Witness Name: CHRISTINA PAGEL Statement No.: Exhibits: Dated: 19 March 2025

UK COVID-19 INQUIRY

WITNESS STATEMENT OF PROFESSOR CHRISTINA PAGEL

I, Prof Christina Pagel, will say as follows: -

Preamble

- 1. My background: Trained in mathematics (BA, MSc) and physics (MSc, PhD), I have been working in Operational Research applied to Health Care at University College London (UCL) since 2005. I have been a Professor of Operational Research since 2018 and was Director of the UCL Clinical Operational Research Unit from 2017 to 2022. I am also serving as Vice President of the UK Operational Research Society (2021-date). Operational Research is a branch of applied mathematics all about using mathematics, statistics, data analysis and problem structuring methods to support decision makers in the real world. My main strands of research have included working with Dept of Health on national immunisation policy and pandemic preparedness (pre-2016); working internationally on policies to reduce maternal and neonatal deaths in low income settings (2008-2014); working with hospitals, commissioners, national audit bodies, charities and patients to use data to support improvement in services for congenital heart disease (2010-date); working with local hospitals to use data from intensive care to inform care for patients (2010-current); working with the NHS, local government, and families to improve services for children with complex health needs (2023-current). In 2016/17 I was a Harkness Fellow in Health Policy and Practice, based in Boston, US, researching US health policy. I have published over 200 academic papers.
- 2. **Covid-19 pandemic**: I have been a member of Independent SAGE since May 2020. We are an interdisciplinary group of scientists who provided independent

scientific advice to the UK government and public on how to minimise deaths and support Britain's recovery from the COVID-19 crisis. From May 2020 to December 2023, Independent SAGE produced 62 reports, 50 short statements, hosted 139 live-streamed briefings, and answered questions relating to the pandemic, from the public, journalists and broadcasters. I have also published peer-reviewed papers on mathematics, data and pandemic policy CP/001 - INQ000475201 [CP/002 - INQ000228175] [CP/003 - INQ000573890] [CP/004- INQ000130648]; Covid vaccine and school policy for children [CP/005- INQ000573988] [CP/006- INQ000573884] [CP/007- INQ000573888] [CP/008- INQ000573975]; Covid hospitalisations in children [CP/009-INQ000573889] [CP/010- INQ000573931]; and health care outcomes of Covid patients [CP/011- INQ000573926] [CP/012- INQ000573934] [CP/013-INQ000573968] [CP/014- INQ000573932]. I have never been a participant in the SAGE committees convened by the UK Government. Following my public communication during the pandemic, I was elected as an Honorary Fellow of the Faculty of Public Health in 2024, and awarded The Companion of OR prize by the UK Operational Research Society (2022), a HealthWatch award (2021), and a BMJ award (2021).

- 3. Acknowledgements: I am very grateful to Bob Hawkins who has volunteered his time to support this statement by collating data, preparing relevant charts and providing feedback. His energy and constructive criticism have been enormously helpful. Bob Hawkins volunteered for Independent SAGE from November 2020 to December 2023, collating source data and producing key charts for our regular live briefings. His professional background is Operational Research, Data Analytics, Business Planning, and Strategy Development.
- 4. Disclaimer and focus of this statement: In my witness statement, I will focus on the fundamental principles behind TTI systems as a mechanism to control infectious disease spread, and how the TTI system in England did or did not exemplify those principles. I will concentrate on the TTI response in England, since I am much less familiar with TTI systems in the other home nations. The National Audit Office (NAO) reviewed the business case for NHST&T written in September 2020. The NAO report [CP/015- INQ000573986] noted that the TTI

business case stated that "*NHST&T aims to avoid the need for a second national lockdown*". Although NAO noted that the business case recognised that NHST&T alone could not suppress the pandemic the TTI business case justified the cost of NHST&T in part with reference to averting a future lockdown: *"the main driver [for TTI] being the avoidance of a second national lockdown and the vast associated social and economic costs*". This aim clearly failed with two further lockdowns (November 2020 and January-April 2021). I will thus focus on the performance of TTI during the first year of the pandemic, because this is where I believe most opportunities were missed.

5. Structure of this statement: I will start with an overview of the principles of TTI. Then I will structure my statement by the different stages of TTI: identifying cases; identifying contacts; contacts of cases isolating; and reducing transmission. In case helpful, a timeline of Test, Trace and Isolate in England is given at the end of this document on page 35.

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Principles of Test, Trace and Isolate: a systems view

- 6. Test, Trace and Isolate is only one measure that can be used to suppress new Covid-19 infections, and should not be considered as the only response [CP/016- INQ000573948]. A simplified systems overview of infection control in the context of Covid-19 is shown in Figure 1. The diagram illustrates that there are two main levers available for infection control: reducing the chance that a susceptible person is exposed to an infectious person ("chance of exposure") and reducing the chance that a susceptible person is actually infected ("chance of infection if exposed").
- 7. The chance of infection if exposed can be reduced in various ways: mask wearing reduces the chance of exhaling infectious aerosols if infected and of inhaling infectious aerosols if exposed; physical distancing or mixing outdoors reduces the chance of inhaling infectious aerosols; improved ventilation or air filtration indoors removes infectious aerosols from the air.
- 8. The chance of being exposed can be reduced in two main ways. Firstly, by limiting contacts in general, for instance by work from home orders or school closures, or by limiting the number of people that can meet at any one time. The second way of limiting exposure is by specifically trying to stop infectious people from mixing with susceptible people. This is what a Test, Trace and Isolate (TTI) systems aim to do [CP/017- INQ000573941]. The more effective your TTI system, the fewer infectious people mix with others and so the lower the chance of a susceptible person being exposed.
- TTI systems work best with low prevalence of infection, especially in populations with little or no immunity (e.g. [CP/015 - INQ000573986] [CP/024 -

INQ000087180] [CP/018 - INQ000573907] [CP/019-INQ000475202]. For instance, Mongin et al [CP/020 - INQ000573915], using retrospective data from Switzerland, showed that contact tracing systems could capture up to 60% of infected contacts during low prevalence but fewer than 25% during epidemic peaks. Consequently, TTI is most likely to have impact if other control mechanisms intended to limit exposure and infection on exposure are in place [CP/021 - INQ000573937].

10. The effectiveness of the contact tracing system itself depends on three main factors [CP/016 - INQ000573948] shown at the top of Figure 1: a) identifying as many new cases of infection as possible as quickly as possible (Test); b) finding as many of their contacts as possible as quickly as possible (Trace); c) as many people actually isolating as possible (Isolate).

A Test, Trace and Isolate system is only as good as the weakest link in this chain – all three must work well for the system to be effective.



Figure 1 - simplified systems overview of how Test, Trace and Isolate can contribute to infection control



Figure 2 - Key steps for a TTI programme

- 11. A more detailed view of the three main aspects of TTI is provided in Figure 2 above.
- 12. Speed is of the essence as a person is most infectious about three days after exposure encrete Fore the symptoms emerge. For those that develop symptoms, this is around the time symptoms emerge. Because people are generally less likely to mix once they start feeling ill, a significant proportion of infections come from exposure to people just before they develop symptoms [CP/021 INQ000573937]. One study estimated that between a third and a half of all infections come from exposure to pre-symptomatic infectious people [CP/023 INQ000573974]. This means that you really need people to test quickly and for their contacts to isolate within days of exposure [CP/016 INQ000573948].
- 13. Overall, effective or partially effective contact tracing systems can reduce the effective reproductive number (i.e. reduce the average number of people infected by a newly infected person) by between 30%-60% [CP/021 INQ000573937] [CP/025 INQ000206672] [CP/026 INQ000573933]. In the context of exponential growth, this represents a significant reduction. When other measures, or existing immunity, are in place to keep the effective reproduction rate, R, close to 1, then contact tracing can be enough to bring R below 1 and so stop the spread of the disease.
- 14. I will now go through each of these steps in turn and examine what happened during the first year of the pandemic. In particular I will focus on the run up to November 2020, the key months where a more effective Test and Trace system (alongside other public health measures) may have avoided the need for a further lockdown.

Testing: failure in rapid and comprehensive identification of new cases

15. You can't isolate contacts of new cases without finding new cases. The first stage in a Test, Trace and Isolate system is to identify new cases (steps 1-3 in Figure 2). There are various ways of doing this. Firstly, you can wait for people to get symptoms and seek a test. If the test is positive then they become a case. Secondly, you can perform mass testing regardless of symptoms, on

either the whole population or targeted populations such as health care workers, schoolchildren or teachers. Thirdly, at the cost of lower accuracy but with the advantage of speed, you can start the tracing process as soon as someone displays symptoms without waiting for a test.

No testing at all

- 16. Due to insufficient capacity in testing, case finding was stopped in England on 12 March 2020 and tests were prioritised to diagnose patients in hospital [CP/018 - INQ000573907]. Consequently, people with symptoms were advised to isolate and, a week later, advice was updated for their contacts to isolate as well [CP/027 - INQ000573921]. People with possible symptoms were left to inform any contacts themselves.
- 17. Essentially, until England could build capacity in testing and tracing, no case identification or contact tracing was possible. It would take another 2 months before Covid-19 testing was available to the general population, missing the first Covid wave entirely [CP/028 INQ000573916]. The late start to NHS Test and Trace was considered a key failing by the National Audit Office, The Houses of Parliament Health and Social Care, and Science and Technology Committees and the Houses of Parliament Public Accounts Committee [CP/015 INQ000573986] [CP/029 INQ000573909] [CP/030 INQ00090541].
- 18. A report for The Houses of Commons Library in October 2020 highlighted that other countries, notably South Korea and Germany, scaled up their testing capability far more rapidly than the UK CPIOLE-INQUOD475202 The Covid-19 Inquiry Module One report has already detailed the lack of UK preparedness to ramp up testing quickly in 2020 [CP/031 - INQ000573925].

Testing symptomatic people only: not everyone knew the symptoms

19. From 28 May 2020, free PCR tests became available to everyone with symptoms of Covid-19. There was not yet the capacity to test people without symptoms nor the capacity to trace the contacts of cases without symptoms.

20. People can however infect others even if they never develop symptoms (asymptomatic) or a day or two before their symptoms start (pre-symptomatic). About 35% of people never develop symptoms [CP/033 - INQ000573899]. Additionally, pre-symptomatic spread is significant [CP/021 - INQ000573937] [CP/023 - INQ000573974].

This means that a case finding strategy that depends only on testing people with symptoms will inevitably miss a significant proportion of cases.

- 21. Thus, when relying on identifying symptomatic cases only, a high proportion of symptomatic people must get tested. Verrall, advising the New Zealand government, recommended that 90% of people with symptoms should have a test [CP/033 - INQ000573899]. SAGE SPI-M often used a best case scenario of 80% of symptomatic people getting tested and isolating in their epidemiological models [CP/025 - INQ000206672].
- 22. It is thus absolutely crucial that people know what the symptoms are that should prompt a test. Until March 2022, there were three symptoms provided on NHS and Gov.uk websites [CP/034 INQ000573919], or in other public communications crives in the should prompt a test. These were a high temperature, a new continuous cough, or a loss of taste or smell. SPI-B repeatedly emphasised the importance of clear communication of symptoms, what you should do on experiencing symptoms and why it mattered [CP/036 INQ000573950] [CP/037 INQ000573885] [CP/038 INQ000573952] [CP/039 INQ000231034].
- 23. There were two persistent issues with communication about symptoms in England. Firstly, many people didn't know, even well into the pandemic, what symptoms should prompt a test. The CORSAIR study reporting to SAGE in September 2020 indicated that only 49% of respondents could identify the three main symptoms of Covid-19 [CP/040 INQ000196824]. This barely improved as the pandemic progressed as seen in Figure 3. Whilst more people could name two of the three (cough and fever) this never exceeded 70%.



Figure 3 - Figure taken from the CORSAIR study report to SAGE [CP/040 - INQ000196824]

24. Secondly, while a high temperature, a new continuous cough, or a loss of taste or smell are all common symptoms of Covid-19 [CP/041 - INQ000573966], they are not the only ones. A blog by the Zoe Symptom Tracker App team in July 2020 [CP/042 - INQ000573984] said "data gathered from app users shows that people can experience a wide range of different symptoms including headaches, muscle pains, fatigue, diarrhoea, confusion, loss of appetite, shortness of breath and more". In addition, the ONS Infection Survey data from April to October 2020 (Table 1, Data sheet from the October 2020 release [CP/043 - INQ000573901]) which surveyed a random sample of the population regardless of symptoms or test-seeking behaviour, shows that on average, about half of people testing positive experienced symptoms that were not fever, cough or loss of taste of smell. Symptoms the ONS Infection Survey asked about included muscle ache; sore throat; fatigue; headache; nausea or vomiting [CP/044 - INQ000573902].

- 25. Given the crucial importance of finding as many cases as possible and in the face of what was by late September 2020 rapidly increasing prevalence, I believe there was a case for expanding the case definition to include more symptoms. SAGE documents from September 2020 showed they considered that increasing the symptoms list would not be as effective as communicating the three main symptoms more widely [CP/045 INQ000120558] [CP/046 INQ000120557]. SAGE were also worried that adding other symptoms would risk many more people with those symptoms but not infected with Covid needing a test and, potentially, wrongly being asked to isolate. However, the report's authors also noted that their analysis was based on the then low prevalence of Covid-19 in the population (during summer 2020), but that these issues would be much less problematic during pandemic peaks [CP/046 INQ000120557].
- 26. Fortunately, public health measures greatly reduced the rate of other respiratory illnesses during the first year of Covid-19 [CP/047 INQ000573887] [CP/048 INQ000573911], thus increasing the chance that someone with cold-like symptoms actually had Covid-19. After the Alpha variant became dominant in December 2020, sore throat, fatigue and muscle aches also became more common Covid-19 symptoms [CP/049 INQ000573892]. Thus the case for adding more symptoms became stronger over the second half 2020 and early 2021, but the symptoms were not updated in government communication until much later.
- 27. I note that a broader symptom list was used in many other countries, including the US [CP/050 - INQ000573980], Germany [CP/051 - INQ000573908], South Korea [CP/052 - INQ000573897] and Japan [CP/053 - INQ000573979]. I also note that in April 2022, along with the removal of free tests for most people and after the end of Test and Trace, official government and NHS websites greatly expanded the list of Covid-19 symptoms [CP/054 - INQ000573942] [CP/055 -INQ000573930].

Seeking a Test: not everyone does

28. Even if someone with symptoms recognises those symptoms as a potential Coronavirus infection, they still need to seek a test to enter the TTI system. The UCL Covid-19 Social Study ran a panel study of over 70,000 respondents in the UK during the pandemic. Their 28th report presents results from surveys undertaken between 21 March 2020 and 10 January 2021 [CP/056 -INQ000573905].

Their findings were that most people (57%) did not ask for a test if they developed symptoms of Covid (Figure 4).



Figure 4 - Results on test seeking behaviour from the UCL Social Study. Chart by Bob Hawkins.

- 29. The Covid-19 Social Study reported that testing was significantly higher in younger people; in those living in higher income households; and in women.
- 30. The CORSAIR study conducted on behalf of the Department of Health also surveyed people on test and isolation behaviours between March 2020 and January 2021 and shared their findings with SAGE throughout [CP/040 -INQ000196824] [CP/057 - INQ000573893]. They reported even lower rates of people with symptoms saying that they had sought a test (about 20%). They did not find any significant associations between demographic factors and test seeking behaviour.

- 31. In November 2020, the Government ran a mass testing trial using Lateral Flow Device (LFD) tests in Liverpool [CP/058 - INQ000488650] [CP/059 -INQ000573891], which coincided with the second national lockdown. In this pilot, people over 18 years old with none of the three main symptoms (new cough, loss of taste/smell, fever) were offered an LFD test (alongside a confirmatory PCR test) across 48 test sites in Liverpool.
- 32. The pilot was then extended to the end of January 2021, coinciding with the rise of the Alpha variant and the start of the third and final lockdown in England [CP/060 INQ000573935]. Green et al. [CP/060 INQ000573935] reported that the uptake of free testing for asymptomatic people was lower in more deprived areas and where distance from home to test sites was further.
- 33. Overall, 43% of Liverpool residents without symptoms had an LFD test between 6 November 2020 and 31 January 2021. When analysed by deprivation, 32% of those in the most deprived areas had an LFD test compared to 53% in the least deprived areas [CP/060 - INQ000573935]. The authors highlight digital exclusion, lack of transport, and lack of financial support for isolation as possible key factors behind the observed differences in uptake. The first factor is about knowledge of the tests being available, the second relates to accessibility of the tests and the third relates to the ability to respond to a positive test. Given the legal requirement to isolate if positive (and fines for not doing so [CP/061 -INQ000573927]), lack of financial ability to isolate might prompt people not to find out if they are positive.
- 34. This suggests that key ways to improve test seeking are better communication (both of symptoms, and the availability of tests for those with no symptoms), ease of access to tests, and supporting people to isolate if they test positive. Symptom recognition [CP/057 - INQ000573893] and financial support for isolation did not improve much during the pandemic (the £500 isolation payment was low and hard to access [CP/062 - INQ000573910]).

Accessing tests was harder than it should have been

35. If you have symptoms of Covid-19 and want to get tested, you have to find a test. You could order tests to take at home (but with delays in receiving the test

and the result, see below), or you could travel to a test site. But if tests are in short supply, there may be no tests available to order for home or to take at a test site.

- 36. September 2020 saw a significant and sustained shortage of test availability in England [CP/063 - INQ000499009] [CP/064 - INQ000573903] [CP/065 -INQ000573940] [CP/066 - INQ000573987]. Several factors were at play: an increase in Covid-19 prevalence from September onwards, a return to work (for some) and education (for children and students) which saw people mixing at scale for the first time since March 2020, cooler weather reducing mixing outside or with open windows, and an increase in seasonal colds [CP/067 -INQ000573989]. These factors combined to create a situation where many more people had potential symptoms of Covid (particularly a fever or a new cough), prompting a test.
- 37. The issue is that all of these factors were predictable. Over the summer of 2020, several bodies emphasised the need for rapid and accessible testing for the autumn and winter of 2020 including the Academy of Medical Science report to SAGE in July 2020 [CP/068 INQ000573886], SAGE [CP/069 INQ000119956] [CP/070 INQ000573954] [CP/071 INQ000573949] and Independent SAGE [CP/072 INQ000573918]. England should have planned for autumn increases in demand by significantly ramping up our testing (and tracing) capacity over the summer. This did not happen, and instead we saw the testing system failing just at a time of rapidly increasing Covid-19 prevalence in a population with barely any immunity. The National Audit Report into Test and Trace in December 2020 [CP/015 INQ000573986] highlighted this lack of preparation within Test and Trace as a problem.
 - 38. In addition to test availability, distance matters [CP/060 INQ000573935] [CP/073 - INQ000573981]. While home tests were available to order, this took time. The chart below (Figure 5), taken from the Test and Trace published data from 14 April 2022 [CP/074 - INQ000573929], shows how distance travelled to testing sites changed over time.
- 39. While the median number of miles needed to travel was quite low by 2021 (about 2 miles), the first five months of availability of tests to the symptomatic general

public (June – October 2020) saw much longer travel distances needed of 4 to 5 miles. When tests were in short supply (as in September 2020), people had to travel further to access testing facilities with capacity. This likely means that some people who wanted to test, did not manage to access one, as highlighted by the National Audit Report into Test and Trace in December 2020 [CP/015 - INQ000573986].



Figure 5 - Distance travelled to a Covid-19 testing site in England over time. Chart by Bob Hawkins.

Accuracy of tests

40. Recognising symptoms, seeking a test and then actually accessing one still require that tests results are accurate. On the whole, PCR tests were extremely accurate but it is worth mentioning the Immensa Lab PCR testing failure in September/October 2021. At that time, positive LFD tests done by people at home should have been followed up with confirmatory PCR tests. For about six weeks almost all the PCR test results reported by Immensa's Lab in Wolverhampton were negative, regardless of actual infection status. UKHSA finally suspended testing at the lab on 15th October 2021. A UKHSA report into the incident estimate that as many as 39,000 people who should have tested positive were wrongly reported as negative, leading to perhaps 23 additional deaths [CP/075 - INQ000513671] [CP/076 - INQ000573920]. A paper by Fetzer estimated that there were an additional 25,800 to 68,800 infections because of the errors [CP/077 - INQ000573990].

- 41. The issue could have been identified and addressed weeks earlier than mid October 2021. During September 2020 there were various spikes in positivity at the lab (the % of tests processed by the lab that were positive) where it would go from near 0% to 7-8% and then back to near 0%. NHS Test and Trace in the South West raised this is an issue with UKHSA in early September but it was not properly investigated. Later spikes were only identified in retrospect. It was only in early October where geographical patterns could be seen in cases where a positive LFD was resulting in a negative PCR, highlighting the South West of England as an anomaly. There were also increasing concerns being raised by members of the public. A proper investigation was started in October [CP/078 -INQ000573923].
- 42. The UKHSA report [CP/075 INQ000513671] found many areas for learning and improvement which should be implemented, but a key one for me is the use of key performance indicators (the metrics by which labs were judged on quality). While positivity rates coming out of labs were available in near real time, they were not being actively tracked. This was a mistake. Given that general positivity rates around the country in September and October were well over 5%, any lab returning rates of near zero over a period of time should have raised alarm bells immediately both within the lab and within Test and Trace.
- 43. If this had happened in 2020, prior to LFD roll out, such a Lab processing issue might have gone unnoticed for considerably longer, with more consequent damage. In future, key performance indicators must be designed to spot accuracy as well as volume of tests processed.

Speed of testing: tests were not processed quickly enough and new cases were not reached quickly enough by contact tracers

- 44. As discussed above, speed is of the essence in any Covid-19 Test, Trace and Isolate system [CP/079 - INQ000573883]. By the end of March 2020, South Korea was processing 20,000 tests a day with a turnaround time of 6 to 24 hours [CP/080 - INQ000573967]. Turnaround times in England never reached that performance.
- 45. NHS Test and Trace aimed to provide test results within 24 hours of the test for all tests not taken at home [CP/015 - INQ000573986]. Figure 6 shows the percentage of PCR test results received within 24 hours of taking a test (including home tests) in England from June 2020 to June 2021 using NHS Test and Trace data [CP/074 - INQ000573929]. After an initial peak of 59% in July 2020, it never again exceeded 40%, and was between 7-10% in the key weeks of autumn 2020, where cases rose rapidly with eventual lockdowns in November 2020 and January 2021. Results also show that home tests, unsurprisingly, consistently had the longest turnaround times (median of 60 hours) [CP/015 - INQ000573986]. While home tests increased access, especially for those unable to travel, this came at the cost of speed in processing tests.



Figure 6 - Timeliness of results from PCR tests for people in the community from Test and Trace datasets in April 2022. Chart by Bob Hawkins.

- 46. For contact tracing, it's not just the speed of the test result that matters (upon which the new case should isolate immediately), but the speed with which a contact tracer can contact the newly identified case to ascertain their close contacts, so that those contacts in turn can be reached and asked to isolate. NHS Test and Trace had a target of reaching 80% of newly identified cases within 24 hours.
- 47. Firstly, not all identified cases were reached. In 2020, 15% of cases transferred to NHS Test and Trace were not reached (294,000 new cases) [CP/074 INQ000573929].
- 48. Secondly, as can be seen from Figure 7, in those key autumn months of 2020 the proportion of new cases reached by Test and Trace within 24 hours was significantly below 80%, dropping to a low of 44% in mid- October 2020. However, the target was largely met from November 2020 onwards.

Timeliness of reaching cases as measured by percentage of referred cases reached within 24 hours by central health protection team.

 Percent of Cases Reached within 24 hours Second Third Lockdown lockdown 90 80% 80 70% 50 40 44% 30 Dec Jul Aug Sep Oct Nov Jan Feb Mar Apr May Jun 2020 2021 Chart: Bob Hawkins • Created with Datawrapper





49. The importance of speed in both test results and then contacting identified cases was repeatedly emphasised by SAGE and the bodies supporting SAGE, throughout 2020 [CP/015 - INQ000573986] [CP/016 - INQ000573948] [CP/068 - INQ000573886] [CP/081 - INQ000120566] [CP/082 - INQ00063145] [CP/083 - INQ000573973] [CP/084 - INQ000120511] [CP/085 - INQ000120552]. Independent SAGE also emphasised the need for speed in its June 2020 report on a proposed Test, Trace and Isolate system for England [CP/072 - INQ000573918].

Expanding testing to others: new methods to increase the number of new cases identified were not rolled out until Spring 2021

- 50. During 2020, the primary way cases were identified in England was by communicating the symptoms of Covid-19 (see above) and asking people to take a PCR test if they were symptomatic.
 - 51. The more new cases are identified, and their contacts traced and asked to isolate, the more effective a TTI system will be. There were two main ways more cases could have been identified.

- 52. The first is by offering testing to people without symptoms this would help identify the approximately 35% of cases who never develop symptoms and the people who are already infectious but have yet to develop symptoms. Effectively this is a mass testing programme. This approach was indeed taken by England, but not until April 2021, when free Lateral Flow Device tests were made available to the general population alongside official advice to test twice weekly [CP/086 INQ000573895]. Additional efforts were made to test health workers, teachers and school children regularly to monitor for new cases.
- 53. SAGE considered mass testing at various times in 2020 and advised that only repeated mass testing made sense from a pandemic control point of view [CP/087 INQ000253896], and that would hinge on uptake and adherence to isolation on a positive test. Any mass testing programme would require infrastructure to both trace contacts and to support people to isolate [CP/088 INQ000573951] [CP/089 INQ000074991]. SPI-M estimated that mass testing of asymptomatic people could have a significant impact in controlling the pandemic but only with the presence of other public health measures, plus effective contact tracing and then isolation of contacts [CP/089 INQ00074991]. SAGE also stated that effort was better spent on finding more people most likely to have Covid, i.e. those with symptoms.
- 54. The high number of tests required for a population mass testing programme (e.g. highlighted by SPI-M in September 2020 [CP/089 - INQ000074991]), seemed to mean that using PCR testing capacity for this purpose was ruled out and never an option for England. Thus a mass testing approach needed to wait until LFD pilots had been run and LFD tests were ready for general roll out in April 2021. I note that there was smaller scale, localised, mass testing in some English hotspots in the summer and autumn of 2020 [CP/090 - INQ000573939] [CP/091 - INQ000573906] – an acknowledgement of both its usefulness in controlling the pandemic when prevalence is high but that it was not possible to do this nationally.
- 55. The second way to increase case identification would be focus on testing more of the people who were most likely to be infected. By definition, this would seem to be the identified contacts of the recently tested cases. This would

suggest that providing tests to contacts identified by test and trace regardless of symptoms would be sensible, since transmission chains can be further broken up by reaching secondary contacts of newly infected contacts [CP/092 -INQ000573944]. But for the first year of the pandemic, only contacts who developed symptoms were advised to test (and on a positive test, would have their contacts traced in turn) [CP/093 - INQ000573914]. SAGE considered there to be insufficient evidence for testing asymptomatic contacts (1 May 2020) [CP/084 - INQ000120511]), while the DELVE report for SAGE in April 2020 [CP/016 - INQ000573948] said that as long as all identified contacts isolated for 14 days, there was likely little additional benefit in testing asymptomatic contacts. The NERVTAG recommendations to SAGE on contact tracing in April 2020 also did not recommend testing of contacts [CP/094 - INQ000074968]. This was likely due to an underestimation of the role that asymptomatic people played in Coronavirus transmission [CP/016 - INQ000573948] and worries about testing capacity [CP/094 - INQ000074968]. By March 2021, when the testing policy was changed to recommend testing for all contacts, it was clear that close contacts were at much higher risk of infection [CP/095 -INQ000573943] and that asymptomatic spread was significant [CP/096 -INQ000573922], added to the emerging evidence that people did not necessarily realise that their symptoms might be Covid [CP/040 -INQ000196824].

56. Nonnenmacher et al [CP/093 - INQ000573914] looked at the efficacy of asking asymptomatic contacts to test in England from 30 March 2021, and found that it had a significant additional impact. In particular, that out of almost 1 million asymptomatic contacts, 214,056 positive cases were identified whose contacts could then be traced and themselves asked to isolate. I think it highly likely that requiring all contacts to test from the beginning of Test and Trace would have increased its effectiveness. While the evidence for testing contacts in the early months may have been inconclusive, other countries (Germany, South Korea, Taiwan, Singapore) nonetheless tested close contacts from early 2020, as reported by DELVE to SAGE in April 2020 [CP/016 - INQ000573948].

Overall performance of the "Test" in Test, Trace and Isolate in England

57. The National Audit Office assessment of Test and Trace in December 2020 [CP/015 - INQ000573986] estimated that overall 44% of all cases were identified between May and November 2020 (Figure 8). Not all were successfully contacted, so overall the NAO estimated that 32% of all cases were successfully traced.

People transferred to the tracing service and successfully contacted represent about 32% of the estimate of new Covid-19 cases by the Office for National Statistics

Estimated number of people in England infected with Covid-19, receiving positive tests, transferred to tracing service and reached by the NHS Test and Trace Service, 28 May to 4 November 2020 Community Prevalence 1.94M ONS estimate of the number of people with Covid-19 Case Identifed Tested positive (44%) 1.09M Not tested (56%) Transferred to tracing Transferred (39%) Not transferred: 83K (4%) Successfully traced Traced (32%) Failed to trace: 137K (7%) 500K 1.5M 1M Chart: Bob Hawkins . Created with Datawrapper

Figure 8 - National Audit Office assessment of Test and Trace performance in December 2020. Chart by Bob Hawkins.

58. These numbers used all cases as a baseline (including those without symptoms) from the ONS infection survey. Assuming that about 65% of cases develop symptoms, this still means that at best Test and Trace identified about 60% of symptomatic cases during 2020. Additionally, the NAO report included within "identified cases", those identified by hospitals (in admitted Covid patients) who are unlikely to have been contact traced, not least because the time window for finding contacts would have passed since hospitalisation typically occurs several days after symptoms start. Thus the NAO estimates should be seen as a **higher bound** on the percentage of cases identified in a timely way for contact tracing. In any case, **it is certain that considerably fewer than 80% of symptomatic cases were identified**.

59. Overall then, in 2020 the TTI system in England first failed to identify any new cases in the community until testing for symptomatic people was rolled out in June 2020, then failed to identify enough new cases, then failed to process their tests quickly enough, and finally failed to contact new cases quickly enough during September and October 2020.

Tracing Contacts: failure in rapid and comprehensive tracing of contacts of new cases

- 60. Identifying and then contacting new cases is only the first step in the Test, Trace and Isolate process. Next comes "Trace", which involves first identifying contacts and then reaching those contacts and asking them to isolate. A commonly used target to aim for is 80% of contacts being identified, reached and isolating [CP/016 - INQ000573948] [CP/025 - INQ000206672] [CP/033 -INQ000573899] [CP/079 - INQ000573883] [CP/084 - INQ000120511]. Note that three of these references are from documents provided to, or produced by, SAGE prior to Test and Trace being set up in England.
- 61. Not all new cases could or would provide contacts. In 2020, 20% of all identified new cases reached (347,000 new cases) did not provide any contacts [CP/074 INQ000573929]. This means that the efficacy of reaching contacts who are provided is even more important.
- 62. Various sources suggest that if the TTI system is slow to reach contacts of newly identified cases (more than 5 days) then contact tracing is just not effective [CP/021 - INQ000573937] [CP/026 - INQ000573933] [CP/084 -INQ000120511]. The faster you can trace and isolate contacts, the more you can get away with imperfect case identification [CP/021 - INQ000573937]. Overall there is a time window of about 3-4 days from a new case developing symptoms (i.e before testing) to asking their contacts to isolate [CP/016 -INQ000573948] [CP/079 - INQ000573883].
- 63. For most of 2020 and early 2021, the primary way of identifying and reaching contacts in England was via a central health protection team by email or phone [CP/015 INQ000573986].

64. Figure 9 shows the average number of close contacts reported per case over time from NHS Test and Trace data [CP/070 - INQ000573954]. Contacts per case peaked around 7 per case and averaged about 3 per case for the autumn and winter of 2020/2021 during periods of significant restrictions. Most identified contacts were within the same household as the new case [CP/093 - INQ000573914].





- 65. The number of identified contacts per case is likely lower than the true number of contacts for a variety of reasons: people may not know who they came into contact with (e.g. in a hospitality venue), they may forget who they came into contact with, or they may be reluctant to share the contact details and thus require those contacts to isolate. While the CORSAIR study reported that most people (80%) were willing to share details of close contacts, that still leaves 1 in 5 people who were not [CP/057 INQ000573893].
 - 66. Additionally, the impact of reaching household contacts of cases could be considered marginal given that they would already most likely know they were contacts without the intervention of Test and Trace. Indeed, this is implicitly

acknowledged by the change in practice in November 2020, whereby all household contacts of new cases were automatically considered as immediately reached, on reaching the new case and asking them to inform their household [CP/093 - INQ000573914].

67. Figure 10 shows the percentage of identified contacts who were reached by whether they were in the same household as the index case or not [CP/074 - INQ000573929]. The change in method in November 2020 for counting household contacts as successfully reached is obvious. However, more concerning is the persistently low rate of identified **non-household contacts** reached (since they were less likely to know that they had been exposed) – only for a few months in the spring of 2021 was this near 80%. For most of 2020 it hovered between 60% and 70%, significantly below the target of 80% of contacts reached. This meant that for the first year of the pandemic almost 500,000 identified non-household close contacts were not reached. Indeed, the target was actually 80% of contacts identified **and** reached **and** who then isolate - and so the proportion of contacts reached would need to be higher than 80% to account for those who would not adhere to isolation.





68. Finally, as seen in Figure 11, contacts were not reached quickly enough. Even once household contacts counted as being reached "immediately", the percentage of all contacts reached within 24 hours never exceeded 80%. It is likely that the majority of non-household contacts were not reached within 24 hours for the first year of the pandemic. The National Audit Office reported that in September 2020 the median total time between an original case presenting with symptoms and their contacts being reached was 123 hours, falling to 119 hours in October 2020 [CP/015 - INQ000573986]. This is around 5 days – meaning that many of the contacts who were infected may have been mixing while infectious for a day or two before being asked to isolate [CP/016 - INQ000573948] [CP/022-ING00047203]. Timeliness of reaching contacts did meaningfully improve over the first half of 2021 [CP/097 - INQ000573983], but too late to help prevent the second and third lockdowns.



Weekly percent of contacts reached within 24 hours of the index case being transferred to TTI: England, 3 June 2020 to 30 June 2021



69. Figure 11 - Timeliness of contacts reached by Test and Trace central teams from Test and Trace data. Chart by Bob Hawkins

Automatic identification and notification of contacts via a mobile app

- 70. Alongside, the central and local health protection teams, England rolled out the Test and Trace app in September 2020 [CP/015 INQ000573986] to help identify and reach contacts of cases. The app used Bluetooth to identify other app users within a certain distance. If an app user tested positive, other app users who were close enough for long enough while both users' apps were active, were automatically notified that they were a contact and should self-isolate.
- 71. The advantage of an app is that it can identify contacts that are not known to the new case (e.g. people at a neighbouring table in a restaurant) and that it can notify contacts immediately on a positive test result of a case. Barriers to effectiveness include reluctance to download the app or to have it switched it on, and then non-adherence to self-isolation if notified.
- 72. Others are better placed than me to discuss the use of an app alongside manual contact tracing, but overall the impact of the NHS Test and Trace app is unclear. Overall 16.5 million people downloaded it (about 30% of the population) and it

sent almost 2 million contact notifications [CP/098 - INQ000573970]. A study by Wymant et al [CP/098 - INQ000573970] and the progress update by the National Audit Office (NAO) in June 2021 [CP/097 - INQ000573983] found that the app was moderately successful and might have prevented several hundred thousand cases (with a lot of uncertainty around the exact number). However, as the NAO noted, it's not clear how many of those contacted might have isolated anyway. The House of Commons Public Accounts Committee in October 2021 reported that the app had had some success but it was hard to quantify how much [CP/099 - INQ000573912].

Overall performance of the "Trace" bit of Test, Trace and Isolate

- 73. During 2020, NHS Test and Trace did not reach enough of the identified contacts, particularly non-household contacts, and those that it did reach it reached too slowly. It also likely did not identify enough non-household contacts.
- 74. That said, of the three components in TTI, "Trace" probably worked the best compared to "Test" and "Isolate". In general, NHS Test and Trace performance in identifying and reaching contacts improved over time but too slowly and performance went down significantly at times of high prevalence.
- 75. Key to the improvement in reach and timeliness was working more closely with local authorities and local public health teams to reach contacts. The NAO and Houses of Parliament Committees highlighted that working more closely with local contact tracing teams should have started much earlier and been more extensive [CP/015 INQ000573986] [CP/029 INQ000573909] [CP/030 INQ000090541] [CP/097 INQ000573983]. The Royal Society DELVE report to SAGE in May 2020 and The Academy of Medical Sciences report to SAGE in June 2020 both emphasised the importance of working closely with local public health teams [CP/016 INQ000573948] [CP/068 INQ000573886]. Independent SAGE also advocated for a more local approach to Test and Trace during 2020 [CP/072 INQ000573918] [CP/100 INQ000573928].

Isolation: the consistent failure to heed advice on supporting people to isolate

- 76. Finally, reaching contacts and asking them to isolate is completely pointless if they don't then actually isolate. That is the whole desired outcome from a Test, Trace and Isolate system and is the part that actually breaks chains of transmission. As many contacts as possible need to self-isolate.
- 77. James et al [CP/021 INQ000573937] found that contacts actually isolating was even more important than finding all the cases. Their modelling showed that tracing 50% of contacts with 100% isolation effectiveness is substantially better than tracing 100% of contacts with 50% isolation effectiveness. The authors go on to say [CP/021 INQ000573937]: "*The crucial importance of effective quarantine and isolation makes it essential that there is universal provision of social security such as paid leave entitlements for pre-symptomatic or asymptomatic individuals in quarantine, and adequate job security and unemployment benefits."*
- 78. SAGE, and the bodies feeding into SAGE, consistently recommended financial and logistical support for cases and contacts needing to isolate [CP/016 - INQ000573948] [CP/039 - INQ000231034] [CP/045 - INQ000120558] [CP/057 - INQ000573893] [CP/068 - INQ000573886] [CP/084 - INQ000120511] [CP/101 - INQ000573962]. The Academy of Medical Sciences report to SAGE in June 2020 stated "Provision of alternative accommodation, food, medicine and essential amenities, and financial support (especially to increase adherence to isolation and quarantine measures) are likely to be important for socioeconomically disadvantaged communities, including some BAME communities who are more likely to live in multigenerational households" [CP/068 -INQ000573886].
- 79. A SPI-B report from September 2020 [CP/039 INQ000231034] explains the sorts of support that should be offered (Figure 12):

- 3. Self-isolation rates would likely be improved with the addition of different forms of support. These include:
 - a. <u>Financial support</u>: Ensuring that those required to self-isolate would not experience financial hardship in doing so.
 - <u>Tangible, non-financial support</u>: Proactive outreach is needed, to identify and resolve any practical needs that people have (e.g. access to food, care for elderly relatives).
 - c. <u>Information</u>: Improved communication to the general public explaining how and when to self-isolate, and why it helps, would be useful, in addition to more detailed advice for those self-isolating (e.g. a help-line or SMS service).
 - d. <u>Emotional support</u>: For those who need it, access to social support or more formal clinical interventions delivered remotely if possible.
- 4. Provision of a support package that encompasses these four components but particularly the first - should be rolled-out and evaluated as a matter of urgency in order to realise the considerable investment made in testing programmes and the potential of testing and self-isolation to contribute to economic recovery and prevention of disease.

Figure 12 - SPI-NB recommendations for support for those isolating from their report to SAGE on 16 September 2020 [CP/039 - INQ000231034]

- 80. In addition, Independent SAGE repeatedly called for financial and practical support for those isolating as a key part of a TTI system in 2020 [CP/072 INQ000573918] [CP/100 INQ000573928] [CP/102 INQ000535912]. The Institute for Government again highlighted in March 2021 that adequate financial support for self-isolation was crucial [CP/103 INQ000573985].
- 81. A systematic review of international approaches to TTI systems by Chung et al. [CP/104 - INQ000573896] [preprinted in June 2020, peer review version published 2021] also highlighted the importance of financial, practical and emotional support for those isolating. Sick pay equivalent to 80%-100% of full salary was offered to cases and contacts isolating in many countries such as Portugal, Slovenia, Germany and Sweden [CP/105 - INQ000573904]. Other countries provided generous one-off payments or other financial support not based on salary such as Australia, Singapore, South Korea or Taiwan [CP/106 -INQ000573894]. Practical support, often in the form of home visits, grocery shopping and/or accommodation outside the home, was also offered by many countries, including Denmark, Norway, South Korea, Taiwan, France and the Netherlands [CP/106 - INQ000573894].

- 82. However, there was no financial support offered by the government in England to those isolating until 28 September 2020, when a £500 one-off payment was brought in for those on both low incomes and benefits. The new payment was introduced alongside new financial penalties for not self-isolating if you tested positive for Covid-19 or were a contact [CP/107 INQ000573982]. Support payments were retrospective and had to be applied for. Additionally, some Local Authorities offered additional financial support for those on low incomes but not on benefits [CP/074 INQ000573929]. An estimated 4 million people were eligible for the national scheme [CP/108 INQ000573898]. By April 2022, 322,000 people had received the payment. Another 250,000 had received support from the other Local Authority schemes. The BBC reported in March 2021 that about two thirds of people applying to the national scheme were rejected [CP/062 INQ000573910].
- 83. Local authorities and the NHS volunteer responders programme offered practical support to people isolating, such as delivery of food parcels and essential supplies, but provision varied over time and by local authority. There was no offer of alternative accommodation. I note that the in-household attack rate in the UK was high (37% of household contacts developed a confirmed infection) as reported by Bernal et al [CP/109 INQ000573913]. The authors note that this household attack rate was higher than in China, South Korea or Taiwan which they suggest could be due to different levels of support for those isolating.
- 84. From early 2020 onwards, SPI-B advised on the importance of trust in the government for people to both follow public health measures and engage with contact tracing and isolation, particularly for ethnic minority communities where trust in government may be lower [CP/036 INQ000573950] [CP/037 INQ000573885] [CP/039 INQ000231034]. However, after reaching a high in May 2020, trust in the government fell while distrust rose following the end of the first lockdown and the Dominic Cummings press conference at the end of May 2020 [CP/110 INQ000573972]

Overall performance of the "Isolate" bit of Test, Trace and Isolate

85. Adherence to self-isolation was low in 2020. An internal Test and Trace survey during August and September of 2020 (before there were either payments or

penalties) asked identified contacts about self-isolation. It reported that only 59% of contacts reported isolating [CP/113 - INQ000496203]. They repeated the survey in March 2021 and found that isolation had improved to between 80%-90% for both cases and contacts. However, I note that this (March 2021) was during lockdown in England when it would have been much easier to isolate.

86. The UCL Covid-19 Social Study reported results from surveys between March 2020 and January 2021 and found that 80% of people said they isolated for at least 10 days if they were a contact, vs 62% if they were a case [CP/056 - INQ000573905]. The CORSAIR study reported lower rates of self-isolation: across the whole time period (March 2020 to January 2021), 42.5% of people reported full duration-adjusted adherence to isolation [CP/057 - INQ000573893]. A summary of the results from the different studies are shown in Figure 13.



Figure 13 - estimated adherence to self-isolation among cases and contacts as measured in different studies.

- 87. The National Audit Office (NAO) report in December 2020 estimated compliance with self-isolation at between 10%-59% drawing on a variety of sources, including those above [CP/015 - INQ000573986]. Understanding the variation behind these different estimates on self-isolation and ways to improve self-isolation is crucial for any future pandemic.
- 88. The two National Audit Office reports and The Houses of Parliament Health and Social Care, and Science and Technology Committees report all highlight a lack of sufficient financial and other support as a key failure of NHS Test and Trace [CP/015 - INQ000573986] [CP/030 - INQ000090541] [CP/097 - INQ000573983]. Additionally there are important lessons to be learned from other countries, particularly South Korea where they achieved almost 100% adherence to selfisolation [CP/114 - INQ000573969].

Concluding remarks on the effectiveness of Test, Trace and Isolate in England

- 89. There is no doubt that an effective Test, Trace and Isolate system can suppress a pandemic, particularly in the presence of other public health measures and low prevalence. Other countries such as South Korea and Japan managed to incorporate contact tracing successfully in their pandemic response and avoided both lengthy national lockdowns and saw far fewer Covid deaths per population than the UK. This was particularly important early in the pandemic before vaccines became available. By May 2023, the UK had recorded 3,330 deaths per million people compared to 670 deaths per million in South Korea and 600 deaths per million in Japan [CP/115 - INQ000573900].
- 90. Fundamentally the Test, Trace and Isolate system in the UK in that first year of the pandemic simply did not function well enough to succeed in its stated aim: to avoid further lockdowns in England [CP/015 INQ000573986] [CP/029 INQ000573909] [CP/097 INQ000573983] [CP/099 INQ000573912]. As laid out in this statement, the English system did not work well enough across all three domains. There was insufficient test capacity and accessibility, insufficient communication of symptoms, insufficient identification of contacts, insufficient support for isolation and the overall process was too slow. While TTI improved in some aspects over time, particularly in test availability and

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speed of contact tracing, these improvements were too little and too late to prevent further lockdowns in 2020 and 2021.

- 91. In particular, the Test, Trace and Isolate system in England failed at the start of the process (identifying as many cases as possible) and at the end (high adherence to self-isolation) (Figure 2). Independent SAGE emphasised both these aspects in its reports by calling it the Find, Test, Trace, Isolate, and Support (FTTIS) system [CP/072 INQ000573918]. Given the enormous amounts spent on the TTI system [CP/099 INQ000573912], the fundamental inability to maximise the number of identified new cases entering it or to maximise the number of people self-isolating was a wasted opportunity.
- 92. I believe the problem at the root of the decisions that restricted case finding was lack of testing capacity. It was lack of testing capacity that meant we couldn't contact trace at all until June 2020, missing the first wave. I believe that concerns about test capacity contributed to decisions not to test contacts of cases, not to offer testing of asymptomatic people more widely, and not to expand the list of Covid symptoms. Failure to ramp up capacity during the summer of 2020 led to several weeks in September 2020 where tests were hard to access and contact tracing timeliness became significantly worse.
- 93. Testing contacts, testing asymptomatic people and communicating more symptoms did eventually happen but not until Lateral Flow Tests became commonly available (spring 2021, although the symptom list was not expanded until TTI had ended and tests stopped being free to the general public in April 2022).
- 94. Nonetheless, the TTI system in England did have some impact. An error in feeding through cases to the central system in September 2020 meant that almost 16,000 identified cases in specific areas were not contact traced. Fetzer and Graeber [CP/116 INQ000573917] used this 'natural experiment' to estimate the impact of contact tracing in England and found that "cases subject to proper contact tracing were associated with a reduction in subsequent new infections of 63% and a reduction in subsequent COVID-19–related deaths of 66% across the 6 [weeks] following the data glitch".

95. If the flawed system we had in September 2020 could have had that much impact, I can't help but think that a better system might have prevented the second and third lockdowns, if implemented alongside other public health measures. We could have built a better TTI system had we been better prepared pre-pandemic and prioritised testing in early 2020 [CP/031 - INQ000573925]. The very low prevalence of Coronavirus at the start of NHS Test and Trace over June and July 2020 should have set us up for success but instead we squandered the opportunity.

Appendix: Timeline of Test, Trace and Isolate in England

96. Figure 14 gives a timeline of Test and Trace in England



Figure 14 - Timeline of key policy related to Test, Trace and Isolate in England

Statement of Truth

I believe that the facts stated in this witness statement are true. I understand that proceedings may be brought against anyone who makes, or causes to be made, a false statement in a document verified by a statement of truth without an honest belief of its truth.



Dated: 29 March 2025