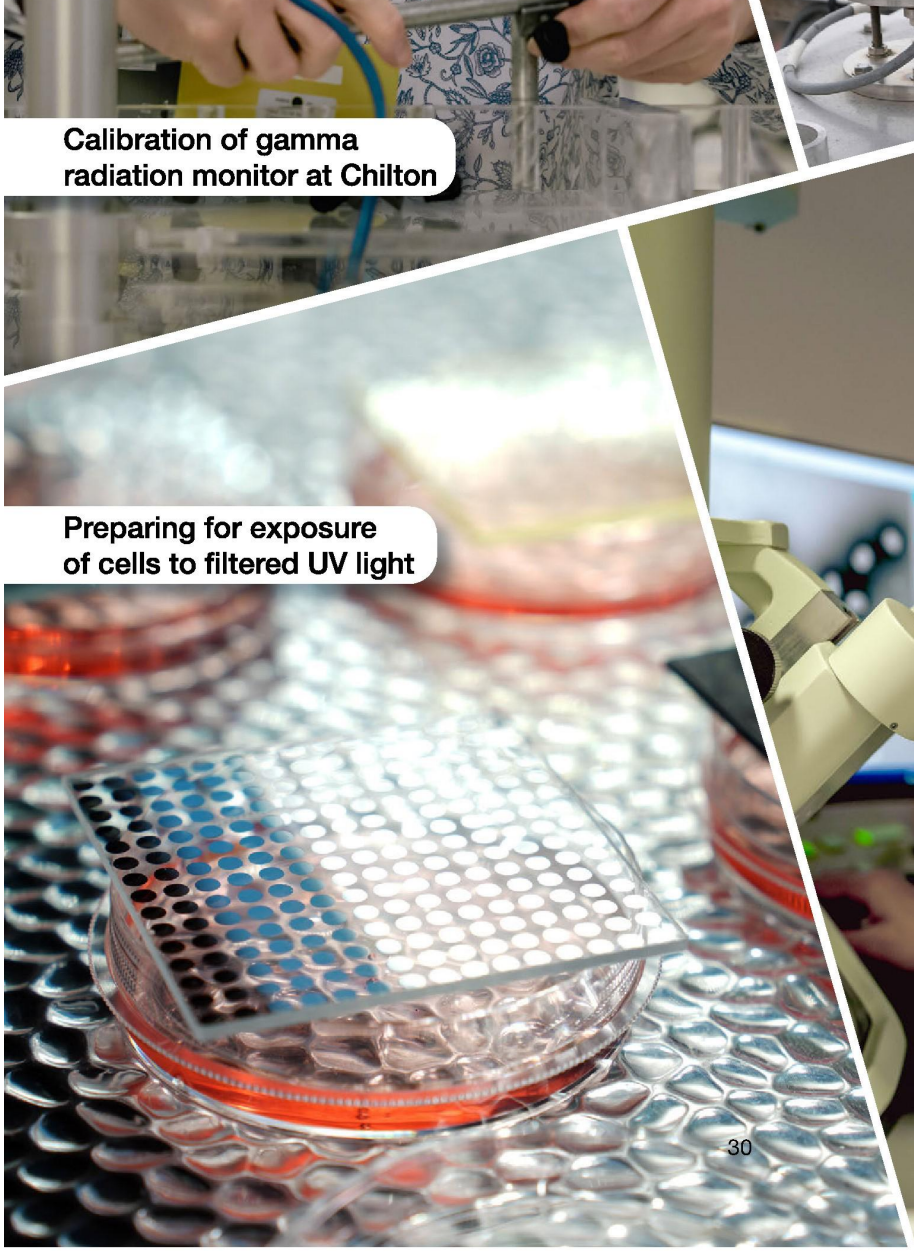
These sites are complemented by laboratories in Bristol, Manchester, Birmingham and Cambridge that cover infectious disease surveillance, genomics and epidemiology and specialised microbiology. This network is broadened through partnership R&D activity, work with the Health Protection Research Units, the NHS and other collaborations.

The COVID-19 pandemic underlined the investment required in our estates and assets. To build on work begun, for example in information technology and whole genome sequencing capabilities, we will:

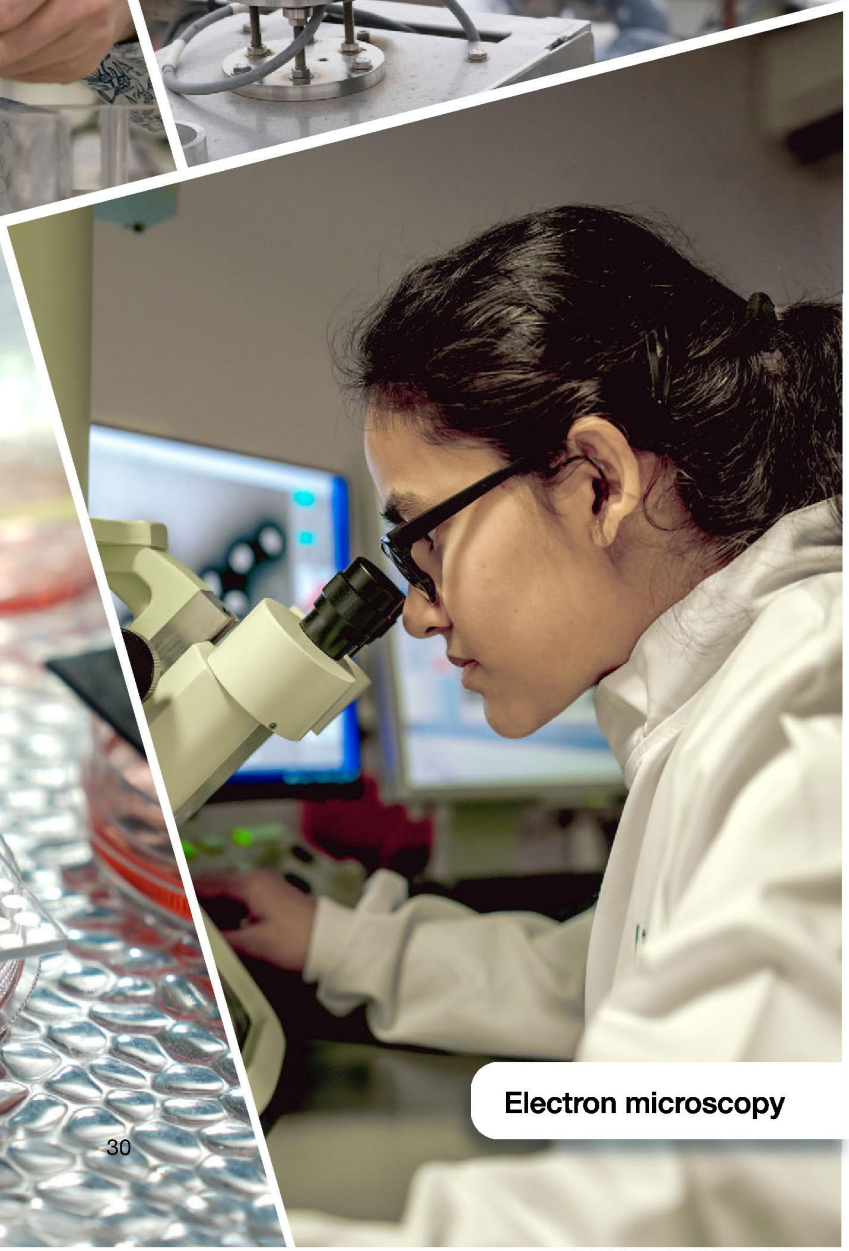
- develop a scientific ecosystem formed by a network of scientific centres of excellence, each making a distinct contribution to the mission of UKHSA
- invest in our facilities to modernise and replace ageing infrastructure. This will include the development of our estate to be a world-leading centre for surveillance and control of infectious diseases
- invest further on genomics and data infrastructure

Calibration of gamma radiation monitor at Chilton

Checking a solar UV monitoring station



Preparing for exposure of cells to filtered UV light



Electron microscopy

Our partnerships

UKHSA will only succeed in its mission by working in partnership with academia, industry and other public sector organisations. The pandemic has demonstrated the impact that these partnerships can have, and a wide track record of successful collaborations. We will bring our unique capabilities and assets to our partnerships, and be clear about their health and societal benefits.

Some of these partnerships will be simple commercial transactions, either where we provide a service for a fee or where UKHSA completes a one-off procurement of something essential for health security. However, a number of our relationships across a range of expertise are more complex and illustrate UKHSA's central role in critical areas of scientific development. For example in the context of new science, our 10-year strategic collaboration with Moderna will ensure we are better prepared against future pandemic threats, including through an onshore mRNA Innovation and Technology Centre. This is illustrative of how UKHSA will catalyse the health protection ecosystem through non-exclusive long-term strategic capability developments. In other areas, such as our radiation work on environmental hazards, partnerships like those outlined in the following section with NIHR Health Protection Research Units (HPRUs) are essential to the funding and/or provision of services that UKHSA provides. Our aspiration is to develop a small but significant number of these focused partnerships. Some will be with industry, others with the NHS or independent academic institutions.

We want to shift from small project-based collaborations with multiple partners. In delivering our strategic priorities we will:

- be an open and collaborative organisation
- work in partnership with academia, industry, NHS and other PSREs to further our mission
- transform our approach to collaboration, by developing a range of partnership models with deeper, longer engagement to secure greater impacts
- bring our unique assets to these partnerships and demonstrate the benefits of such collaborations to UK health security. That includes securing intellectual property generated from UKHSA science

Our research and access to external scientific expertise

Research and development are at the core of UKHSA. Research, the generation of evidence and tools, and the translation of its findings actively inform health security policies, practices and services – locally, nationally and internationally. This is a critical enabler for UKHSA when preparing for, preventing and responding to public health emergencies. Research is vital to providing the highest quality public health advice, and as such is profiled here as an enabler.

We face major public health challenges. To protect health most effectively UKHSA will access the scientific skills and expertise in academia, industry and other Public Sector Research Establishments (PSREs). UKHSA will work with the leading scientific experts nationally and internationally to secure the best health outcomes. Research is essential to develop the evidence base for our work. UKHSA undertakes research to address gaps in the evidence and to protect health most effectively. Our research will always be aligned to the delivery of our mission and strategic priorities.

UKHSA is not a research funder. As a leading PSRE, we will need access to research funding to inform health security policy and action. To maintain the highest standards in research and science, UKHSA will competitively access external research funding, both independently and in collaboration with partners. We will also maintain a small fund, so that we can competitively allocate funds internally to pump-prime projects and to address emerging research needs not addressed by funding bodies.

UKHSA will build on the outstanding success of the NIHR Health Protection Research Units (see next page).

These and other collaborations with academia will help us to build strong research consortia to develop the evidence-base to tackle the health security threats of our time. UKHSA brings a unique set of skills and assets to those partnerships. Our specialist capabilities, for example, in high-containment microbiology, biological models and radiation exposure assessment mean that we are best placed to lead research in these specialist areas (see 'Assets, Capabilities and Ambitions'). However, most of our research will be carried out in collaboration with academia, and industry and other PSREs, because the complementary skills brought by each partner will enable the best science.

In ensuring that health security research priorities access the best scientific expertise from external partners and are met in a timely manner, we will:

- develop a robust, transparent, inclusive and responsive approach to identifying evidence gaps and prioritising research questions. Working together with partners and funders, we will ensure the key evidence needs are addressed
- strengthen public and patient involvement in UKHSA's scientific work and research
- commit to open science and translation of knowledge and evidence into practice, working with the NHS, local authorities and other partners
- strengthen academic honorary contracts and other arrangements to ensure that UKHSA has access to the best scientific advice and expertise when needed

NIHR Health Protection Research Units (HPRUs)

HPRUs are NIHR-funded research collaborations between UKHSA and academic research institutions working on identified public health challenges. At present, there are 15 HPRUs covering 13 topic areas (the 3 units marked with an asterisk below are cross-cutting):

- Behavioural science and evaluation*
- Chemical and radiation threats and hazards
- Emerging and zoonotic infections
- Environmental change and health
- Environmental exposures and health
- Environmental exposures and health (developmental unit)
- Blood borne and sexually transmitted infections
- Emergency preparedness and response
- Genomics and enabling data*
- Gastrointestinal infections
- Healthcare associated infections and antimicrobial resistance (Imperial)
- Healthcare associated infections and antimicrobial resistance (Oxford)
- Respiratory infections
- Vaccines/Immunisation
- Modelling and health economics*

HPRUs have a focus on collaboration and knowledge mobilisation. As well as translational research, the HPRUs have a commitment to training, Patient and Public Engagement, Involvement and Participation (PPIE) and Knowledge Mobilisation (KM), and each HPRU has specific named leads across each of these activities.

HPRU outputs result in peer-reviewed publications. The HPRU responsive mode is designed to provide flexibility and support for UKHSA's urgent research requirements, particularly during incident responses. HPRUs are designed to do this from within their allocated funding and have undertaken responsive research in support of COVID-19, mpox, and other priorities.

The HPRUs have a critical role in allowing UKHSA to maintain and to develop the evidence base by synergising our research expertise and strengths with the wider force of academia. The combined might of the UKHSA and the HPRUs allows dynamism and focus, and ensures that UKHSA is able to provide the highest quality advice to government which can inform the best possible policies and decision making.

High throughput serology testing at Porton

Delivering our strategy

UKHSA will work towards delivering this strategic vision for science through an operational plan which will be refreshed every 3 years.

Accountability:

The Director of Science Strategy will oversee the implementation of this strategy, and report to the Chief Scientific Officer. Monitoring and evaluating UKHSA's performance will become part of our routine business.

Reporting on progress:

We will provide quarterly progress reports to the Science Futures and Research Governance Board of the Executive Committee, and the Science and Research Committee of the Advisory Board.

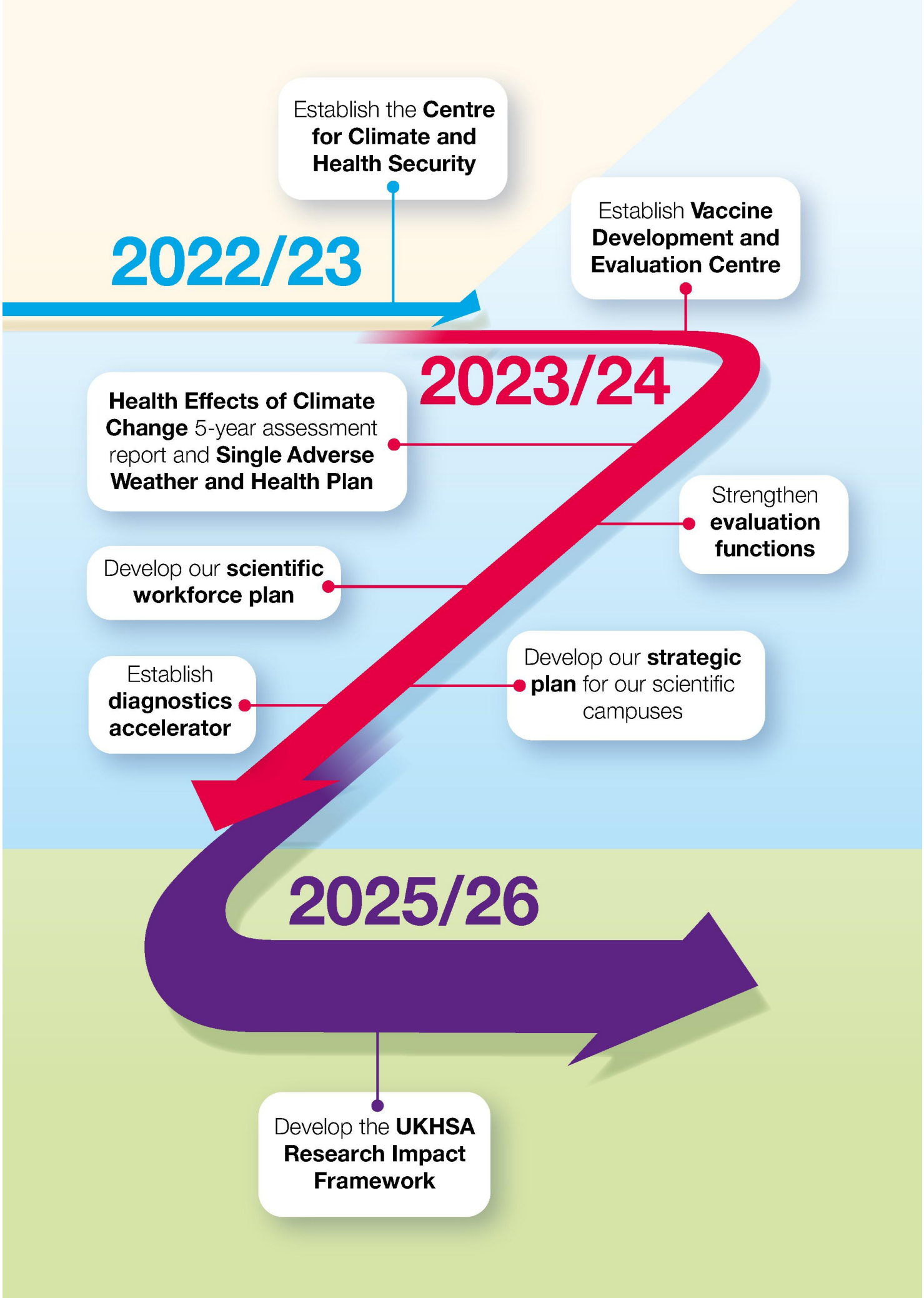
Communication:

We will develop a communication plan to increase the visibility of our scientific work and its impact. This will promote our offer to partners and share our progress in implementing our Science Strategy.

Impact assessment and evaluation:

We will assess the impact of our Science Strategy in saving more lives and contributing to the prosperity of the UK. We will evaluate our strategy through indicators drawing on quantitative and qualitative evidence from various sources within and outside UKHSA.

A summary of some of the delivery milestones over the duration of this Science Strategy are captured on the next page.


Establish the **Centre for Climate and Health Security**
2022/23
Establish **Vaccine Development and Evaluation Centre**
2023/24
Health Effects of Climate Change 5-year assessment report and **Single Adverse Weather and Health Plan**
Strengthen **evaluation functions**
Develop our **scientific workforce plan**
Develop our **strategic plan** for our scientific campuses
Establish **diagnostics accelerator**
2025/26
Develop the **UKHSA Research Impact Framework**

Looking forward and working with us

Although UKHSA has existed for little over a year, we have already accomplished a significant amount with the wider public health system. This Strategy outlines UKHSA's scientific ambition for the next decade.

In the context of climate change we know there will be another pandemic. We know that environmental hazards and antimicrobial resistance will have a profound impact on health and society.

We can prevent much of the harm from threats to our health. However, this won't be possible without concerted effort, great science and innovative technologies.

We are actively seeking partnerships across government, industry and academia in pursuit of the ambitions in this Strategy. Whether it is targeting AMR, blood-borne viruses, climate health hazards, diagnostics development or other UKHSA's strategic goals – our science is strongest in collaboration.

Unlocking the potential of our science will save more lives, contribute to national prosperity, and cement the UK's position as a science and innovation superpower.

If we realise the ambition within this Strategy, we will meet the health security challenges, now and in the future.

The analysis that underpins our strategy included a structured review of over 30 strategies from the UK government and the devolved administrations. It also drew on evidence from other countries, and from respected think tanks and professional bodies.

If you'd like to know more or discuss how to collaborate with us in the delivery of these scientific ambitions over the decade you can get in touch with us at sciencestrategy@ukhsa.gov.uk

UKHSA Industry Event – March 2023

Appendix A: Glossary

AMR: antimicrobial resistance
BRC: Biological Resource Centre
BSL: biosafety level
CBRN: chemical, biological, radiological and nuclear
CE: European Conformity
COVID-19: coronavirus disease caused by the SARS-CoV-2 virus
DHSC: Department of Health and Social Care
FEPTU: Food and Environmental Proficiency Testing Unit
MHRA: Medicines and Healthcare products Regulatory Agency
NEQAS: UK National External Quality Assessment Service
NIHR: National Institute for Health and Care Research
NVAP: New Variant Assessment Programme
PSRE: public sector research establishment
R&D: research and development
TB: tuberculosis
UKCA: UK Conformity Assessed marking
UKHSA: UK Health Security Agency
VTF: Vaccines Task Force
WHO: World Health Organization

Acknowledgements

This Strategy outlines UKHSA's scientific ambition for the next decade. It has been developed through extensive internal and external engagement across the health sciences ecosystem.

The insightful advice of the Executive and Non-Executive members of UKHSA's Advisory Board and Executive Committee alongside the expert opinion of attending non-members was crucial in finalising this Strategy.

Considerable thanks are due to those from outside UKHSA who have inputted into this strategy over UKHSA's first year. This includes the Chief Medical Officer, officials at the Department of Health and Social Care, the Office for Life Science and the community of Chief Scientific Advisors across government.

In addition, we thank the attendees of sector-based workshops with the life sciences industry, academia and health system partners, those who participated in the developmental conversations held at UKHSA's inaugural Conference in Leeds in November 2022, and those who participated in discussions with colleagues in Scotland, Wales and Northern Ireland.

This Strategy would not have been possible without the input of UKHSA's team of scientists, clinicians and staff who formed a core team across the organising Groups of UKHSA.

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About the UK Health Security Agency

UKHSA is responsible for protecting every member of every community from the impact of infectious diseases, chemical, biological, radiological and nuclear incidents and other health threats. We provide intellectual, scientific and operational leadership at national and local level, as well as on the global stage, to make the nation health secure.

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