

MAKING SENSE OF COVID-19 TESTING

Tests are used to:

- Diagnose people who have the Covid-19 virus
- Care for them and stop it spreading
- Establish who has had Covid-19 already
- Monitor Covid-19 and assess how many people have had it

Free testing in the UK is limited to people who have Covid-19 symptoms, have had close contact with a case, work in a high risk job (eg care) or live in places where Covid-19 is spreading fast¹. These criteria mean the health service is testing in places where cases are most likely to be found, to manage the disease. To get a more accurate rate of infection overall the Office for National Statistics and other research groups run an infection survey with many thousands of households².



Monitoring Covid-19

Statistics from Covid-19 test data help to monitor and manage the disease. The number of tests performed by the health service changes daily, so it's important to look at the number of positive cases as a proportion of tests done, and at infection survey data.

These give a clearer picture amid daily changes in the numbers of tests and places in which they are performed.

To detect the virus, antigen or molecular tests are used.

These tests detect Covid-19 DNA markers or antigen (substances made by the virus) from a swab of the throat and/or nose³.

Testing for the virus is essential - so is being clear about what it can and can't tell us.

- **There will be false negatives.** A negative result does not rule out Covid-19. When test kits are used by clinicians and in the community, more than one in five negative results could be false negatives⁴. The weakest links in the process are:

- Swabbing, which is not precise and can miss the virus
- Taking the test too early or too late - the viral load is undetectable at first, then it rises and falls again

This is why, if someone gets a negative test result but has Covid-19 symptoms, they are advised to continue isolating and test again.

- **A positive result confirms virus is present but does not say how infectious you are.** Laboratory PCR tests can detect both living and dead virus from recent infections, so a positive result doesn't necessarily tell us whether someone is still infectious⁵. In addition, there are occasionally false positives because cross-contamination can occur⁶. False positives skew the picture much more when the infection rate falls. If only 10 in 100,000 people tested actually have the virus, a test with a low false positive rate of 0.1% will produce 100 false positives and 10 true positives.



Testing for the virus: fast or slow?

To analyse swab tests in the UK, a laboratory process called RT-PCR is used. This can take 24 hours or more to return a result and has four key steps:

- The sample from a swab is prepared, any Covid-19 virus that is present is deactivated, and the virus RNA is extracted and converted to DNA.
- Primers which match a segment of the DNA are used for a polymerase chain reaction (PCR) process.
- The PCR process multiplies segments that match the primers to amplify their genetic signal.
- If Covid-19 is present, this can be detected by the laboratory.



Rapid tests have also developed to help diagnose people without laboratory processing. Some take only 15-30 minutes. Small, pre-market studies show that the current rapid tests miss more cases than the RT-PCR laboratory process, so they produce more false negatives (evaluations call this the test's sensitivity)⁷. Some have also produced more false positives in practice than their pre-market studies suggest⁸. Re-testing and diagnostic observations are needed to ensure rapid testing doesn't cause harm by misdiagnosis, especially in places like care homes.

The most reliable way to diagnose people is to interpret their test results in the context of whether they have symptoms or close contact with Covid-19:

- If someone has symptoms, and lives with a person who has Covid-19, but their test result comes back negative, this raises a flag that it might be a false negative.
- If their test comes back positive, their symptoms and exposure to the disease make it almost certain it is a true positive.

If people are tested without symptoms or known exposure, none of this interpretation is possible.

This use of testing is screening rather than diagnosis. A wrong result is harder to spot, but screening is needed for places where the risk of transmission is high or dangerous. Re-testing can be done to reduce false positives. Screening with PCR laboratory tests has been used to detect symptomless cases in:

- Patients being admitted to hospital
- Health and care workers
- People who are planning to travel through airports, in the UK or overseas
- University students

“Moonshot”

The UK government’s proposal to test large swathes of the population.

The UK and other countries are beginning to use new rapid tests with large groups of the population. It is not known how well the tests will perform at finding the virus, especially in symptomless people. Scientific studies to compare the rapid test results with those of established, well-validated laboratory tests are essential to find out, and repeat testing will also be essential to check the rate of false positives⁹.

Who has had Covid-19?

For people who have had Covid-19 symptoms which ended more than two weeks ago, an **antibody test** could confirm past Covid-19. These tests use blood samples and are currently only freely available to some people as part of research. The tests don’t detect cases where antibodies haven’t been produced yet, or did not reach detectable levels, or have fallen. Detecting antibodies is most likely between fourteen days and three months after having Covid-19¹⁰. We don’t yet know how well antibodies protect people from getting it again¹¹.

It’s important to remember that testing alone will make little difference to Covid-19. Ensuring the right people isolate will make the difference, and that depends on using testing properly.

A referenced version of this guide is available:

<https://senseaboutscience.org/activities/making-sense-of-covid-19-testing>

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References

- 1 Covid-19 symptoms are wide-ranging. The NHS website lists three main symptoms to guide access to testing: a high temperature; new, continuous cough; a loss or change to your of sense of taste or smell. The World Health Organisation's website has a longer list of possible symptoms, including shortness of breath, tiredness, diarrhoea, conjunctivitis, and skin rash.
- 2 Office for National Statistics 'Coronavirus (COVID-19) Infection Survey, UK' [webpage], 6 November 2020. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/coronaviruscovid19infectionsurveypilot/6november2020> (accessed 6 November 2020)
- 3 Some new tests that are being evaluated are also designed to be used with saliva samples (no swab).
- 4 Mayer, C. & Baker, K. Impact of false-positives and false-negatives in the UK's COVID-19 RT-PCR testing programme [PDF], 3 June 2020. Available from UK Government website: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895843/S0519_Impact_of_false_positives_and_negatives.pdf (accessed 4 November 2020)
- 5 Mayer C. & Baker, K., as above.
- 6 Mayer C. & Baker, K., as above.
- 7 The World Health Organisation (WHO) has listed two rapid tests for emergency use, which do not require laboratory processing. The manufacturers of these tests, Abbott [1] and SD Biosensor [2], state that they are for professional interpretation by clinicians, that all results are preliminary, that negative results do not rule out Covid-19 infection, and that negative results should be confirmed with a viral culture, molecular assay or ELISA. These details are contained in the manufacturers' Instruction for Use [PDFs], available at: [1] https://www.who.int/diagnostics_laboratory/eual/eul_0564_032_00_panbi_covid19_ag_rapid_test_device.pdf, [2] https://www.who.int/diagnostics_laboratory/eual/eul_0563_117_00_standard_q_covid19_ag_ifu.pdf
- 8 Tozzi, J. Lavito, A. Court, E. 'Coronavirus: Rapid COVID test effort stumbles over risk of false positives', Bloomberg News [online], 9 October 2020. Available at: <https://www.bnnbloomberg.ca/rapid-covid-test-effort-stumbles-over-risk-of-false-positives-1.1506175> (accessed: 6 November 2020)
- 9 [1] Innova Biotime, which manufactures one of the tests in use by UK government for 'moonshot' testing, states similar limitations to WHO-listed tests (above). Their product details state that the test is not evaluated for use in asymptomatic [symptomless] people. They also state that negative results should be confirmed with a molecular assay if necessary for patient management. These details are available from their website at: <https://static1.squarespace.com/static/5e8444f9372f7161749366af/t/5f252b2cb71b7012a5403a0f/1596271422787/TriedandTested+Rapid+Antigen+Test+v2.0.pdf> (accessed 4 November 2020)
- 10 [2] Wu, K. 'A Rapid Virus Test Falts in People Without Symptoms, Study Finds', New York Times, 2 November 2020. Available at: <https://www.nytimes.com/2020/11/02/health/coronavirus-testing-quidel-sofia.html> (accessed 4 November 2020)
- 11 University of Birmingham, 'Antibody tests may help detect COVID-19 infection - if used at right time.' [webpage], 25 June 2020. Available at: <https://www.birmingham.ac.uk/news/latest/2020/06/antibody-tests-covid-19-infection.aspx> (accessed 4 November 2020)
Imperial College Healthcare, 'Latest findings from REACT 2 study show that coronavirus antibody prevalence may be falling in England' [webpage]. 27th October 2020. Available at: <https://www.imperial.nhs.uk/about-us/news/latest-findings-from-react-2-study-show-antibodies-falling> (accessed 4 November 2020)