COVID-19 TESTING IN THE UK: UNPICKING THE LOCKDOWN

Report | Posted on: 6th April 2020

By Multiple Authors

Foreword by Tony Blair

This paper outlines the importance of testing and the suggestion of a new structure around decision-making to get it at scale with speed.

It is not a criticism of government efforts up to now. Everyone within government is working with enormous energy and commitment in dealing with a crisis, unique in complexity and difficulty, global in nature, and where the strategic decisions

Those working in our NHS are demonstrating the finest parts of the British character and have rightly been praised and celebrated. But I know that everyone on the frontline of serving the public, including carers, workers in essential businesses and services, and civil servants involved in the fight, will all be doing their utmost and deserve our gratitude.

This includes those in government.

Having done the job of prime minister for 10 years, I know how hard it is to do and how easy it is to criticise from outside.

This is constructive advice not criticism.

I do not see a way out of this crisis without mass testing and the development of a clear exit strategy involving testing and tracing, together with innovations in treatment and the use of technology.

The coronavirus dilemma is simply expressed: The disease is more serious than flu. Its lethality may be anything up to 10 times more. Therefore, we cannot let it “run through the herd”.

On the other hand, we know that probably between 40 to 50 per cent of those who get it show no symptoms at all. Many more get a mild version. But for the 5 per cent or so who get it severely, it is life threatening.

Hence the decision to suppress the disease through prevention of social interaction, bringing the rate of infection right down, so that our health-care system can manage the inflow of severe cases and so that many fewer people get the virus.

The aim is to ensure that only a small percentage of the population contracts the disease.

But of course, the economic consequences of such a lockdown are profound. With each week that passes, more people lose their jobs and more businesses go under. This is sometimes presented as a choice between prioritising the economy or people’s health. But the reality is more complicated.

If we shut down our economy for a long time, the economic damage impacts our health, directly through reducing the money available for public spending and indirectly through the effect of unemployment and poverty on people’s health, both mental and physical.

Exiting lockdown is only possible through a chartered course that finely balances public health and economic considerations. My Institute’s second paper on testing presents a series of conditions and options for an eventual exit strategy. This is a national debate we need. None of the options are without problems, but it does remain crystal clear that mass testing is fundamental to exiting lockdown. Any other approach is to do this balancing act blind – a road to unacceptable loss of life or financial ruin so grave that it will crush those public services that have performed heroically in this

At any one time, only a small fraction of the population will be at risk of serious illness from Covid-19.

But because that number is not negligible, and because we do not know who has the disease and who has had it – and therefore are likely immune at least for this season – the whole country has to shut down.

So, it follows that unless we can track who has the disease and who has had it, we cannot release ourselves from the otherwise irrational situation in which everyone has to be isolated so that we don't miss the small number of cases that need to be isolated. Even then, because we have those who must work, the system is not watertight.

This is why testing is not simply of importance. It is fundamental to success. It is not one dimension that ranks alongside all the others. It is paramount. Without it, the lockdown is longer and the exit less predictable and more hazardous.

Yet, the logistical and procurement challenges of testing – to say nothing of the science – are vast. There are two types of test – antigen and antibody. As for the latter, it is not clear there is one that works completely.

The companies that manufacture tests are totally unused to operating at the scale and with the speed necessary to meet demand.

The effort required is Herculean.

I don't think it can be met in the time we want without radical redirection of resource and focus.

Think of it like the provision of armaments in wartime. Both in the First and the Second World Wars, some time into the conflict we had to make radical changes in management to secure the industrial-scale production we needed.

I think this is similar.

That is why I suggest the government appoints one senior minister of capability whose sole task is to step up to the challenge of producing testing capacity, both PCR and antibody. Alongside him or her should be a team that includes business people familiar with industrial production and procurement; and of course those with the scientific expertise.

They should form one dedicated unit, reporting directly to the prime minister. It can be an already serving minister. It's just that they need to be solely on this task and nothing else.

I would do the same around mobilising what technology can do in all the different aspects of this fight, as we set out in another paper *(https://institute.global/policy/technology-and-response-covid-19-our-approach)* .

In this paper we make other suggestions besides the structure of

better to wait until we have an antibody test that we regard as virtually near 100 per cent accurate, or is it better to have a lower specification of accuracy – though still high – and go with that now and take the risk there will be false negatives. This is a vital question to interrogate.
The same issue arises around treatments presently trialled.
As I say, this is not offered as criticism, but as the only way we can get out of this unprecedented situation of lockdown without damage from which we take a decade or more to recover.
Tony Blair
Executive Chairman

Key Points

- Last week Secretary of State for Health Matt Hancock set a target of achieving 100,000 tests per day by the end of April (made up of both tests that determine if someone has the virus – PCR testing – and tests that determine if someone has had the virus – antibody testing).
- On 2 April, daily testing had reached 10,200, surpassing the government's immediate target of 10,000 tests per day.
- Overall 163,100 people in the UK have now been tested since the end of January. Of these, 5,000 are NHS staff.
- To achieve the new target of 100,000 tests per day, Hancock set out a five-pillar strategy:
  1. Ramping up in-house testing conducted by Public Health England (PHE) to ensure the target of 25,000 tests per day is met by mid-April
  2. Harnessing the capacity of the private sector by buying up commercially available test swabs, utilising research and other labs to process the results
  3. Rolling out millions of antibody tests
  4. Conducting a large-scale survey of the population on the spread of the virus
  5. Calling on manufacturers, inventors and others to assist in developing diagnostic capacity in UK comparable to Germany's
- While the Government and PHE are working flat out, there are concerns about whether the target of 100,000 tests per day can be met.
- These concerns centre around whether PHE alone can handle

[redacted]

- This paper sets out potential steps the government can take to achieve this testing target, in particular by appointing a specific senior minister responsible for testing. This minister would be supported additionally by experts in logistics and large-scale procurement and delivery, including those from business, bioscience and biotech backgrounds.

How Do We Test for Covid-19?

There are currently two ways to test for Covid-19:

1. Antigen testing, to see if someone currently has the virus [1] *(https://institute.global/tony-blair/covid-19-testing-uk-unpicking-lockdown#article-summary-footnote-1)*
2. In Covid-19, tests that test for the presence of the virus have commonly been referred to as “antigen tests” including by the Chief Medical Officer – where antigen refers to some component of the virus, typically the external (coat) protein of the virus. However, the test currently being used for Covid-19 is looking for viral RNA which is technically not a viral antigen. For the purposes of this paper, we use the term “antigen” to cover those tests that test for the presence of the virus. Credit to Prof Eleanor Riley, professor of immunology and infectious disease at the University of Edinburgh, for bringing this to the attention of the public.

3. Antibody testing, to see if somebody has had the virus

At the moment the NHS is focusing on antigen testing, mainly for critical-care patients and frontline health-care workers, to detect if they currently have the virus.
Antibody tests exist commercially but none, as yet, have been validated by PHE.

Antigen Testing

This is currently a PCR test that involves extracting ribonucleic acid (RNA) from the back of the nose, or via a throat swab, and then converting it into DNA.

This is then replicated many times so that a significant quantity of the DNA can be detected by a PCR machine.
Detection indicates whether the virus is present in a patient's system.
Lab-based antigen tests are generally taking around 24 hours to process. The government has made excellent strides in reducing these times, including partnerships with logistics companies, drive-through testing facilities and the building of "super labs" across the country.
A critical element to mass testing will be driving and scaling innovations in rapid antigen testing and tests that can be delivered at the point of care.

Antibody Testing

The antibody (or serological) test involves taking a blood sample and looking at whether immunity has been developed by the presence of antibodies in the blood – in this case the Covid-19 IgG antibody, which develops around two weeks after the infection.

Covid-19 antigens are placed on the surface of a microtiter plate. Patient serum is then incubated in each well and the IgG antibody from the patient is detected using a secondary antibody that binds to human IgG. If the patient has antibodies to the Covid-19 antigen, this patient will be called seropositive for the Covid-19 antigen. This process is typically done via a finger-prick blood test. Acting very much like a pregnancy test, with lines that appear to show the result, this test offers three interesting signals:

1. A solitary positive for IgM means the person has had a very recent (potentially current) infection.
2. Positives for both IgM and IgG mean the user was infected some time within the past month.
3. A positive for IgG alone means that the infection occurred more than a month ago and the user should now be immune to a

A negative result probably means no infection, though it could also mean that it is too early in the course of an infection for antibodies to have appeared, since the first IgMs typically turn up only 7 to 10 days after an infection has begun. This is why PCR testing will remain important.

> A Note on Immunity
> There is a consensus in the scientific community that some immunity is conferred once a patient has had Covid-19. A report from the European Centre for Disease Control and Prevention *(https://www.ecdc.europa.eu/sites/default/files/documents/RRA-seventh-update-Outbreak-of-coronavirus-disease-COVID-19.pdf#page=8)* on 25 March says, "there is emerging evidence from early studies suggesting that individuals develop antibodies after infection and are likely to be immune from reinfection in the short term".

Antibody Tests: Validation

The solution to validation and scaling tests is a question of quality, capacity and process. As the Annex of this paper demonstrates, tests are commercially available but none have yet been authorised by PHE. There are many rapid care testing kits – including antibody tests – that have passed other credible regulatory systems. This includes the US Food and Drug Administration (FDA), which told one provider that: "The known and potential benefits of your product when used for diagnosing Covid-19, outweigh the known and potential risks of your product." It would appear that higher standards are being applied to innovative testing kits in the UK compared to other countries. As of 3 April, nine different tests have been submitted for validation by UK authorities and none have passed. This is despite there being many on the market – including some that are being made in the UK and shipped elsewhere. Included in the Annex are test kits on the market but not yet approved by PHE that have met criteria for and received the following credentials:

- A CE marking, which shows that the manufacturer has checked that these products meet EU safety, health or environmental requirements. It is an indicator of a product's compliance with EU legislation and allows the free movement of products within the European mark
- The FDA's Emergency Use Authorization (EUA) is granted in recognised public-health emergencies. Authorisation is based on the totality of scientific evidence available to the FDA. An EUA will be granted if it is reasonable to believe that a product may be effective in diagnosing Covid-19, and that the known and potential benefits of the product when used for diagnosing Covid-19 outweigh the known and potential risks of the product

[redacted]
alternative to the emergency use of the product.

PHE itself has acknowledged that "…no test is 100% reliable" (Prof. Van Tam on 3 April) but it's important that a lowest acceptable rate is offered. The lack of transparency about the validation methodology is challenging, leading to speculation and confusion among manufacturers. A new operating system would make the following information available immediately:

- The sensitivity and specificity requirements
- The "gold standard" antibody test that other tests are being evaluated against
- The process of testing the tests

PHE have done some exceptional work in relation to ventilator innovation, including publishing their specification *(https://www.gov.uk/government/publications/coronavirus-covid-19-ventilator-supply-specification)* for these machines. The same should be done for antibody tests, allowing manufacturers to respond much faster and more effectively.

Alongside this, there must be sufficient capacity in the validation process. This means multiple people running parallel workstreams, compressing the time between testing where they can.

> A Note on Sensitivity and Specificity
>
> Sensitivity refers to how good a test is at detecting the thing it is meant to detect—in this case the IgM and IgG antibodies associated with Covid-19. The higher the sensitivity, the more likely a test will correctly identify the relevant antibodies – and give fewer false negatives.
>
> Specificity measures how focused the test is on the antibodies it's designed to test, without being triggered by other similar ones. Low specificity means tests could identify another set of antibodies in the body as deriving from Covid-19 and give a false positive. The higher the specificity, the more likely it will only identify Covid-19 and give fewer false positives.
>
> An ideal test would be 100 per cent sensitive and 100 per cent specific but there is always a trade-off between the two. This must be taken into consideration when the government is validating tests. For example, if the objective is establishing immunity among health-care workers, then very high specificity is required from the test. If the objective is establishing where infection has spread through the country, then very high sensitivity is required from the test.

What Companies Are Involved in Testing?

Lab-Based PCR Testing:

1. [redacted]

[redacted]

Capacity: They are producing PCR swab kits, scaling to 5 million per week. And assisting the UK with ramping up capacity for PCR test with their PCR testing machines.

2. Roche
   Swiss multinational health-care company that operates worldwide under two divisions: Pharmaceuticals and Diagnostics. They also produce PCR test kits and the testing machines.
   Capacity: Their CEO said on 23 March that they had provided 400,000 kits in the US over the last week alone.

Antibody Testing:

1. Mologic
   British firm Mologic is working with partners in Africa to develop tests that will be manufactured in Senegal.
   Capacity: It has been granted £1 million to produce two different types of test by the UK government: one antigen, one antibody.

2. Biopanda
   Northern Irish biotech company Biopanda produces a rapid antibody test.
   Capacity: The company is selling its testing privately within the UK and has also previously despatched orders “throughout Europe and across the world.”

3. SureScreen
   SureScreen is a private firm based in Derby. They say they have created a test (Rapid Test Cassette) that can determine with 98 per cent accuracy if a person is infected. It involves taking a blood sample via a finger prick and using a screening device. They say diagnostic time is ten minutes.
   Capacity: SureScreen says its test has been validated and is already being used by private buyers in the UK, Ireland, Germany, Spain, Switzerland, the Netherlands, Turkey, UAE, Kuwait and Oman. It is believed around 175,000 tests have been conducted with the SureScreen kit so far. The company claims it has had more than 2 million orders for next month.

Rapid-Test Kits:

1. Randox
   Northern Ireland-based company Randox Laboratories has also developed a “multiplex viral respiratory infection array” that tests for Covid-19 and nine other infections simultaneously. Randox said the test is capable of processing 324 patient samples, generating 3,240 reportable results, in just eight hours.

2. Novacyt

   This company is working on a rapid-test PCR kit, which works through a nose or throat swab. It produces a result in two hours.

   Capacity: The company says it has enough raw materials to manufacture 3.5 million PCR tests that can provide results in a couple of hours. The company says it has made almost £18 million selling test equipment to more than 80 countries.

3. Quadram Institute

   Quadram Institute, based in Norwich, has produced a kit that works from a throat swab sample and is a molecular test to establish if a person currently has Covid-19 (a rapid-test PCR kit). The company says the test could be used in a hospital anteroom, processing 16 samples at a time and displaying the result on a smartphone.

   Capacity: We believe it is a small-scale trial at present.

Where Is Antibody Testing Already Being Used?

The US regulatory body the Food and Drug Administration (FDA) has authorised – on an emergency basis – the use of the first antibody test there, produced by Cellex. The FDA said it is "reasonable" to believe the testing kit works effectively. [2] *(https://institute.global/tony-blair/covid-19-testing-uk-unpicking-lockdown#article-summary-footnote-2)*

https://edition.cnn.com/2020/04/02/health/fda-coronavirus-antibody-test-authorization/index.html

In authorising the Cellex test, the FDA said that "the known and potential benefits of your product when used for diagnosing Covid-19, outweigh the known and potential risks of your product."

China has approved eight antibody tests, while kits have also been approved in countries like Singapore, South Korea and Australia. In Europe, it is understood that Germany will be launching a mass antibody testing regime in the coming weeks.

Why Testing Is Vital

Mass testing is the only way we can mitigate the impact of Covid-19 on the economy. As Paul Romer, a Nobel prize-winning economist, has written, "If we contrast a nonspecific policy of social distance with a targeted policy guided by frequent testing … how much more disruptive is the nonspecific policy? Answer? Way more disruptive."

By scaling up the testing available, we will be able to detect new outbreaks and isolate individuals once the current lockdown is lifted and circumvent the need for further damaging and costly national lockdowns. If we don't build mass-testing capacity, we face lockdown over and over again.

[redacted]
type of test, we risk a situation where we have a target without a clear strategy of what is to be achieved. Our recommendation is that the two types of test are scaled.
Type of Test Role in Mass Testing Antiagen Identifies who has the virus and, combined with track and trace, will inform who needs to isolate. It enables identification of uninfected individuals in the health service that can return to work. Antibody Identifies who has had the virus and is therefore immune, reducing the burden on antigen testing and developing a “core” workforce over time. In the short term, it will tell us who can come out of lockdown.

Experience From Other Countries

When we consider testing strategies in other countries, it becomes clear that early preparedness and a commitment to making testing widely available has a positive impact on containing and controlling the virus. The below examples illustrate the approaches of, and lessons learned from, different countries.

Iceland

- Iceland’s focus has been on testing rather than stressing self-distancing.
- They adopted a random sampling approach, akin to an opinion poll.
- Anyone in the population is invited to sign up on a website and opt-in to a test.
- This allows them to build up a picture of infection rates.
- 11,727 people have been tested (3.2 per cent of its 364,000 population).
- Iceland has been screening high-risk or sick people for the coronavirus since early February – before there were any confirmed cases in the country.

How and when has testing taken place?

- Since 14 March, government has offered a free coronavirus test to any Icelander sick or healthy.
- Citizens fill out an online form.
- By screening healthy and sick people, Iceland has assembled an accurate picture of Covid-19.

What do the results show and tell us?

- The virus had a much, much wider spread in the community than assumed from original screening of high-risk people.

[redacted]

Italy

- Veneto in Italy also followed a model of mass testing. When the first Italian died of coronavirus on the evening of 20 February in a town called Vò, the regional authorities decided to test the whole of the town (population 3,000) and ordered a lockdown.
- This first set of testing was then followed up with a second set of tests to gain an accurate picture.
- The first test found:
  - 89 people infected – 3 per cent of the population.
  - 25 per cent of those infected showed symptoms like flu.
  - 75 per cent were asymptomatic.
- There was no difference in contagion between symptomatic and asymptomatic, meaning anyone infected could infect others.
- The second test, conducted a week later found:
  - 60 per cent of individuals testing positive on the first test were now negative, irrespective of how they tested on first survey.
  - The overall infection rate had dropped to 0.41 per cent among the population.
  - 6 people were infected and all were symptomatic.
- Professor Andrea Cristanti, who oversaw the study, said it, "established a valuable principle: testing all citizens, whether or not they have symptoms, provides a way to control this pandemic." [3] *(https://institute.global/tony-blair/covid-19-testing-uk-unpicking-lockdown#article-summary-footnote-3)*
- https://www.theguardian.com/commentisfree/2020/mar/20/eradicated-coronavirus-mass-testing-covid-19-italy-vo

South Korea

South Korea has applied the lessons of its 2015 Middle East respiratory syndrome (MERS) outbreak, when a chain of transmission infected 186 and killed 36. Tracing, testing, and the quarantining of nearly 17,000 people quashed the outbreak after two months.

The country of 50 million slowed its Covid-19 epidemic by getting ahead of the game. When China shared the genome code of the virus in January, South Korean firms quietly began developing and stockpiling test kits alongside the government. This was well before the country had its first outbreak.

As cases mounted, preparedness meant the country had testing capacity. The country is now testing 8,996 [4]

per 1 million of its population, compared to 5,006 in the US and 2,698 in the UK. There are 43 drive-through testing stations nationwide, a concept now copied in the US, Canada and the UK. Anyone with a mobile phone in the country received alerts to avoid areas where the virus was active. In parallel, the government created a GPS-enabled app to monitor those under quarantine and set off an alarm if they ventured outdoors. Travellers entering the country were asked to record their symptoms on a state-sponsored app.

The term “social distancing” first originated with the South Korean president’s campaign against the virus, and the country managed to turn its outbreak around without locking down cities or banning travel.

South Korea’s experience shows that “diagnostic capacity at scale is key to epidemic control,” according to Raina MacIntyre, an emerging infectious disease scholar at the University of New South Wales, Sydney.

> Modelling on Testing
>
> Economist Paul Romer, mentioned above, recently wrote a detailed blog on modelling he had done on social distancing and community mass tasting. The modelling showed the importance of testing as part of a wider approach to handling the virus. The simulations show that if testing is used to determine who to isolate then the number of people needing to be confined is dramatically smaller. [5] *(https://institute.global/tony-blair/covid-19-testing-uk-unpicking-lockdown#article-summary-footnote-5)*
> https://paulromer.net/covid-sim-part2/
>
> His modelling shows that these benefits are possible even with an imperfect test and without conducting contact tracing. As he argues, “How much difference does it make if the test used to send people into quarantine is bad? Not as much as you might think.”
>
> Romer goes on to say that, “This comparison shows that isolation based on test results requires much less disruption to normal patterns of social interaction. An economy can survive with 10% of the population insolation. It can’t survive when 50% of the population is in isolation.”
>
> He concludes that, “It is not hard to see why targeting the isolation based on test results reduces the total number of people in isolation. What matters for controlling the infection is how many infectious people it isolates. If people are isolated at random, you have to isolate a lot more to get the same number of people who are infectious”. [6] *(https://institute.global/tony-blair/covid-19-testing-uk-unpicking-lockdown#article-summary-footnote-6)*

> This argument was reinforced by Professor Anthony Costello who stated, “The message is clear … Scaled up community mobile testing everywhere will isolate people/contacts/disease …We should quickly devolve testing to local authorities and PCR labs, not under PHE/NHS.”

What Is the UK Government’s Testing Strategy?

Speaking on Thursday 2 April after returning to work from isolation, Secretary of State for Health Matt Hancock said he was pressing the “accelerator” on testing. He pledged to deliver a testing capacity of 100,000 per day by the end of April. He set out five pillars to ramp up testing that includes:

1. Speeding up the in-house testing PHE is conducting to ensure it hits the target of 25,000 tests per day by the middle of April
2. Efforts to harness the capacity of the private sector by buying up commercially available test swabs and utilising research sector and other labs to process results
3. Rolling out millions of antibody tests
4. Conducting a large-scale survey of the population to create a database on virus spread
5. Calling for manufacturers, inventors and other commercial developers to assist in creating UK diagnostic capacity along the lines of Germany

We welcome this further clarity on the government’s strategy but believe structural change is needed to achieve it.

The Road to Mass Testing

We recommend a new operating model for testing that sits outside and above PHE.

This operating model would have three objectives:

1. Scaling up testing
2. Rolling out mass testing
3. Connecting testing with tracing

It would bring in expertise from across different industries, including experts in:

- Bioscience
- Biotech
- Logistics and procurement
- Technology and innovation (including finance)

Political Leadership

A “Minister for Testing” would be appointed, reporting directly to the prime minister. This would need to be a senior minister. They would have political oversight of the operation, be department-agnostic and be ultimately accountable for testing.

Operational Leadership

The operational team would be led by a CEO who has experience in both scaling and distribution. They would bring a track record of scaling a complex, global supply chain and rolling out a product at scale.

Key Principles

1) Diversity

The government and PHE have tried to centralise testing in order to ramp up. They have sought to do so, in particular, through supercentres. This is an important element in delivering a large number of PCR swab tests, as the government has promised.

But this is the biggest health crisis for a century. As Sir Paul Nurse, chief executive of the Francis Crick Institute, has said, we need regional and smaller labs and businesses to now all come forward to help – a wholesale effort to get every test possible on the frontline. This crisis will only be solved through a diverse ecosystem of suppliers.

Any lab capable of processing testing should be harnessed. Any company working on a viable test should be supported and, where possible, provided support to scale.

By pursuing a strategy of both large international suppliers and a wide range of UK domestic suppliers, the government increases its chances of meeting testing targets and de-risking potential issues around supply disruption.

2) Transparency

Targets would be broken down and tied to the testing strategy. Furthermore, specifications on antibody and rapid PCR testing would be made clear, particularly those around sensitivity and specificity rates (i.e. accuracy) of tests.

3) Innovation

Funding, data and anonymised positive patient samples would be made fully available to start-ups with promising tests. Innovators in diagnostics are not able to fully mobilise without the PHE providing full access to anonymised patient samples (particularly bloods) and publishing clear guidance on how to access these.

4) Oversight

The existing approach of seeking to deliver increased testing through existing PHE structures has put incredible pressure on that body.

To deliver industrial scale mass testing, we propose a change in

i) A Minister for Testing should be appointed. This would be a senior minister.

ii) As part this new structure the right architecture should be put around the minister. Critically this would include working closely with a senior figure from business with deep expertise in delivering large-scale procurement and delivery projects of this kind. It would also bring in experts from bioscience, biotech, venture capital and business.

iii) The minister would report to the prime minister and specifically focus on delivering the testing capacity.

5) Quality

The Minister for Testing would be responsible for applying the rigorous and high standards that we associate with diagnostics in the United Kingdom. These would be informed by the existing PHE guidelines and guided by the need to develop and deliver testing at scale. As such, rapid audit, approval and action will be vital.

6) Communication

Establish a clear and effective route into the government and PHE for suppliers.

Many companies we have spoken with – who could be providing tens of thousands of tests – have not been able to establish a dialogue with PHE. This is understandable given the incredible strain PHE is under, but to ramp up testing, new and effective channels of communication must be opened.

7) Community

In order to achieve mass testing, the collection of samples needs to be available within the community. This will allow larger volumes of people to be processed at pace and prevent the unecessary movement of people.

To achieve this will require providing the equipment (including PPE) and training necessary to carry out the sampling as well as identifying appropriate locations.

The ideal approach is to make use of existing infrastructure rather than create something new, be that private sector or public/voluntary sector. There are a range of options for this that can be found in every community, such as libraries, children's centres, supermarkets, pubs. However, the options will look slightly different across the country. The single most uniform process that we can switch on with ease and which opens facilities highly local to everyone across the country is the network of polling stations.

Therapeutics – Ease Symptoms, Exit Lockdown

There is a vital role for therapeutics in navigating the exit from lockdown. By alleviating symptoms of Covid-19 and allowing community-based medical interventions, they will increase the

This is one of the key pre-conditions for triggering an exit from lockdown.

It's therefore vital that trials for these therapeutics are done effectively and efficiently. Given the global in-country stockpiling we've seen of drugs cited in the media – including in the US – it's critical that the UK secures supply chains for promising candidates and clears production lines. The British pharmaceutical industry is one of the best in the world and, supported by a focused and properly organised governmental effort, we can lead the way in the trialling and scaling of therapeutics. This includes:

1. Rapid trialling and testing
2. Fast-tracking drugs that have cleared other respected regulatory systems
3. Rolling the development and delivery of therapeutics into the remit of the newly created role of Minister for Testing

Below is a selection of therapeutics currently being trialled [7] *(https://institute.global/tony-blair/covid-19-testing-uk-unpicking-lockdown#article-summary-footnote-7)*

https://www.europeanpharmaceuticalreview.com/article/115842/potential-covid-19-therapeutics-currently-in-development/

.

Name	Status
Favilavi	The first approved coronavirus drug in China has reportedly shown efficacy in treating Covid-19 safely in a clinical trial involving 70 patients.
Gilead's Remdesivir (GS-5734)	An experimental broad spectrum anti-viral that was originally designed to treat Ebola; it has undergone clinical trials in China. The trials are being performed on 761 patients in a randomised, placebo-controlled, double-blind study at multiple hospitals in Wuhan. The results from the trials are expected to be available over the next few weeks.
Roche's Actemra	Approved in China for the treatment of severe complications related to coronavirus, the drug is being evaluated in a clinical trial in China, which is expected to enrol 188 coronavirus patients. The clinical trial is expected to be conducted until 10 May.

Name	Status
Chloroquine and Hydroxychloroquine	These drugs have been shown to be safe and efficacious against malaria for decades. Coronavirus patients administered with the Chloroquine Phosphate drug achieved a better drop in fever and shorter recovery time in clinical trials being conducted in Chinese hospitals. Large-scale clinical trials with both these drug are taking place in April.
Baricitinib [8] *(https://institute.global/tony-blair/covid-19-testing-uk-unpicking-lockdown#article-summary-footnote-8)* Richardson, P., Griffin, I., Tucker, C., Smith, D., Oechsle, O., Phelan, A. and Stebbing, J., 2020. Baricitinib as potential treatment for 2019-nCoV acute respiratory disease. The lancet, 395(10223), pp.e30-e31.	Artificial intelligence is providing answers. BenevolentAI provides a large repository of structured medical information, including numerous connections extracted from scientific literature by machine learning. Together with customisations bespoke to 2019-nCoV, a team used BenevolentAI to search for approved drugs that could help, focusing on those that might block the viral infection process. This process identified baricitinib, which is predicted to reduce the ability of the virus to infect lung cells.

What Is the Role of Tech?

Technology will be critical to fighting the virus, to cushioning the impact and to the eventual release from lockdown. The necessity of NHSX has been made clear by this crisis, as well as the need for much greater digital maturity within our health system, but for now there are some areas in which technology can play a role.

Testing

In testing *(https://institute.global/policy/mass-community-testing-crucial-covid-19-response-heres-how-we-get-there)* , technological solutions can be applied at different stages of the process, all of which can accelerate the process. They include:

- Prioritisation: Digital tools can be used for patients to enter information about their symptoms, enabling medical professionals to triage. Governments could support the creation of a user-friendly digital service so priority groups such as health-care workers can easily register for testing.
- Conducting: Innovations in this space have already happened, such as NHS drive-through facilities, but technology offers the possibility to accelerate and scale this in safe ways. For example, authorities in Spain have invested in robots *(https://www.computerweekly.com/news/252480445/Coronavirus-Spain-to-use-Artificial-intelligence-to-automate-testing)* to

conducting tests.

- Coordination: As testing capacity increases, the government will need to adopt an efficient method to coordinate these tests. Digital tools can support community testing by enabling citizens to book tests and health-care workers and volunteers to register their availability.
- Delivery: For distribution, governments will need to leverage private-sector logistics capabilities – such as Amazon's fulfilment centres and distribution network – to deliver and pick up tests. The UK government has recently reported *(https://www.ft.com/content/dacc0712-6ce1-11ea-9bca-bf503995cd6f)* that it is in talks with Amazon and other companies to use their services to deliver tests to frontline health and social-care workers.

Standardised data will then need to be collected and aggregated in biomedical datasets to accelerate research and innovation.

Contact Tracing

The next critical step for exiting the lockdown will be contact tracing. Various different technological solutions can be applied to contact tracing, including the use of GPS data, Bluetooth and deeper, automated tracing that uses AI to analyse unified tracing data from multiple sources.

Countries such as Singapore, South Korea and Taiwan, are leading the way on this issue, while the NHSX has announced that it is in the process of developing an app in unison with software partners. It is also being informed by research *(https://science.sciencemag.org/content/early/2020/03/30/science.abb6936)* from the Big Data Institute at Oxford University. This research suggests that digital tracing could bring the Covid-19 reproduction number (Rx) – which indicates how contagious an infectious disease is and tells you the average number of people who will catch the disease from one contagious person – below 1 and therefore effectively control the pandemic.

Like Singapore's TraceTogether *(https://www.gov.sg/article/help-speed-up-contact-tracing-with-tracetogether)* app, which the government made open source, this would detect and securely record when two devices have been in close proximity. However, the efficacy of such measures is likely to be greater at the early stage of outbreaks and where little transmission has occurred. Singapore, for example, has had to announce school closures as a result of problems of tracking the origins of infection.

Concerns over false positives and accuracy are also likely.

response to Covid-19, while the government has said any data collected will be time-limited. And if the R number can be brought below 1 for an extended period, contact tracing will be essential to exiting lockdown and controlling rebound.

Real-Time Data

Technology will also be a key circuit-breaker should there be a rebound in transmission as restrictions ease. Putting in play mechanisms for real-time data is therefore key. The NHS Platform that is being developed with tech companies is crucial to understand system capacity and how this interlinks with disease transmission. But further measures will be necessary, for example:

- The app developer Evergreen Life, along with UK scientists, is working to create a Covid-19 heatmap which represents the number of people with symptoms in the UK. This will help inform researchers and the NHS about how the virus is moving.
- Smart thermometers and automated temperature checking, such as what Kinsa is doing in the US and the AI-powered temperature screening solution *(https://www.fastcompany.com/90479220/this-ai-camera-detects-people-who-may-have-covid-19)* being trialled in Singapore, should be explored.

Monitoring and Compliance

The acceleration of telemedicine has happened by necessity, and greater focus will need to go on separation of services as restrictions ease. Digital triage of symptomatic patients will still need to be done remotely, while at-risk individuals will still need to be isolated. The NHSX have said that *(https://digital.nhs.uk/services/future-gp-it-systems-and-services/approved-econsultation-systems)* , as a short-term measure, general practitioners can use video-conferencing tools such as Skype, WhatsApp and FaceTime as well as commercial products.

In considering how to ease lockdown, governments are also exploring the possibility of individuals proving that they have immunity to Covid-19. Germany, for example, is researching issuing immunity certificates to people to prove they have previously had the virus and can go back to work. In the UK, Matt Hancock stated during Thursday's press conference, "We are looking at an immunity certificate". One solution is that governments could introduce digital "immunity passports" *(https://www.spiegel.de/wissenschaft/medizin/coronavirus-grosse-antikoerper-studie-soll-immunitaet-der-deutschen-feststellen-a-c8c64a33-5c0f-4630-bd73-48c17c1bad23)* for people who have

[redacted] digitisation of the NHS.

Conclusions

As this paper shows, the only viable route out of the current lockdown is through mass testing.

We welcome the government's commitments that move towards such a strategy, for instance, that it has options to buy 17.5 million antibody tests, depending on their viability.

Ultimately, we believe the government will require the capability to potentially test the whole population: both for whether someone has the virus and/or if they have had the virus.

Reaching this industrial scale of testing is a huge task and, given the ongoing public-health crisis, is not one PHE should have to tackle alone.

We recommend appointing a specific minister for testing. The minister would be supported by those in industry, who bring a proven track record in delivering projects of this scale, and assisted by a team of experts, drawn from bioscience, biotech, business, technology, venture capital and procurement.

Annex: Rapid Tests That Have Passed Other Regulatory Systems

Developer
Bodysphere
Abbott
Guangzhou Wondfo Biotech (Guangzhou, China) *(https://en.wondfo.com.cn/2020/03/18/chinese-testing-kit-exports-soar-a covid-19-spreads/)*
Innovita Biological Technology
Jiangsu Medomics Medical Technologies (Nanjing, China) *(https://doi.org/10.1002/jmv.25727)*

Developer

Pharmact (Berlin) *(https://pharmact-health.com/en/sars-cov-2-rapid-tes*

Snibe Diagnostic *(http://www.snibe.com/zh_en/en_newsView.aspx?id=5* (Shenzhen, China)

Sona Nanotech (Halifax, Nova Scotia)

Sherlock Biosciences *(https://www.prnewswire.com/news-releases/cepl and-sherlock-biosciences-establish-collaboration-on-new-genexpert-tes infectious-diseases-and-oncology-leveraging-crispr-technology-301013198.html)* , Cepheid

Zhejiang Orient Gene Biotech (Zhejiang, China) *(https://stocknewsnow.com/companynews/5035338834942348/AYTU/1*

Biomerica

Caspr Biotech *(https://doi.org/10.1101/2020.02.29.971127)*

Sugentech (Daejeon, South Korea)

Cepheid

Xiamen AmonMed Biotechnology (Fujian, China)

RayBiotech

Developer

ERA-BIO (Era Biology Group)

Sources: FDA, Company websites, PubMed and data collated by nature.com

Tags: