

Table 1. Recommendations to improve testing, tracing and isolation based on evidence and international experience.

Key recommendations to improve testing
(1) Invest in NHS and PHE labs to scale up additional testing locally and utilise unused lab capacity in universities and research institutes where possible, and ensure there is sufficient slack in the testing system to cope with surges in demand.
(2) Validate and implement pooled reverse transcriptase polymerase chain reaction for surveillance testing and asymptomatic testing of healthcare workers, care homes and hospital pre-admissions and initiate environmental surveillance by testing wastewater as an early warning system for outbreaks.
(3) Provide urgent evidence about how to manage asymptomatic cases with high cycle threshold values, who may not be infectious to prevent non-infectious healthcare and social care staff isolating unnecessarily.
(4) Consider orthogonal assays ^a to improve specificity when performing asymptomatic testing. ⁷ This could increase the positive predictive value and minimise some of the theoretical limitations of mass testing, leaving mostly logistical challenges.
(5) Assess the risks and benefits of widening the testing criteria to include the 11 symptoms defined by the CDC, also accounting for the distinctive presentation among children compared to adults. ⁸
(6) Continue to invest in developing, validating and manufacturing novel assays mentioned above and avoid promoting or publicising specific assays until appropriately validated to ensure public trust is maintained.
(7) Publish evidence to support the reliability of unsupervised self-swabbing at population level.
(8) Stratify testing data by the presence of symptoms and case setting. Publish testing and outbreak metrics in long-term care.
Key recommendations to improve tracing
(1) Invest in workforce and technology in existing regional public health teams, while providing further training to existing Serco and Sitel tracers and ensuring they follow up to check if people are isolating properly and need any support.
(2) Ensure any new systems to contact trace are co-designed and integrated as a whole system response with regional public health and local authority teams, ensuring health protection practitioners are consulted to ensure best practice.
(3) Increase resources to enable a greater focus on identifying clusters using retrospective tracing for more effective control.
(4) Focus on increasing all outputs of contact tracing and publishing detailed and granular reports of these figures weekly, including number of contacts who are isolating and number lost to follow-up.
(5) Prevent outbreaks by ensuring that guidance is clear, evidence-based, feasible and is supported by a national helpline to empower communities to understand it.
(6) Increase resources for local authority compliance checks in high-risk settings.
(7) To prevent outbreaks, improve public health communications to promote hand hygiene, prevent avoidable mixing within households and provide isolation advice.
(8) Promote training and recruitment of health protection practitioners and increase training numbers for consultants in public health.
(8) Ensure closer multiagency working between local public health, NHS and local authority teams.
Key recommendations to improve isolation
(1) Expand the criteria for pay covered by statutory sick pay and ensure all employees qualify.
(2) Identify employers who do not allow staff to self-isolate or discriminate against them for doing so.
(3) Issue regular support and information to those self-isolating as per Scientific Advisory Group for Emergencies recommendations.
(4) Follow Scientific Advisory Group for Emergencies advice to swab isolating contacts/international arrivals 7 days after exposure/arrival to reduce the quarantine period from 14 to 8 days and incentivise compliance. ⁹

^aOrthogonal assays differentiate between compounds that generate false positives from those that are genuinely active against the target.

Inadequate sampling could also require more re-tests than necessary,¹⁴ using up capacity.

As part of their ambitious 'Operation Moonshot', the government has proposed regular mass population testing using a variety of rapid point of care tests, which are typically less sensitive than the conventional swab tests.¹⁵ While this may seem appealing, the false-negative rate will be higher and more cases will be missed.¹⁶ Further, when prevalence is low, the positive predictive value for any test will fall, even if it is highly specific, and so positives would require orthogonal repeats (using two different targets or types of test).¹⁷ While mass testing has potential to facilitate an effective find, test, trace, isolate, support system, it requires tight coordination, public engagement and support to ensure compliance, none of which have been apparent in responses so far. The cost of Moonshot has been estimated at £100 billion, about two-thirds of the entire annual NHS budget. Exceptionally, it has not been referred to either the National Screening Committee or the National Institute for Clinical Excellence.

One way to significantly increase capacity in a relatively short space of time is to use pooled testing.^{18,19} When test positivity is low enough (the U.S. Food and Drug Administration recommend < 10%), evaluating samples in batches rather than individually and re-testing only the groups that come up positive means fewer reactions overall are needed. Several countries, including China, USA, Germany, Portugal, New Zealand, Rwanda, Uruguay, Israel and Vietnam, have used this to considerably increase testing capacity, decrease pressure on lab reagents and operators, and facilitate case finding of asymptomatic cases in key workers. Some NHS labs already use this technique and the lighthouse labs are attempting validation, but this is moving extremely slowly. However, as positivity rates rise, pooling becomes less efficient because more samples have to be re-tested. We are close to missing that window of opportunity unless we can control transmission quickly. For now, pooling may be best reserved for surveillance testing and asymptomatic screening of healthcare workers, care homes and hospital pre-admissions.

Novel assays such as lamPORE, LAMP, SHERLOCK, pooled saliva reverse transcriptase polymerase chain reaction, antigen assays, and combined viral and antibody tests have great potential to scale up future capacity, although each test type would first have to be validated, and would come with its own unique advantages and limitations. Wastewater testing offers scope for early warning of outbreaks,²⁰ now used in Australia, New Zealand and the Netherlands, with Germany and Estonia expected to follow.

Although significantly more capacity has been promised by the end of October, it is uncertain whether this will be enough to meet demand. Germany, often cited as the example to follow in Europe, has also experienced capacity constraints as testing eligibility has increased and society has reopened, with some labs reporting peak workloads at over 100%. It now accepts the need for sufficient slack to cope with surges in demand and its system is being expanded to run at 65%–80% of full capacity normally. Additionally, as both Scientific Advisory Group for Emergencies and Independent Scientific Advisory Group for Emergencies maintain, capacity is not everything: testing must be easy to access, locally run, accurate and quick.

Tracing

Modelling estimates that a high proportion of cases would need to self-isolate and a high proportion, over 80%, of their contacts to be successfully traced and isolated within 48 hours of the first person experiencing symptoms to maintain the effective reproduction number below one in the absence of other measures.^{21,22} Control of transmission is more likely to be achieved when combined with moderate physical distancing measures. Until 9 September, NHS Test and Trace report reaching 83% of cases, of which 83% provided at least one contact, but much less than expected with an average of only three in non-complex settings. They spoke to only 74% of contacts overall (64% for non-complex cases and 99% for complex cases managed by PHE health protection teams), equivalent to only about 50%.²³

This poor performance seems likely to reflect the system design. Although Serco and Sitel hired around 20,000 contact tracers, they were inexperienced, poorly trained and worked in a disjointed system, disconnected from local health protection teams. Success was judged against recruitment targets rather than quality, with widespread dissatisfaction leading some local authorities to set up their own systems.

Pubs, households and organised sports now seem to be the main settings for spread in some places according to some local authorities, marking a transition from predominantly household transmission and mixing in communities. Yet despite a requirement to keep records, Office for National Statistics data report just 31% of adults visiting public indoor places always being asked to provide details for contact tracing, with 11% rarely providing their details.²⁴ The delays in test turnaround times add to the challenge of contact tracing. After a previous failure, England is now introducing a contact tracing app, but this will require a high uptake (estimates from

modelled 56% to 95%), while there are widespread public concerns about privacy and equity.²⁵

Several countries that have been most successful, such as Japan, South Korea²⁶ and Uruguay,²⁷ have focused on investigating clusters through thorough retrospective tracing to identify common sources of infection, recognising the important role played by super-spreading events. This requires a major investment in people on the ground, so-called shoe leather epidemiology. This can be delivered quickly. Massachusetts announced a \$44 million budget for an ambitious contact tracing programme to hire and, importantly, train 1000 people to support existing local public health volunteers, with additional funds to support individuals to isolate. Much less costly than Operation Moonshot, they have reached 91.8% of cases and 78.8% of contacts and daily incidence has surpassed 8 per 100,000 in only a few towns, with the number of tests performed and total test positivity remaining steady since July, accompanied by a continuous steady decline in the seven-day average of active cases in Boston, and only a relatively slow increase in the states daily cases since August.²⁸ The system was up and running within weeks, and has formed part of a broader public health strategy in the COVID response, complete with a dashboard that includes a map of Boston's 29 testing sites (the entire UK has about 50 sites²⁹), and a detailed weekly COVID-19 report including granular data on local cases and testing, contact tracing (including both the numbers being monitored in quarantine and those lost to follow-up) and deaths. They also include details on their evidence-based surveillance programmes for testing staff in all long-term care facilities along with compliance data. It is unclear whether the Department of Health and Social Care has such granular data: if it does, it does not publish it, and certainly not all together in one easily accessible place.

Isolation

Testing and tracing will only significantly reduce transmission if positive cases isolate effectively. Yet currently fewer than 20% of those who should isolate are fully adherent.¹⁶ Recent survey data shows that intention to adhere to test, trace, and isolate behaviours is higher than self-reported adherence: whilst 76% of people intend to share contacts, only 50% of people correctly recognise COVID-19 symptoms and just 12% get a test, 18% isolate, and 11% of contacts isolate properly.³³ Self-reported ability to self-isolate is three times lower in those who earn less than £20,000 per year or have less than £100 saved.³⁰ The UK has one of the lowest proportions of pay covered by statutory sick pay in Europe (29% compared to 100% in Germany and 93% in Belgium),

and millions do not qualify.³¹ An OECD review showed paid sick leave is important well beyond its core function to protect sick workers during a health pandemic and subsequent economic crisis.³² Scientific Advisory Group for Emergencies and Independent Scientific Advisory Group for Emergencies agree that individuals need to be supported properly for them to isolate, advising a daily text or phone call, with provision of food supplies, essential goods and employment protection, stressing solidarity and togetherness. Existing test-and-trace policies have deviated from advice provided by Scientific Advisory Group for Emergencies and, without support to self-isolate, any improvements to the test-and-trace system will have only marginal impact. From 28 September, 4 million people on low incomes will be offered £500 to support them to self-isolate, authorities will check up on people to see if they are self-isolating, and fines will be issued to those found to have broken self-isolation rules. Although countries such as Germany, Lithuania and Denmark have similar enforcement policies, this policy may disincentivise people to get tested and could negatively impact on Scientific Advisory Group for Emergencies emphasis on positive collective action.

Conclusion

England stands on the edge of a precipice: find, test, trace, isolate and support strategies need to be rethought to have any chance of avoiding a considerable rise in cases over the coming months requiring a return to stricter social-distancing measures nationwide. We provide evidence-based recommendations to improve testing efficiency, strengthen the contact tracing system and promote isolation, drawing from experience in other countries. We believe these recommendations are feasible, do not require further individual sacrifice and would likely have a significant impact on driving down the reproduction number and reducing the socioeconomic impact of the pandemic if they were implemented quickly.

Declarations

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