



**Bridging the gap:**  
Protecting the nation from  
public health threats

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## Deloitte Centre *for* Health Solutions

### About the Centre for Health Solutions

Established in 2011, the Centre is the research arm of Deloitte's Life Sciences and Health Care practices operating in the UK and across our European member firms. Our aim is to be a trusted source of relevant, timely and reliable insights on emerging trends, challenges and solutions. We use our research to encourage collaboration across all stakeholders, from pharmaceuticals and medical technology companies to health and care providers and commissioners, to the patient and health and care consumer.

# Foreword

Welcome to the third report in our future of public health series, *Bridging the gap: Protecting the nation from public health threats*. This report examines the UK's policies and approach to health protection including the availability of the specialist resources, knowledge and skills needed to tackle the many diverse and challenging public health threats. The pandemic exposed critical gaps in the health protection system, including workforce and funding shortages, a lack of surveillance capacity, and fragmented and unclear accountabilities. However, the response resulted in unprecedented government spending and generated some highly innovative solutions. These include, the extraordinary pace of vaccine development and the impressive rollout of the vaccination programme, the rapid adoption of digital and diagnostic technologies and the effective use of data, genomics and science.

The UK public's understanding of health protection has increased in recent years due to incidents and events such as SARS, Ebola, pandemic flu, and now COVID-19. The responses to these, while effective, were largely reactive. Health protection also needs to be proactive if it is to protect the public from both global and national health threats, for example, new pathogens, climate change, antimicrobial resistance, healthcare-associated infections, and environmental hazards. All public health systems therefore need to make choices on how best to deploy funding and other resources, and especially how to prepare for low probability, high impact events such as COVID-19.

The pandemic found the UK, and indeed most countries, unprepared for this extraordinary health threat. Despite the growing concerns from the scientific community that highlighted the increasing likelihood of a global pandemic, the onslaught of the SARS-CoV-2 virus took the world by storm. The huge health, social, and economic consequences have affected every country to some degree, and it will take years to recover from the legacy of the pandemic.

The exceptionally rapid development of COVID-19 vaccines and the UK's rollout of the vaccination programme have been two crucial public health successes during the pandemic which are helping to bridge the health protection gap. Likewise, advances in genomics, which proved vital to the development of vaccines, are helping identify and track viral mutations and improve scientists' understanding of trends in transmission while increasing the opportunity for innovations.

The government's decision, mid-pandemic, to close Public Health England, and transfer the organisation's protection and security responsibilities to a new agency, the UK Health Security Agency, took most stakeholders by surprise. However, in bringing together the national public health science and response capabilities, including NHS Test and Trace and the Joint Biosecurity Centre, together with the COVID-19 Genomics UK (COG-UK) consortium, there is a real opportunity to learn lessons, build on the strengths, and re-prioritise health protection more effectively.

This report examines the changes, complex challenges and suggested solutions affecting health protection at the national and local level. As always, we welcome your feedback.

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# Key facts and trends on health protection in the UK

## UK statistics on COVID-19

By 17 November 2021 over **9.67m COVID-19 cases** had been reported and more than **143,360 people had died of/with COVID-19** within 28 days of positive test.<sup>1</sup>



By 17 November 2021, some 110.2m COVID-19 vaccine doses had been administered with **88% of the population** aged 12 years and above receiving their first dose and **80%** two doses.<sup>2,3</sup> In the UK, **over 13m doses of third dose/boosters** have been given.<sup>4</sup>

### First COVID-19 vaccine dose



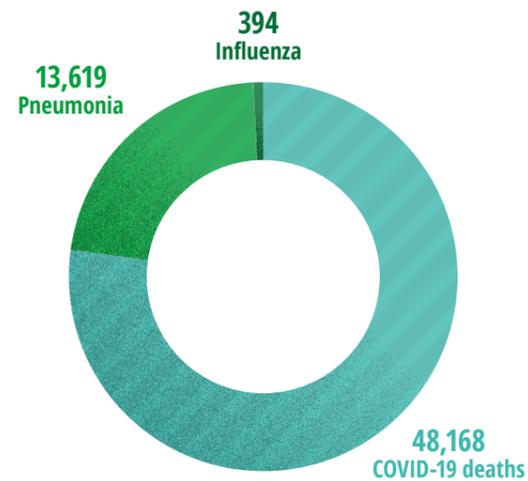
### Second COVID-19 vaccine dose



By August 2021, some **14.5m people** had signed-up to the **NHS App** largely in response to being able to access details of vaccination status but also to book appointments, order repeat prescriptions and access information on health risks and mitigation strategies.<sup>5</sup>

## UK statistics on COVID-19 compared to influenza and pneumonia

Between January and August 2020, there were **48,168 deaths** due to COVID-19 compared with **13,619 deaths** due to pneumonia and **394** due to influenza. **Influenza and pneumonia deaths in 2020 were below the previous five-year average** (2015 to 2019) in each of the eight months under review.<sup>6</sup>



In England, uptake of the **influenza vaccine** for 65+ year olds, babies under six months old and at-risk groups **increased** from **49%** in 2011-12 to **59%** in 2018-19.<sup>7</sup>

### 2011-12

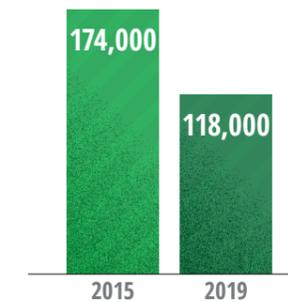
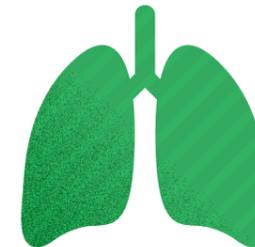


### 2018-19



## Decline in prevalence of other infectious diseases

**Between 2011 and 2018** the number of tuberculosis (TB) cases declined by **43%**, but in 2019, the number of people notified with TB **rose by 2% for the first time in nine years.**<sup>8</sup>



The number of people living with chronic hepatitis C virus (HCV) infection, fell by around **one third** to 118,000 in 2019, from 174,000 in 2015, due to greater numbers treated with interferon-based treatment or higher rates of spontaneous clearance.<sup>9</sup>

## Public health workforce numbers

In England, there are

**134**

directors of public health (DsPH), based in local authorities across the country.<sup>13</sup>

The wider public health workforce totals

**15m**<sup>14</sup>



## Genomic sequencing

By 11 October 2021, the UK had **uploaded over 1m genome sequences** of SARS-CoV-2 to the international GISAID database, accounting for nearly a quarter of all sequences published globally to date.<sup>10</sup>



Launched in 2012 'the 100,000 Genomes Project' reached its target of sequencing 100,000 genomes in December 2018. NHS Genomic Medicine Service (GMS) aims to sequence

**500,000**  
whole genomes by 2023/24.<sup>11</sup>

By December 2020, the COVID-19 Genomics UK Consortium (COG-UK) sequences around

**8,000-10,000**

SARS-CoV-2 genomes every week.<sup>12</sup>

# Protecting the nation from public health threats

Health protection involves a complex array of targeted and cross-functional approaches to tackle diverse and challenging public health threats. These threats need to be managed in an optimal way to reduce health inequalities, avoidable disability and premature death. Historically, the UK was recognised globally as having a world leading national health protection system, however, the Health and Care Act 2012 reforms in England, that transferred responsibility for public health to local authorities, led to reductions in overall funding and created a more siloed and fragmented approach to public health protection. This was despite numerous reports warning of the challenges that the world was facing in relation to infectious diseases, antibiotic resistance, and climate change. The UK's preparedness for a pandemic had been widely acclaimed, but performed less well than many other countries in practice. While the response includes examples of global best practice, there were also some mistakes and lessons from both need to be learned to inform future responses and ensure the sustainability of health protection services.

## The management and control of health protection

Public health protection is crucial in improving the health of a defined population by protecting them from threats. These include infectious disease incidents and outbreaks, and environmental hazards (chemical, biological, radiological and nuclear incidents), as well as the health impacts of climate change. Health protection also needs to be proactive in protecting the public from ongoing health risks such as sexually transmitted diseases, hospital-acquired infections and the rapid increases in the rate of drug resistance in numerous infectious pathogens.

In recent years public awareness of public health's role in health protection has increased due to several high-profile unforeseen global events such as:

- the emergence of a new infectious disease, severe acute respiratory syndrome (SARS) in 2003, spread to 26 countries causing the WHO to issue a global alert; it is estimated to have infected 8,500 people and caused 912 (most cases occurred in China, Taiwan, Hong Kong and Singapore)<sup>15</sup>
- an outbreak of swine flu in 2009 which was declared a pandemic by the WHO and which spread across the world with 18,449 laboratory confirmed deaths but researchers suggest it actually killed about 284,000 people<sup>16</sup>
- Middle East respiratory syndrome (MERS) which was first identified in Saudi Arabia in 2012 and by 2021 was estimated to have affected over 2,589 people and caused over 940 deaths, concentrated largely in Saudi Arabia, Middle East and South Korea (with five cases identified in the UK).<sup>17</sup>

Other recent high-profile public health threats in the UK include the Salisbury 'Novichok' poisoning and now, COVID19. These events have highlighted the importance of health protection and shone a spotlight on the extent of preparedness to respond to them. Given the wide range and growing number of health threats, all public health systems have to make choices about how to deploy funding and resources, and especially how to prepare for low probability, high impact, events such as a global pandemic.

While national governments have the ultimate responsibility for tackling emergencies and protecting the population against events from which they cannot protect themselves, between April 2013 and October 2021, responsibility for health protection in England was vested in Public Health England (PHE), an executive agency of the Department of Health and Social Care (DHSC). In October 2021 the government closed PHE and established a new UK Health Security Agency (UKHSA) to take over responsibility for health protection – see box below. However, because the research for this report was conducted between March and July 2021, our findings relate to the system for health protection that was in place under the leadership of PHE. We discuss the expectations for and ambitions of UKHSA later in the report.

Until October 2021, when PHE cease to function, it was accountable to the Secretary of State for Health and responsible for providing Parliament, central and local government, the NHS, industry and the public with evidence-based professional scientific advice and delivery expertise and support. In addition, PHE was also a distinct autonomous delivery organisation, responsible for funding and ensuring the provision of public health services, through regionally based, multidisciplinary health protection and public health teams.<sup>18</sup>

In March 2021, the government announced its decision to close PHE and establish a new public health organisation as part of its detailed plans for reforming public health (see our overview report *Narrowing the gap: building a fairer and sustainable public health system*). As a result, from October 2021, PHE's health protection functions, and the NHS Test and Trace system, have been combined into a new UK Health Security Agency (UKHSA). The UKHSA brings together the UK's national public health science and response capabilities to protect against infectious diseases and external health threats. However, the research for this report, was conducted during March and July 2021 when responsibilities were vested in PHE and our findings relate to the management of public health under the stewardship of PHE. Nevertheless, our findings, have implications for the new UKHSA, which we will return to later in the report.

Alongside its national protection responsibilities, PHE was a Category 1 emergency responder, working with partners under the terms of the Civil Contingencies Act 2004 to support the public, other emergency responders and governments during emergencies where there is a threat to human health from communicable diseases or environmental PHE's Emergency Preparedness Resilience and Response resources worked with other agencies and partners at local, regional and national level.

**Day-to-day responsibilities for health protection pre-COVID-19**

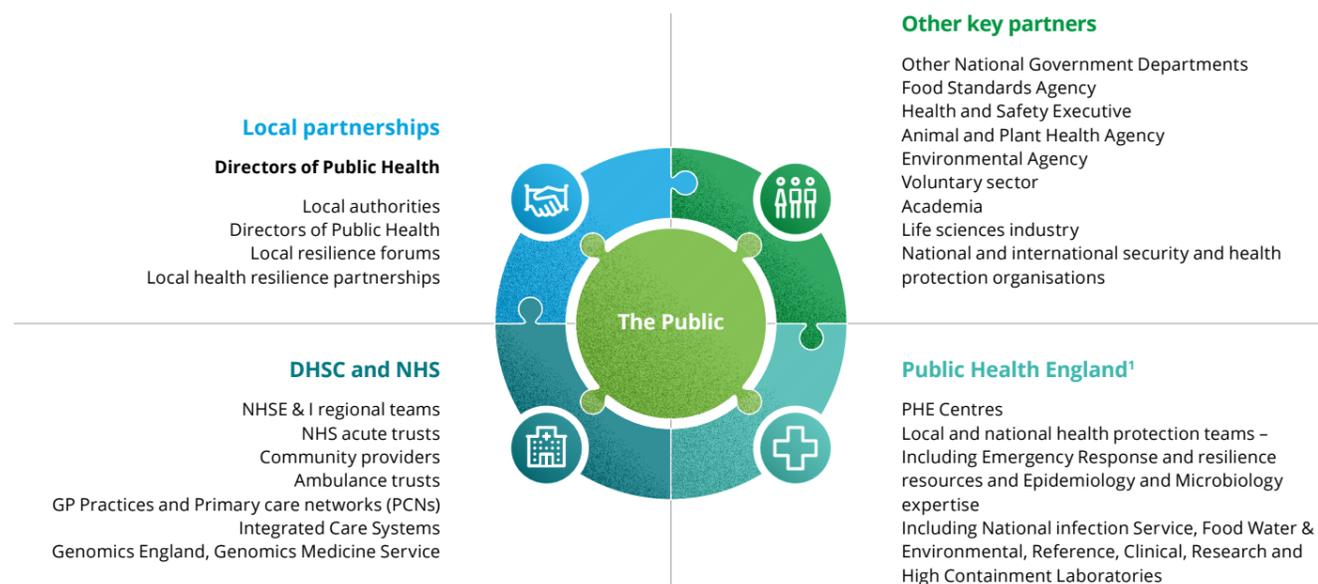
Providing the complex array of health protection services involves a broad network of stakeholders working in partnership across the NHS, academia, national government, other government agencies, industry and, importantly, the public (see Figure 1).

Delivery of PHE's day to day health protection duties was through their regionally based, multidisciplinary health protection teams (HPTs) comprising nurses, practitioners, doctors and surveillance and administrative staff working closely with environmental health departments, hospital microbiologists, reference and specialist laboratories, hospital and community infection control teams, general practitioners (GPs), community specialists, and academic institutions. These staff provide support to local communities through surveillance, monitoring infectious diseases, strategic health protection work, emergency planning and operational support, as well as education and training for healthcare professionals and the public. Key areas of expertise include water borne diseases, environmental hazards, travel-associated infections, and community – and hospital-acquired and respiratory infections (such as TB).<sup>19</sup>

At the local level, however, Directors of Public Health (DsPH), who were transferred from the NHS to local authorities following the Health and Social Care Act 2012, provide leadership for the public health system working closely with NHS partners and PHE's HPTs.<sup>20</sup> Moreover, delivering the combination of public health protection duties and services requires DsPH to work in partnership with the NHS, academia, national government and other government agencies, industry, and the public. DsPH have a statutory place on local health and wellbeing boards to help them fulfil this broader role, as well as strong connections back to the NHS, and they are the local leader for health protection issues, such as terrorism and outbreaks of infectious diseases.<sup>21</sup>

In September 2019, PHE published its first infectious disease strategy, the Disease Strategy Framework for 2020-2025, which is organised around six interrelated core functions and ten strategic priorities (see Figure 2). This provides an overview of how public health protection services have been organised over the past two years, including pre-pandemic.<sup>22</sup>

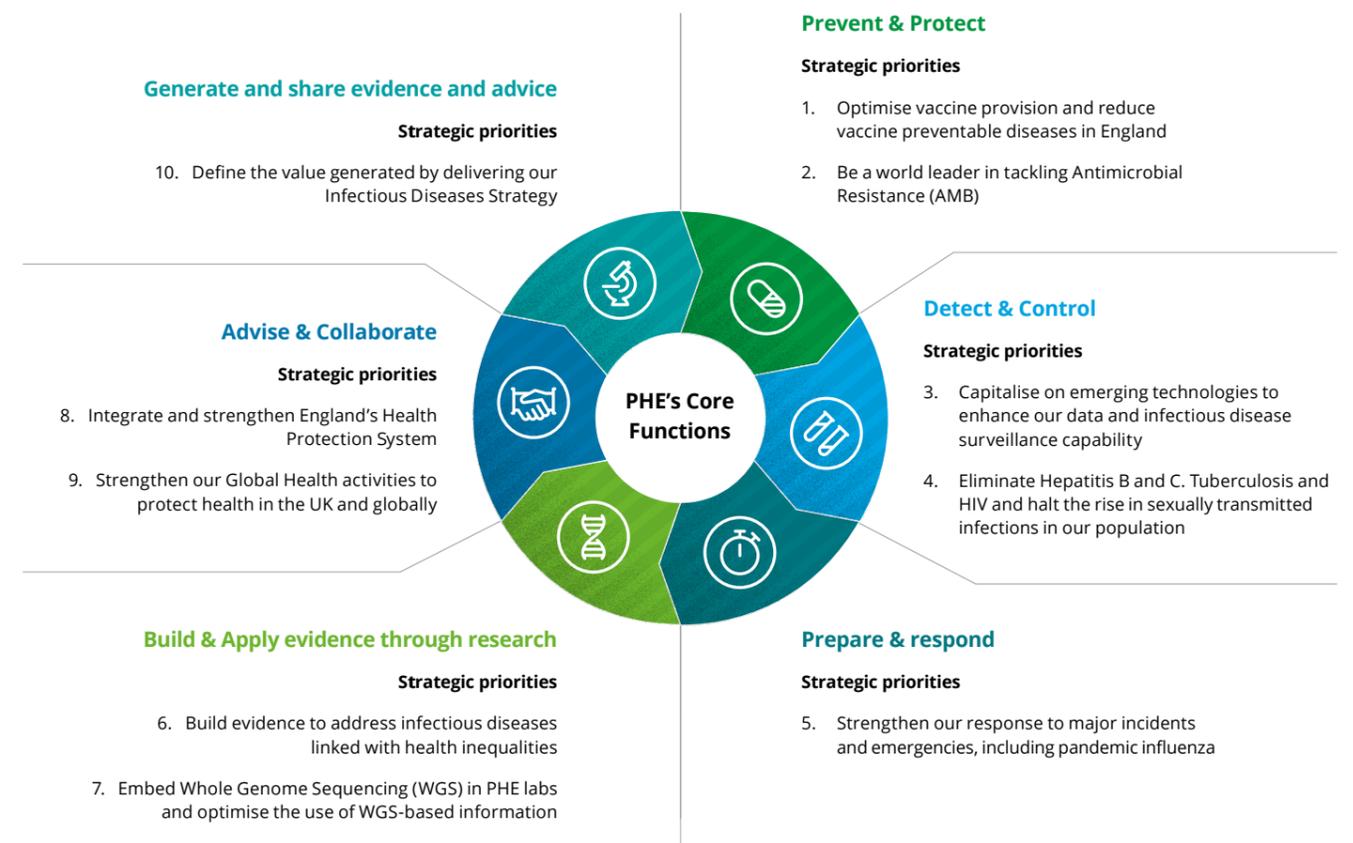
**Figure 1. The complex array of key stakeholders with a role in health protection**



1. From 1st October 2021 the UK Health Security Agency assumed these responsibilities from Public Health England

Source: Adapted from PHE Infectious Disease strategy framework 2020-2025.

**Figure 2. The six core functions and 10 strategic priorities of PHE's 2019 strategy**



Source: Adapted from PHE Infectious Disease strategy framework 2020-2025.

“Health protection requires specialist skills and knowledge across multi-disciplinary teams to tackle diverse and evolving threats and reduce the risk of history repeating itself.”

**Policy maker**



### Tools to support health protection activities

PHE guidance included a number of methods and tools that local systems can use to manage their core functions, such as clinically validated whole genome sequencing (to identify and treat Hepatitis C); surveillance, analytics and population health management (PHM) tools; health screening; and vaccination programmes. There were also a number of evidence-based toolkits on infection control, laboratory and point of care diagnostic testing, and evidence-based prescribing of antibiotics.<sup>23</sup>

### COVID-19 has changed how countries perceive global health threats

As explained in the methodology annex in our Executive overview report, our primary research, conducted between March and July 2021, consisted of a survey of 1,504 front-line health and care professionals across the UK, and interviews with 85 public health experts, together with insights from Deloitte colleagues and an extensive literature review.<sup>24</sup> We asked our survey respondents how well they thought protection was being managed pre-pandemic: 36 per cent said not very well and 36 per cent reasonably well; the remainder didn't know. A general comment made by most of the interviewees was that there are too few people in the health protection workforce and the health protection system is too fragmented with confusion over roles and responsibilities.

COVID-19 exposed the extent to which preparedness for a pandemic was insufficient, leaving health systems in most countries overwhelmed by a new, fast-moving, virus. In the UK, the pandemic highlighted a lack of vigilance in preparing for pandemics including inadequate surveillance and unclear accountabilities. It also exposed the inadequacy of investment in the health protection infrastructure.<sup>25</sup>

Our interviewees believed that a key reason for the lack of investment in the health protection infrastructure was the year-on-year cuts to the public health grant and that improving preparedness will require not only sustained investment, but also a new approach to the leadership dimension and accountability for prevention services. Interviewees also emphasised that in the first wave of the pandemic the response was far too centralised and that more use could have been made of the expertise and local knowledge of public health teams. They also raised concerns that the health protection system was too fragmented and that there were too few people in the workforce, undermining the capacity for an effective, populationwide response.

We asked our interviewees what aspects of the pandemic response had resonated with them most? The majority identified health inequalities and mentioned the unequal impact on certain occupations, including health and social care staff, who faced greater exposure to infection. They also recognised that the risk of mortality increased in younger people who were unemployed, had lost their jobs, and lived in overcrowded housing. These views are supported by research from the Health Foundation, which estimated that mortality rates for people under 65 were 3.7 times higher in the most deprived areas compared to the least deprived and that areas of high deprivation and child poverty had higher mortality rates. People from ethnic minority communities had significantly higher risk of mortality, for example, black African men were 3.7 times more likely to die during the first wave than their white counterparts and Bangladeshi men more than five times more likely to die during the second wave. They also highlighted a lack of compliance with hand hygiene, and lack of compliance with COVID mitigation strategies, such as social distancing and face coverings. They noted that vaccine hesitancy/non-compliance aligns strongly with the social gradient.<sup>26</sup>

“One of the biggest problems in the pandemic was a lack of health protection – just think about people in care homes.”

**Director of Public Health**

“When the pandemic hit, everything else stopped. We just focused on the pandemic response and health protection. We're now just trying to get back to some sort of normality.”

**Director of Public Health**

The consensus view from our interviews is that there is a need for greater vigilance in preparing for major outbreaks and ensuring an early response to new and emerging threats to the nation's health. Key lessons identified by our interviewees about the health protection response to COVID-19 include:

- the need for timely surveillance data, including test, track and trace abilities, and to combine local knowledge with centralised data capabilities alongside regional laboratory and diagnostic centres that enable national government agencies to remain alert and capable of responding to emerging infections
- the importance of genomic sequencing capabilities and using data to provide insights into the epidemiology of infectious diseases, and assess control measures
- the critical role of vaccinations in protecting the health of the nation
- the irrefutable link between health and the environment, and the threat to public health posed by climate change.

Many of these points are echoed in the October 2021 'Coronavirus lessons learned to date' joint report by the Health and Social Care and Science and Technology Committees which covers six topics, 'pandemic preparedness', 'lockdowns and social distancing', 'testing and contact tracing', 'social care', 'at-risk communities', and 'vaccines'. The extensive inquiry noted that a crucial issue was that as of October 2019, the Johns Hopkins Global Health Security Index, had the UK and the US as the best prepared in the world, yet COVID-19 has had a significantly bigger impact on these two countries compared to many others who ranked lower. Their findings on the six areas have important recommendations for government, including the fact that much of the UK's preparation was for an influenza like pandemic (not one characterised by asymptomatic transmission which meant testing was important).<sup>27</sup> The Health and Social Care and Science and Technology Committees:

- commended the prescience of the government in recognising that a vaccine would be a long term route out of the pandemic and its early support of the research and development of a number of vaccines and other treatments identified through the NHS-wide RECOVERY trial.
- emphasised the need to learn both positive as well as negative lessons from the UK's handling of the pandemic.<sup>27</sup>

### The role of surveillance, science, and technology in crucial enablers of health protection

A crucial part of the protection response is the development of new technologies to enhance detection and control capabilities. These include innovations in surveillance, rapid communication capabilities and genome sequencing, which provide the tools to share information and advice rapidly, bringing greater accuracy to the response and opportunities to embed new technologies, to link and integrate data and improve surveillance. The UK's history of strong surveillance capability and wide range of facilities and scientific expertise has meant that it was well placed to take a leading role in developing a science-based understanding of COVID-19. Assets included microbial culture collections and outbreak and incidence data and materials, and Whole Genome Sequencing (WGS) capability. There also existed a wide network of effective partnerships with national and international government agencies and academic collaborators.

### Effective surveillance and access to timely data are key ingredients for improving prevention

Improving prevention through a timely nationwide surveillance requires robust interoperable data, analytics and insights about defined populations, across multiple care settings. Surveillance is supported by test, track and trace capabilities aligned to appropriate biosecurity and infection control measures, underpinned by a network of efficient laboratory services. Surveillance has been a core function of PHE and indeed, the UK has long been recognised as having several effective data systems and laboratory networks underpinning disease surveillance.<sup>28</sup>

These include passive surveillance to monitor for changes in the epidemiology of infectious diseases; active surveillance to collect in-depth information to assess new and emerging problems; and extensive reliance on laboratory expertise and data from NHS and PHE's microbiology laboratories as well as other providers of clinical and laboratory services. PHE's health protection strategy identified ongoing opportunities to embed new technologies to integrate data and improve surveillance. COVID-19 has amplified the importance of having a robust surveillance infrastructure of laboratory functions and diagnostic centres able to carry out testing and analysis at the local, regional and national level.

In May 2020, in response to the pandemic, the government established the Joint Biosecurity Centre (JBC) to bring additional and complementary analytical capacity to build on that already in place at a local and regional level across the UK.

The JBC is an integral part of the **NHS Test and Trace service** within the Department of Health and Social Care (DHSC) and provides evidence-based, objective analysis to inform local and national decision-making in response to COVID-19 outbreaks. Initially working in partnership with PHE and now as part of the UKHSA, the JCB is seen as an important element of an evolving and strengthening health protection ecosystem, working collaboratively with the devolved administrations in the UK.<sup>29</sup>

At the outset of the COVID-19 outbreak, PHE was also responsible for test and trace for the relatively low numbers of initial infections. However, the system was quickly overwhelmed, and community testing was suspended early in the pandemic. Our interviewees were critical of this decision and the resulting lack of data on what was happening on the ground. They also highlighted a lack of data sharing among national public bodies as detrimental to the initial response.

As the number of infections grew, the DHSC significantly scaled up testing capacity in England and in May 2020 launched its new NHS Test and Trace Service (NHST&T) as part of a single national programme. In December and June, England's National Audit Office (NAO) published two reports to Parliament on the NHST&T programme.

- The December 2020 report found that NHST&T had achieved a rapid scale-up in activity in respect of both testing and tracing and had built a robust national infrastructure and capacity from scratch. However, the NAO concluded that issues with implementation and the initial choice of delivery model meant that it was slow to achieve its objectives.<sup>30</sup>
- The June 2021 report concluded that NHST&T was operating in an environment of high uncertainty, where demand for testing and tracing could be affected at short notice by new variants, case numbers and policy decisions. It identified that NHST&T performance has improved in reaching contacts; however, local authorities were still not getting timely access to the data they need to deal with localised outbreaks.

Likewise, the Health and Social Care and Science and Technology Committees inquiry also called out the delays in establishing a national testing system and criticised the fact that the adoption of a central model failed to harness local capabilities.

However, they acknowledged the sheer scale of the operation and the fact that once the full infrastructure was in place, the testing capacity and performance is one of the most comprehensive in the world.<sup>31</sup>

They concluded that the optimal structure for test and trace is one that is locally driven with the ability to draw on central surge capacity.<sup>32</sup>

Our interviewees considered that following a rapid implementation of surveillance reporting and the deployment of NHST&T, the UK public health system was able to deliver a reasonably effective population-wide response due to the extent and quality of testing and other surveillance data, improvements in data integration and, for the most part, improved access to data for DsPH and their teams.

#### Genomics has revolutionised the way people think about health

The UK has played a significant role in the history and development of genomics and is widely regarded as having strong academic talent and expertise in the field.<sup>33</sup> The UK's establishment of Genomics England, the launch of its 100,000 Genome Project, the development of Whole Genome Sequencing service under the PHE national infection service and the establishment of an NHS Genomics Medicine Service in England has been instrumental in helping public health bodies respond to emerging threats, including outbreaks of infectious disease.<sup>34</sup> For example, in 2017, England performed the first public health sequencing of Mycobacterium tuberculosis (TB) developed in partnership between PHE and the University of Oxford, reducing the time needed to confirm treatment from one month to days at PHEs Birmingham and London laboratories. This in turn has improved detection and treatment and reduced opportunities for spread of drug resistant TB.<sup>35</sup>

In March 2020, the COVID-19 Genomics UK (COG-UK) consortium was created bringing together the genomics and analytics expertise of the four UK Public Health Agencies, multiple regional university hubs, and large sequencing centres such as the Wellcome Sanger Institute.<sup>36</sup> The initial remit of COG-UK was to contribute to the UK's response to COVID-19 by sequencing the SARS-CoV-2 genomes, providing these data to support the identification of new variants of the virus, and combining this with clinical information to inform public health actions and policy decisions (see Case study 1).

## Case study 1

### COG-UK and its use of genomics to inform the public health response to COVID-19 and beyond

#### Situation

Recent improvements in genomic sequencing technology, the availability and affordability of genomic technology, and access to biobanks and other sources of big data have led to new clinical applications in the field of precision public health (PPH). PPH uses big data and data analytics to drive public health assessment and policy, and activities are aimed at improving public health surveillance, developing targeted interventions to improve health and reduce health disparities, and applying pathogen genomics to inform the public health response to infectious diseases.<sup>37</sup>

#### Action

In March 2020, the COVID-19 Genomics UK (COG-UK) Consortium was formed comprising an innovative partnership of NHS organisations, the four public health agencies of the UK, the Wellcome Sanger Institute and academic partners. Its purpose was to support the response to COVID-19 by providing large-scale and rapid whole-genome virus sequencing to local NHS centres and the UK government. On 1 April 2020, £20 million grant funding was provided to COG-UK from the COVID-19 rapid-research-response 'fighting fund' from Her Majesty's Treasury established by Professor Chris Whitty and Sir Patrick Vallance and administered by the National Institute for Health Research (NIHR), UK Research and Innovation (UKRI), and the Wellcome Sanger Institute. In December 2020, COG-UK was awarded a further £12.2 million funding from the DHSC Testing Innovation Fund and has since been funded by NHS Test and Trace.<sup>38</sup>

COG-UK established systems of data collection from public health laboratories conducting COVID-19 testing and from the central records held by public health agencies across the UK, in a way that kept the data secure and protected confidentiality for individuals taking tests. The consortium recognised the importance of consent and trust. The COG-UK Mutation Explorer (COG-UK-ME) interface gives researchers globally access to data on SARS-CoV-2 mutations and variants of interest using UK data.<sup>39,40</sup>

From the outset of COG-UK's inception was a wish to provide the foundations of a national, public health-led sequencing network. During 2021 this became a reality based on an orchestrated process of handover of its foundations, deep subject matter expertise, and technical know-how, to NHS Test and Trace.<sup>41</sup> This transition occurred between April and September 2021, during which the provision of testing came under the remit of the NHS Test and Trace genomics programme. This included some of the COG-UK network of labs as well as other laboratories contracted to NHS Test and Trace.

#### Outcome

By the end of March 2021, the COG-UK network of laboratories had sequenced around 440,000 SARS-CoV-2 genomes for use by public health agencies; national and international collaboration. It had also established the administration, legal framework and logistics for a consortium of over 500 members and associates from academia, clinical medicine and public health, had also run a series of events and seminars and published regular blogs and external reports.<sup>42</sup>

COG-UK shares the government's vision and values of transparency, open access data release and collaborative working between public health, research and the NHS. The evolving threat from SARS-CoV-2 variants remains, and the integration of data and emerging SARS-CoV-2 sequences has the potential to facilitate the automated detection of potential 'variants of concern' at low frequencies. Tracking the emergence of viruses flagged as potential antigenically significant variants will help guide the implementation of targeted control measures and further laboratory characterisation.

### The growing importance of genomics in health protection and prevention

Throughout the pandemic, the use of genomics has been invaluable in a number of crucial areas including the rapid development of vaccines, tracking viral mutations, understanding trends in transmission and outbreaks, and deepening scientists' understanding of the immune response to COVID-19 and other pathogens. Researchers are also using genomic technology to support the development of vaccines and therapeutics for more effective protection against future pandemics.

The DHSC's ambition over the next ten years is to bring together the UK genomics community – from researchers through to the NHS – to harness the latest advances in genetic and genomic science, research and technology to create the most advanced genomic healthcare system in the world. In January 2021 leadership for SARS-CoV-2 sequencing transferred to NHS Test and Trace which has seen UK capacity to undertake sequencing scale exponentially. The new National Genomic Healthcare Strategy – [Genome UK: the future of healthcare](#) – launched in September 2020, expects to harness the potential of advanced genome sequencing to provide patients with the best possible preventive, preventative and personalised care, and deliver better health outcomes at a lower cost.<sup>43</sup> The ambition is to expand the number of pathogens that are sequenced to support ongoing public health practice and future pandemic preparedness.

Our interviewees highlighted the fact that once the surveillance test, track and trace system was up and running, and SARS-CoV-2 sequencing was operational, the combination of skills and expertise had become an important part of the response, especially in identifying the emergence of COVID-19 variants. Following the staged handover of routine genome sequencing and responsibility for shaping the sampling strategy to NHS Test and Trace, the UK's capacity to undertake sequencing has increased exponentially. In October 2021, the UK had surpassed one million SARS-CoV-2 genome sequences uploaded to the international Global Initiative on Sharing Avian Influenza Data (GISAID) database, representing 24 per cent of all samples uploaded from across the world to inform the global pandemic response. With NHS Test and Trace now part of the UK Health Security Agency, it is responsible for continuing to develop the UK's whole genome sequencing capability, in partnership with scientific organisations including the Wellcome Sanger Institute and COVID-19 Genomics UK (COG-UK) consortium.<sup>44</sup> December 2021, the total number of SARS-CoV-2 genomes sequenced was 1,373,204.<sup>45</sup>

### Vaccination is the most effective health intervention for saving lives

Vaccination has made an enormous contribution to both human and animal health and is the most effective health intervention in the world for saving lives and promoting good health. It is also a key contributor to improving life expectancy and reducing mortality and disability in children. Global vaccination against many important infectious childhood diseases has been enhanced dramatically since the creation of WHO's Expanded Programme of Immunization in 1974 and the Global Alliance for Vaccination and Immunization (GAVI) in 2000. Smallpox has been eradicated and polio almost eradicated, and there has been immense success in controlling the more complex measles and flu viruses.<sup>46</sup>

The pace of improvements in vaccine science has accelerated as a result of extensive research undertaken in the race to find vaccines against COVID-19, raising the public profile of vaccination in health protection. Consequently, the development of vaccines against more complex infections, such as malaria, tuberculosis and HIV, now has a greater chance of success. In the longer term, vaccines are likely to be used to prevent or modulate the course of some non-infectious diseases. Progress has already been made with therapeutic cancer vaccines, and future targets include addiction, diabetes, hypertension and Alzheimer's disease.<sup>47</sup>

The UK is a leader in childhood vaccinations, with one of the most comprehensive programmes in the world. However, PHE data show that although coverage remains high, children's vaccine uptake has been slowly decreasing since 2012-13. This means that some children have missed out and may remain vulnerable to serious or even fatal infections that are vaccine-preventable.<sup>48</sup>

While the impact of COVID-19 on existing vaccination programmes has yet to be evaluated, data published by the WHO and UNICEF in July 2021 identifies serious concerns that many children may have missed out on routine vaccination programmes during 2020 and that progress in improving childhood vaccination globally has gone into reverse, with a majority of countries experiencing a drop in immunisation rates.<sup>49</sup>

### The use of technology in driving the success of the COVID-19 vaccine programme

The development of COVID-19 vaccines and the UK's rollout of vaccination capabilities are among the major public health successes during the pandemic. In December 2020 the UK was the first country in the world to approve a COVID-19 vaccine for emergency use.

The NHS also built a new supply chain in six weeks for administering tens of millions of doses of the vaccines. A key driver of success has been the technical infrastructure behind the vaccination programme, with wide-scale adoption of technology to link different parts of the NHS to the programme – hospital hubs; mass vaccination centres (booked via the National Booking System); and local vaccination services, including GPs, community pharmacies and mobile vaccination teams (which target residential care including care homes, people who are housebound, and people in secure accommodation such as prisons and detention centres).<sup>50</sup>

Another contributor to success has been bringing different datasets together into a single data processing architecture within NHS Digital's Data Processing Service (DPS), a service made up of many different data flows and integration points across multiple organisations and suppliers.

Its aim is to track each vaccination that is given, ensuring that a patient's GP record is updated, and that adverse reactions can be monitored and tracked for every individual across the different vaccine types and clinical settings. The DPS transfers relevant data to authorised third parties such as the patient's GP record and the Medical and Healthcare Products Regulatory Agency (MRHA) to enable them to monitor adverse reactions. Furthermore, the Summary Care Record application allows access to a patient's COVID-19 vaccination history for other care settings such as emergency departments.<sup>51,52</sup>

A contentious issue that has yet to be resolved is on the need for proof of vaccine status for travel and to access certain services and events, otherwise known as a vaccine certificate or passport. Case study 2 demonstrates how the NHS App in England is being used as proof of vaccination.

## Case study 2

### Protecting the public by demonstrating COVID-19 vaccination status through the NHS App in England

#### Situation

As a result of the COVID-19 pandemic, more people are fully informed about their health risks and are taking a more proactive rather than reactive approach to prevention and treatment. This includes embracing social distancing measures and using digital technologies to demonstrate vaccine status.

#### Action

In May 2021, the NHS App added features to show a user's vaccination status, including the 'NHS COVID Pass'. The NHS App, which as of August 2021 had recorded over 14.5 million sign-ups, is one of the first internationally compliant systems to demonstrate vaccine status. From 21 June, the NHS COVID Pass has enabled individuals to not only demonstrate their COVID-19 vaccination status for international travel, but also, if required, for access to certain sporting and entertainment venues. It is also compliant with WHO guidance.<sup>53</sup>

#### Outcome

There were more than 2.8 million new registrations to use the NHS App within the first month after the NHS COVID Pass was added. The increase in app usage has also had potentially life-saving benefits as over 89,800 people registered their organ donation preference via the app during May and June out of a total of 90,519 total organ donation registrations. In addition, over 1.2 million repeat prescriptions were ordered, and more than 103,900 GP appointments booked via the app, saving valuable time for patients and clinicians.<sup>54</sup>

NHS App users can access a wide range of personalised services from booking appointments to viewing GP and hospital records. They can also register organ donation preferences and choose whether the NHS uses their data for research and planning.<sup>55</sup> Anyone in England who has had two doses of any approved vaccine, and does not use the app or is unable to access the NHS website to request a letter can contact NHS England's COVID advice line, 119 and request a letter.<sup>56</sup>

**Compliance with health protection mitigation strategies is important for recovery**

Despite the above successes, inconsistent communication and disconnected roles, responsibilities, and accountabilities across national, regional, and local organisations, alongside insufficient workforce capacity has made it difficult to steer a rapid and consistent public health response, including championing the deployment of effective mitigation strategies. Figure 3 illustrates the response strategies needed to enable an effective recovery.

A critical challenge in the response to the pandemic has been overcoming vaccine hesitancy and encouraging as many people as possible to get vaccinated. Tackling vaccine hesitancy requires organisation to have shared goals, underpinned by robust scientific evidence and data, which reflect local needs.

Local approaches that draw on the expertise and support of local leaders (including faith leaders) and community champions (such as the voluntary sector and health coaches) can also overcome people's hesitancy in relation to vaccination but also the adoption of other mitigation strategies like mask wearing and social distancing.

**Lessons from other countries response to the pandemic**

We asked our interviewees which countries had impressed them with their health protection response. Most were reluctant to commit as they considered that those that had responded well in the first wave had subsequently experienced problems. However in general they felt that countries that appeared successful in their protection response had introduced swift lockdowns and border closures, timely triage and referral of suspected COVID-19 cases, swift case identification, and effective contact tracing.

They also tended to provide designated isolation facilities (such as hotel rooms or hostel facilities), either for everyone or for those unable to self-isolate. High-performing countries also developed partnerships at multiple levels across government sectors and with the private and voluntary sectors. Many considered that governments with consistent and transparent messaging, and engaged community health workers and community leaders, also tended to have better outcomes. And a swift and effective vaccine rollout had been a critical game changer, breaking the link between infections, hospitalisations, and deaths.<sup>57</sup>

In contrast, interviewees considered that countries with poor results had uncoordinated approaches that devalued science, denied the potential impact of the pandemic, delayed comprehensive action, and allowed distrust to undermine efforts. Many of these countries had underfunded health systems with insufficient capacity to mobilise rapidly and coordinate national and sub-national responses, and lacked coherent mitigation and communication strategies to prevent community transmission.

When pushed to name countries that had impressed most, the top mentioned countries were New Zealand, due to its early lockdown and clear government communications, and Singapore due to its use of technology in its approach to surveillance. Public compliance with mitigation strategies was a common trait in these and other better-performing countries such as South Korea and Taiwan. But many interviewees said that it was too early to tell since some countries that impressed initially are now having a more challenging time in responding to the new variants.

Indeed, views on mitigation strategies are continually shifting. For example, while zero-COVID worked for the countries that embraced it during 2020 and 2021, the failure to eliminate COVID-19 elsewhere means this approach is becoming increasingly untenable. Furthermore, the emergence of the more infectious Delta variant that has become entrenched around much of the world, together with research evidence that suggests the effectiveness of even the best vaccines also reduces over time, means the virus is likely to remain in circulation for some time. Consequently, border closures and drastic lockdowns simply postpone the moment when COVID-19 will become endemic in a population while limiting citizen's freedom. This means those countries that aimed for zero-COVID are now considering how best to emerge from their extended lockdowns or risk significant damage to their economies. And those that relaxed all restrictions are having to find a balance of mitigation strategies that will work for them, suggesting that a multidimensional approach is required.

**Climate change is the next biggest threat to public health**

“Climate change is the greatest threat to global health in the 21st century. Health professionals have a duty of care to current and future generations.”

WHO<sup>58</sup>

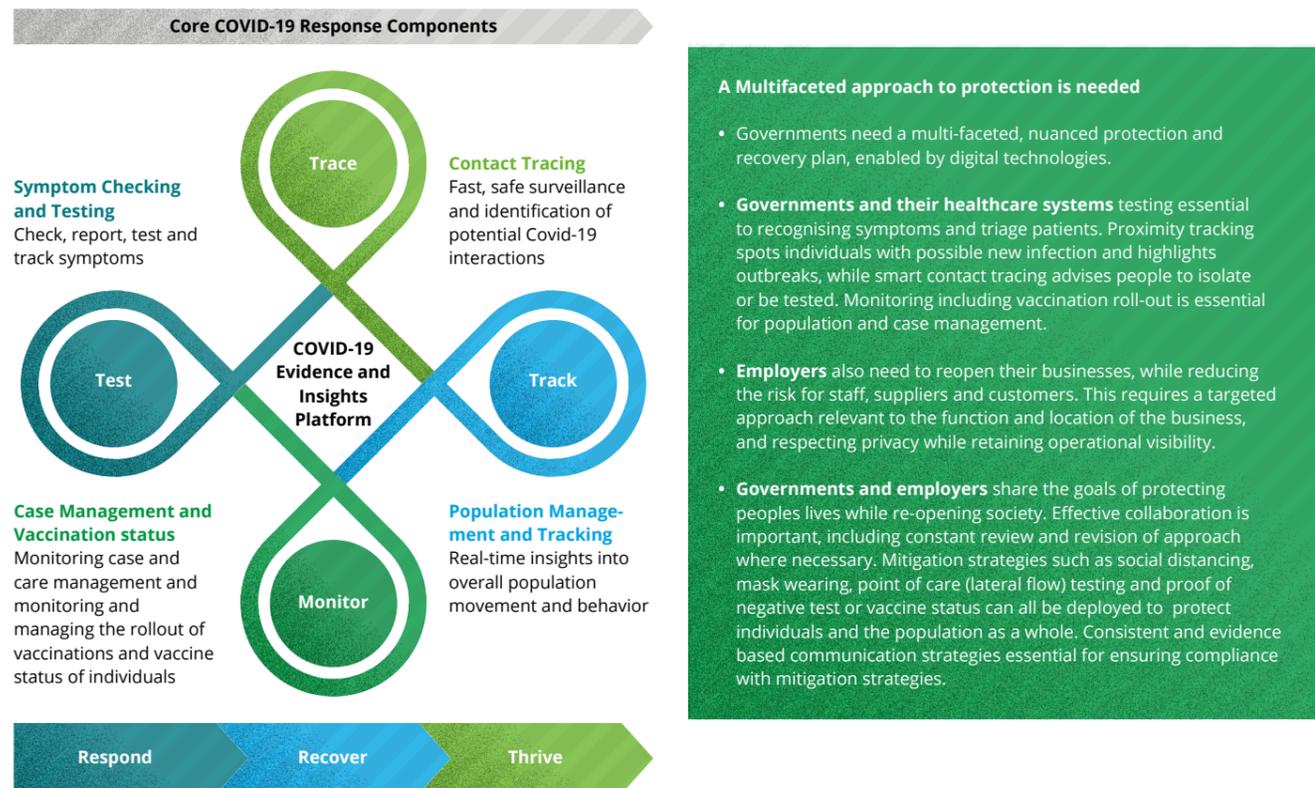
The WHO describes climate change as the greatest public health threat of our time; and tackling it as the greatest global health opportunity of the 21st century. This is both a scientific argument and a challenge, with human health and wellbeing at its core. While the direct impact of climate change may not be as immediately visible in the UK as it is in places where glaciers and ice sheets are breaking up, flooding is extensive and forest fires are raging, it is nevertheless a threat.<sup>59</sup>

Extreme weather events already impact public health through more deaths and ill health, and demand on health and social care services. Moreover services themselves can be affected by flooding of essential buildings, overheating of care homes, or wildfires. PHE, like many other public health authorities, has established research programmes to evaluate the public health impact associated with extreme weather events and ensure that lessons are learned and incorporated into long-term planning such as the Cold Weather Plan and Heatwave Plan for England. Government policymakers have been tasked with devising strategies to contend with the UK's changing climate.<sup>60</sup>

While the response to the COVID pandemic has demonstrated the capacity of individuals and organisations to respond and adapt in an emergency. It has also highlighted the inextricable link between health and the environment and the need to prepare for the public health impact of future threats.<sup>61</sup> The NHS has recognised that climate change threatens to undermine years of health gains and that 'the climate emergency is a health emergency' with poor environmental health contributing to major diseases such as cardiac problems, asthma and cancer. It has therefore declared its intention to become the world's first net zero national health service.<sup>62</sup>

Globally, the drivers for increasing the priority that every industry gives to climate change are growing as expectations of society and organisations continue to rise.

**Figure 3. Health protection response strategies**



Source: Deloitte.

While public expectations and behaviour were shifting before the pandemic, the pandemic has accelerated these trends. In the UK, increasing numbers of local authorities and health and care organisations are committing to ambitious carbon reduction targets and goals, however, bridging the gap between ambition and action requires cross sector collaboration and collective approaches including the adoption of consistent standards for measuring and reporting progress. Moreover, climate needs to be integrated into every organisation and system's purpose and strategy and embedded into their operations, culture and communications.<sup>63</sup>

#### Shaping the future of health protection in the UK

In 2019 PHE and the Association of Directors of Public Health (ADPH) developed guidance on *What Good Looks Like for High Quality Local Health Protection Systems*, aimed at supporting place-based leaders and professionals in promoting quality to:

- protect the public's health
- deliver sustainable reductions in health inequalities
- secure best value for the public purse.<sup>64</sup>

The guidance acknowledges that local public health organisations and leaders have to operate in an increasingly complex national policy and commissioning environment, while maintaining their effectiveness in protecting and improving health in the face of multiple interrelated challenges, such as including the establishment of integrated care systems (ICSs) and ongoing financial pressures. It also emphasises that maintaining a focus on high quality health protection services requires close working partnerships between public health organisations, the NHS and local government.<sup>65</sup> The NHS reforms and the establishment of ICSs as statutory organisations from April 2022, provides an opportunity for DsPH's to ensure health protection is a priority on the ICS agenda. However, to be effective, DsPH and their teams will need to be fully recognised and valued as an integral component of the ICS.

#### The 2021 reform of the public health system

In September 2020, the government announced plans for reforming public health, with a focus on prevention and population health and important national capabilities will be transferred to NHS E&I that will help drive improved health as a priority for the whole NHS.<sup>66</sup> In March 2021, the government set out the details of its transformation of national health protection capabilities, putting health promotion at the heart of government, and embedding prevention and health improvement expertise more deeply across local and national government and the NHS.<sup>67</sup>

It confirmed that DsPH and their teams will remain part of local government and that the public health functions of PHE will be split across two new areas:

- The health protection capabilities of PHE and the NHS Test and Trace service (NHST&T) (including the Joint Biosecurity Centre) will be combined into a new UK Health Security Agency (UKHSA). The UKHSA will bring together national public health science and response capabilities to protect against infectious diseases and external health threats.
- The current health improvement, prevention, and public health functions of PHE will become part of a new Office for Health Improvement and Disparities, part of the Department of Health and Social Care (DHSC), led by the Chief Medical Officer.<sup>68</sup>

The formal handover of responsibilities to the UKHSA was in October 2021 albeit they had been operating in parallel since April. The UKHSA is expected to act as a system leader for health security, providing intellectual, scientific, and operational leadership at national and local level. It is intended that the UKHSA will be close to policy making and able to exert influence over the system to ensure threats to health security are acted on and brought under control. It does not replace the public health agencies in the other three UK countries, but will continue to build on the ongoing cooperation and collaboration model that exists with the devolved administrations, including public health agencies for Scotland, Wales, and Northern Ireland.<sup>69</sup>

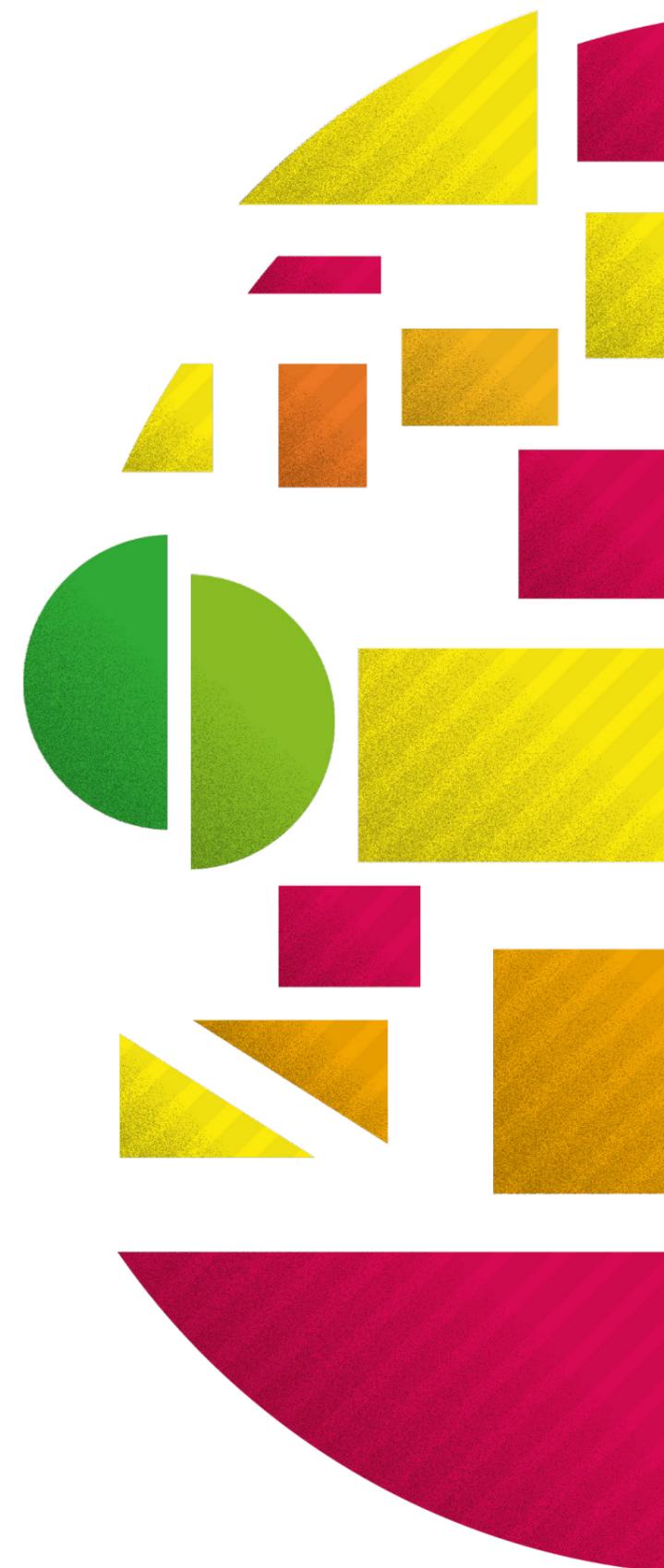
The UKHSA is an integral part of the public health system and the national security infrastructure and will deploy state-of-the-art technologies and expert capabilities in data analytics and genomic surveillance to tackle coronavirus (COVID-19) and future threats locally, nationally, and globally. A priority will be to develop critical health protection capabilities, including data science and analytics, genomics and diagnostics innovation, and behavioural science. Its aim is to ensure that the UK has an ever ready and scalable emergency response capability.

The immediate priority of UKHSA is to fight the COVID-19 pandemic, including supporting the development of vaccines effective against new and emerging variants. In the longer term, UKHSA expects to build on the infrastructure developed for COVID-19 to tackle and prevent other infectious diseases and external health threats. Specifically, high consequence infectious diseases remain the among the top 'worst case planning scenarios..

This work will include a strong focus on life sciences, strengthening relationships with academia, research organisations and industry which have developed and grown through the pandemic. As well as playing a key role in maintaining the UK's position as a world leader in whole genome sequencing (WGS), including deployment of its New Variant Assessment Platform (NVAP) to support other countries' response to COVID-19, strengthening global health security and protecting people at home and abroad.<sup>70</sup>

The core priorities of the UKHSA are to:

- Prevent – anticipating and taking action to mitigate infectious diseases and other hazards to health before they materialise, for example through vaccination and influencing behaviour
- Detect – detecting and monitoring infectious diseases and other hazards to health, including novel diseases, new environmental hazards, and other threats through world class health surveillance, joined-up data, horizon scanning and early warning systems
- Analyse – analysing infectious disease and other hazards to health to determine how best to control and respond to them, through coordinated and intelligent data analysis, modelling, and evaluation of interventions based on robust evidence and developing the knowledge base
- Respond – taking action to mitigate and resolve infectious diseases and hazards to health when they occur, through direct delivery, supporting health protection system partners with tools and advice, engaging with citizens, and flexibly deploying resources, including scaling operations at pace
- Lead – providing health protection system leadership, working in partnership with wider central government, the devolved administrations and public health agencies for Scotland, Wales and Northern Ireland, local authorities, the NHS, academia and industry to provide effective preparation and response to the full range of threats to health and strengthening the health protection system and workforce.<sup>71</sup>



### Lessons learned from the COVID-19 response

What is incontrovertible, is that COVID-19 has been a pandemic of inequality, exacerbated between and within countries, with the impact being particularly severe on people who are already marginalised and disadvantaged. Moreover, inequality has been a determining factor in explaining why COVID-19 has had such differing impacts on peoples' lives and livelihoods.

The pandemic has tested the ability of every government to protect its citizens from unexpected threats. While there have clearly been some failings in health protection, there have also been some outstanding successes. Nevertheless, the pandemic has and will continue to have a negative impact on health and care. But, as almost every interviewee noted, following the establishment of the COVID-19 Genomics UK (COG-UK) consortium and the roll-out of one of the most comprehensive vaccination programmes in the world, the UK public health system did deliver an effective population-wide response to the pandemic. The outcome is that a very high percentage of the population has now been vaccinated, and the continued high level of testing (by far the highest level of tests per million population anywhere in the world) means that the UK has a comprehensive view of the trajectory of the virus and a forensic understanding of the risk of new variants emerging.

However, public health threats are many and varied, and as the recovery phase continues, the UK has an opportunity to learn the lessons from the pandemic and apply them to all other types of threats. It also has an opportunity to change the narrative and state categorically that the previous problems and under-investment can no longer be tolerated, and that new priorities and new efforts are needed in the way the country thinks about security and health protection, alongside reducing both inequities and inequalities.

There is undoubtedly a greater role for data and analysis to inform public health strategy and for more effective collaborative working with local health and care systems, local authorities and public health teams. However, implementing the biggest structural shakeup of public health in a decade while fighting the continuing waves of COVID-19 infections (including a growing number of people with long-COVID, lengthening waiting lists, severe workforce shortages and a need to collaborate and find new ways of working with local authorities and other key stakeholders) means that the task ahead will require extraordinary efforts and commitment alongside a willingness to embrace change.

The planned reform of public health, and specifically health protection and the creation of the UKHSA provide an opportunity to re-prioritise protection services and address health inequalities in more coordinated and collaborative ways. However, the clearest evidence from the response to COVID-19 is that while the government has to take responsibility for having a robust, health protection infrastructure in place that protects everyone equally, wherever they live, the response has to be locally led but with the opportunity to draw on national capabilities and capacity. Health protection also has to be adequately funded and resourced, including investing in addressing the workforce shortages and multi professional training and expertise needed for an effective response.

Going forward it will also be important that the changes in health protection work are translated quickly into clinical pathways where needed- so that there is a truly integrated approach to care. This will likely need to involve detailed scenario planning to improve preparedness at every level and combat threats as they arise.

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