Guiding the UK and international response during the Covid-19 pandemic

The NIHR Health Protection Research Unit in Modelling and Health Economics played a critical role in providing urgent public health advice to policy makers during the Covid-19 pandemic. Their research contributed to saving tens of thousands of lives in the UK and internationally.

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Real-time tracking of the pandemic

The emergence of the SARS-Cov-2 virus in early 2020 and the ensuing Covid-19 pandemic posed an unprecedented threat to public health in the UK and around the world. The rapid spread of infection and risk to lives demanded a prompt response from public health advisors and policy makers to control the spread and protect the most vulnerable.

The NIHR Health Protection Research Unit (HPRU) in Modelling and Health Economics, supported by additional funding from UK Research and Innovation and the Medical Research Council, played a critical role in this early response.

Representing a partnership between the UK Health Security Agency, Imperial College London and the London School of Hygiene & Tropical Medicine (LSHTM), the HPRU team provided up-to-date, real-time evidence and advice to UK and overseas governments about the spread and threat from the novel coronavirus.

Led by Professor Neil Ferguson lead researcher at the NIHR HPRU in Modelling and Health Economics at Imperial College London and Professor Mark Jit at LSHTM, the HPRU rapidly developed infectious disease models and carried out data analyses to inform urgently needed national policies. Their models used mathematical and statistical methods to understand and predict how the virus may spread among different populations and suggest how it could be controlled.

Using data from various sources, including daily Covid-19 confirmed cases, hospitalisations and deaths in the UK in real-time, the models took account of several factors. These included virus biology and evolution, transmission, clinical presentations and immunity, and the impact of non-pharmaceutical and pharmaceutical interventions.

"As the world faced its most serious public health crisis in generations, we were able to provide concrete estimates of the scale of the threat countries faced." Professor Neil Ferguson

Informing the national and global response

As the pandemic unfolded, the team's early research was the first to estimate the true, larger scale of the outbreak in Wuhan, China in January 2020 (see published Report 2 (.PDF), published on the Imperial College London website). This work, alongside their reports to advisory committees such as the Scientific Advisory Group for Emergencies (SAGE) and the Scientific Pandemic Influenza

sub-group on Modelling (SPI-M-O), raised global awareness of the pandemic's potential threat.

Their work estimated how transmissible the virus was (R number, see Report 3 and *Lancet Infectious Diseases*) and how many people infected with SARS-CoV-2 were likely to die from Covid-19 (infection fatality ratio, IFR), consistently delivering evidence to support UK government policy and NHS planning.

As infections escalated during March 2020, the team's model and subsequent reports shared with SAGE (see published Report 9 and *Lancet Public Health*) indicated that hundreds of thousands of people would die and the NHS would be overwhelmed without a strategy to suppress the spread of SARS-CoV-2. The government responded with social distancing measures and the UK's first national lockdown.

This modelling was shared with other countries including the United States, where the data suggested that 2.2 million people could die without infection control. The White House issued new guidance on social distancing soon afterwards. They then estimated the potential global impact of the pandemic under different policy options (see Report 12 and *Science*).

Professor Neil Ferguson said: "Countries needed to act collectively to rapidly respond to the fast-growing epidemic. Sharing both resources and best practice was critically important if the potentially catastrophic impacts of the pandemic were to be prevented at a global level."

Advising on the impact of Covid-19 policies

As social distancing, school closures and national lockdowns had major social and economic impacts for many countries, it was important to understand whether they were effective. Published in *Nature*, the team's research confirmed that lockdowns played a major role in reducing transmission and provided further evidence for government policies around the world.

As PCR testing became more widespread, they analysed whether isolating case contacts could limit the spread of infection (*Lancet Global Health*) and

estimated a “reasonable worst-case scenario” for an expected rise in infections in the autumn of 2020. SPI-M-O used this to support planning across various governmental areas.

Late 2020 saw the spread of new SARS-CoV-2 variants across the UK, with one particular variant causing the majority of infections. Published in the journals *Science* and *Nature*, two HPRU analyses showed that it spread about 80% more efficiently between people than the original viral strain. This made global surges in hospitalisation and deaths more likely when infection control measures were eased. They also reported that the Alpha variant was more likely to cause severe disease (*Nature*). Their data collectively supported a third lockdown in January 2021 to manage the pressure on the NHS and prevent further deaths.

The HPRU contributed extensively to England’s “roadmap” to reopen the country in March 2021, producing models outlining how restrictions might be lifted (published in *The Lancet*). Dr Anne Cori, a statistical modeller for the HPRU at Imperial College London, explained their models’ results saying: “Our analyses highlighted the clear benefit of early and accessible national vaccination programmes that allow population immunity to increase to high levels before restrictions were lifted".

“We were able to advise that careful monitoring of vaccine uptake, effectiveness, virus variants and social contact patterns as restrictions were lifted was crucial for a successful exit strategy.” Dr Anne Cori

Creating a model to predict the spread and transmission of the emerging, fast-spreading Covid-19 virus represented a significant challenge, with such complex models commonly taking several months or years to develop. However, the team’s new models began generating results within days, helping save tens of thousands of lives in the UK and internationally. They also contributed to a range of public resources such as web tools, training and webinars to support learning in the UK and around the world.

The pandemic's dramatic impact on the way of life in the UK and around the world triggered many uncertainties about the virus, NHS capacity and effects on society and the economy. Throughout this time, the team's efforts to communicate their work clearly and quickly ensured policy makers, scientists and the public understood the impact of the threat from the virus.

In October 2022, their exceptional contribution to supporting the government's response to the pandemic was recognised by the SPI-M-O Award for Modelling and Data Support, which was endorsed by Chief Medical Officer for England Professor Chris Whitty, and the Government Chief Scientific Adviser, Sir Patrick Vallance.

More information about the NIHR HPRU Modelling and Health Economics Unit is available on the NIHR's Research Units website.

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