Preparing for the next pandemic: reserve laboratory staff are crucial

Lack of laboratory staff was an important obstacle in scaling up covid-19 testing. Jordan Skittrall and colleagues consider how we can be better prepared in future

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UK laboratories conducted over 200 million SARS-CoV-2 polymerase chain reaction tests between January 2020 and April 2022.1 Laboratory tests were used to diagnose disease, to inform public health actions such as isolation, and to reduce spread through testing asymptomatic people.2 6 The rate of laboratory testing in the UK expanded rapidly at the start of 2020, from 100 tests a day on 4 January 2020, to 10 000/day on 23 March, to 100 000/day on 9 July.1

Although these numbers are substantial, demand for testing at that time exceeded availability, and only those meeting a strict set of criteria were tested. Despite government pledges to provide 100 000 tests per day by May 2020 as part of the UK test and trace scheme,5 6 demand quickly outstripped capacity to set up testing safely in new laboratories, conduct quality assurance of the tests, and process samples. In short, surge capacity was already required by the time the first tests were available.7 Availability of laboratory facilities and resources—from basic reagents to IT support—was a substantial challenge,8 9 but aside from the distribution of positive control material (which was quickly solved) the biggest bottleneck was finding trained staff to carry out the tests.10 11 Maintaining surplus laboratory capacity for emergencies is expensive, and therefore politically and economically unpalatable. Nevertheless, covid-19 has shown that effective surge capacity is a vital part of pandemic preparedness.

Skills bottleneck

Highly trained scientists are required to get a new assay working in local diagnostic laboratories. Use of new tests involves many highly skilled manual steps and interpretation, and the initial job of a scientist is not only to run the assay but also to optimise it for a diagnostic laboratory and train others.12 13 Over time, testing is increasingly automated, and skilled staff move from a hands-on role to supervision, including quality assurance.14 15

Because of the length and specialism of training required, laboratory staff are the hardest resource to increase quickly. As well as being a problem during the covid-19 pandemic, staffing was identified as a key weakness in laboratory preparedness after the 2009 influenza pandemic.16 Unfortunately, most pandemic plans at national, European, and global levels give little attention to requirements for laboratory staff.17 26 Germany’s plans, as an exception, included a subsection on expanding diagnostic capacity,24 and increased covid-19 testing rates faster than the UK.25

In order to improve our response to the next pandemic, we need to consider how to maintain enough laboratory staff with skills to provide surge capacity in infection diagnostics in sustainable, affordable, and politically feasible ways. This could be through raising staff when required or setting up a system of volunteer, retained, or permanent reserve staff.

Raise emergency staffing when required

The most straightforward option is “do nothing” until there is a crisis, at which point a government or government body tenders for individuals or organisations to fill the gap.26 Engaging private staff and entities when required is viable. The UK did this at the start of the covid-19 pandemic, both to slot into existing structures and by creating privately run diagnostic “lighthouse laboratories” that carried out SARS-CoV-2 testing in parallel to existing public health laboratories. The lighthouse laboratories ran diagnostics in a production line industrial setting, housed in large spaces such as warehouses or repurposed laboratories. The extensive standardisation required for a production line approach meant these laboratories could be staffed by people without full public health scientist training. However, there was a long lead time in setting them up (the UK’s first testing lab opened in June 202129) and inflexibility, as shown when the pathogen mutated so that one of tests no longer worked.30

Raising capacity when required inevitably incurs staffing, training, and material costs at a time of high demand and places responsibility for raising extra forces on private companies or individuals. Limited advance preparation may also impair effectiveness, but the model may be necessary in specific contexts. For example, Nigeria generated extra laboratory staff as part of its covid-19 response by using a presidential task force to coordinate federal and direct funding from non-governmental organisations and the private sector.26 By recruiting staff mostly from existing state hospital non-virology laboratories, university departments, and research centres, Nigeria expanded its decentralised laboratory capacity from a single reference laboratory with few additional laboratories, to each state having a SARS-CoV-2 testing laboratory. Before covid-19, competing calls on finances and variable prioritisation of public health expenditure across its 36 states made supporting a diagnostic laboratory workforce in Nigeria challenging.31 Despite the difference in national public health spending between Nigeria and the UK, the UK similarly did not build reserve capacity in advance and had to engage the private sector as the default option.
Voluntary reserves

Unlike efforts to assemble ad hoc staff when required, the volunteer reserve approach is to identify a reserve team before an emergency and train them in advance. However, because training is typically unpaid, it is not possible to get reserves for highly skilled roles by this route. Unlike emergency recruited staff, voluntary reservists tend to work alongside existing staff.

This approach has also been used before. For example, in England and Wales, St John Ambulance has existed since the late 19th century, originally to provide voluntary medical assistance. In the United States, the Medical Reserve Corps, established after September 11 2001, provides volunteer emergency support and assisted with the health protection response to covid-19. The extent to which partial financial compensation is offered for training or active duty shifts varies between reserve forces, but the teams primarily act on a voluntary basis. Consequently, this model is still subject to the availability of its reserve staff and employer support, for training as much as for activation.

Retained reserves

One approach used extensively outside the healthcare sector is a retained reserve corps for skilled roles. Staff are paid to train and when called out but are otherwise not employed in the role. Often, they are committed to respond when called, with only limited exemptions. Like voluntary reserves, retained reserves work alongside full time employees where appropriate, rather than forming a parallel infrastructure. Some modern military reserves, including the UK’s, use this approach. The UK also uses retained or on-call firefighters, solving the need for geographical coverage without the need for full time intensity, especially in rural areas.

Retained reserve staff typically have more training than voluntary reserves or emergency staff and are better integrated with the regular workforce, but because of the effect of compulsory callouts on reservists’ other employers, an agreed societal agreement, codified in legislation, is required. This makes it harder to set up a retained reserve.

Permanent reserves

Finally, additional capacity can be generated by keeping trained reserve staff permanently available, ready to function independently when required rather than relying on voluntary action or competing with other health sector needs. The UK public health laboratory service used to have such extra capacity until the 1990s, but reorganisation of public health and cost pressures reduced the number of laboratories. The initial German response to covid-19, which saw faster expansion of testing capacity than in the UK, called on existing trained staff.

Singapore provides another example. After the 2003 SARS outbreak, “always on” pandemic readiness has included additional laboratory staff dedicated to providing diagnostic capability in one centralised laboratory. A single laboratory is feasible because the country is small, allowing for short transit times. Staff may undertake other functions, but the first call on their time is providing diagnostic response.

Other sectors have used permanent additional infrastructure models for some time—for example, the United States Air National Guard, which customarily trains and deploys in operational units, as opposed to integrating individual staff within other units for deployment. Compared with the other approaches, the permanent reserves model is costly, but it is effective if that cost is sustainable. In Singapore, for example, sustained political will for centralised laboratory capacity has so far enabled the model to be resourced since 2009 using financing from central government through the Ministry of Health as part of a wider pandemic preparedness strategy.

Hybrid solution

The UK seems unlikely to commit to the budget required to recreate a permanent reserves model. However, the 2020 strategy of raising staff when required led to a prolonged phase of increasing diagnostic testing at the expense of unmet testing needs, continued viral transmission (without the ability to accurately identify and isolate people with covid-19), and thus higher mortality and morbidity. The voluntary reserves model requires fewer resources than the retained reserves model because it pays reservists less. However, because volunteers do not have to commit to training or receive a financial incentive, it is harder to develop advanced skills using this model.

We suggest that a hybrid retained reservists and voluntary reserve model would best meet the UK’s requirements for diagnostic surge capacity across the different phases of a pandemic (fig 1). Typical models of voluntary reserves and retained reserves cover a spectrum of skill levels, training, and time commitments. Highly skilled staff such as clinical and biomedical scientists, who require substantial training and regular practice to develop and maintain their skills, are required in smaller numbers, typically in the earliest stages of an emergency response. This small, select group should be assembled and paid on retainer. For example, people from academia and industry and those who recently retired with appropriate skillsets could be employed as retained reservists to help in the initial phases of an emergency.
Many more staff members with less specialised skillsets are needed, including a large number of technicians to process tests locally in an outbreak, epidemic, or pandemic scenario. Such staff could be given training relatively quickly with only periodic training refreshers. These staff are essential and should be recruited to a large volunteer reserve that can be quickly accessed during an emergency in a way that is relatively low cost and does not generate parallel infrastructure. People working in sectors of the economy likely to experience job insecurity during an emergency (such as the entertainment and hospitality industries) could be candidates for voluntary reserve roles. In all cases, people would be paid to fill roles to support diagnostic services as they come under pressure, rapidly expanding the capability of services.

We are not aware of any widespread use of the hybrid option we propose in laboratory diagnostic services, although a mix of retained and voluntary reserves are used in other sectors to good effect. The UK fire services, for example, engage a hybrid of retained and unpaid volunteers to cover different roles depending upon skill level. In England in 2021, 35% of firefighters, representing 28% of whole time equivalent employment, were retained reservists. Demands on the time of reservists are likely to be minimal outside a pandemic, with the possibility of small scale deployments supporting local surges in need. Economic analyses supported by pilot projects are required to determine the optimal mix of a diagnostics reserve for the UK.

**Building reserve capacity for the future**

The covid-19 pandemic has challenged 21st century public health microbiology. Having seen how the UK responded to this challenge, we are well positioned to make recommendations to improve our response to the threat of pandemic diseases, within and between future emergencies. Three specific developments now make the possibility of reserve workers in laboratory diagnostics more feasible in the UK than in the past. Firstly, the advances in molecular diagnostics mean reserves need training in a smaller number of techniques to make a meaningful impact. Secondly, the scale of testing during the covid-19 pandemic in countries such as the UK shows that high demand for testing capacity is likely in future. Thirdly, expanding biotechnology sectors within industry and academia provide larger pools from which reservists can be trained.

Responding to future challenges will require people; preparing people requires a long lead time. The UK public health system must now work towards building a fit-for-purpose hybrid laboratory reserve that combines a small but highly skilled retained reserve with a larger, more flexible volunteer reserve as part of its pandemic preparedness and response. This model would strike the right balance between sustainability, especially outside times of reserve activation, and effectiveness when required.

**Key messages**

- Reserve laboratory capability is needed to provide surge capacity for disease outbreaks and future pandemics
- Developing and establishing new tests requires highly skilled staff who are expensive to maintain
- Large numbers of less skilled people are also needed to provide widescale testing
- Preparedness planning has to balance effectiveness with sustainability
- A hybrid of retained and voluntary reserves is recommended for the UK

Oversight of the Cambridge University First Aid Society, which is associated with a St John Ambulance.

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