Mass Testing with Contact Tracing Compared to Test and Trace for Effective Suppression of COVID-19 in the UK: A rapid review

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Abstract

Background: Making testing available to everyone and tracing contacts might be the gold standard towards the control of COVID19. Many countries including the UK have relied on symptom-based test and trace in bringing the coronavirus pandemic under control. The effectiveness of a test and trace strategy based on symptoms has been questionable, for failing to meet testing and tracing needs. This is further exacerbated by it not being delivered at point-of-care, leading to rising cases and deaths. Rising COVID-19 cases and the death toll in the UK amid performing the highest number of tests in Europe are suggestive of the fact that symptom-based test and trace might not be effective as a control strategy. An alternative strategy is making testing available to all. This study evaluated the effectiveness of mass testing and contact tracing in the suppression of COVID-19 compared to conventional Test and Trace in the UK.

Objective: The primary objective was to compare mass testing and contact tracing with test and trace in the control of community spread of SARS-CoV-2 infections. The secondary objective was to determine the proportion of asymptomatic cases of SARS-CoV-2 reported during mass testing interventions.

Methods: English literature was searched in September through December 2020 in Google Scholar, ScienceDirect, Mendeley and PubMed. Search terms included [mass testing], [test and trace], [contact tracing], [COVID-19], [SARS-CoV-2], [effectiveness], [asymptomatic], [symptomatic], [community screening], [UK] and [2020]. Search results were synthesized without meta-analysis using the direction of effect as the standardized metric and vote counting as the synthesis metric. A statistical synthesis was performed using STATA 14.2. The tabular and graphical methods were used to present study findings.

Results: The literature search yielded 286 articles from Google Scholar, 20 from Science Direct, 14 from Mendeley, 27 from Pubmed and 15 through manual search. Altogether 35 articles were included, making a sample size of close to a million participants. This review found a 76.9% (95% CI: 46.2–95.0, P = .09) majority vote in favour of the intervention under the primary objective. The overall proportion of asymptomatic cases among those tested positive and tested sample populations under the secondary objective was 40.7% (95% CI: 38.8–42.5) and 0.01% (95% CI: 0.010–0.012) respectively.

Conclusions: There was a very low level but promising evidence that mass testing and contact tracing could be more effective in bringing the virus under control and even more effective if combined with social distancing and face coverings. Conventional test and trace should be superseded by decentralised and regular mass rapid testing and contact tracing, championed by GP surgeries and low-cost community services.services

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Mass Testing with Contact Tracing Compared to Test and Trace for Effective Suppression of COVID-19 in the UK: A rapid review

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Abstract

Background: Making testing available to everyone and tracing contacts might be the gold standard towards the control of COVID-19, particularly when significant transmissions are without symptoms. This study evaluated the effectiveness of mass testing and contact tracing in the suppression of COVID-19 compared to conventional Test and Trace in the UK.

Design: A rapid review of available evidence

Primary research question: Is there evidence that mass testing and tracing could suppress community spread of SARS-CoV-2 infections better than Test and Trace?

Secondary research question: What is the proportion of asymptomatic cases of SARS-CoV-2 reported during mass testing interventions?

Methods: Literature was searched in September through December 2020 in Google Scholar, ScienceDirect, Mendeley and PubMed.

Results: Literature search yielded 286 articles from Google Scholar, 20 from Science Direct, 14 from Mendeley, 27 from Pubmed and 15 through manual search. Altogether 35 articles were included, making a sample size of close to a million participants.

Conclusion: There was a very low level but promising evidence of 76.9% (95% CI: 46.2 – 95.0, P=0.09) majority vote in favour of the intervention under the primary objective. The overall proportion of asymptomatic cases among those tested positive and tested sample populations under the secondary objective was 40.7% (95% CI: 38.8 – 42.5) and 0.01% (95% CI: 0.01 – 0.012) respectively. Conventional test and trace should be superseded by a decentralised and regular mass rapid testing and contact tracing, championed by GP surgeries and low cost community services.

Keywords: COVID-19, test and trace, universal testing, mass testing, contact tracing

[1] Independent Scholar

Introduction

UK's Test and Trace has been suboptimal in addressing the testing needs of those infected with SARS-CoV-2, let alone handling its new variant(1). The panic over rising cases and a potentially more dangerous second wave led to the creation of the National Institute for Health Protection(2). Follow-up measures have been national lockdown, increased testing, tier system, furlough scheme and approval of the Pfizer, Oxford AstraZenaca and Moderna vaccines(3,4). As part of the above, about 56 million tests have been performed as at January 10, 2021, with about 1.3 million vaccinated(5). The plans to launch the 100 billion pound "moonshot" programme will only sound as good if tests are delivered based on infections rather than on symptoms(6,7). I concur with the Director General of WHO that "*you cannot fight a fire blindfolded. And we cannot stop this pandemic if we don't know who is infected*"(8). Infections could better inform public policy and facilitate equitable rollout of vaccines. While hoping that vaccines will proof as effective as deemed in the development of herd immunity, it is important not to lose sight of other control measures. Regular mass testing combined with contact tracing could be a novel control strategy not just to inform vaccination but also to guard against uncertainties arising from any new variant(9).

Research in Context

Prior to this study

Three modelling studies implemented in the UK dealing with mass testing were found. One of the models did a feasibility analysis of mass testing as a lockdown exit strategy. One model compared mass testing with symptom-based test and trace, while another model compared mass testing with symptom-based testing and isolation. There have been no real-time study in the UK comparing mass test and trace with the conventional test and trace system, reason being that mass testing and contact tracing was judged to be impossible. One systematic review was found, evaluating the effectiveness of universal screening for SARS-CoV-2 compared to no screening.

In this study

This is the first review to the best of my knowledge that sought to evaluate the benefits of mass testing and contact tracing (hybrid strategy) compared to test and trace, in the control of COVID-19 in the UK. The proportion of asymptomatic cases has also been explored.

Way forward

There is urgent need for a strategy that will identify SARS-CoV-2 carriers when their viral load is high and are most likely to be infectious. Real-time studies are needed to (1) get a true picture of disease burden, (2) validate various mass testing options and (3) better inform vaccination programme and other control measures.

Definitions

Contact Tracing: The process of reporting, identifying, listing and follow-up of individuals that have come in contact with those told to self-isolation due to positive COVID-19 test results, in view of asking them to quarantine(10–12).

A Contact: A COVID-19 contact is defined as any person who has been in close contact with a COVID-19 confirmed case either 2 days before symptom onset or before sample collection and 14 days after the onset of symptoms or after the sample was taken(10).

Isolation: The act of being restrained from social interaction for a period of 10 days from symptom onset, as a result of either exhibiting COVID-19 symptoms or confirmed positive test result(13).

Quarantine: To restrict the movement of contacts or people suspected to have come in contact with COVID-19 cases for a period of 14 days from the time of last contact. This includes contacts as defined herein, household members, passengers of inbound flights from high-risk zones(13).

Test and Trace: The process of 1) testing COVID-19 symptomatic individuals in view of asking them to stay in isolation and declare contacts, if with positive test results and 2) identifying, listing and follow-up of reported contacts so as to ask them to quarantine(10,11). It is called Test and Protect in Scotland and Test, Trace and Protect in Wales and Northern Ireland(14–16).

Mass testing: Also known as active case finding is the proactive approach of testing individuals irrespective of symptoms so as to track the contacts of those infected and break the transmission circuit of the virus early enough(17).

Effectiveness: The extent to which the rolling out of the intervention and/or control benefits the public, economy and environment in terms of limiting the spread of SARS-CoV-2/COVID-19, measured as the reduction in reproduction number-R(18).

Suppression: Implementation of a package of control measures in the middle of differential community transmissions of SARS-CoV-2/COVID-19 in view of reasonably bringing the reproduction number (R) below 1, so as to safely reopen the economy(19).

Conventional Test and Trace (TT) System

Figure 1 below shows the traditional “Test and Trace” system currently implemented in the UK, with a number of possible implications. Kindly refer to www.gov.uk for further details on how the Test and Trace system works(20). In the face of rising asymptomatic infectivity, the present TT delivery strategy can be categorised as “the cake not worth the candle”, since the programme fails to determine the true burden of the disease.

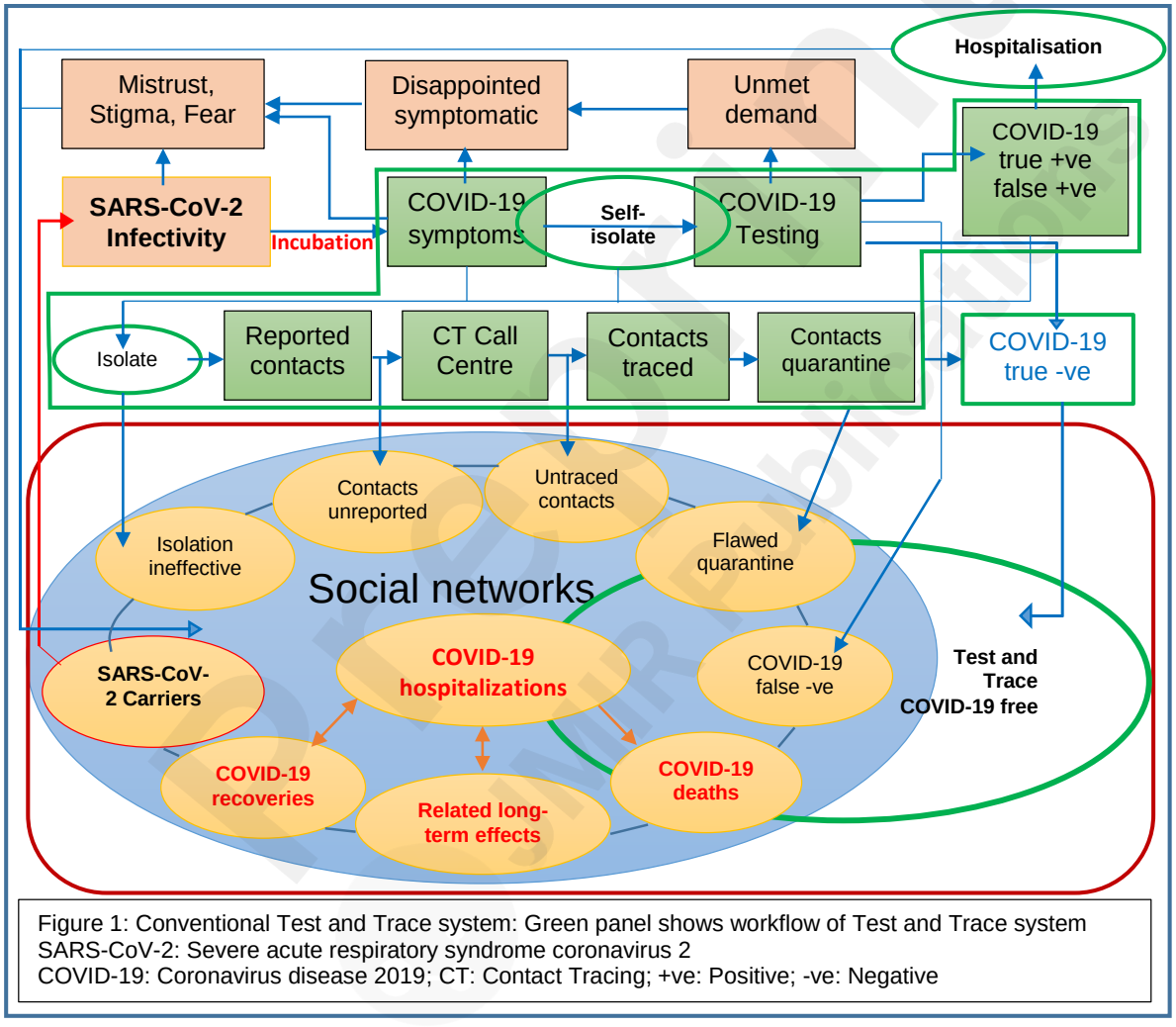

Figure 1: Conventional Test and Trace system: Green panel shows workflow of Test and Trace system
SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2
COVID-19: Coronavirus disease 2019; CT: Contact Tracing; +ve: Positive; -ve: Negative

The following can generally be observed from the above conventional system;

1) Individuals who are asymptomatic and presymptomatic are missed out(21–23)
2) People are generally afraid of quarantine and may shy away from TT(24).
3) The decision of public safety about getting tested has been shifted to the public
4) Operational false positive estimates in the UK are currently unknown(25)

5) Proportion of daily asymptomatic cases is still not part of the national statistics
6) Test and trace depends on self-reported contacts which may be flawed
7) A proportion of the public is hesitant due to stigma surrounding data ethics(26)
8) TT is a shift away from Universal Health Coverage, amid a pandemic(27)
9) Long travel among others is a serious barrier to accessing test centres

The "Infectivity Problem" of COVID-19

The "infectivity problem" can be summarized into 1) Test ramp-up controversy, 2) TT system leakages, 3) Time-to-test paradox and 4) Inequitable test delivery and delays.

Test Ramp-up Controversy: This is the heated discussion and lockdown-related antagonism from the public, regarding the undesired positive correlation which was presumed inverse, between testing capacity and COVID-19 cases. The supposed endgame of test ramp-up was to contain the virus but countries have found themselves in the "opposite-of-things". This may be due to more cases now being detected as a result of increased testing or because the testing is not comprehensive and early enough to outweigh the viral shedding. This may culminate into the UK's "operation moonshot" controversy if testing rate continues to be less than infectivity rate(28).

Test and Trace System Leakages: Leakages refer to the infectious population that apparently was supposed to be tested but end up not being detected. This includes those with either unreported symptoms or not presenting for test, those sent home due to unavailability of tests, asymptomatic and presymptomatic individuals, unreported and untraced contacts, false negatives as well as the non-compliant to isolation and quarantine rules(29,30).

Time-to-test Paradox: This refers to the conflicting interest of whether to test prior to symptoms or upon reported symptoms. The TT programme has been designed not to test people at very early stages of infection for fear of missing out the very cases it is meant to detect. The same is true when people are tested late(31,32). Research suggest that the serial interval of Covid-19 is shorter than the incubation period, indicating possible infectivity multiplier effect prior to symptom onset(33,34). This is further compounded by operational false positives and false negatives(25).

Inequitable Test Delivery and Delays: This has to do with testing that is not delivered at point-of-care thereby eliminating a certain group of persons, delays in testing those reporting symptoms, test-to-results delay as well as contact tracing time lapse. The

aforementioned in addition to not testing those without symptoms led to increasing infections in the face of delivering the highest number of tests in Europe(35). A disease that is as deadly as the present gives no tolerance to turnaround time and mitigation programme mistakes, the biggest of which has been the apparently neglected asymptomatic infectivity.

How the Intervention Should Work

The novel mass test and contact trace strategy is one that 1) extends the present Test and Trace system to the general public and 2) moving it from laboratory based to point-of-care thereby enhancing acceptability, accessibility and equity. This framework is a modification of that proposed by Lassi et al(36). Community ownership involves each individual registering with a general practitioner (GP) surgery, capacitated to perform routine open invitation testing irrespective of symptoms. The strategy necessitates the availability of rapid easy-to-run cost effective tests and a succinct exit strategy. Inputs include macro policies (fiscal, support schemes, PPE, hygiene and sanitation, environmental, tier system etc.), messa policies (GP capacitation, social gathering, at-risk group, vaccination etc.) and micro policies (health status, personal hygiene, compliance to national guidelines, tracing app acceptability). Routine health checks with GPs have hardly raised concerns around privacy due to trust. It is more reliable and confident for GPs to run testing programmes, offer direct vaccination and therapeutic treatment to those that have tested positive, as well as request those with positive test results to report contacts on the NHS contact tracing platform. Through a shared platform, Contact Tracing Centre (CTC) could be granted access to a limited dataset or transferred to the NHS Contact Tracing system. The CTC liaises with index cases for any additional contacts, and calls all listed contacts for quarantine advice. Based on data collected, the tier management team and environmental health officers work in synergy with local councils towards local containment strategies, similar to how the local outbreak in Leicester was managed. Figure 2 below shows the workflow of proposed framework.

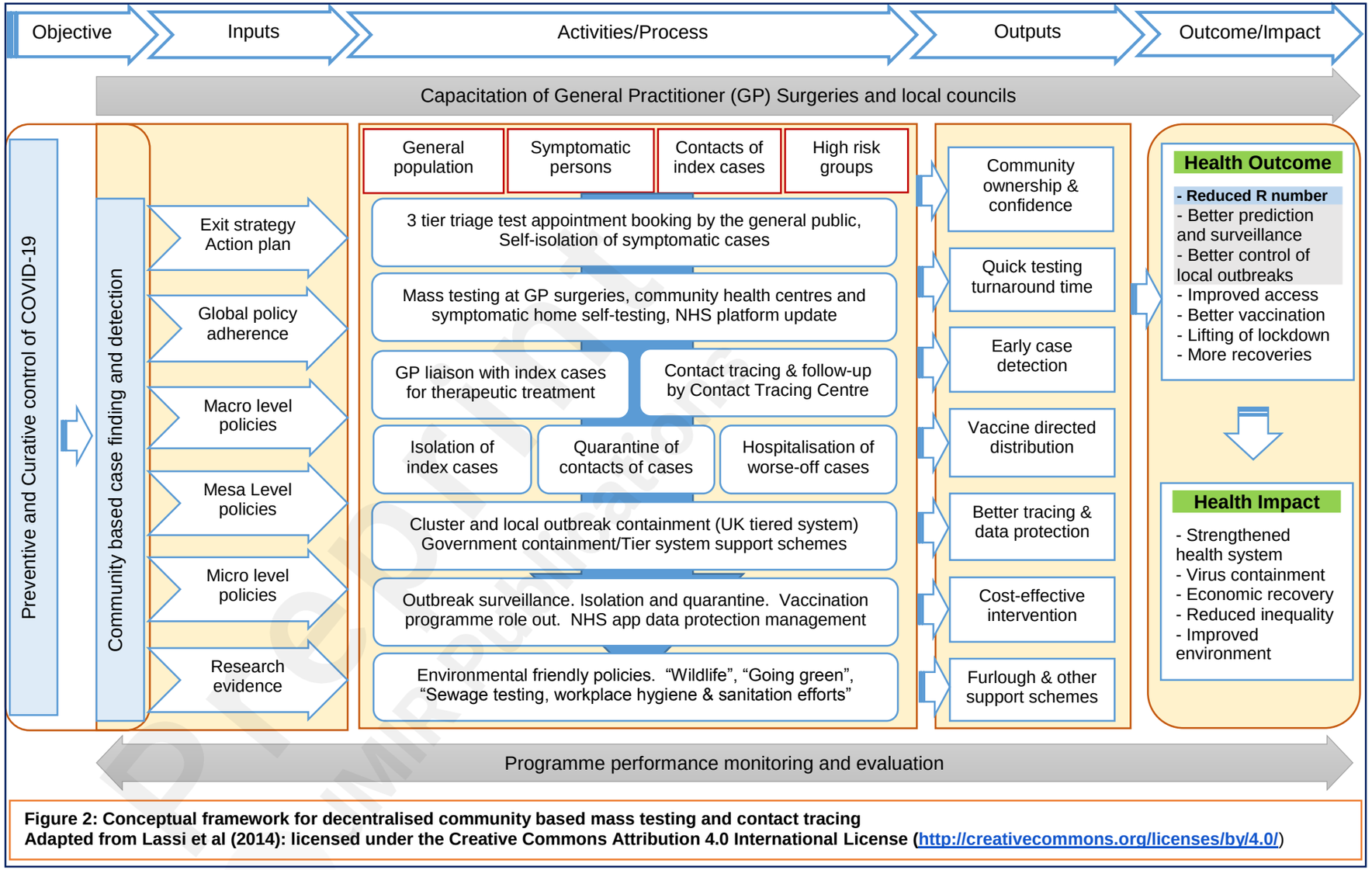

Figure 2: Conceptual framework for decentralised community based mass testing and contact tracing
Adapted from Lassi et al (2014): licensed under the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/)

Objectives

The study objective is twofold. Firstly to evaluate the evidence of Mass Test and Trace compared to Test and Trace in the suppression of community transmissions of SARS-CoV-2/COVID-19. Secondly to find out the proportion of reported asymptomatic carriers during mass testing interventions.

The population of interest included symptomatic and apparently healthy individuals within the UK setting. Coronavirus disease 2019 (COVID-19) is a recently emerged acute respiratory disease caused by a highly pathogenic coronavirus called Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that emerged in 2019 in Wuhan China(37). SARS-CoV-2 shares more than 90% amino acid and 79% genome sequence identities with SARS-CoV and 50% genome identity with the Middle East Respiratory Syndrome coronavirus (MERS-CoV). Symptoms of COVID-19 include prolonged high fever (≥38°C), prolonged cough, dyspnea and loss of taste. The intervention of interest is mass testing irrespective of symptoms and tracing contacts of positive cases, while the control is symptom-based test and trace.

Primary research question

Is there evidence that testing irrespective of symptoms combined with tracing could suppress SARS-CoV-2 infections better than symptom-based testing and tracing?

Secondary research question

What is the proportion of asymptomatic carriers of SARS-CoV-2 reported during mass testing interventions?

Methodology

Study Outcomes

- ✓ Effectiveness
- ✓ Cost-effectiveness
- ✓ Safety
- ✓ Acceptability
- ✓ Equity
- ✓ Asymptomatic proportion

Search Strategy

A literature search was performed on September 9, 2020 and constantly refreshed through December 22, 2020. The search involved all English articles published in 2020 including grey literature. Search terms in Google Scholar included “[UK] [Effectiveness of mass testing] [COVID-19] [SARS-CoV-2] [Contact OR tracing] [Contact tracing] [Effectiveness of test and trace] –Animals –Influenza –HIV –Cancer”. An advanced search was performed in ScienceDirect for “[Test and trace] OR [contact tracing] AND [COVID-19] AND [SARS-CoV-2] AND [asymptomatic] AND [symptomatic] OR [screening for SARS-CoV-2] OR [mass testing for SARS-CoV-2]”, whose title included “[UK] AND [test and trace] OR [contact tracing] OR [community screening for SARS-CoV-2] OR [mass testing for SARS-CoV-2]” restricted to the year 2020. A search in PubMed included “(((((((Mass testing for COVID-19 and "Contact tracing") OR (Mass testing for SARS-CoV-2 and "Contact tracing")) OR ("Test and trace")) OR ("Mass testing" and "symptom-based testing")) NOT (Animals)) NOT (HIV)) NOT (Influenza)) NOT (Ebola)) NOT (Cancer)”. Finally, a search for “Mass testing for COVID-19” AND “contact tracing for COVID-19” OR “mass testing for SARS-CoV-2” AND “contact tracing for SARS-CoV-2” was done in Mendeley.

Exclusion Criteria

All articles published before the year 2020, non-English articles, articles whose full texts were not accessible, non-COVID-19 articles, articles on non-human subjects and non-mass testing articles. Given that this review was about detecting people currently infected, we excluded antibody studies. We also excluded editorials and protocols

Eligibility Criteria

Full text articles comparing testing irrespective of symptoms and contact tracing with symptom-based test and trace, as well as any partial comparison between the above.

Data Management

Data Extraction

Data extraction was done by a single reviewer who also did a detailed review of extracted data for individual studies. Extracted data included the study date, author, setting, study design, study objective, type of intervention, outcome, type of

participants, strategies used, assumptions, data analysis, results, study limitations and bias.

Criteria for Grouping Studies

In accordance with the study objective and logical framework, studies for synthesis were grouped according to outcome. In order to capture the studies whose interventions geared towards evaluating effects on outcomes of interest(38). This made it easy to articulate synthesis to research questions.

Standardized and Synthesis Metrics

Direction of effect was used as the standardize metric because there was a lack of precision specific to the effect of intervention and control in the results presented by different studies. This did not permit the calculation of summary statistics(39). In light of the above, vote counting was the best match in synthesising the results. A sign test was used to indicate whether there was an evidence of effect. Equivocal effects between the intervention and control were considered to be distributed around the null hypothesis of no effect. This study made use of Synthesis Without Meta-Analysis (SWiM) reporting guidelines to report review results(40).

Heterogeneity Assessment

Heterogeneity of studies was assessed following the GRADE risk assessment factors(41). The lack of pooled effect size of modelling studies did not warrant us to perform a methodological diversity(42). Regarding the second objective however, variability was assessed by directly observing confidence intervals on plotted graphs.

Data Analysis

Review findings were synthesised thematically. The quality of studies was critically appraised using most recent tools based on study design, in accordance with PHO MetQAT 1.0 quality appraisal tool(43,44). The methodology and risk of bias of modelling studies was assessed using Relevance and Credibility Assessment (RCA) tool proposed by Caro and colleagues(45). Cohort studies were assed using Critical Appraisal Skills Programme (CASP) tool(46). Specialist Unit for Review Evidence (SURE) tool was used to assess cross sectional studies(47). Studies were grouped into 6 main categories according to outcome, as outlined in the methodology section for easy analysis and synthesis. Quality of evidence generated by different studies was

assessed using the Grading Recommendations Assessment, Development and Evaluation (GRADE) tool(48).

Data Presentation and Visualization

Tabular and graphical methods were deployed in presenting results. The GRADE summary of findings table was used to present certainty of evidence and a bar chart to present the effect direction of studies for the primary objective. In the secondary objective, forest plots were used to present the proportion of asymptomatic cases of SARS-CoV-2, using an excel model proposed by Neyeloff et al(91)

Criteria for Prioritizing Results

In relation to the primary question, results of studies that evaluated the effectiveness of the intervention and control within the UK, with low risk of bias were prioritized because this was in line with the review objective. Real-time studies were also prioritized as these are more likely to be close to reality.

Selection and Publication Bias

Preferential publication was counteracted by including grey literature. Missing data effect verification was performed by searching for grey literature that sought to compare the effectiveness of the intervention to the control(49). Editorials, thesis, protocols and news articles were excluded. This increased quality of included articles.

Search Results

The search yielded 286 articles from Google Scholar, 20 articles from Science Direct, 14 articles from Mendeley, 27 articles from Pubmed and 15 articles from other sources giving a total of 362 articles. Altogether 64 eligible articles were screened for inclusion. Given the ambiguity in the use of contact tracing in most studies to include testing, studies evaluating the effectiveness of contact tracing provided they had a component of mass testing were included. Considering the novelty of the term Test and Trace used in this study, it is common place to find contact tracing based on symptom testing used in studies to be likened to Test and Trace in this review.

A total of 35 articles that met the eligibility criteria were included. Table 1 below shows summary characteristics of included studies. A flow chart of how articles were selected can be seen in figure 3 below. Summary characteristics of studies excluded due to eligibility criteria are presented in supplement 1 of the appendix.

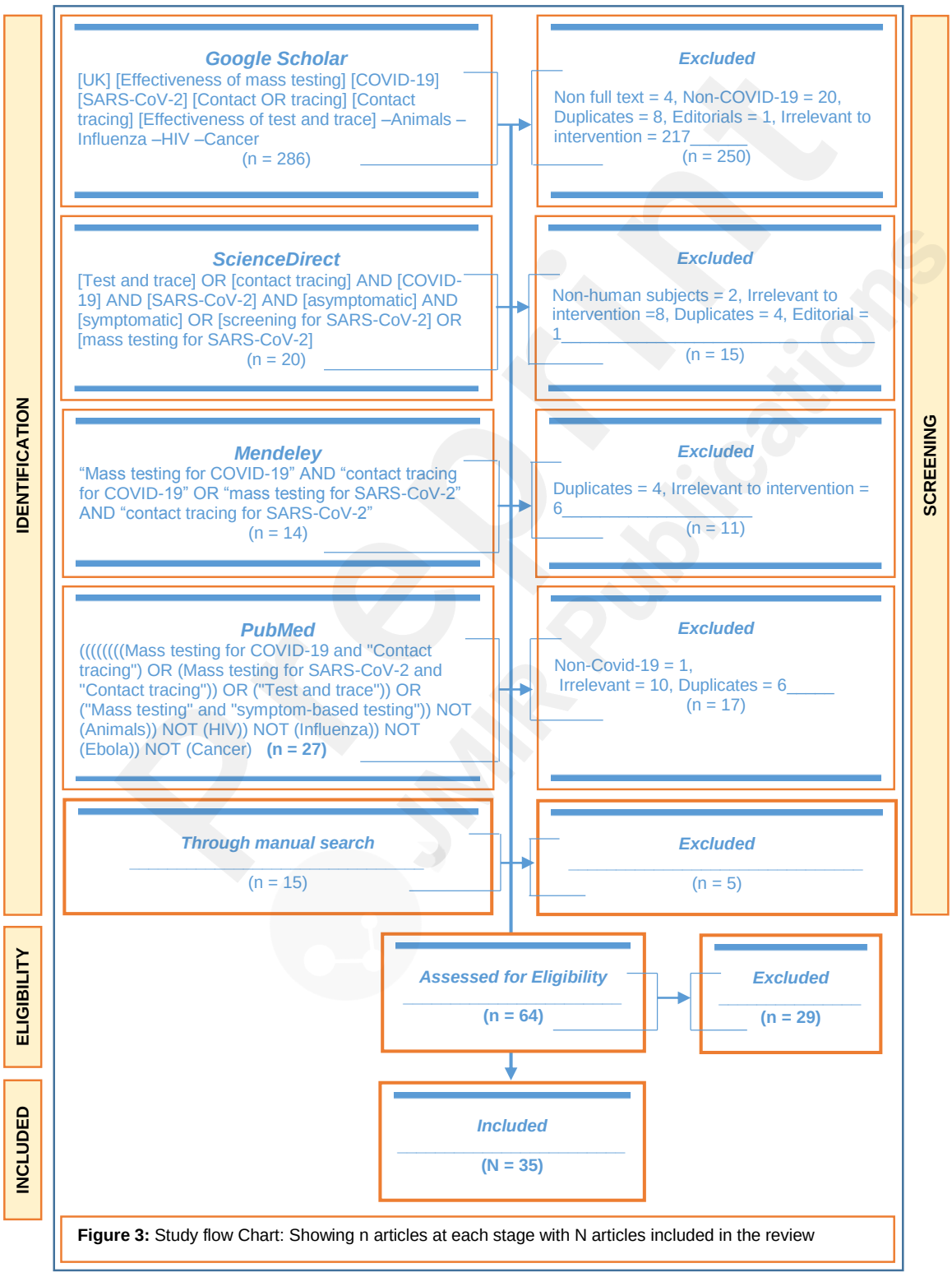

Figure 3: Study flow Chart: Showing n articles at each stage with N articles included in the review

Table 1: Summary characteristics of included studies

Study	Design/Outcome	Sample/ setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
1. Primary Question							
Effectiveness (Outcome 1)							
Emery(2020)(23)(http://www.ncbi.nlm.nih.gov/pubmed/32831176)	Modelling study Transmissions from asymptomatic carriers	3,711 cruise ship passengers & crew Japan	- Symptom-based testing - Symptom-agnostic testing	- Constant infectiousness - Progress to presymptomatic/asymptomatic is irrespective of origin of infections - Unavailable symptom onset date for 115 cases proportional to cases with reported dates - Unavailable test dates for 13 persons proportionate to tests among those with unreported symptom onset - Proportion of asymptomatic infections and infectiousness - Individual test negative after infectious period - Test accuracy = 100% - People are 50% more likely to be tested in biased symptom-agnostic testing	- Asymptomatic infections - Presymptomatic infections - Relative passenger-crew contact rate - Latent period duration - Duration of asymptomatic infection - Age dependent proportion asymptomatic	R version 3.5.0 and LibBi Bayesian calibration wuth RBi	Testing irrespective of symptoms showed to be more effective in case identification than symptom-based testing
Grassly(2020)(50)(https://www.thelancet.com/action/showPdf?pii=S1473-3099%2820%2930630-7)	Modelling study % reduction in reproduction number R	Modelled sample, UK	- Symptom-based self-isolation - Symptom testing and case isolation - Regular testing of high-risk groups irrespective of symptoms & isolation - Test and trace of contacts & isolation - Contact tracing by symptoms alone	- Asymptomatic individuals are less infectious than symptomatic individuals - 100% PCR test sensitivity - 100% coverage of Test and Trace - Sample collection done at symptom onset - 1 day delay from sample collection and quarantining of contacts - 80% of symptomatic cases are reported	- Proportion of asymptomatic infections - Relative infectiousness - Average serial interval if no isolation - Incubation period - PCR test sensitivity over infection diagnosis interval	Simulations	Self-isolation upon symptom onset will reduce transmissions by 47% (95% Uncertainty Interval, UI: 32-55) Screening all healthcare workers and other high at-risk populations every week will further reduce transmission by 23% (95% Uncertainty Interval: UI 16–40) in addition to that achieved by isolation (if PCR test results return within 24

Study	Design/Outcome	Sample/setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
			- Test-trace-test contacts and isolate	- 80% of symptomatic contacts are traced - Testing done the day of symptom onset			hours), while Test and trace will further reduce transmissions by 26% (95% UI:14-35)
Tsou(2020)(51)(https://www.sciencedirect.com/science/article/pii/S1551714420301798)	Modelling study COVID-19 outbreak containment	393 by April 13, 2020, Taiwan	A) Symptom-based testing and isolation of index cases B) Mass testing of symptomatic and asymptomatic subclinical cases C) Symptom-based testing, isolation and quarantine of all at risk group	- Incubation period per case and symptom onset to isolation delay follows a Weibull distribution - Potential secondary cases follow a negative binomial distribution with mean = reproduction number R - Strategies differed in their control of subclinical cases - Initial number of cases = 5, 20 & 40 - At-risk persons investigated = 40%, 60%, 80% & 90% - 40%, 60%, 80% of subclinical cases assumed to be detected and isolated - Subclinical cases can completely be prevented	- % of subclinical cases - Epidemiological investigations - isolation effectiveness - incubation period - Number of initial cases - Number of secondary infections per new infection - Serial interval	Simulations	Symptom-based testing, isolation and quarantining all subclinical cases was most effective However, strategy B was better than A in the prevention of transmissions prior to symptom onset
Mizumoto(2020)(52)(https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2020.25.10.2000180)	Modelling study Asymptomatic proportion	3,063 cruise ship passengers Japan	Mass testing	N/A	- Number of test - Positive cases - Asymptomatic cases - Symptomatic cases	Hamiltonian Monte Carlo (HMC) with the No-U-Turn-Sampler (NUTS)	A total of 634 cases were detected 328 of whom were asymptomatic. Proportion of asymptomatic increased over the weeks
Sasmita(2020)(53)(https://ghrp.biomedcentral.com/articles/10.1186/s41256-020-00163-2)	Modelling study - Incidence - Peak of cumulative COVID-19	COVID-19 daily data Indonesia	Scenario 1 = u1+u4+u5 Scenario 2 = u1+u2+u4+u5 Scenario 3 = u1+u2+u3+u4+u5	- 95% false positive rate from susceptible to exposed - Reinfection possibility as recovered patients loss immunity - All parameters assumed to be positive and constant	- Number of susceptible persons - Number of exposed individuals - Number of SARS-CoV-2 carriers - Number of reported infectious cases	MATLAB and R software	COVID-19 cases attained peak for strategy 1, 2 and 3 on 59th, 38th and 40th day after initial outbreak with 33151, 37908 and 39305 cases respectively

Study	Design/Outcome	Sample/setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
			U1 = Large-scale social restriction U2 = Contact tracing U3 = Mass testing U4 = Case detection and treatment U5 = Face masks use	- Availability of rapid PCR tests	- Number of recover cases - Infection rate between the susceptible and infectious persons - Immunity rate		The optimal control measure is scenario 2 with (u1), (u2), (u4) and (u5) (see column 4)
Moghadas(2020)(54)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7395516/)	Modelling study Required isolation Curtail of silent transmission	10,000 hypothetical population Canada	- No self-isolation - 100% severe cases self-isolate - 100% symptomatic case self-isolate - 100% isolation of symptomatic cases plus detection and isolation of asymptomatic cases	- Proportion of asymptomatic infections is 17.9% and 30.8%	- Secondary cases at each stage - Proportion of the attack rate attributable to asymptomatic infection - Proportion of the attack rate attributable to presymptomatic infection - Proportion of the attack rate attributable to symptomatic infection	Simulations Agent Based Model Lab	Isolating all symptomatic will still be inefficient in outbreak control Combined with case isolation, our results indicate that 33% and 42% detection and isolation of silent infections would be needed to suppress the attack rate below 1%, for asymptomatic proportions of 17.9% and 30.8%, respectively
Bracis(2020)(55)(https://linkinghub.elsevier.com/retrieve/pii/S2468042720300737)	Modelling study SARS-CoV-2 transmission projection	Daily cases of King County from Mar 8-Mar 29 USA	- No intervention - Isolating the elderly - Schools opening in fall - Testing, treatment, isolation and contact tracing in combination with physical distancing	- 20% of infections are symptomatic - Homogenous infectivity and outcome - Constant diagnostic rate during reopening - > 40% diagnosed during early testing - 50% of contacts are successfully traced - Contact tracing permits 5% of asymptomatic and subclinical to be tested - Differential post COVID-19 physical interaction	- Non-infectious exposed - Status of infection - Asymptomatic cases - Subclinical cases - Symptomatic cases - Recovered - Treatment status - Hospitalized	NSGA-II multivariate optimization algorithm in the mco R package Monté Carlo	Ramping up testing, isolation and contact tracing of symptomatic cases reduced post-COVID interactions by 60% and very few deaths Mass testing was not found to be feasible
Pollmann(2020)(56)(https://doi.org/10.	Modelling study	10,000 hypothetic	- Digital contact tracing (based on	- All contacts using digital contact tracing can be traced	- Fraction of exposed population	Monté Carlo with second order	Contact tracing must be combined with either random mass testing or

Study	Design/Outcome	Sample/setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
1101/2020.09.13.20192682)	Impact of digital contact tracing	al population	reported symptoms), - Quarantining, - Testing - Social distancing - Random testing	- Unreported symptoms and untested symptomatic cases - Tracing of infected contacts - Immediate quarantine upon report of symptoms - 100% test accuracy - Homogeneous population - Immunity once recovered - No symptoms-testing delay - Absence of manual tracing - Fixed latent period - Backward/Forward tracing	- Fraction of sick population - Population in quarantine - Effective reproduction number - Fraction of simulations with no outbreak		social distancing to control epidemic Daily random testing of 20% of population as effective as social distancing
Hill(2020)(57)(https://doi.org/10.1101/2020.10.15.20208454)	Modelling study Reduction in infections	1,000 hypothetical population, using 2010 Social contact survey data UK	- Test and trace - Regular mass testing	- Each person can infect - Contact network follows poisson distribution - Contact probabilities fall with level of accommodation - No random accommodation - People can infect 1 day post symptom onset - 100% test specificity - Possible to Forget contacts - Self-isolation time=10 days - Test- results delay= 2 days - Contact isolation = 14 days - Adherence to test and trace - No contacts during isolation - No COVID-19 student beginning the term	- Timing and frequency of mass testing - Coverage - Adherence to isolation, test and trace Proportion infected - Time spent in isolation	Simulations	Daily and weekly testing combined with contact tracing adherence reduced the number of infections by more than 50% compared to test and trace alone
Gorji(2020)(58)(https://doi.org/10.1101/2020.03.27.20045237)	Modelling study Reduction in reproduction number	Switzerland	- Mass testing - Contact tracing - Smart testing[2] and contact tracing	- 90% infection reduction due to self-isolation - Basic reproduction number of 2.4 if no mitigation - Test results take 1 days - Children under 10 contribute little to infections - At-risk subpopulation have 27 fold prevalence rate	- Number of required test - Reproduction number - Population using app - Identified individuals with high contacts - Tested population - Number of contacts - Contact traced	MATLAB and the Statistics Toolbox Release 2018b	Testing high risk individuals irrespective of symptoms with contact tracing will reduce R to 1. Contact tracing based on symptom testing will miss most cases.

[2] Mass testing of individuals with high contact rates (at-risk group)

Study	Design/Outcome	Sample/ setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
				- Detection of high contact individuals every 7 days			
Alsing(2020) (59)(https://doi.org/10.1101/2020.05.05.20092221)	Modelling study Efficacy	2011 commuter data BBC pandemic dataset 1000 simulations UK	- Contact tracing and social distancing - Contact tracing with Mass testing - Contact tracing with lockdowns	- Active infections at 8 months - Number of daily tests required - Effective reproduction number (R_E) per scenario - number of people in lockdown	- Social interaction at home, school, work and community - Offsprings drawn from a negative binomial distribution with mean=R - Reproduction number (R) is country specific - Herd immunity -Baseline R_0 = 2.5 - Onset-to-isolation delay follows a Weibull distribution with mean 3.43 and 2.4 days standard deviation - Generation time is normally skewed	-	Possible to control 38% of outbreak simulations within 8 months using contact tracing with 63.3% of outbreak still leaves R>1 Mass testing and contact tracing contains 74% of the outbreak simulations with 36.8% of outbreaks results in R<1
Hagan(2020) (60)(https://www.cdc.gov/mmwr/volumes/69/wr/mm6933a3.htm)	Cross sectional Prevalence of SARS-CoV-2	16,161 incarcerated persons in six jurisdictions USA	- Symptom-based testing - Mass testing		- Number of positive cases per test approach	-	Mass testing increased the number of COVID-19 cases from 642 (range = 2–181, median = 19) after symptom-based testing to 8,239 (range = 10–2,193, median = 403) giving a median increase of 12.3 fold
Cost-Effectiveness (Outcome 2)							
Paltiel(2020) (61)**(**https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2768923?utm_campaign=article**)**	Modelling study Clinical Performance (tests, required isolation and infections) Economic performance	4,990 hypothetical cohort USA	- Base case scenario with a reproduction number (Rt) of 2.5, test specificity of 98% and 10 new infections each week - Worst case scenario with an Rt of 3.5, test specificity of 98%,	- Test frequency = 1, 2, 3 & 7 - Test sensitivity = 70%- 99% - Importation of infections via exogenous shocks - Specificity of 98% - 99% - Reproduction number = 1.5, 2.5 and 3.5 - Case fatality = 0.05% - 30% chance that infection will lead to virus symptoms - Cost per test = $10 - $50 - Abbreviated 80-days period	- Number of test administered - Number of true-positives - Number of false positives - Number of new infections - Required person-days for isolation - Cost - Incremental cost-benefit	Microsoft Excel with an interactive dashboard	A willingness-to-pay of ≤$5,500/infection averted, screening every week using a 70% sensitive test was optimal. Regular screening (7, 3 & 2 days) was optimal if only a single test of $25 with 80% sensitivity was available There was no condition under which symptom-based

Study	Design/Outcome	Sample/ setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
	(cost, incremental cost and budget)		and 25 new infections every week - Best case scenario with an Rt of 1.5, test specificity of 99.7%, and 5 new infections each week	- A cohort of non-immune students in congregate setting of 5,000 students - 8-hour test turnaround time - Availability of 100% confirmatory tests at $100	- Budget impact		screening alone will contain outbreak
Safety (Outcome 3)							
None							
Acceptability (Outcome 4)							
None							
Equity (Outcome 5)							
None							
2. Secondary Question							
Proportion of Asymptomatic Cases (Outcome 6)							
Nishiura(2020)(62)(https://www.ijidonline.com/article/S1201-9712(20)30139-9/pdf)	Cross sectional Asymptomatic ratio	565 passengers Japan	RT-PCR testing	N/A	- Positive cases - Asymptomatic cases - Symptomatic cases		63 passengers were symptomatic. Four (30.8%, 95% CI: 7.7–53.8%) of 13 positive cases were asymptomatic and 9 were symptomatic
Porru(2020)(63)(https://www.mdpi.com/1660-4601/17/14/5104)	Cohort study Health surveillance	5,942 staff of a large hospital Italy	Mass RT-PCR testing using oropharyngeal and nasopharyngeal swabs	N/A	- Positive cases - Asymptomatic cases - Symptomatic cases	Fisher's exact test or the chi-square test ANOVA or the Kruskal–Wallis test	A total of 238 cases detected of whom 109 were asymptomatic Mass testing permitted prompt isolation and monitoring of cases

Study	Design/Outcome	Sample/ setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
Treibel(2020)(64)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7206444/)	Cross sectional Asymptomatic carriers	400 healthcare staff UK	Nasopharyngeal swap PCR test	N/A	- Positive cases - Negative cases - Symptomatic cases - Asymptomatic cases		Twelve (27%) of 44 positive cases were asymptomatic Positive Fifty staff self-isolated as a result of symptoms
Abeysuriya(2020)(65)(https://doi.org/10.1016/j.ejogrb.2020.07.035)	Diagnostic test Prevalence of SARS-CoV-2	180 pregnant women (39 weeks) UK	Nasopharyngeal swap PCR test	N/A	- Positive cases - Number asymptomatic	Medcalc Diagnostic Test Evaluation Calculator	Seven women tested positive with 6 (85.7 %, 95% CI: 42.1–99.6) as asymptomatic. Symptom-based testing sensitivity was 14.3% (0.36–57.87) and specificity was 91.86% (86.72–95.48)
Brown(2020)(66)(https://www.sciencedirect.com/science/article/pii/S0163445320304503)	Cross section study SARS-CoV-2 prevalence	1152 healthcare workers in 6 hospitals UK	Nasopharyngeal/ oropharyngeal swap PCR tests	N/A	- Positive test - Asymptomatic carriers - Symptomatic cases - Viral load	Stata (version 15, StataCorp, Texas)	Thirteen (57%) of 23 positive cases had symptoms compliant with COVID-19, of whom 4 (17.4%) were asymptomatic
Graham(2020)(67)(https://www.sciencedirect.com/science/article/pii/S0163445320303480)	Cross sectional Infections Clinical features Outcome	464 residents & staff in Care homes UK	- Comprehensive testing with Oropharyngeal and nasopharyngeal swaps - Symptom screening	N/A	- Positive case - Negative cases - Symptomatic cases - Asymptomatic cases	Chi Square and non-parametric test in R version 3.6.0	126 (40%, 95% CI 35 to 46) of the 313 tested residents were positive. Only 72 (57%, 95% CI 49–66) positive cases would have been diagnosed based on symptom-testing
Arons(2020)(68)(http://www.nejm.org/doi/10.1056/NEJMoa2008457)	Cross section survey Transmission Adequacy of symptom-based screening	89 residents of skilled nursing home USA	Point prevalence testing with RT-PCR on nasopharyngeal and oropharyngeal swabs	N/A	- Positive cases - Negative cases - Number asymptomatic - Number symptomatic	SAS software, version 9.4 (SAS Institute)	48 (63%) of 76 tested residents were positive of whom 27 (56%) were asymptomatic. 24 of the 27 developed symptoms 1 week post test

Study	Design/Outcome	Sample/ setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
Jameson(2020)(69)(https://doi.org/10.1017/ice.2020.361)	Cross sectional Asymptomatic infections	121 non-symptomatic healthcare staff USA	- Universal testing - Universal symptom: screening - Isolation of cases (RT-PCR test on nasopharyngeal swaps)	N/A	- Positive cases - Negative cases - Number asymptomatic - Number symptomatic	-	No positive case was found among 121 out of 499 eligible healthcare workers screened
Callaghan(2020)(70)(http://www.cdc.gov/mmwr/volumes/69/wr/mm6926a4.htm?s_cid=mm6926a4_w)	Cross sectional Effectiveness of preventive procedures & prevalence of SARS-CoV-2	46 patients& 171 healthcare professionals US	Nasopharyngeal swap PCR test	N/A	- Positive cases - Number asymptomatic	-	No participant tested positive for COVID-19
Louie(2020)(71)(https ://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa1020/5873783)	Cross-sectional survey Transmission monitoring	734 persons USA	Outbreak response mass testing with PCR on nasopharyngeal swaps	N/A	- Number symptomatic cases - Number of asymptomatic cases - Number of hospitalized cases - Number of dead cases	ABI 7500 platform. Automated Abbott m2000 RT-PCR platform	Mass testing identified a high proportion of asymptomatic cases. Symptom-based screening is ineffective in detecting cases among healthcare workers
Gudbjartsson(2020)(72)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7175425/)	Cross sectional SARS-CoV-2 transmissions	22,279[3] At-risk group and general population Iceland	- Targeted testing - Open invitation screening - Random invitation screening Using nasopharyngeal and oropharyngeal samples	N/A	- Positive cases - Negative cases - Symptomatic cases - Asymptomatic cases	R Package (https://CRAN . R - project . org/ package=binom)	13.3% tested positive in targeted testing, 0.8% in open invitation testing and 0.6% in random invitation testing.
Reid(2020)(73)(file:///E:/telechargemen	Cross sectional	5,204 healthcare staff	- Symptomatic testing	N/A	- Positive cases per regime - Symptomatic cases	SAS statistical	188 (6.4%) positive cases detected during symptomatic testing and 5 (0.2%)

[3] Sample of 9199 targeted persons, 10797 openly invited and 2283 randomly invited

Study	Design/Outcome	Sample/ setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
t/jammi-2020-0027.pdf)	Test uptake Test positivity	Canada	- Asymptomatic testing Using nasopharyngeal swabs		- Asymptomatic cases	software (version 9.4	positive cases during asymptomatic testing, with a low probability of testing positive
Lavezzo(2020)(74)(https://www.nature.com/articles/s41586-020-2488-1?fbclid=IwAR0Y69FXQqJqogOf-1ln)	Cross sectional Asymptomatic infection contribution	2,812 2,343 Italy	RT-PCR on nasopharyngeal swabs	N/A	- Number of positive cases per survey - Number of negative tests per survey - Number of positive cases that are asymptomatic per survey	Fisher's exact test Exact Wilcoxon–Mann–Whitney test	The first survey gave a prevalence of 2.6% (95% CI: 2.1–3.3%) and 1.2%; 95% CI: 0.8–1.8%) for survey 2. 29 (39.7%; 95% CI: 28.5–51.9%) of positive tests in the survey 1 were asymptomatic and 13 (44.8%; 95% CI: 26.5–64.3%) in survey 2.
Kimball(2020)(75)(http://www.cdc.gov/mmwr/volumes/69/wr/mm6913e1.htm?s_cid=mm6913e1_w)	Cross sectional Utility of symptom screening	76 older adults in skilled nursing care home USA	RT- PCR mass testing on nasopharyngeal and oropharyngeal swabs	N/A	- Positive cases detected - Asymptomatic cases - Symptomatic cases	SAS statistical software (version 9.4)	Twenty three (30%) residents were positive with 13 (57%) either presymptomatic or asymptomatic. Testing based on symptom screening could miss up to 50% of cases
Olalla(2020)(76)(https://academic.oup.com/qjmed/article/113/11/794/5890491)	Cross sectional Prevalence of asymptomatic cases	498 healthcare workers Spain	- Symptom screening - Asymptomatic testing PCR on naso- and oropharyngeal swaps	N/A	- Positive cases - Positive IgG and IgM - Number symptomatic on day of sampling - Number symptomatic 14 days prior to sampling	SPSS 15,	2 asymptomatic on day of sampling tested positive. 1 reported having gad symptoms in last 14 days
Guery(2020)(77)(https://www.sciencedirect.com/science/article/pii/S0399077X20301268)	Cross sectional SARS-CoV-2 cases	136 nursing care home staff France	RT-PCR mass testing (using Nasopharyngeal swap)	N/A	- Positive cases detected - Asymptomatic cases - Symptomatic cases	-	Three (2.2%) cases detected, 1 of which was symptomatic and 1 developed symptoms within 24 hours

Study	Design/Outcome	Sample/ setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
Roxby(2020)(78)(http://www.cdc.gov/mmwr/volumes/69/wr/mm6914e2.htm?s_cid=mm)	Cross sectional COVID-19 morbidity	142 staff & residents in residential community USA	RT-PCR mass testing (using Nasopharyngeal swap)	N/A	- Positive cases detected - Asymptomatic cases - Symptomatic cases	-	Five (7%) cases were detected, 3 were asymptomatic Symptom-based testing might not identify all positive cases
Lytras(2020)(79)**(a)**(https://academic.oup.com/jtm/article/doi/10.1093/jtm/taaa054/5820895)	Cross sectional SARS-CoV-2 prevalence	357 passengers repatriated from UK Greece	RT-PCR mass testing (using Nasopharyngeal swap)	N/A	- Positive cases detected - Asymptomatic cases - Symptomatic cases	-	Thirteen (3.6%, CI: 2.0–6.1) positive asymptomatic cases
Lytras(2020)(79)**(b)**(https://academic.oup.com/jtm/article/doi/10.1093/jtm/taaa054/5820895)	Cross sectional SARS-CoV-2 prevalence	394 passengers repatriated from Spain Greece	RT-PCR mass testing on nasopharyngeal swaps	N/A	- Positive cases detected - Asymptomatic cases - Symptomatic cases	-	Twenty five (6.3%, 95% CI: 4.1–9.2%) positive asymptomatic cases
Lytras(2020)(79)**(c)**(https://academic.oup.com/jtm/article/doi/10.1093/jtm/taaa054/5820895)	Cross sectional SARS-CoV-2 prevalence	32 passengers repatriated Turkey Greece	RT-PCR mass testing (Nasopharyngeal swap)	N/A	- Positive cases detected - Asymptomatic cases - Symptomatic cases	-	Two (6.3%, 95% CI: 0.8–20.8%) positive asymptomatic cases
Hoehl(2020)(80)(https://www.nejm.org/doi/10.1056/NEJMc2001899)	Cross sectional SARS-CoV-2 infection	125 passengers evacuated from Wuhan Germany	RT-PCR mass testing (Nasopharyngeal swap and sputum)	N/A	- Positive cases detected - Asymptomatic cases - Symptomatic cases	-	Two (1.8%) of 114 asymptomatic passengers tested positive. All 11 symptomatic patients tested negative Symptom-based testing failed to detect SARS-CoV-2 patients.

Study	Design/Outcome	Sample/ setting	Strategies	Assumptions	Measurements or parameters	Analysis	Findings
Cao(2020)(81)(https://www.nature.com/articles/s41467-020-19802-w?fbclid=IwAR2mBbIIfSagfobcID5cOcjQ3yh9KjTpnNCISj-MuT3Y8GyLv-AfrB3_efY)	Cross sectional Prevalence estimate	9,899,828 residents in Wuhan China	Citywide mass testing using TR-PCR on nasopharyngeal and throat swaps	N/A	- Positive cases detected - Asymptomatic cases - Symptomatic cases	R peackage “binom” version 1.1-1 SPSS version 22.0	No symptomatic case was found compared to 300 asymptomatic cases (0.303/10,000, 95% CI 0.270–0.339/10,000)
Baggett(2020)(82)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7186911/)	Cross sectional Positive SARS-CoV-2 cases	408 homeless shelter residents USA	- Mass testing - Symptom screening (PCR on nasopharyngeal swaps)	N/A	- Positive cases - Symptomatic cases - Asymptomatic cases	-	147 (36.0%) subjects tested positive, of whom 87.8% were asymptomatic
Imbert(2020)(83)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7454344/pdf/ciaa1071.pdf)	Cross sectional Infected persons	150 homeless shelter residents USA	Mass RT-PCR testing on nasopharyngeal specimens	N/A	- Positive cases detected - Asymptomatic cases - Symptomatic cases	SAS System (SAS Institute Inc., Cary, NC)	Fity two (52%) of tested residents were asymptomatic. This occurred when registered incidence was 5.1 case per 100,000

Methodological and Risk of Bias Assessment

I went for whole study assessment and deployed study design specific tools due to the lack of a standardized tool for non-randomised controlled studies(44,84). The critical appraisal is also in accordance with PHO MetQAT 1.0 quality appraisal tool(43).

Modelling studies

A total of 12 modelling studies were included and assessed for bias, 5 (41.7%) of which were rated at low risk, 4 (33.3%) at moderate risk and 3 (25%) at high risk of bias. The main concerns for ratings are summarized in table 2 below;

Table 2 Risk of bias of modelling studies

Study	Relevance	Credibility	Overall Risk Assessment
Primary question			
Effectiveness			
Emery et al(23)	Insufficient	Insufficient	Low: Unsuitable population and setting
Grassly(2020)(50)	Sufficient	Sufficient	Low
Tsou(2020)(51)	Insufficient	Insufficient	High: Reduced at-risk population to subclinical cases. Population, setting and dataset were not appropriate. Contact tracing not considered. Validation process was not reported. Conflict of interest not declared
Mizumoto(2020)(52)	Insufficient	Insufficient	Moderate: Unsuitable population and setting, inadequate internal validity and treatment of structural and parameter uncertainty
Sasmita(2020)(53)	Insufficient	Insufficient	Moderate: Validation process unclear, Measures highlighted have been implemented in many countries (including the UK) that still see their daily cases rising. Setting not relevant
Moghadas(2020)(54)	Sufficient	Insufficient	High: Population and setting not relevant with some missing outcome measures. Validation process unreported. No real-life dataset was used in modelling
Bracis(2020)(55)	Insufficient	Sufficient	Low: Population and setting were not relevant
Pollmann(2020)(56)	Insufficient	Insufficient	High: Hypothetical population and setting, no use of real-world data in parameterization, possible conflict of interest,
Hill(2020)(57)	Sufficient	Sufficient	Low: No concerns
Gorji(2020)(58)	Insufficient	Insufficient	Moderate: Unrepresentative population and setting no use of real word data and declaration of conflict of interest
Alsing(2020)(59)	Sufficient	Insufficient	Low: Underreported validation process and undeclared conflict of interest
Cost-effectiveness			
Paltiel(2020)(61)	Insufficient	Insufficient	Moderate: Unsuitable population and setting. No use of real-world dataset and neither was the validation process reported. Lack of precision

Cohort Studies

The lone included cohort study was rated at moderate risk of bias. A summary of the methodological assessment is presented in table 3 below;

Table 3: Risk of bias of Cohort Studies

Study	Risk of bias	Main concerns
Secondary question		
Proportion of asymptomatic cases		
Porru(2020)(63)	Moderate	Unrepresentative population and setting, contact tracing limited to control, no eligibility criteria, unreported loss to follow-up

Cross sectional studies

Out of 22 cross-sectional studies assessed, 5 (23%) were judged to be at low risk of bias, 1 (4%) at moderate risk and 16 (73%) at high risk of bias. Table 4 below highlights the main concerns of bias.

Table 4 Risk of bias of cross sectional studies

Study	Risk of bias	Main concerns
Primary question		
Effectiveness		
Hagan(2020)(60)	High	Lack of study design, no contact tracing, unrepresentative population and setting, unjustified sample size, No eligibility criteria leading to possible selection issues, reasonable refusal rate, unreported statistical methods, actual sample collection and testing procedures unreported and unreported participant characteristics.
Secondary Question		
Proportion of asymptomatic cases		
Nishiura(2020)(62)	High	Unrepresentative population and setting. No contact tracing, unspecified study design, participant characteristics not provided, underreported statistical analysis and results, details of sample management and testing unreported, unreported study limitations
Treibel(2020)(64)	High	Unreported study design, no contact tracing, unjustified sample size, Not sure of fairness in participant selection due to lack of eligibility criteria, unreported statistical methods, actual sample collection and testing procedures unreported, no study limitations, and declaration of conflict of interest, unreported participant characteristics.
Brown(2020)(66)	Low	No contact tracing, sample size justification
Graham(2020)(67)	Low	No contact tracing, unreported eligibility criteria and therefore issue with selection
Abeysuriya(2020)(65)	Low	No contact tracing, sample collection, transportation and analysis procedures unreported

Study	Risk of bias	Main concerns
Arons(2020)(68)	High	Unrepresentative population and setting. Lack of justification of sample size, no eligibility criteria, exclusion of asymptomatic staff, unreported statistical methods and unreported conflict of interest
Jameson(2020)(69)	High	Unrepresentative population and setting, study design not clear, no eligibility criteria with unknown fairness in selection, unreported participant characteristics and statistical methods, no details of sample collection and management, lack of precision in results and reported with no study limitations
Callaghan(2020)(70)	High	No contact tracing, unrepresentative population and setting. Unjustified sample size, eligibility criteria not reported, unreported statistical analysis.
Louie(2020)(71)	Moderate	No justification for sample size, description of statistical methods unclear and no eligibility criteria
Gudbjartsson (2020)(72)	High	Unrepresentative population and setting, no contact tracing, unreported sample size justification, eligibility criteria and study limitations
Reid(2020)(73)	High	Unrepresentative population and setting, no contact tracing, no study limitations, sample collection and management unreported, undeclared conflict of interest, unreported confidence intervals
Lavezzo(2020)(74)	Low	Participant characteristics not provided
Kimball(2020)(75)	High	No clear statement of study design, no contact tracing, no sample size justification, unrepresentative population and setting, no eligibility criteria. Underreported statistical methods and funding and no confidence intervals in estimates
Olalla(2020)(76)	High	Partial analysis with no contact tracing, unrepresentative population and setting, unjustified sample size, underreported statistical methods, no mention of eligibility criteria and funding.
Guery(2020)(77)	High	No contact tracing unrepresentative population/setting, selection issues due to no eligibility criteria, unjustified sample size, unreported statistical methods, imprecise reported results
Roxby(2020)(78)	High	Unspecified study design, no contact tracing, likely participant selection issues due to lack of eligibility criteria, no sample size justification, unreported statistical methods and lack of precision in the reported results
Lytras(2020)(79)	High	No study design, no contact tracing, no sample size justification and eligibility criteria. Unreported statistical methods, Lack of eligibility criteria and unclear selection of participants, no mention of collection and transportation procedure of samples and no study limitations
Hoehl(2020)(80)	High	Unrepresentative population and setting, no study design, no contact tracing, no sample size justification and eligibility criteria. Unreported statistical methods, Lack of eligibility criteria and unclear selection of participants, unreported collection and transportation procedure of samples, lack of precision in results, possible conflict of interest and no study limitations
Cao(2020)(81)	Low	No concerns
Baggett(2020)(82)	High	No clear statement of study design, no contact tracing in the intervention, unrepresentative population and setting, no sample size justification and eligibility criteria. Underreported statistical methods
Imbert(2020)(83)	High	No statement of study design, unrepresentative population ad setting, no sample size justification, lack of eligibility criteria made fair selection of participants unclear, lack of precision in results, underreported sample collection, transportation testing

Synthesis of Results

Primary Question: Is there evidence that mass testing and contact tracing could suppress community spread of SARS-CoV-2 infections better than test and trace?

Vote counting was deployed as the method to synthesize results, in line with direction of effect that was used. Studies were prioritized based on their degree of bias in the reported evidence. The GRADE diagram for assessing the quality of evidence was used to grade the evidence presented by the different studies(85). GRADE summary of findings table of the different studies can be seen in Table 5 below.

Outcome 1: Effectiveness

Four of 12 studies (33.3%) under this outcome were at high risk of bias, three (25%) were at moderate risk of bias and five (41.7%) were rated as low. Nine studies [75%, 95% Binomal Exact CI: 42.8%-94.5%, p=0.15] including Emery (2020), Tsou (2020), Mizumoto (2020), Moghadas (2020), Pollmann (2020), Hill (2020), Gorji (2020), Alsing (2020) and Hagan (2020) were voted in favour of the intervention. Three studies [25%, 95% BE CI: 5.5%-57.1%, p=0.15] including Grassly (2020), Sasmita (2020) and Bracis (2020) showed an unfavourable direction of effect and were voted in favour of the control. The body of evidence presented by the 11 modelling studies for this outcome was downgraded by 3 levels to very low. Firstly, because studies were neither randomized control trials nor real-time studies leading to one level down. An additional 2 levels downgrading was due to serious study bias, inter-study variation, imprecision and indirectness. The evidence from the lone cross-sectional study (Hagan, 2020), was downgraded by 3 levels to “very low” as well. It was downgraded by one level because the study was not a randomized control trial. It was further downgraded by 2 levels due to methodological issues, imprecision and indirectness.

Outcome 3: Cost-Effectiveness

A single study found for this outcome (Paltiel, 2020), was voted in favour of the intervention. This study was at high risk of bias. The quality of evidence was downgraded by one level given that it is not a randomized control trial. Being a model

based on assumptions coupled with study limitations, imprecision and indirectness, the evidence was further downgraded by 2 levels. Evidence was classed as very low.

Outcome 2: Safety

I found no study addressing this outcome. However, a body of literature exist regarding safety and security concerns from the public with contact tracing(86–88). Also, both nasopharyngeal and oropharyngeal swaps appear to be slightly invasive. The possible harms of mass testing have also been analysed by some authors(89).

Outcome 4: Acceptability

Again, no study was found regarding this outcome. Altmann and colleagues found a high level of acceptance for app-based contact tracing in their investigation across different countries including the UK(90).

Outcome 5: Equity

There was no study for this outcome. It remains however clear that the test and trace system is not equitable(27).

Binomial Test and 95% Confidence Interval

A total of 13 studies were retained for the primary objective. Statistical synthesis for the primary objective was based on binomial probability test and binomial exact confidence intervals performed in StataCorp 14.2 (Texas, USA) with input. Ten of the studies favoured the intervention [76.9%: 95% Binomial Exact CI: 46.2% - 95.0%, P=0.09], with just three [23.1%, 95% BE CI: 5.0%-53.8%, p=0.09] voted in favour of the control. The above indicates that the intervention is a better strategy than the control in the control of SARS-CoV-2/COVID-19 transmissions. The probability that the above estimate is true if conventional Test and Trace programme was truly better than Mass Testing and Contact Tracing is just 9%. The 76.9% favourable direction of effect is a clear enough majority vote to say that mass test and trace is truly more beneficial.

Assuming that the true probability of both MTT and TT being equivocal is 0.5 under the null hypothesis (H_0: MTT=TT), this study observed 10 votes well above the expected mean of 6.5 ± 1.803 votes. Four of 10 studies (40%) in favour of the intervention were at high risk of bias, 3 at moderate risk and 3 at low risk of bias. Twenty three percent of 13 retained studies were of representative sample and setting. Two of all 3 studies

(Hill, 2020 and Alsing, 2020) implemented in the UK, voted in favour of the intervention were judged to be at low risk of bias. The effect direction plot of different studies is shown in figure 4 below.

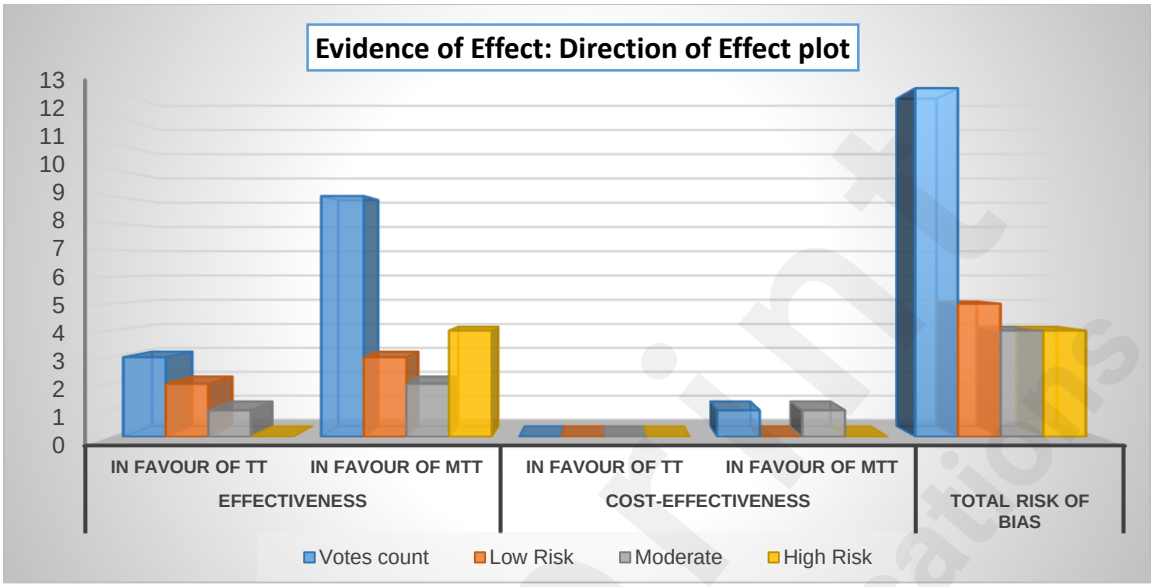

Figure 4: Evidence of effect attributable to the intervention and control for the primary objective. MTT = Mass Test and Trace (Intervention), TT = Test and Trace (Control)

The generated GRADE evidence profile was used to present the synthesis findings regarding the primary objective as seen in table 6 below. Supplement 6 provides details of how the evidence for different outcomes was graded.

The results of 6 studies including Emery (2020), Muzimoto (2020), Gorji (2020), Hill (2020), Alsing (2020) and Paltiel (2020) were prioritized. These contributed more to the conclusion that the intervention was better because they were judged to be at low to moderate risk of bias. Three of the studies (Emery, 2020; Hill, 2020; Alsing, 2020) were judged to be at low risk of bias. Two of these (Hill, 2020 and Alsing, 2020) were both of the representative population and evaluated mass testing and contact tracing as a hybrid strategy, in line with the primary objective. Emery (2020) failed to consider contact tracing but compared the effect of testing based on symptoms and testing irrespective of symptoms. The direction of effect will not be different if contact tracing were to be integrated since contact tracing is contingent on testing.

Table 6: Table of Certainty of Evidence of Included Studies

GRADE Evidence Profile: Is there evidence that testing irrespective of symptoms combined with tracing could suppress SARS-CoV-2 infections better than symptom-based testing and tracing?								
	Quality of Evidence Factors					Direction of Effect Summary of Findings		
Outcome, No of Studies (Design)	Limitation or Study bias	Heterogeneity	Indirectness	Imprecision	Publication Bias	Conventional Test an Trace	Mass Test and Trace (MTT)	Quality of evidence[4]
						Control of SARS-CoV-2/COVID-19 Transmissions		
Effectiveness n=11 (Modelling studies)	Serious	Serious	Serious	Serious	Unlikely	3 studies	8 studies ↑	⬤◯◯◯
Effectiveness n=1 (Cross-sectional study)	Not serious	Unlikely	Serious	Serious	Unlikely	0	1 study ↑	⬤◯◯◯
Cost-effectiveness n=1 (Modelling study)	Serious	Unlikely	Serious	Serious	Unlikely	0	1 study ↑	⬤◯◯◯

Better ↑ Worse ↓ Equal ↔

[4] Quality of evidence graded as either "Very low", "Low", "Moderate" or "High"

Secondary Question: What is the proportion of asymptomatic cases of SARS-CoV-2 reported during mass testing interventions?

A total of 21 cross sectional studies and 1 cohort study (33 reports and 9942828 participants) (Nishiura, 2020; Treibel, 2020; Brown, 2020; Graham, 2020; Abeysuriya, 2020; Arons, 2020; Jameson, 2020; Callaghan, 2020; Louie, 2020; Gudbjartsson, 2020; Reid, 2020; Lavezzo, 2020; Kimball, 2020; Olalla, 2020; Guery, 2020; Roxby, 2020; Lytras, 2020; Hoehl, 2020; Cao, 2020; Baggett, 2020; Imbert, 2020) were retained under the secondary objective. Mean number of positive and asymptomatic cases were 80.6±187.7 and 32.8±57.1 respectively. There was limited precision in effect estimates with just 27% of studies providing data on confidence intervals useful for the research question. Thirty two percent of studies were at low to moderate risk of bias and 68% at high risk of bias. Risk of bias evaluation can be found in table 4 above.

Outcome among detected positive cases

The proportion of asymptomatic cases among those testing positive ranged from 28% (95% CI: 25.9 – 30.2) in the general population to 96.6% (95% CI: 82.2 – 99.9) among care home staff. The overall proportion was found to be 40.7% (95% CI: 38.8 – 42.5) as can be seen in figure 5 below. Two studies (Jameson, 2020 and Callaghan, 2020) neither detected any cases nor found asymptomatic carriers and so were excluded.

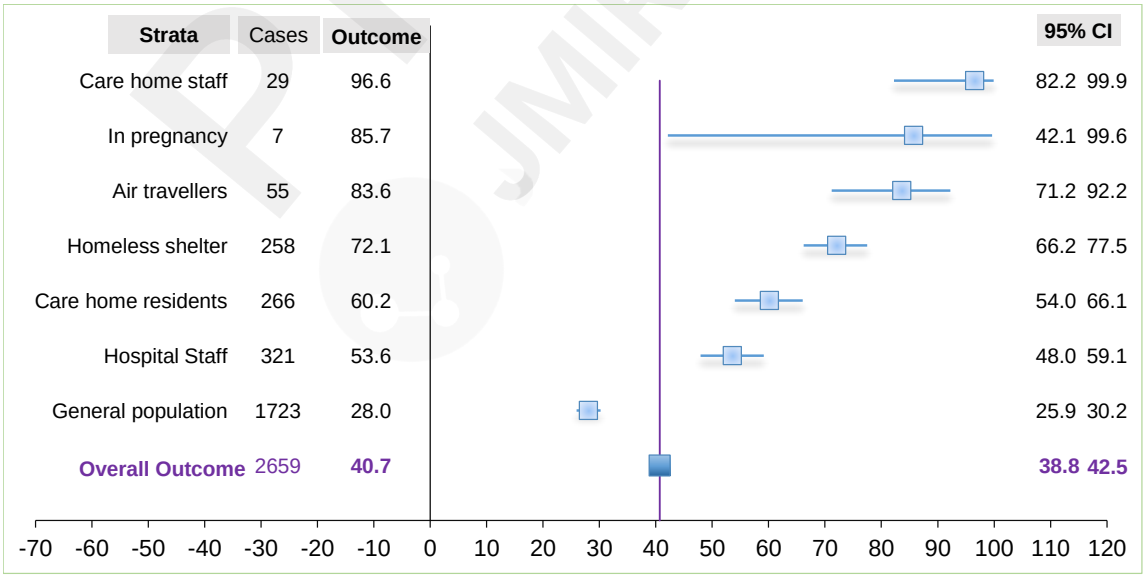

Figure 5: Proportion of asymptomatic SARS-CoV-2 carriers (outcome in %) among detected positive cases of SARS-CoV-2 in different settings from 22 studies
CI: Confidence Interval

Outcome in tested sample population

Prevalence of asymptomatic SARS-CoV-2 was highest among homeless shelter residents [30.1%, 95% CI: 26.5-33.9], followed by care home residents [21%, 95% CI: 18 – 24) and lowest among hospital patients [0%, 95% CI: 0.0 – 1.2]. Besides screening in the general population, overall asymptomatic SARS-CoV-2 prevalence for all other settings was 3.9% (95% CI: 3.6 – 4.2). Figure 6 below shows outcome prevalence in different specific populations.

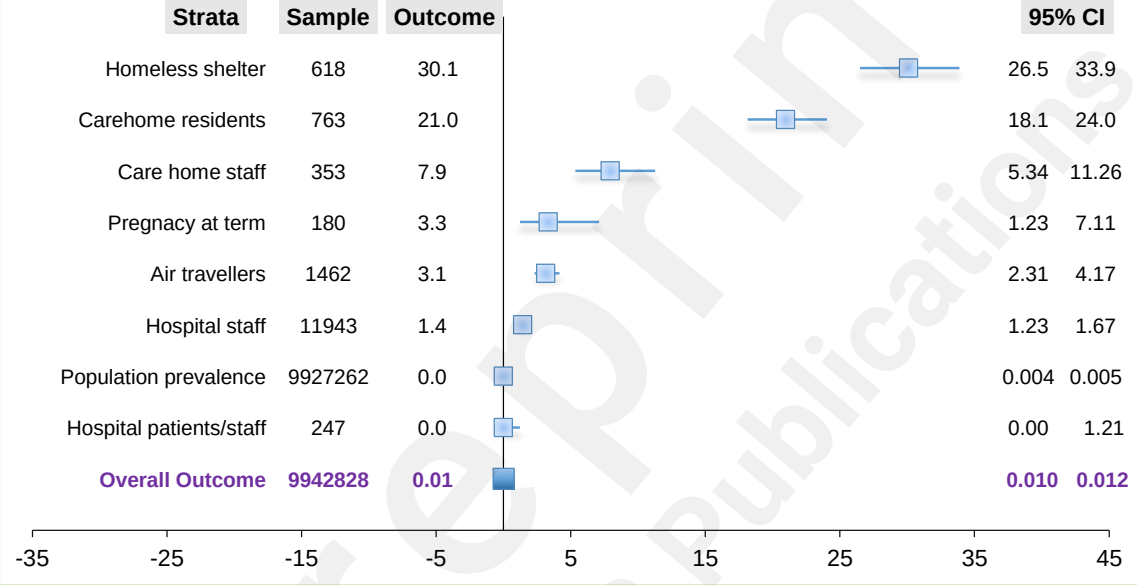

Figure 6: Proportion of asymptomatic SARS-CoV-2 carriers (outcome in %) in sampled population in different settings from 22 studies
CI: Confidence Interval

The prevalence among asymptomatic populations from 6 studies (Louie, 2020; Treibel, 2020; Lytras, 2020; Graham, 2020; Hoehl, 2020; Reid, 2020) was 3.4% (95% CI 3-4%). The prevalence in a mixed population from 17 studies (Nishiura, 2020; Brown, 2020; Abeysuriya, 2020; Arons, 2020; Jameson, 2020; Callaghan, 2020; Gudbjartsson, 2020; Lavezzo, 2020; Kimball, 2020; Olalla, 2020; Guery, 2020; Roxby, 2020; Cao, 2020; Baggett, 2020; Imbert, 2020; Graham(a), 2020; Porru, 2020), averaged 0.01% (95% CI: 0.008-0.010). Supplement 7 and 8 provides more details.

Outcome within the United Kingdom

Four studies including Treibel (2020), Brown (2020), Graham (2020) and Abeysuriya (2020) evaluated the outcome within the UK among hospital staff (Treibel, 2020 and

Brown, 2020), in care homes (Graham, 2020) and among pregnant women (Abeysuriya, 2020). The proportion of asymptomatic cases among those tested positive ranged from 44% (95% CI: 35.5 – 53.2) in care homes to 85.7% (95% CI: 42.1% - 100%) in pregnancy. The overall proportion among detected cases was found to be 56.6% (95% CI: 49.6 – 63.4). Figure 7 below shows the relationship of asymptomatic proportion among detected cases and in sampled population in different settings within the UK.

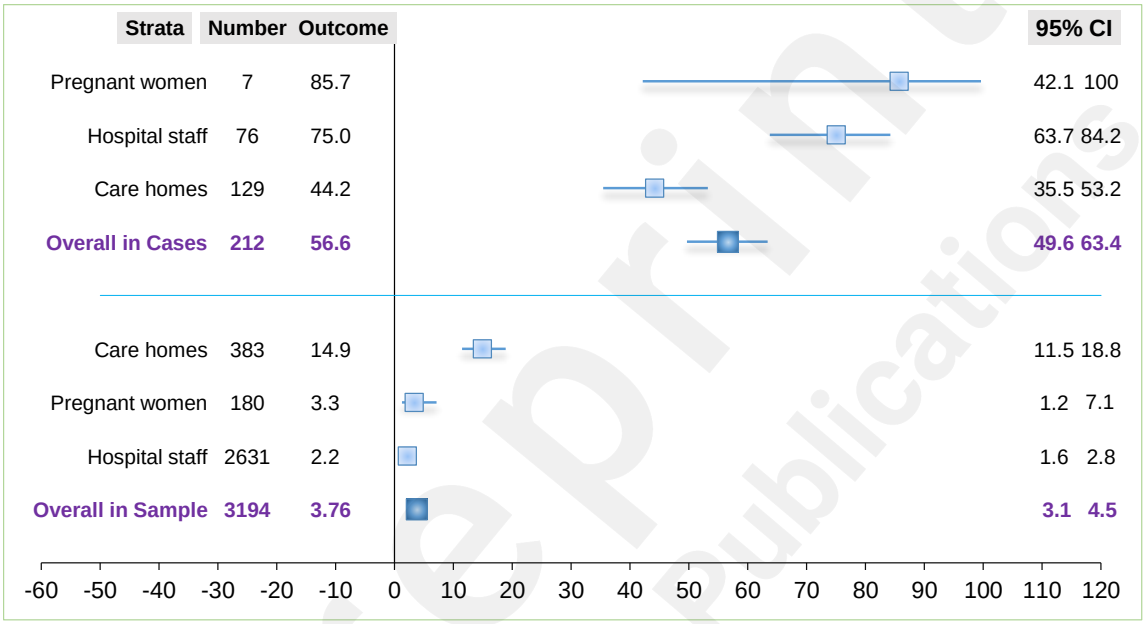

Figure 7: Proportion of asymptomatic SARS-CoV-2 carriers (outcome in %) in detected positive cases and sampled population in different settings from 4 studies in the UK
CI: Confidence Interval

Overall prevalence of asymptomatic cases within the UK was found to be 3.76% (95% CI: 3.1 – 4.5) with rates ranging from 2.2% (95% CI: 1.6 – 2.8) among hospital staff to 14.9% (95% CI: 11.5 – 18.8) in care homes. Figure 7 above clearly demonstrates a higher overall rate among detected cases compared to that of all studies (z=4.53, p=0.00001 at p=0.05). Asymptomatic cases were 1.4 times more likely to be detected among positive cases in the UK than all studies put together. There was no significant difference between overall prevalence rate in the UK (3.76%) and all studies put together (3.9%), besides population screening (z = -0.37, p=0.71 at p=0.5)

All unreported confidence intervals were generated in SATA 14.2 (binomial exact) and exported to excel. The rule of three was applied to all studies with no outcome event (Jameson, 2020 and Callaghan, 2020).

Inter-study Variability

Variations among studies included in the primary objective were mainly due to study population and setting, assumptions together with model structure. Only 3 of 13 studies synthesised under the primary objective were of the representative population. Apart from deploying different model types, some studies made use of real-time COVID-19 dataset, others used historic datasets while others relied on hypothetical samples. This increased variability and reduced the generalizability of results. However two of three studies implemented in the UK were in favour of the intervention.

An observation of plotted graphs under the secondary objective, showed minimal heterogeneity mostly stemming from the study implemented among pregnant women. Also, a stratification by setting gave a better picture and produced similar rates for studies in the UK and all studies pooled together, besides population level studies.

Discussion

Albeit considered very low level evidence, review synthesis have shown a clear enough majority vote of 76.9% (95% Binomial Exact CI: 46.2% - 95.0%, P=0.09) in favour of the intervention. Studies that were in favour of the control (Kucharski et al, 2020; Grassly et al, 2020 and Bracis et al, 2020) failed to consider mass testing and contact tracing as a hybrid strategy. These studies went on the assumption that mass testing was not feasible, as acknowledged in an open letter by Peto (2020)(92). Evidence from countries that embarked on mass testing including Taiwan, Germany, Ireland, China and India support the fact that regular mass testing and contact tracing could be the game changer. The analysis by Peto et al (2020) showed that mass testing and contact tracing is by far more cost-effective than present test and trace, in line with the second outcome. Maslov (2020) on the contrary shares an opposing view in that even the slightest false positives will render random mass testing an unreliable policy(93). While Maslov seem to be concerned with the inherent moral decadence of unjust isolation, it is rather better to be on a safe side than in a pool of false negatives and contented asymptomatic carriers. Identification of asymptomatic carriers is crucial because Viswanathan and colleagues also acknowledged that strategies based on symptom screening could miss between 40 – 100% of infected persons(94). Paying attention to asymptomatic infectiousness no matter how small the proportion may be

has also been underscored in Byambasuren et al(2020)(95). This argument is also in accordance with the key messages and objectives of European Centre for Disease Prevention and Control, that whole population be tested in high transmission settings(96).

This review also found an overall proportion of asymptomatic carriers among detected positive cases to be 40.7% (95% CI: 38.8-42.5) and 56.6% (95% CI: 49.6 – 63.4) within the UK when stratified. Proportions across studies ranged from 28% among cases detected in the general population to 96.6% among care home staff with positive tests. Also, asymptomatic SARS-CoV-2 prevalence was highest among residents in homeless shelter (30.1%) and lowest among hospital patients (0.0%). The 40.7% asymptomatic proportion among positive cases is in accordance with the 40 – 45% proportion estimated by Oran et al(97). Clarke and colleagues reported a similar rate of 40.3% among haemodialysis patients(98). This proportion is also concordant to that reported in Spain (40.5%) by Albalate et al(99). The proportion of detected positive air travellers (83.6%) found in this review is higher than the 76.6% reported in Al-Qahtani et al(100) perhaps due to more awareness as the study was implemented at a much later date. Yanes-Lane reported an asymptomatic proportion of positive cases among care home residents (54%) just a little lower than the 60.2% reported in this review(101). Notwithstanding the overarching reported high infectivity from asymptomatic individuals, this review reports rates ranging from 0.005 – 1.2% in the population, similar to rates (1.5 – 2%) reported by Wu et al(102). The estimate that the proportion of asymptomatic SARS-CoV-2 among cases in the general population is 28% is in agreement with the community asymptomatic proportion of 28% in Beale et al(103). In contrast, Petersen et al reported a community asymptomatic proportion that was three times higher (76.5% to 86.1%)(104). This population level study was undertaken in the UK, contrary to those included in this review (Iceland, Italy and China). The largest population sample in this review (about a million) was a study done immediately after lockdown which could be the reason behind the low rates.

Study Limitations

A majority of included studies were modelling studies which normally rely on assumptions that sometimes may hardly be achieved in real life. Expert knowledge

was needed to evaluate the validation process of models and it cannot be guarantee that the conclusions on bias were as accurate as would have otherwise expected. The fact that this review went through a single reviewer might have introduced some bias in study selection and analysis. The variability in the understanding of mass testing by different researchers might have had an effect on the analysis as well. This review was language biased since the literature search was limited to English articles. Non peer reviewed articles (preprints) were included in the review thereby reducing the quality of evidence. This review was not registered with PROSPERO for standard systematic review practice and will be erroneous to be considered as such.

Public Health Implications

Controlling a virus whose manifestation is increasingly without signs is not about number of tests but about who needs to be tested. An appropriate public health strategy that will get the right people tested, at the right time and in the right place requires a community based and participatory approach which will not be without a greater cost burden. Among others, winning the quenched public confidence, ensuring data privacy, acceptability of the NHS app and equity of testing and contact tracing, use of rapid test, capacity building, effective monitoring of isolation and quarantine and programme sustainability are some of the considerations that will have to be made. More real-time research is needed regarding the effectiveness of mass testing and contact tracing, for a better picture of disease burden and mitigation strategies.

Conclusion and Recommendations

This review sought to critically evaluate the evidence that mass testing and contact tracing is more effective in controlling local transmissions of COVID-19 in the UK, compared to conventional Test and Trace. It has demonstrated a very low level of promising evidence that mass testing and contact tracing could be more effective in bringing the virus under control and even more effective if combined with social distancing and face coverings. The implementation of test and trace has to be done at mass irrespective of symptoms with the local community, through GP surgeries, community health centres and local councils(105). The proposal is for the present Test and Trace to be superseded by a decentralised and continuous mass testing

programme with rapid tests, championed by low-resource-need community services(106). The following recommendations are therefore useful;

Capacitate GP surgeries and community health services to deliver mass testing at point-of-care.

Government should work in synergy with local councils for robust surveillance, isolation and quarantine(107). This showed major success in Germany(108,109)

Regular organizational and company-wide testing including the NHS, care homes and schools for the safe return of workforce and students(71,74).

Coronavirus testing should be a boarder control measure for all travellers(111,112).

Testing of prisoners, detainees and all those in congested accommodations(55). The Lesbos camp testing in Greece led to more than 240 positive cases(113,114)

Sewage and environment related testing should be part of mitigation strategies

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Conflict of Interest

The author declares no competing interest

Patient Consent

Not applicable

Declaration of Data Sharing

There is no additional data

References

1. Wise J. Covid-19: Test and trace system is not fit for purpose, says Independent SAGE. BMJ [Internet]. 2020 Jun 9 [cited 2020 Sep 14];369:m2302. Available from: https://bmj.com/coronavirus/usage

2. Burns C. National Institute for Health Protection takes over COVID-19 pandemic response from PHE. Pharm J [Internet]. 2020 Aug 18 [cited 2020 Sep 7]; Available from: https://www.pharmaceutical-journal.com/news-and-analysis/news/national-institute-for-health-protection-takes-over-covid-19-pandemic-response-from-phe/20208276.article?firstPass=false

3. Dunn P, Allen L, Cameron G, Malhotra M, Alderwick H. COVID-19 policy tracker [Internet]. The Health Foundation. 2020 [cited 2021 Jan 11]. Available from: https://www.health.org.uk/news-and-comment/charts-and-infographics/covid-19-policy-tracker

4. NHS. Coronavirus (COVID-19) vaccine [Internet]. 2021 [cited 2021 Jan 11]. Available from: https://www.nhs.uk/conditions/coronavirus-covid-19/coronavirus-vaccination/coronavirus-vaccine/

5. PHE & NHSX. Daily summary: Coronavirus in the UK [Internet]. 2020 [cited 2020 Dec 5]. Available from: https://coronavirus.data.gov.uk/

6. Ryan Wain, Lizzie Install DS. Pressing Go on Mass Testing | Institute for Global Change [Internet]. Institute for Global Change. [cited 2020 Sep 9]. Available from: https://institute.global/policy/pressing-go-mass-testing

7. Peto J, Alwan NA, Godfrey KM, Burgess RA, Hunter DJ, Riboli E, et al. Universal weekly testing as the UK COVID-19 lockdown exit strategy [Internet]. Vol. 395, The Lancet. Lancet Publishing Group; 2020 [cited 2020 Sep 22]. p. 1420–1. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30936-3/fulltext

8. WHO Director-General's opening remarks at the media briefing on COVID-19 - 16 March 2020 [Internet]. WHO. 2020 [cited 2020 Nov 11]. Available from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---16-march-2020

9. Davies NG, Barnard RC, Jarvis CI, Kucharski AJ, Munday J, Pearson CAB, et al. Estimated transmissibility and severity of novel SARS-CoV-2 Variant of Concern 202012/01 in England. 2020 [cited 2021 Jan 12];1–6. Available from:

https://www.medrxiv.org/content/10.1101/2020.12.24.20248822v1,

10. ECDC. Public health management of persons having had contact with cases of novel coronavirus in the EU. 2020 [cited 2020 Sep 22];(January):1–4. Available from: papers3://publication/uuid/4D261CA4-0AD6-487C-8F1C-3074F9C454A8

11. Canetti R, Kalai YT, Lysyanskaya A, Rivest RL, Shamir A, Shen E, et al. Privacy-Preserving Automated Exposure Notification [Internet]. 2020 [cited 2020 Sep 23]. Available from: https://eprint.iacr.org/2020/863.pdf

12. Owusu PN. Digital technology applications for contact tracing: the new promise for COVID-19 and beyond? Glob Heal Res Policy [Internet]. 2020 Dec 3 [cited 2020 Sep 15];5(1):36. Available from: https://ghrp.biomedcentral.com/articles/10.1186/s41256-020-00164-1

13. CDC. Quarantine and Isolation [Internet]. 2020 [cited 2020 Oct 16]. Available from: https://www.cdc.gov/quarantine/index.html

14. Gov.Scot. Test and Protect: A Step-By-Step Guide [Internet]. 2020 [cited 2020 Oct 14]. Available from: https://www.nhsinform.scot/campaigns/test-and-protect

15. Gov.Wales. Test Trace Protect: summary of testing strategy [Internet]. [cited 2020 Oct 14]. Available from: https://gov.wales/test-trace-protect-summary-testing-strategy

16. Department of Health Northen Ireland. Covid-19 Test, Trace and Protect Strategy Saving lives by minimising SARS-CoV2 transmission in the community in Northern Ireland [Internet]. 2020 [cited 2020 Oct 14]. Available from: https://www.health-ni.gov.uk/sites/default/files/publications/health/Test-Trace-Protect-Support-Strategy.pdf

17. Raffle AE, Pollock AM, Harding-Edgar L. Covid-19 mass testing programmes. BMJ [Internet]. 2020 Aug 20 [cited 2020 Sep 14];370. Available from: https://www.bmj.com/content/370/bmj.m3262

18. Wales PH. Critical Appraisal: Using Evidence Guide [Internet]. [cited 2020 Sep 25]. Available from: http://www2.nphs.wales.nhs.uk:8080/PubHObservatoryProjDocs.nsf/($All)/14F0A854DDB3EEC68025834A003A024F/$File/Guide_5_(final3).pdf?OpenElement

19. Li Z, Chen Q, Feng L, Rodewald L, Xia Y, Yu H, et al. Active case finding with case

management: the key to tackling the COVID-19 pandemic [Internet]. Vol. 396, The Lancet. Lancet Publishing Group; 2020 [cited 2020 Sep 13]. p. 63–70. Available from: https://www.sciencedirect.com/science/article/pii/S0140673620312782

20. Department of Health and Social Care. NHS test and trace: how it works - GOV.UK [Internet]. Gov.uk. 2020 [cited 2020 Sep 6]. Available from: https://www.gov.uk/guidance/nhs-test-and-trace-how-it-works

21. Li R, Pei S, Chen B, Song Y, Zhang T, Yang W, et al. Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2) [Internet]. [cited 2020 Sep 22]. Available from: https://science.sciencemag.org/content/368/6490/489

22. Maugeri A, Barchitta M, Battiato S, Agodi A. Estimation of Unreported Novel Coronavirus (SARS-CoV-2) Infections from Reported Deaths: A Susceptible–Exposed–Infectious–Recovered–Dead Model. J Clin Med [Internet]. 2020 [cited 2020 Sep 22];9(5):1350. Available from: https://www.mdpi.com/2077-0383/9/5/1350/htm

23. Emery JC, Russell TW, Liu Y, Hellewell J, Pearson CA, CMMID COVID-19 Working Group, et al. The contribution of asymptomatic SARS-CoV-2 infections to transmission on the Diamond Princess cruise ship. Elife [Internet]. 2020 Aug 24 [cited 2020 Sep 8];9. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7527238/

24. Ransing R, Ramalho R, de Filippis R, Ojeahere MI, Karaliuniene R, Orsolini L, et al. Infectious disease outbreak related stigma and discrimination during the COVID-19 pandemic: Drivers, facilitators, manifestations, and outcomes across the world [Internet]. Vol. 89, Brain, Behavior, and Immunity. Academic Press Inc.; 2020 [cited 2020 Oct 22]. p. 555. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7384410/

25. Mayers C, Baker K. Impact of false-positives and false-negatives in the UK's COVID-19 RT-PCR testing programme. 2020 [cited 2020 Sep 27];1(March):3–7. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895843/S0519_Impact_of_false_positives_and_negatives.pdf

26. De Montjoye Y-A, Houssiau F. Blogpost: Can we fight COVID-19 without re-sorting to mass surveillance? [Internet]. [cited 2020 Sep 14]. Available from: https://cpg.doc.ic.ac.uk/blog/pdf/fighting-covid-19.pdf

27. WHO. What is universal coverage? [Internet]. WHO. World Health Organization; 2014 [cited 2020 Sep 17]. Available from: http://www.who.int/health_financing/universal_coverage_definition/en/

28. Iacobucci G, Coombes R. Covid-19: Government plans to spend £100bn on expanding testing to 10 million a day. BMJ [Internet]. 2020 [cited 2020 Sep 10]; Available from: http://dx.doi.org/10.1136/bmj.m3520

29. Fraser C, Briggs A. NHS Test and Trace performance tracker [Internet]. The Health Foundation. 2020 [cited 2020 Dec 29]. Available from: https://www.health.org.uk/news-and-comment/charts-and-infographics/nhs-test-and-trace-performance-tracker

30. Davis EL, Lucas TCD, Borlase A, Pollington TM, Abbott S, Ayabina D, et al. An imperfect tool: COVID-19 "test & trace" success relies on minimising the impact of false negatives and continuation of physical distancing. medRxiv [Internet]. 2020 Aug 21 [cited 2020 Sep 8];2020.06.09.20124008. Available from: https://www.medrxiv.org/content/10.1101/2020.06.09.20124008v2

31. Kucirka LM, Lauer SA, Laeyendecker O, Boon D, Lessler J. Variation in False-Negative Rate of Reverse Transcriptase Polymerase Chain Reaction–Based SARS-CoV-2 Tests by Time Since Exposure. Ann Intern Med [Internet]. 2020 Aug 18 [cited 2020 Sep 8];173(4):262–7. Available from: https://www.acpjournals.org/doi/10.7326/M20-1495?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub 0pubmed

32. Wölfel R, Corman VM, Guggemos W, Seilmaier M, Zange S, Müller MA, et al. Virological assessment of hospitalized patients with COVID-2019. Nature [Internet]. 2020 May 28 [cited 2020 Oct 19];581(7809):465–9. Available from: https://doi.org/10.1038/s41586-020-2196-x

33. Nishiura H, Linton NM, Akhmetzhanov AR. Serial interval of novel coronavirus (COVID-19) infections. Int J Infect Dis [Internet]. 2020 Apr 1 [cited 2020 Sep 8];93:284–6. Available from: https://www.ijidonline.com/article/S1201-9712(20)30119-3/pdf

34. Liu Y, Funk S, Flasche S, Jit M, Bosse NI, Gimma A, et al. The contribution of pre-symptomatic infection to the transmission dynamics of COVID-2019. Wellcome Open Res [Internet]. 2020 [cited 2020 Sep 8];5. Available from: https://doi.org/10.12688/wellcomeopenres.15788.1https://doi.org/10.12688/wellcomeopenres.15788.1

35. Rae M, Friedman E. Covid-19: An efficient and effective test trace regime is not a numbers game. BMJ [Internet]. 2020 Sep 14 [cited 2020 Dec 29];370:m3553. Available from: http://dx.doi.org/10.1136/bmj.m3553

36. Lassi ZS, Salam RA, Das JK, Bhutta ZA. The conceptual framework and assessment methodology for the systematic reviews of community-based interventions for the prevention and control of infectious diseases of poverty [Internet]. Vol. 3, Infectious Diseases of Poverty. BioMed Central Ltd.; 2014 [cited 2020 Oct 22]. p. 22. Available from: http://idpjournal.biomedcentral.com/articles/10.1186/2049-9957-3-22

37. Hu B, Guo H, Zhou P, Shi Z-L. Characteristics of SARS-CoV-2 and COVID-19. Nat Rev Microbiol [Internet]. 2020;(December). Available from: http://dx.doi.org/10.1038/s41579-020-00459-7

38. McKenzie JE, Brennan SE, Ryan RE, Thomson HJ, Johnston RV TJ. Chapter 3: Defining the criteria for including studies and how they will be grouped for the synthesis. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version [Internet]. Cochrane. 2020 [cited 2020 Nov 4]. Available from: https://training.cochrane.org/handbook

39. Higgins JPT, Li T DJ (editors). Chapter 6: Choosing effect measures and computing estimates of effect. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.1 (updated September 2020) [Internet]. Cochrane. 2020 [cited 2020 Nov 5]. Available from: https://training.cochrane.org/handbook

40. Campbell M, McKenzie JE, Sowden A, Katikireddi SV, Brennan SE, Ellis S, et al. Synthesis without meta-analysis (SWiM) in systematic reviews: Reporting guideline. BMJ [Internet]. 2020 Jan 16 [cited 2020 Oct 21];368. Available from: http://dx.doi.org/10.1136/bmj.l6890http://www.bmj.com/

41. Siebert M. Heterogeneity: what is it and why does it matter? [Internet]. Students 4 Best Evidence. 2018 [cited 2020 Nov 4]. Available from: https://s4be.cochrane.org/blog/2018/11/29/what-is-heterogeneity/

42. Deeks JJ, Higgins JPT AD (editors). Chapter 10: Analysing data and undertaking meta-analyses. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.1 (updated September 2020) [Internet]. Cochrane. 2020

[cited 2020 Nov 6]. Available from: https://training.cochrane.org/handbook

43. Morgan S. Meta-tool for quality appraisal of public health evidence PHO MetaQAT 1.0 QUALITY APPRAISAL TOOL [Internet]. 2015 [cited 2020 Nov 22]. Available from: https://www.publichealthontario.ca/-/media/documents/m/2016/metaqat.pdf?la=en

44. Ma LL, Wang YY, Yang ZH, Huang D, Weng H, Zeng XT. Methodological quality (risk of bias) assessment tools for primary and secondary medical studies: What are they and which is better? [Internet]. Vol. 7, Military Medical Research. BioMed Central Ltd.; 2020 [cited 2020 Nov 29]. p. 1–11. Available from: https://doi.org/10.1186/s40779-020-00238-8

45. Jaime Caro J, Eddy DM, Kan H, Kaltz C, Patel B, Eldessouki R, et al. Questionnaire to assess relevance and credibility of modeling studies for informing health care decision making: An ISPOR-AMCP-NPC good practice task force report. Value Heal [Internet]. 2014 Mar 1 [cited 2020 Oct 5];17(2):174–82. Available from: http://dx.doi.org/10.1016/j.jval.2014.01.003

46. Critical Appraisal Skills Programme. CASP Checklist. Casp [Internet]. 2018 [cited 2020 Sep 3];4(2018):1. Available from: http://www.casp-uk.net/casp-tools-checklists

47. Specialist Unit for Review Evidence (SURE) 2018. Questions to assist with the critical appraisal of cross-sectional studies. [cited 2020 Oct 15]; Available from: https://www.cardiff.ac.uk/__data/assets/pdf_file/0010/1142974/SURE-CA-form-for-Cross-sectional_2018.pdf

48. Schünemann, Holger; Brożek, Jan; Guyatt, Gordon; Oxman A. GRADE Handbook | Cochrane Training [Internet]. [cited 2020 Nov 27]. Available from: https://training.cochrane.org/resource/grade-handbook

49. Eyding D, Lelgemann M, Grouven U, Härter M, Kromp M, Kaiser T, et al. Reboxetine for acute treatment of major depression: Systematic review and meta-analysis of published and unpublished placebo and selective serotonin reuptake inhibitor controlled trials [Internet]. Vol. 341, BMJ (Online). British Medical Journal Publishing Group; 2010 [cited 2020 Nov 6]. p. 816. Available from: https://www.bmj.com/content/341/bmj.c4737

50. Grassly NC, Pons-Salort M, Parker EPK, White PJ, Ferguson NM. Comparison of molecular testing strategies for COVID-19 control: a mathematical modelling study. 2020 [cited 2020 Sep 8]; Available from:

https://www.thelancet.com/action/showPdf?pii=S1473-3099%2820%2930630-7

51. Tsou HH, Cheng YC, Yuan HY, Hsu YT, Wu HY, Lee FJ, et al. The effect of preventing subclinical transmission on the containment of COVID-19: Mathematical modeling and experience in Taiwan. Contemp Clin Trials [Internet]. 2020 Sep 1 [cited 2020 Sep 13];96:106101. Available from: https://www.sciencedirect.com/science/article/pii/S1551714420301798

52. Mizumoto K, Kagaya K, Zarebski A, Chowell G. Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19) cases on board the Diamond Princess cruise ship, Yokohama, Japan, 2020 [Internet]. Vol. 25, Eurosurveillance. European Centre for Disease Prevention and Control (ECDC); 2020 [cited 2020 Sep 14]. Available from: https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2020.25.10.2000180

53. Reandy Sasmita N, Ikhwan M, Suyanto S, Chongsuvivatwong V. Optimal control on a mathematical model to pattern the progression of coronavirus disease 2019 (COVID-19) in Indonesia. [cited 2020 Sep 26]; Available from: https://ghrp.biomedcentral.com/articles/10.1186/s41256-020-00163-2

54. Moghadas SM, Fitzpatrick MC, Sah P, Pandey A, Shoukat A, Singer BH, et al. The implications of silent transmission for the control of COVID-19 outbreaks. Proc Natl Acad Sci U S A [Internet]. 2020 Jul 28 [cited 2020 Oct 15];117(30):17513–5. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7395516/pdf/pnas.202008373.pdf

55. Bracis C, Burns E, Moore M, Swan D, Reeves DB, Schiffer JT, et al. Widespread testing, case isolation and contact tracing may allow safe school reopening with continued moderate physical distancing: A modeling analysis of King County, WA data. Infect Dis Model [Internet]. 2021 [cited 2020 Nov 25];6:24–35. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2468042720300737

56. Pollmann TR, Pollmann J, Wiesinger C, Haack C, Shtembari L, Turcati A, et al. The impact of digital contact tracing on the SARS-CoV-2 pandemic-a comprehensive 2 modelling study. 2020 [cited 2020 Dec 19]; Available from: https://doi.org/10.1101/2020.09.13.20192682

57. Hill EM, Atkins BD, Keeling MJ, Tildesley MJ, Dyson L. Modelling SARS-CoV-2 transmission in a UK university setting. [cited 2020 Dec 19]; Available from:

https://doi.org/10.1101/2020.10.15.20208454

58. Gorji H, Arnoldini M, Jenny DF, Duc A, Hardt W-D, Jenny P. STeCC: Smart Testing with Contact Counting Enhances Covid-19 Mitigation by Bluetooth App Based Contact Tracing. [cited 2020 Dec 19]; Available from: https://doi.org/10.1101/2020.03.27.20045237

59. Alsing J, Usher NN, Crowley PJ. Containing Covid-19 outbreaks with spatially targeted short-term lockdowns and mass-testing. MedRix [Internet]. 2020 [cited 2020 Dec 22];1–12. Available from: https://doi.org/10.1101/2020.05.05.20092221

60. Hagan LM, Williams SP, Spaulding AC, Toblin RL, Figlenski J, Ocampo J, et al. Mass Testing for SARS-CoV-2 in 16 Prisons and Jails — Six Jurisdictions, United States, April–May 2020. MMWR Morb Mortal Wkly Rep [Internet]. 2020 [cited 2020 Sep 9];69(33):1139–43. Available from: https://www.cdc.gov/mmwr/volumes/69/wr/mm6933a3.htm

61. Paltiel AD, Zheng A, Walensky RP. Assessment of SARS-CoV-2 Screening Strategies to Permit the Safe Reopening of College Campuses in the United States. JAMA Netw open [Internet]. 2020 Jul 1 [cited 2020 Oct 15];3(7):e2016818. Available from: https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2768923?utm_campaign=articlePDF&utm_medium=articlePDFlink&utm_source=articlePDF&utm_content=jamanetworkopen.2020.16818

62. Nishiura H, Kobayashi T, Miyama T, Suzuki A, Jung S mok, Hayashi K, et al. Estimation of the asymptomatic ratio of novel coronavirus infections (COVID-19) [Internet]. Vol. 94, International Journal of Infectious Diseases. Elsevier B.V.; 2020 [cited 2020 Sep 8]. p. 154–5. Available from: https://www.ijidonline.com/article/S1201-9712(20)30139-9/pdf

63. Porru S, Carta A, Monaco MGL, Verlato G, Battaggia A, Parpaiola M, et al. Health Surveillance and Response to SARS-CoV-2 Mass Testing in Health Workers of a Large Italian Hospital in Verona, Veneto. Int J Environ Res Public Health [Internet]. 2020 Jul 15 [cited 2020 Sep 9];17(14):5104. Available from: https://www.mdpi.com/1660-4601/17/14/5104

64. Treibel TA, Manisty C, Burton M, McKnight Á, Lambourne J, Augusto JB, et al. COVID-19: PCR screening of asymptomatic health-care workers at London hospital [Internet]. Vol. 395, The Lancet. Lancet Publishing Group; 2020 [cited 2020 Sep 12]. p. 1608–10. Available from:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7206444/

65. Abeysuriya S, Wasif S, Counihan C, Shah N, Iliodromiti S, Cutino-Moguel MT, et al. Universal screening for SARS-CoV-2 in pregnant women at term admitted to an East London maternity unit. Eur J Obstet Gynecol Reprod Biol [Internet]. 2020 Sep 1 [cited 2020 Sep 13];252:444–6. Available from: https://doi.org/10.1016/j.ejogrb.2020.07.035

66. Brown CS, Clare K, Chand M, Andrews J, Auckland C, Beshir S, et al. Snapshot PCR surveillance for SARS-CoV-2 in hospital staff in England. J Infect [Internet]. 2020 Sep 1 [cited 2020 Sep 13];81(3):427–34. Available from: https://www.sciencedirect.com/science/article/pii/S0163445320304503

67. Graham NSN, Junghans C, Downes R, Sendall C, Lai H, McKirdy A, et al. SARS-CoV-2 infection, clinical features and outcome of COVID-19 in United Kingdom nursing homes. J Infect [Internet]. 2020 Sep 1 [cited 2020 Sep 13];81(3):411–9. Available from: https://www.sciencedirect.com/science/article/pii/S0163445320303480

68. Arons MM, Hatfield KM, Reddy SC, Kimball A, James A, Jacobs JR, et al. Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility. N Engl J Med [Internet]. 2020 May 28 [cited 2020 Sep 14];382(22):2081–90. Available from: http://www.nejm.org/doi/10.1056/NEJMoa2008457

69. Jameson AP, Biersack MP, Sebastian TM, Jacques Dnp LR. SARS-CoV-2 screening of asymptomatic healthcare workers. Infect Control Hosp Epidemiol [Internet]. 2020 [cited 2020 Sep 15];1–2. Available from: https://doi.org/10.1017/ ice.2020.361

70. Callaghan AW, Chard AN, Arnold P, Loveland C, Hull N, Saraiya M, et al. Screening for SARS-CoV-2 Infection Within a Psychiatric Hospital and Considerations for Limiting Transmission Within Residential Psychiatric Facilities — Wyoming, 2020. MMWR Morb Mortal Wkly Rep [Internet]. 2020 Jul 3 [cited 2020 Sep 15];69(26):825–9. Available from: http://www.cdc.gov/mmwr/volumes/69/wr/mm6926a4.htm?s_cid=mm6926a4_w

71. Louie JK, Scott HM, DuBois A, Sturtz N, Lu W, Stoltey J, et al. Lessons from Mass-Testing for COVID-19 in Long Term Care Facilities for the Elderly in San Francisco. Clin Infect Dis [Internet]. 2020 Jul 20 [cited 2020 Sep 16]; Available from: https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa1020/5873783

72. Gudbjartsson DF, Helgason A, Jonsson H, Magnusson OT, Melsted P, Norddahl GL, et al. Spread of SARS-CoV-2 in the Icelandic Population. N Engl J Med [Internet]. 2020 Jun 11 [cited 2020 Sep 26];382(24):2302–15. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7175425/

73. Robert J. Reid, Laura Rosella, Natasha Milijasevic LNS. Mass testing for asymptomatic COVID-19 infection among health care workers at a large Canadian Hospital [Internet]. Official Journal of the Association of Medical Microbiology and Infectious Disease Canada. 2020 [cited 2020 Oct 15]. Available from: https://jammi.utpjournals.press/doi/pdf/10.3138/jammi-2020-0027

74. Lavezzo E, Franchin E, Ciavarella C, Cuomo-dannenburg G, Navarin N, Abate D, et al. Suppression of a SARS-CoV-2 outbreak in the Italian municipality of Vo '. 2020;584(August). Available from: https://www.nature.com/articles/s41586-020-2488-1?fbclid=IwAR0Y69FXQqJqogOf-1lnHI6fi25CSuM1q4zJEpfFMVZaISsOnS3W7vxcUOM

75. Kimball A, Hatfield KM, Arons M, James A, Taylor J, Spicer K, et al. Asymptomatic and Presymptomatic SARS-CoV-2 Infections in Residents of a Long-Term Care Skilled Nursing Facility — King County, Washington, March 2020. MMWR Morb Mortal Wkly Rep [Internet]. 2020 Apr 3 [cited 2020 Dec 13];69(13):377–81. Available from: http://www.cdc.gov/mmwr/volumes/69/wr/mm6913e1.htm?s_cid=mm6913e1_w

76. Olalla J, Correa AM, Martín-Escalante , M D, Hortas ML, Martín-Sendarrubias MJ, Fuentes V, et al. Search for asymptomatic carriers of SARS-CoV-2 in healthcare workers during the pandemic: a Spanish experience. QJM An Int J Med [Internet]. 2020 Nov 1 [cited 2020 Dec 11];113(11):794–8. Available from: https://academic.oup.com/qjmed/article/113/11/794/5890491

77. Guery R, Delaye C, Brule N, Nael V, Castain L, Raffi F, et al. Limited effectiveness of systematic screening by nasopharyngeal RT-PCR of medicalized nursing home staff after a first case of COVID-19 in a resident [Internet]. Vol. 50, Medecine et Maladies Infectieuses. Elsevier Masson s.r.l.; 2020 [cited 2020 Dec 14]. p. 748–50. Available from: https://www.sciencedirect.com/science/article/pii/S0399077X20301268

78. Roxby AC, Greninger AL, Hatfield KM, Lynch JB, Dellit TH, James A, et al. Detection of SARS-CoV-2 Among Residents and Staff Members of an Independent and Assisted Living Community for Older Adults — Seattle, Washington, 2020. MMWR Morb Mortal Wkly Rep [Internet]. 2020 Apr 10 [cited

2020 Dec 14];69(14):416–8. Available from: http://www.cdc.gov/mmwr/volumes/69/wr/mm6914e2.htm?s_cid=mm6914e2_w

79. Lytras T, Dellis G, Flountzi A, Hatzianastasiou S, Nikolopoulou G, Tsekou K, et al. High prevalence of SARS-CoV-2 infection in repatriation flights to Greece from three European countries. J Travel Med [Internet]. 2020 May 18 [cited 2020 Dec 14];27(3):1–2. Available from: https://academic.oup.com/jtm/article/doi/10.1093/jtm/taaa054/5820895

80. Hoehl S, Rabenau H, Berger A, Kortenbusch M, Cinatl J, Bojkova D, et al. Evidence of SARS-CoV-2 Infection in Returning Travelers from Wuhan, China. N Engl J Med [Internet]. 2020 Mar 26 [cited 2020 Dec 14];382(13):1278–80. Available from: https://www.nejm.org/doi/10.1056/NEJMc2001899

81. Cao S, Gan Y, Wang C, Bachmann M, Wei S, Gong J, et al. Post-lockdown SARS-CoV-2 nucleic acid screening in nearly ten million residents of Wuhan, China. Nat Commun [Internet]. 2020;11(5917):1–7. Available from: http://dx.doi.org/10.1038/s41467-020-19802-w

82. Baggett TP, Keyes H, Sporn N, Gaeta JM. Prevalence of SARS-CoV-2 Infection in Residents of a Large Homeless Shelter in Boston [Internet]. Vol. 323, JAMA - Journal of the American Medical Association. American Medical Association; 2020 [cited 2020 Dec 11]. p. 2191–2. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7186911/

83. Elizabeth Imbert, Kinley PM, Scarborough A, Cawley C, Sankaran M, Cox SN, et al. Coronavirus Disease 2019 (COVID-19) Outbreak in a San Francisco Homeless Shelter [Internet]. Oxford University Press. 2020 [cited 2020 Dec 16]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7454344/pdf/ciaa1071.pdf

84. Farrah K, Young K, Tunis MC, Zhao L. Risk of bias tools in systematic reviews of health interventions: an analysis of PROSPERO-registered protocols. Syst Rev [Internet]. 2019 Nov 15 [cited 2020 Nov 22];8(1):280. Available from: https://systematicreviewsjournal.biomedcentral.com/articles/10.1186/s13643-019-1172-8

85. Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ WV (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.1 (updated September 2020) [Internet]. Cochrane. 2020 [cited 2020 Oct 29]. Available from: https://training.cochrane.org/handbook

86. Ryan M. In defence of digital contact-tracing: human rights, South Korea and Covid-19. Int J Pervasive Comput Commun [Internet]. 2020 [cited 2020 Sep 14]; Available from: https://www.emerald.com/insight/content/doi/10.1108/IJPCC-07-2020-0081/full/html

87. Breeher L, Boon A, Hainy C, Murad MH, Wittich C, Swift M. A Framework for Sustainable Contact Tracing and Exposure Investigation for Large Health Systems [Internet]. Vol. 95, Mayo Clinic Proceedings. 2020 [cited 2020 Sep 25]. p. 1432–44. Available from: https://doi.org/10.1016/j.mayocp.2020.05.008

88. Anglemyer A, Moore TH, Parker L, Chambers T, Grady A, Chiu K, et al. Digital contact tracing technologies in epidemics: A rapid review. Cochrane Database Syst Rev [Internet]. 2020 Aug 18 [cited 2020 Sep 16];(8). Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD013699/full

89. Gill M, Gray M. Mass testing for covid-19 in the UK [Internet]. Vol. 371, The BMJ. BMJ Publishing Group; 2020 [cited 2020 Dec 29]. Available from: http://dx.doi.org/10.1136/bmj.m4436

90. Altmann S, Milsom L, Zillessen H, Blasone R, Gerdon F, Bach R, et al. Acceptability of App-Based Contact Tracing for COVID-19: Cross-Country Survey Study. [cited 2020 Sep 15]; Available from: http://mhealth.jmir.org/2020/8/e19857/

91. Neyeloff JL, Fuchs SC, Moreira LB. Meta-analyses and Forest plots using a microsoft excel spreadsheet: Step-by-step guide focusing on descriptive data analysis. BMC Res Notes [Internet]. 2012 Dec 20 [cited 2021 Jan 3];5(1):52. Available from: https://bmcresnotes.biomedcentral.com/articles/10.1186/1756-0500-5-52

92. Peto J. Covid-19 mass testing facilities could end the epidemic rapidly [Internet]. Vol. 368, The BMJ. BMJ Publishing Group; 2020 [cited 2020 Sep 8]. Available from: https://www.bmj.com/content/bmj/368/bmj.m1163.full.pdf

93. Maslov A. Why Mandatory Mass Testing for COVID-19 is a Poor Policy. 2020 Jun 22 [cited 2020 Sep 16]; Available from: https://papers.ssrn.com/abstract=3643408

94. Viswanathan M, Kahwati L, Jahn B, Giger K, Dobrescu AI, Hill C, et al. Universal screening for SARS-CoV-2 infection: a rapid review [Internet]. Vol. 2020, Cochrane Database of Systematic Reviews. John Wiley and Sons Ltd; 2020 [cited 2020 Nov 11]. Available from:

https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD013718/epdf/standard

95. Byambasuren O, Cardona M, Bell K, Ba JC, Mclaws M-L, Glasziou P. Estimating the extent of asymptomatic COVID-19 and its potential for community transmission: Systematic review and meta-analysis. JAMMI [Internet]. 2020 [cited 2020 Oct 18]; Available from: https://jammi.utpjournals.press/doi/pdf/10.3138/jammi-2020-0030

96. European Centre for Disease Prevention and Control. COVID-19 testing strategies and objectives. 15 September 2020. ECDC: Stockholm; [Internet]. 2020 [cited 2020 Dec 8]. Available from: https://www.ecdc.europa.eu/sites/default/files/documents/TestingStrategy_Objective-Sept-2020.pdf

97. Oran DP, Topol EJ. Prevalence of Asymptomatic SARS-CoV-2 Infection : A Narrative Review [Internet]. Vol. 173, Annals of internal medicine. NLM (Medline); 2020 [cited 2020 Oct 9]. p. 362–7. Available from: https://www.acpjournals.org/doi/abs/10.7326/M20-3012

98. Clarke C, Prendecki M, Dhutia A, Ali MA, Sajjad H, Shivakumar O, et al. High Prevalence of Asymptomatic COVID-19 Infection in Hemodialysis Patients Detected Using Serologic Screening. J Am Soc Nephrol [Internet]. 2020 Sep 1 [cited 2021 Jan 10];31(9):1969–75. Available from: www.jasn.org

99. Albalate M, Arribas P, Torres E, Cintra M, Alcázar R, Puerta M, et al. High prevalence of asymptomatic COVID-19 in hemodialysis. Daily learning during first month of COVID-19 pandemic. Nefrologia [Internet]. 2020 May 1 [cited 2021 Jan 10];40(3):279–86. Available from: https://www.revistanefrologia.com/en-high-prevalence-asymptomatic-covid-19-in-articulo-S2013251420300754

100. Al-Qahtani M, AlAli S, AbdulRahman AK, Salman Alsayyad A, Otoom S, Atkin SL. The prevalence of asymptomatic and symptomatic COVID-19 in a cohort of quarantined subjects. Int J Infect Dis [Internet]. 2021 Jan 1 [cited 2021 Jan 9];102:285–8. Available from: https://doi.org/10.1016/j.ijid.2020.10.091

101. Id MY-L, Winters N, Fregonese F, Bastos M, Perlman-Arrow S, Campbell JR, et al. Proportion of asymptomatic infection among COVID-19 positive persons and their transmission potential: A systematic review and meta-analysis. 2020 [cited 2021 Jan 10]; Available from: https://doi.org/10.1371/journal.pone.0241536

102. Wu Z, McGoogan JM. Asymptomatic and Pre-Symptomatic COVID-19 in China [Internet]. Vol. 9, Infectious Diseases of Poverty. BioMed Central; 2020 [cited 2021 Jan 10]. p. 72. Available from: https://idpjournal.biomedcentral.com/articles/10.1186/s40249-020-00679-2

103. Beale S, Hayward A, Shallcross L, Aldridge RW, Fragaszy E. A Rapid Review of the Asymptomatic Proportion of PCR-Confirmed SARS-CoV-2 Infections in Community Settings [Internet]. [cited 2021 Jan 10]. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/925128/S0745_Rapid_review_of_asymptomatic_proportion_of_SARS-CoV-2_infections_in_community_settings.pdf

104. Petersen I, Phillips A. Three Quarters of People with SARS-CoV-2 Infection are Asymptomatic: Analysis of English Household Survey Data . Clin Epidemiol [Internet]. 2020 Oct 8 [cited 2021 Jan 10];Volume 12:1039–43. Available from: https://www.dovepress.com/three-quarters-of-people-with-sars-cov-2-infection-are-asymptomatic-an-peer-reviewed-article-CLEP

105. Nazareth J, Minhas JS, Jenkins DR, Sahota A, Khunti K, Haldar P, et al. Early lessons from a second COVID-19 lockdown in Leicester, UK [Internet]. Vol. 396, Journal of Cleaner Production. Elsevier Ltd; 2020 [cited 2020 Sep 16]. p. e4–5. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)31490-2/fulltext

106. Di Domenico L, Pullano G, Sabbatini CE, Boëlle PY, Colizza V. Impact of lockdown on COVID-19 epidemic in Île-de-France and possible exit strategies. BMC Med [Internet]. 2020 Jul 30 [cited 2020 Sep 15];18(1):240. Available from: https://bmcmedicine.biomedcentral.com/articles/10.1186/s12916-020-01698-4

107. Redgrave P, Miller J, Czauderna J, Heller T, Tomson M, Jones B, et al. Train and deploy a community level public health workforce to combat covid-19 [Internet]. Vol. 369, BMJ (Clinical research ed.). NLM (Medline); 2020 [cited 2020 Sep 8]. p. m1821. Available from: https://www.bmj.com/content/bmj/369/bmj.m1821.full.pdf

108. Reintjes R. Lessons in contact tracing from Germany: Germany built on existing local infrastructure to get ahead of the covid-19 pandemic [Internet]. Vol. 369, The BMJ. BMJ Publishing Group; 2020 [cited 2020 Sep 17]. Available from: https://www.bmj.com/content/bmj/369/bmj.m2522.full.pdf

109. Sunjaya AF, Sunjaya AP. Pooled Testing for Expanding COVID-19 Mass Surveillance. Disaster Med Public Health Prep [Internet]. 2020 [cited 2020 Sep

16]; Available from: https://doi.org/10.1017/dmp.2020.246

110. F. Zhou, Li J, Lu M, Ma L, Pan Y, Liu X, et al. Tracing asymptomatic SARS-CoV-2 carriers among 3674 hospital staff:a cross-sectional survey. EClinicalMedicine [Internet]. 2020 [cited 2020 Sep 25]; Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7490283/

111. Quilty BJ, Clifford S, Flasche S, Eggo RM. Effectiveness of airport screening at detecting travellers infected with novel coronavirus (2019-nCoV) [Internet]. Vol. 25, Eurosurveillance. European Centre for Disease Prevention and Control (ECDC); 2020 [cited 2020 Sep 8]. Available from: https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2020.25.5.2000080

112. Gostic KM, Gomez ACR, Mummah RO, Kucharski AJ, Lloyd-Smith JO. Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. Elife [Internet]. 2020 Feb 1 [cited 2020 Sep 8];9. Available from: https://elifesciences.org/articles/55570

113. BBC News. Lesbos: Hundreds test positive for Covid-19 after migrant camp fire [Internet]. [cited 2020 Oct 18]. Available from: https://www.bbc.co.uk/news/world-europe-54239446

114. Homaira N, Islam MS, Haider N. COVID-19 in the Rohingya refugee camps of Bangladesh: challenges and mitigation strategies. Glob Biosecurity [Internet]. 2020 [cited 2020 Sep 12]; Available from: https://www.humanitarianresponse.info/sites/w

115. Kucharski AJ, Klepac P, Conlan AJK, Kissler SM, Tang ML, Fry H, et al. Effectiveness of isolation, testing, contact tracing, and physical distancing on reducing transmission of SARS-CoV-2 in different settings: a mathematical modelling study. Lancet Infect Dis [Internet]. 2020 Jun [cited 2020 Sep 13]; Available from: www.thelancet.com/infectionPublishedonline

116. Kirshblum SC, DeLauter G, Lopreiato MC, Pomeranz B, Dawson A, Hammerman S, et al. Screening Testing for SARS-CoV-2 upon Admission to Rehabilitation Hospitals in a High COVID-19 Prevalence Community. PM&R [Internet]. 2020 Aug 31 [cited 2020 Sep 16];pmrj.12454. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/pmrj.12454

117. Firth JA, Hellewell J, Klepac P, Kissler S, Jit M, Atkins KE, et al. Using a real-world network to model localized COVID-19 control strategies. Nat Med [Internet].

2020 Aug 7 [cited 2020 Sep 28];1–7. Available from: https://www.nature.com/articles/s41591-020-1036-8

118. Keeling MJ, Hollingsworth TD, Read JM. Efficacy of contact tracing for the containment of the 2019 novel coronavirus (COVID-19). J Epidemiol Community Health [Internet]. 2020 [cited 2020 Sep 8]; Available from: https://jech.bmj.com/content/jech/early/2020/06/16/jech-2020-214051.full.pdf

119. Bilinski A, Mostashari F, Salomon JA. Modeling Contact Tracing Strategies for COVID-19 in the Context of Relaxed Physical Distancing Measures. JAMA Netw Open [Internet]. 2020 Aug 21 [cited 2020 Sep 10];3(8):e2019217. Available from: https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2769618?resultClick=1

120. Kretzschmar ME, Rozhnova G, Bootsma MCJ, van Boven M, van de Wijgert JHHM, Bonten MJM. Impact of delays on effectiveness of contact tracing strategies for COVID-19: a modelling study. Lancet Public Heal [Internet]. 2020 Aug 1 [cited 2020 Sep 8];5(8):e452–9. Available from: https://www.thelancet.com/journals/lanpub/article/PIIS2468-2667(20)30157-2/fulltext

121. Skoll D, Miller JC, Saxon LA. COVID-19 testing and infection surveillance: Is a combined digital contact-tracing and mass-testing solution feasible in the United States? Cardiovasc Digit Heal J [Internet]. 2020 Oct 2 [cited 2020 Nov 11]; Available from: https://www.sciencedirect.com/science/article/pii/S2666693620300360

122. Kerr CC, Mistry D, Stuart RM, Rosenfeld K, Hart GR, Nunez RC, et al. Controlling COVID-19 via test-trace-quarantine Cliff. medRxiv [Internet]. 2020 Jul 29 [cited 2020 Sep 8];2020.07.15.20154765. Available from: http://medrxiv.org/content/early/2020/07/16/2020.07.15.20154765.abstract

123. Panovska-Griffiths J, Kerr CC, Stuart RM, Mistry D, Klein DJ, Viner RM, et al. Determining the optimal strategy for reopening schools, the impact of test and trace interventions, and the risk of occurrence of a second COVID-19 epidemic wave in the UK: a modelling study. Lancet Child Adolesc Heal [Internet]. 2020 Aug 3 [cited 2020 Sep 8]; Available from: https://www.thelancet.com/action/showPdf?pii=S2352-4642%2820%2930250-9

124. Hellewell J, Abbott S, Gimma A, Bosse NI, Jarvis CI, Russell TW, et al. Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. Lancet Glob Heal [Internet]. 2020 Apr 1 [cited 2020 Sep 8];8(4):e488–96. Available from:

https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(20)30074-7/fulltext

125. Ferretti L, Wymant C, Kendall M, Zhao L, Nurtay A, Abeler-Dörner L, et al. Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing. Science (80-) [Internet]. 2020 May 8 [cited 2020 Sep 8];368(6491). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7164555/

126. Min KD, Kang H, Lee JY, Jeon S, Cho S Il. Estimating the Effectiveness of Non-Pharmaceutical Interventions on COVID-19 Control in Korea. J Korean Med Sci [Internet]. 2020 Sep 7 [cited 2020 Sep 25];35(35):e321. Available from: http://www.ncbi.nlm.nih.gov/pubmed/32893522

127. He B, Zaidi S, Elesedy B, Hutchinson M, Paleyes A, Harling G, et al. Technical Document 3: Effectiveness and Resource Requirements of Test, Trace and Isolate Strategies [Internet]. 2020 [cited 2020 Oct 2]. Available from: https://rs-delve.github.io/pdfs/2020-05-27-effectiveness-and-resource-requirements-of-tti-strategies.pdf

128. Goscé L, Phillips PA, Spinola P, Gupta DRK, Abubakar PI. Modelling SARS-COV2 Spread in London: Approaches to Lift the Lockdown. J Infect [Internet]. 2020 Aug 1 [cited 2020 Sep 17];81(2):260–5. Available from: https://www.sciencedirect.com/science/article/pii/S0163445320303157?pes=vor

129. Kennedy-Shaffer, Lee, Michael B, and William H. Perfect as the Enemy of the Good: Using Low-Sensitivity Tests to Mitigate SARS-CoV-2 Outbreaks [Internet]. 2020 [cited 2020 Sep 16]. Available from: https://dash.harvard.edu/handle/1/37363184

130. Peto J, Carpenter J, Smith GD, Duffy S, Houlston R, Hunter DJ, et al. Weekly COVID-19 testing with household quarantine and contact tracing is feasible and would probably end the epidemic. R Soc Open Sci [Internet]. 2020 Jun 24 [cited 2020 Sep 8];7(6):200915. Available from: https://royalsocietypublishing.org/doi/10.1098/rsos.200915

131. Campbell JR, Uppal A, Oxlade O, Fregonese F, Bastos ML, Lan Z, et al. Active testing of groups at increased risk of acquiring SARS-CoV-2 in Canada: Costs and human resource needs. CMAJ [Internet]. 2020 Sep 9 [cited 2020 Sep 15];192(40):E1146–55. Available from: https://www.cmaj.ca/content/early/2020/09/09/cmaj.201128

132. Cleevely M, Susskind D, Vines D, Vines L, Wills S. A workable strategy for COVID-19 testing: stratified periodic testing rather than universal random testing. Oxford Rev Econ Policy [Internet]. 2020 Sep 28 [cited 2020 Nov 10];36(Supplement_1):S14–37. Available from: https://academic.oup.com/oxrep/article/36/Supplement_1/S14/5899015

133. Yokota I, Shane PY, Okada K, Unoki Y, Yang Y, Inao T, et al. Mass screening of asymptomatic persons for SARS-CoV-2 using saliva. Clin Infect Dis [Internet]. 2020 Sep 25 [cited 2020 Nov 11]; Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7543374/

134. Eilersen A, Sneppen K. Cost – benefit of limited isolation and testing in COVID - 19 mitigation. Sci Rep [Internet]. 2020;(0123456789):1–7. Available from: https://doi.org/10.1038/s41598-020-75640-2

135. Altawalah H, AlHuraish F, Alkandari WA, Ezzikouri S. Saliva specimens for detection of severe acute respiratory syndrome coronavirus 2 in Kuwait: A cross-sectional study. J Clin Virol [Internet]. 2020 Nov 1 [cited 2020 Nov 11];132:104652. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7527795/

136. Dollard P, Griffin I, Berro A, Cohen NJ, Singler K, Haber Y, et al. Risk Assessment and Management of COVID-19 Among Travelers Arriving at Designated U.S. Airports, January 17–September 13, 2020. MMWR Morb Mortal Wkly Rep [Internet]. 2020 Nov 13 [cited 2020 Dec 16];69(45):1681–5. Available from: http://www.cdc.gov/mmwr/volumes/69/wr/mm6945a4.htm?s_cid=mm6945a4_w

137. Telford CT, Onwubiko U, Holland DP, Turner K, Prieto J, Smith S, et al. Morbidity and Mortality Weekly Report Preventing COVID-19 Outbreaks in Long-Term Care Facilities Through Preemptive Testing of Residents and Staff Members-Fulton County, Georgia, March-May 2020 [Internet]. [cited 2020 Dec 16]. Available from: https://gov.georgia.gov/executive-action/executive-orders/2020-executive-orders.

138. Bosetti P, Tran Kiem C, Yazdanpanah Y, Fontanet A, Lina B, Colizza V, et al. Impact of mass testing during an epidemic rebound of SARS-CoV-2: A modelling study. MedRix [Internet]. 2020 [cited 2020 Dec 22];1–10. Available from: https://doi.org/10.1101/2020.12.08.20246009

Supplement 1: Characteristics of excluded articles

Study	Design/ Outcome	Sample/ setting	Strategies	Reason for exclusion
Kucharski(2020)(115)(www.thelancet.com/infectionPublishedonline)	Modelling study Reduction in transmission Daily contacts quarantined	40,162 participants and BBC 2017-18 social contact dataset, UK	- No control measure - Self-isolation of symptomatic cases - Household quarantine - Quarantine of work or school contacts - Manual tracing of acquaintances - Manual tracing of all contacts - App-based tracing - Mass testing - Daily limit of other setting contacts	Unsuitable design. No comparison either between intervention and control or between mass testing and symptom-based testing
Kirshblum(2020)(116)(https://onlinelibrary.wiley.com/doi/abs/10.1002/pmrj.12454)	Retropective study Test results Symptoms onset	103 admitted patients in Rehab hospital USA	Analysis of samples collected at time of admission	Unsuitable design
Firth et al(117) (https://www.nature.com/articles/s41591-020-1036-8)	Modelling study Number of tests, Number of contacts	468 Real-world social network data, UK	- Outbreak progress under no intervention - Outbreak progress under case isolation - Outbreak progress under primary contact tracing - Outbreak progress under secondary contact tracing	Contact tracing limited to symptom-based testing
Keeling et al(118) (https://jech.bmj.com/content/jech/early/2020/06/16/jech-2020-214051.full.pdf)	Cross sectional survey Tracing efficacy Distribution of secondary cases	> 5802 subjects reporting >50,000 contacts UK	N/A	Contact tracing limited to symptom-based testing
Bilinski et al(119) (https ://jamanetwork.com/journals/jamanetworkopen/fullarticle/2769618?resultClick=1)	Modelling study % reduction in R	Hypothetical, US	- Symptom testing with 30% isolation and quarantine - Test all individuals, with 30% isolation and quarantine - Symptom testing with 60% isolation and quarantine - Test all individuals, with 60% isolation and quarantine -Symptom testing, with 90% isolation and quarantine - Test all individuals, with 90% isolation and quarantine	Contact tracing limited to symptom-based testing
Kretzschmar et al(120) (https ://www.thelancet.com/journals/lanpub/article/PIIS2468-2667(20)30157-2/fulltext)	Modelling study Reduction in Reproduction number	Hypothetical, Netherlands	- Conventional contact tracing - Mobile app contact tracing - Physical distancing strategy - Testing and isolation of cases without tracing contacts	Contact tracing limited to symptom-based testing
Skoll(2020)(121)(https ://www.sciencedirect.com/s	Non-systematic review - Role of technology	N/A	- Digital contact tracing and mass testing	Unsuitable design

Study	Design/ Outcome	Sample/ setting	Strategies	Reason for exclusion
cience/article/pii/S2666693620300360)	- Barriers - Scale-up strategies			
Kerr(2020)(122)(http://medrxiv.org/content/early/2020/07/16/2020.07.15.20154765.abstract)	Modelling study Feasibility of control strategies	Demographic, mobility and epidemiological data of Seattle USA	Test and trace (testing, contact tracing and quarantine)	Limited to control
Panovska-Griffiths(2020)(123)(https://www.thelancet.com/action/showPdf?pii=S2352-4642%2820%2930250-9)	Modelling study Reduction in Reproduction number	Modelled sample, UK	- Full time schooling - Part-time weekly rota system of 50% each schooling - 68% contact tracing with no scale-up in testing - 68% contact tracing with sufficient testing - 40% contact tracing with sufficient testing	No suitable comparison
Hellewell(2020)(124)(https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(20)30074-7/fulltext)	Modelling study Onward transmission	Modelled sample, UK	- 5, 20 and 40 initial cases of outbreak - 0, 0.2, 0.4, 0.6, 0.8 and 1 probabilities of tracing a contact - Short symptom onset to isolation - Long symptom onset to isolation	Contact tracing limited to symptom-based testing
Ferretti(2020)(125)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7164555/)	Modelling study Basic reproduction number – R Generation time	Pair of 40 hypothetical recipients Singapore	- Symptomatic transmission - Presymptomatic transmission - Asymptomatic transmission - Environmental transmission - Isolating symptomatic persons - Tracing the contacts of symptomatic cases and quarantining	Contact tracing limited to symptom-based testing
Min(2020)(126)(http://www.ncbi.nlm.nih.gov/pubmed/32893522)	Modelling study Epidemic size Effective contact rate	Daily reported cases (Feb12-March3) Korea	- Social distancing among adults - Spring semester postponement - Intensive contact tracing - Large-scale diagnostic testing	No suitable comparator
Quilty(2020)(111)(https ://www.eurosurveillance.org/docserver/fulltext/eurosurveillance/25/5/eurosurv-25-5-2.pd)	Modeling study Infected travellers	Air travellers	- Symptoms screening	Unsuitable design
Domenico(2020)(106)(https ://bmcmedicine.biomedcentral.com/articles/10.1186/s12916-020-01698-4)	Modelling study - Lockdown impact - Number of contacts	Age profile data of Ile-de- France and 2012 social contact matrix	- School closure - Employee telework at from home - Senior isolation (high risk group) - Lockdown and non-essential activity ban - Case isolation with large-scale testing	Unsuitable comparator

Study	Design/ Outcome	Sample/ setting	Strategies	Reason for exclusion
Gostic(2020)(112)(https ://elifesciences.org/articles/55570)	Modelling study Screening outcome and missed cases	Hypothetical population of infected travellers,	- Symptomatic but not aware of exposure risk - Aware of exposure risk but without detectable symptoms - Symptomatic and aware that exposure may have occurred - Neither symptomatic nor aware of exposure risk	Lack of intervention
He(2020)(127)(https ://rs-delve.github.io/pdfs/2020-05-27-effectiveness-and-resource-requirements-of-tti-strategies.pdf)	Modelling study Resources required Effect on R	40,162 BBC pandemic data UK	- Symptom-based contact tracing - Test-based contact tracing - Testing of asymptomatic contacts	Contact tracing limited to symptom-based testing
Goscé(2020)(128) (https://www.sciencedirect.com/science/article/pii/S0163445320303157?pes=vor)	Modelling study	PHE, NHS and TfL data[5] UK Royal Borough of Kensington and Chelsea (RBKC)	- Isolation of RBKC residents from the rest of the city - Removal of lockdown - Weekly testing (business reopens but people work from home) - Shielding 60+ age group with lifting of lockdown - Combined universal testing and use of face coverings with no lockdown - Universal testing, contact tracing and isolation, lockdown	Unsuitable design
Li(2020)(19)(https://www.sciencedirect.com/science/article/pii/)	Descriptive study	N/A	- Containment - Suppression	Unsuitable design
Kennedy-Shaffer(2020)(129)(https://dash.harvard.edu/handle/1/37363184)	Modelling study Reduction in transmissions	Unknown	Hypothetical rapid test - Transmission tracing - Full isolation of all contacts of cases - Isolate contacts with positive test result	Unsuitable design
Maslov(2020)((93)(https ://papers.ssrn.com/abstract=3643408)	Logical description Economic benefits	Non	Random mass testing	No comparator
Peto(2020)(130) (https://royalsocietypublishing.org/doi/pdf/10.1098/rsos.200915)	Modelling study Reproduction number Number of daily tests	Hypothetical UK	- Weekly mass test and trace using isothermal single-step RT-PCR	No comparator
Campbell(2020)(131)(https://www.cmaj.ca/content/early/2020/09/09/cmaj.201128)	Cross sectional Cost, human resource and lab capacity	41 751 COVID-19 contacts, staff of hospitals, health centres, care homes &	- Systematic trace and test contacts - Test all staff of acute care hospitals - Test all community health workers and staff/residents of long-term care homes	No suitable comparator

[5] PHE : Public Health England, NHS : National Health Service, TfL : Transport for London

Study	Design/ Outcome	Sample/ setting	Strategies	Reason for exclusion
		essential businesses, school children & staff Canada	- Test all major public and interpersonal contact essential workers - Test all children and staff of schools	
Cleevely(2020)(132)(https://academic.oup.com/oxrep/article/36/Supplement_1/S14/5899015)	Modelling study	Hypothetical UK	- Stratified periodic sample testing - Universal random testing	Unsuitable comparator
Yokota(2020)(133)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7543374/)	Diagnostic tests Utility of nucleic acid amplification	1,924 asymptomatic persons Japan	- Nasopharyngeal swap-based (NPS) RT-PCR test - Saliva-based PCR test	Unsuitable design
Eilersen(2020)(134)**(**https://doi.org/10.1038/s41598-020-75640-2**)**	Modelling study Quarantine measures Cost-effectiveness	Hypothetical	- No intervention - Reduced work contacts by 75% - Reduced social contacts by 75% - Infection probability reduced by 50% - Workplace size reduced by half - Infection probability plus workplace size reduced	Limited to control
Altawalah(2020)(135)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7527795/)	Cross sectional study	891 suspects Kuwait	- Nasopharyngeal swap-based (NPS) RT-PCR test - Saliva-based PCR test	Unsuitable design
Dollard(2020)(136)**(** http://www.cdc.gov/mmwr/volumes/69/wr/mm6945a4.htm?s_cid=mm6945a4_w**)**	Diagnostic test COVID-19 infections	298 air travellers USA	RT-PCR	Asymptomatic proportions unknown
Telford(2020)(137) https://gov.georgia.gov/executive-action/e**)**	Cross sectional Timing of mass testing	5,671 residents & staff in 28 long term care facility USA	Mass RT-PCR test	Asymptomatic proportion unknown
Bosetti(2020)(138)(https://doi.org/10.1101/2020.12.08.20246009)	Modelling study Impact of intervention	Real-time data France	Mass testing	No comparator

Supplement 2: Methodological quality assessment of modelling studies

Relevance and Credibility of Modelling Studies for Informing Health Care Decision Making															
Study	Relevance				Credibility										
					Validation			Design	Data	Analysis		Reporting	Interpretation	Conflict of interest	
	Is the population relevant?	Are any critical interventions missing?	Are any relevant outcomes missing?	Is the context (settings and circumstances) applicable?	Is external validation of the model sufficient to make its results credible for your decision?	Is internal verification of the model sufficient to make its results credible for your decision?	Does the model have sufficient face validity to make its results credible for your decision?	Is the design of the model adequate for your decision problem?	Are the data used in populating the model suitable for your decision problem?	Were the analysis performed using the model adequate to inform your decision problem?	Was there an adequate assessment of the effects of uncertainty?	Was the reporting of the model adequate to inform your decision problem?	Was the interpretation of the results fair and balanced?	Were there any potential conflicts of interest?	If there were potential conflicts of interest, were steps taken to address these?
Effectiveness (Outcome 1)															
Emery(2020)(23)	No	No*	No*	No	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	No*	N/A*
Grassly(2020)(50)	Yes*	No*	No*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	No*	N/A
Tsou(2020)(51)	No	No*	No*	No	Yes*	No	Yes*	Yes*	No	No	Yes*	Yes*	Yes*	Can't answer	Not reported
Mizumoto(2020)(52)	No	Yes	No*	No	Yes*	No	Yes*	Yes*	Yes*	Yes*	No	Yes*	Yes*	No*	N/A*
Sasmita(2020)(53)	No	No*	No*	No	Yes*	No	Yes*	Yes*	No	No	Yes*	Insufficient information	Yes*	No*	N/A
Moghadas(2020)(54)	No	No*	No*	No	No	No	Yes*	Yes*	No	Yes*	Yes*	Yes*	Yes*	No*	N/A

Relevance and Credibility of Modelling Studies for Informing Health Care Decision Making															
Study	Relevance				Credibility										
					Validation			Design	Data	Analysis		Reporting	Interpretation	Conflict of interest	
	Is the population relevant?	Are any critical interventions missing?	Are any relevant outcomes missing?	Is the context (settings and circumstances) applicable?	Is external validation of the model sufficient to make its results credible for your decision?	Is internal verification of the model sufficient to make its results credible for your decision?	Does the model have sufficient face validity to make its results credible for your decision?	Is the design of the model adequate for your decision problem?	Are the data used in populating the model suitable for your decision problem?	Were the analysis performed using the model adequate to inform your decision problem?	Was there an adequate assessment of the effects of uncertainty?	Was the reporting of the model adequate to inform your decision problem?	Was the interpretation of the results fair and balanced?	Were there any potential conflicts of interest?	If there were potential conflicts of interest, were steps taken to address these?
Bracis(2020)(55)	No	No*	No*	No	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	No*	N/A*
Pollmann(2020)(56)	Yes	No*	No*	Yes	No	No	Yes*	Yes*	Not enough information	Yes*	Yes*	Yes*	Yes*	Can't answer	Not reported
Hill(2020)(57)	Yes*	No*	No*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	No*	N/A*
Gorji(2020)(58)	No	No*	No*	No	No	Yes*	Yes*	Yes*	No	Yes*	Yes*	Yes*	Yes*	Can't answer	Not reported
Alsing(2020)(59)	Yes	No*	No*	Yes*	Yes*	Not enough information	Yes*	Yes*	No	Yes*	Yes*	Yes*	Yes*	Can't answer	Not reported
Cost-Effectiveness (Outcome 3)															
Paltiel(2020)(61)	No	No*	No*	No	No	No	Yes*	Yes*	No	Yes*	Yes*	Yes*	Yes*	No*	N/A*

* Favourable/Strength

Supplement 3: Methodological quality assessment of Cohort Studies

Critical Appraisal Skills Programme (CASP) Tool														
	Are the results of the study valid?								What are the results?					
Study	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Have they taken account of the confounding factors in the design and/or analysis?	Was the follow up of subjects complete enough?	Was the follow up of subjects long enough?	What are the results of this study?[4]	How precise are the results?	Do you believe the results?	Can the results be applied to the local population?	Do the results of this study fit with other available evidence?	What are the implications of this study for practice?
Effectiveness (Outcome 1)														
Porru(2020)(63)(https://www.mdpi.com/1660-4601/17/14/5104)	Yes	Yes	Yes	Yes[1]	No[2]	Yes	Yes[3]	Yes	A total 238 workers had a positive test with a cumulative incidence of 4.0%. A third of positive cases were symptomatic while 2.3% were asymptomatic; Incidence among the exposed was 40.5% and 0.5% among the non-exposed group	Cumulative incidence was 4.0% (95% CI 3.5–4.5%). The risk odds ratio in medical wards was 2.7 (95% CI 1.9–3.9) and 4.3 (95% CI 2.4–7.6) in health services	Yes	No[5]	Yes	Yes[5]
Comments 1. Neither subjects nor outcome assessors were blinded 2. Ethnicity of healthcare workers might have been important 3. No report on whether there was loss to follow-up or not 4. Absolute risk reduction unreported 5. Limited applicability due to study population and contextual differences 6. Study highlights the importance of mass testing and contact tracing in a healthcare setting which can be applicable to any context														

Supplement 5: Methodological quality assessment of cross sectional studies

Specialist Unit for Review Evidence (SURE) Profile Table												
Study	**Is the study design clearly stated?**	**Does the study address a clearly focused question?**	**Are the setting, locations and relevant dates provided?**	**Were participants fairly selected?**	**Are participant characteristics provided?**	**Are the measures of exposures & outcomes appropriate?**	**Is there a description of how the study size was arrived at?**	**Are the statistical methods well described?**	**Is information provided on participant eligibility?**	**Are the results well described?**	**Is any sponsorship/conflict of interest reported?**	**Did the authors identify any limitations and, if so, are they captured above?**
Primary Question												
Effectiveness of intervention compared to control												
Nishiura(2020)(62)(https://www.ijidonline.com/article/S1201-9712(20)30139-9/pdf)	No	Yes	Yes	Yes	No	No	N/A	No	N/A	No	Yes	No
Hagan(2020)(60)(https://www.cdc.gov/mmwr/volumes/69/wr/mm6933a3.htm)	No	Yes	No	Can't tell	Yes	No	No	No	No	Yes	Yes	Yes
Treibel(2020)(64)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7206444/)	No	Yes	Yes	Can't tell	No	No	No	No	No	Yes	Yes	No
Brown(2020)(66)(https://www.sciencedirect.com/science/article/pii/S0163445320304503)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Graham(2020)(67)(https://www.sciencedirect.com/science/article/pii/S0163445320303480)	Yes	Yes	Yes	Can't tell	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Abeysuriya(2020)(65)**(https://doi.org/10.1016/j.ejogrb.2020.07.035)**	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes*	N/A	Yes	Yes	Yes

Specialist Unit for Review Evidence (SURE) Profile Table												
Study	Is the study design clearly stated ?	Does the study address a clearly focused question ?	Are the setting, locations and relevant dates provided?	Were participants fairly selected ?	Are participant characteristics provided?	Are the measures of exposures & outcomes appropriate?	Is there a description of how the study size was arrived at?	Are the statistical methods well described?	Is information provided on participant eligibility?	Are the results well described?	Is any sponsorship/conflict of interest reported ?	Did the authors identify any limitations and, if so, are they captured above?
Arons(2020)(68)(http://www.nejm.org/doi/10.1056/NEJMoa2008457)	Yes	Yes	Yes	Can't tell	Yes	Yes	No	No	No	Yes	No	Yes
Jameson(2020)(69)(https://doi.org/10.1017/ice.2020.361)	No	Yes	Yes	Yes	No	No	N/A	No	No	No	Yes	No
Callaghan(2020)(70)(http://www.cdc.gov/mmwr/volumes/69/wr/mm6926a4.htm?s_cid=mm6926a4_w)	Yes	Yes	Yes	Can't tell	Yes	Yes	No	No	No	Yes	Yes	Yes
Louie(71)(https ://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa1020/5873783)	Yes	Yes	Yes	Can't tell	Yes	Yes	No*	No*	No*	Yes	Yes	Yes
Gudbjartsson(2020)(a)(72)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7175425/)	Yes	Yes	Yes	Can't tell	Yes	Yes	No	Yes	No	Yes	Yes	No
Gudbjartsson(2020)(b)(72)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7175425/)	Yes	Yes	Yes	Can't tell	Yes	Yes	No	Yes	No	Yes	Yes	No
Reid(2020)(73)(file:///E:/telechargement/jammi-2020-0027.pdf)	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes	N/A	No	Yes	No
Lavezzo(2020)(74)(https://www.nature.com/articles/s41586-020-2488-	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Specialist Unit for Review Evidence (SURE) Profile Table												
Study	Is the study design clearly stated ?	Does the study address a clearly focused question ?	Are the setting, locations and relevant dates provided?	Were participants fairly selected ?	Are participant characteristics provided?	Are the measures of exposures & outcomes appropriate?	Is there a description of how the study size was arrived at?	Are the statistical methods well described?	Is information provided on participant eligibility?	Are the results well described?	Is any sponsorship/conflict of interest reported ?	Did the authors identify any limitations and, if so, are they captured above?
1?fbclid=IwAR0Y69FXQqJqogOf-1ln)												
Kimball(2020)(75)(http://www.cdc.gov/mmwr/volumes/69/wr/mm6913e1.htm?s_cid=mm69)	No	Yes	Yes	Can't tell	Yes	Yes	No	No	No	No	Yes	Yes
Olalla(2020)(76)(https://academic.oup.com/qjmed/article/113/11/794/5890491)	Yes	Yes	Yes	Can't tell	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Guery(2020)(77)(https://www.sciencedirect.com/science/article/pii/S0399077X20301268)	Yes	Yes	Yes	Yes	Yes	Yes	N/A	No	N/A	No	Yes	Yes
Roxby(2020)(78)(http://www.cdc.gov/mmwr/volumes/69/wr/mm6914e2.htm?s_cid=mm)	No	Yes	Yes	Can't tell	Yes	Yes	No	No	No	No	Yes	Yes
Lytras(2020)(a)(79)(https://academic.oup.com/jtm/article/doi/10.1093/jtm/taaa054/5820895)	No	Yes	Yes	Can't tell	Yes	No	No	No	No	No	Yes	No
Lytras(2020)(b)(79)(https://academic.oup.com/jtm/article/doi/10.1093/jtm/taaa054/5820895)	No	Yes	Yes	Can't tell	Yes	No	No	No	No	No	Yes	No

Specialist Unit for Review Evidence (SURE) Profile Table												
Study	Is the study design clearly stated ?	Does the study address a clearly focused question ?	Are the setting, locations and relevant dates provided?	Were participants fairly selected ?	Are participant characteristics provided?	Are the measures of exposures & outcomes appropriate?	Is there a description of how the study size was arrived at?	Are the statistical methods well described?	Is information provided on participant eligibility?	Are the results well described?	Is any sponsorship/conflict of interest reported ?	Did the authors identify any limitations and, if so, are they captured above?
Lytras(2020)(c)(79)(https://academic.oup.com/jtm/article/doi/10.1093/jtm/taaa054/5820895)	No	Yes	Yes	Can't tell	Yes	No	No	No	No	No	Yes	No
Hoehl(2020)(80)(https://www.nejm.org/doi/10.1056/NEJMc2001899)	No	Yes	Yes	Can't tell	No	No	No	No	No	No	No	No
Cao(2020)(81)(https://www.nature.com/articles/s41467-020-19802-w?fbclid=IwAR2mBblIfSaqfobcID5cOcjQ3yh9KjTpnNCISj-MuT3Y8GyLv-AfrB3_efY)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baggett(2020)(82)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7186911/)	No	Yes	Yes	Can't tell	Yes	Yes	No	No	No	Yes	Yes	Yes
Imbert(2020)(83)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7454344/pdf/ciaa1071.pdf)	No	Yes	Yes	Can't tell	Yes	No	No	Yes	No	No	Yes	Yes

Supplement 6: Certainty of Evidence for the Primary Objective

GRADE Evidence Profile: Mass Testing and Contact Tracing compared to Conventional Test and Trace

Outcome, No of Studies (Design)	Quality of Evidence Factors					Direction of Effect Summary of Findings		Quality of evidence
	Limitation or Study bias	Heterogeneity	Indirectness	Imprecision	Publication Bias	Conventional Test an Trace	Mass Test and Trace (MTT)	
						Control of SARS-CoV-2/COVID-19 Transmissions		
Effectiveness n=11 (Modelling studies)	Serious[6]	Serious[7]	Serious[8]	Serious[9]	Unlikely	Emery(2020)(23) 53% (95% Posterior Interval, PI: 51-56%) of asymptomatic carriers under symptom-agnostic testing went undetected compared to mass testing.	↑	●○○○
						Grassly(2020)(50) Test and trace will reduce R by 8% (95% Uncertainty Interval 5–11) for 50% coverage and 48 hour sample-quarantine delay, compared to mass PCR testing	↓	
						Tsou(2020)(51) Symptom-based testing prevented no subclinical case while symptom-based and at-risk group testing prevented 40%, 60% and 80% subclinical cases	↑	
						Mizumoto(2020)(52) A total of 634 detected due to mass testing compared to 306 symptomatic cases that would have been detected through symptom-based approach	↑	
						Sasmita(2020)(53) Contact tracing (test trace) combined with other measures showed to be more effective than mass testing combined with other measures in outbreak prediction	↓	
						Moghadas(2020)(54) Symptom-based test and trace must be combined with testing irrespective of symptomology	↑	
						Bracis et al(55) Symptom test and trace was more effective than mass testing in reducing daily deaths and when aiming for 70% post COVID physical interactions	↓	

[6] Internal validation for most studies and treatment of parameter/structural uncertainties unclear for some studies

[7] Differences in study populations and settings. Lack of confidence intervals and statistical significance

[8] Population and settings in 5 studies not representative

[9] No precise effect estimates in reported prediction in 8 studies

GRADE Evidence Profile: Mass Testing and Contact Tracing compared to Conventional Test and Trace

Outcome, No of Studies (Design)	Quality of Evidence Factors: Limitation or Study bias	Heterogeneity	Indirectness	Imprecision	Publication Bias	Direction of Effect Summary of Findings: Conventional Test an Trace | Mass Test and Trace (MTT) — Control of SARS-CoV-2/COVID-19 Transmissions		Quality of evidence
						Pollmann(2020)(56) Mass random testing and contact tracing can control the outbreak as oppose to contact tracing (test and trace)	↑	
						Hill(2020)(57) Regular mass testing and contact tracing reduced infections by more than 50% compared to when there is no mass testing	↑	
						Gorji(2020)(58) Mass testing (about 166 per 100,000) based on contact counting is more effective, reducing reproduction number from R = 2.4 to R = 1	↑	
						Alsing(2020)(59) Mass testing and contact tracing can contain 74% of the outbreak and get R below 1 more than contact tracing	↑	
Effectiveness n=1 (Cross-sectional)	Serious[10]	Unlikely	Serious[11]	Serious[12]	Unlikely	Hagan(2020)(60) Mass testing identified 8,239 (Range; 10-2193, Median=403) compared to 642 (Range: 2-181, Median=19) during symptom-based testing	↑	●○○○
Cost-effectiveness n=1 (Modelling study)	Serious[13]	Unlikely	Serious[14]	Serious[15]	Unlikely	Paltiel(2020)(61) Mass testing/screening (every 1, 2 or 7days) was found to be more effective for R=3.5, 2.5 or 1.5 respectively, compared to symptom-based screening	↑	●○○○

Favourable ↑ unfavourable ↓ Neutral ↔

[10] Huge methodological issues around subjects recruitment and outcome measurements
[11] Unrepresentative population and setting
[12] Unreported effect estimates
[13] No use of real dataset and lack of clear external and internal validation
[14] Unsuitable population and setting
[15] No precision in effect estimates

Supplement 7: Proportion of detected asymptomatic cases during mass testing

Study	Test Details	Cases	Asymptomatic	Sample	% in Cases	(95% CI)	% in Sample	(95% CI)
Secondary Question								
Proportion of Asymptomatic (Outcome 6)								
Nishiura(2020)(62)	Reverse transcription PCR	13	4	565	30.8%	(7.7– 53.8%)	0.7%	(0.2 – 1.8%)
Porru(2020)(63)	real-time PCR (Seegene AllplexTM2019-nCoV Assay) on oropharyngeal and nasopharyngeal swabs	238	109	5942	45.8%	(39.3 – 52.4%)	1.8%	(1.5 – 2.2%)
Treibel(2020)(64)(staffw1)		28	28	396	100%	(87.6 – 100%)	7.1%	(4·9%–10·0%)
Treibel(2020)(64)(staffw2)		14	14	284	100%	(76.8 – 100%)	4.9%	(3·0%–8·1%)
Treibel(2020)(64)(staffw3)		4	4	263	100%	(39.8 – 100%)	1.5%	(0·6%–3·8%)
Treibel(2020)(64)(staffw4)		4	4	267	100%	(39.8 – 100%)	1.5%	(0·6%–3·8%)
Treibel(2020)(64)(staffw5)		3	3	269	100%	(29.2 – 100%)	1.1%	(0·4%–3·2%)
Brown(2020)(66)	Applied Biosystems 7500 FAST system and ELITe InGenius (OSANG Healtcare)	23	4	1152	17.4%	(5.0 – 38.8%)	0.3%	(0.1 – 0.9%)
Graham(2020)(67)(redts)	AusDiagnostics, Roche Cobas and Abbott RealTime SARS- CoV-2 assays	126	54	313	42.9%	(34%–52%).	17.3%	(13.2 – 21.9%)
Graham(2020)(67)(staff)		3	3	70	100%	(29.2 – 100%)	4.3%	(1% to 9%)
Abeysuriya(2020)(65)		7	6	180	85.7%	(42.1–99.6%)	3.3%	(1.2 – 7.1%)
Arons(2020)(68)	SARS-CoV-2 CDC assay protocol	48	27	76	56.3%	(41.2 – 70.5%)	35.5%	(24.9 – 47.3%)
Jameson(2020)(69)	GeneXpert RT-PCR assay (Cepheid, Sunnyvale, CA)	0	0	121	-	-	0.0%	(0.0 – 1.2%
Callaghan(2020)(70)	(RT)–PCR Diagnostic Panel	0	0	247	-	-	0.0%	(0.0 – 1.2%
Louie(71)(redts-staff)	Abbott m2000 RT-PCR	86	86	303	100%	(95.8 – 100%)	28.4%	(23.4 – 33.8%)
Gudbjartsson(2020)(72)(targettest1)	TaqMan™ Fast Virus 1- step Master Mix, 2019-nCoV Assay kits v1 (Thermo Fisher)	177	24	1924	13.6%	(8.9 – 19.5%)	1.2%	(0.8 – 1.9%)
Gudbjartsson(2020)(72)(poptest)		87	51	10797	58.6%	(47.6 – 69.1%)	0.5%	(0.4 – 0.6%)
Gudbjartsson(2020)(72)(targettest2)		1044	59	7275	5.7%	(4.3 – 7.2%)	0.8%	(0.6 – 1.0%)

Study	Test Details	Cases	Asymptomatic	Sample	% in Cases	(95% CI)	% in Sample	(95% CI)
Gudbjartsson(2020)(72)(randomtest1)		13	7	2283	53.8%	(25.1 – 80.8%)	0.3%	(0.1 – 0.6%)
Reid(2020)(73)		5	5	2751	100%	(47.8 – 100%)	0.2%	(0.1 – 0.2%)
Lavezzo(2020)(74)(survey1)	TaqMan Fast Virus 1-Step Master Mix (Thermo Fisher)	73	29	2812	39.7%	(28.5–51.9)	1.0%	(0.7 – 1.5%)
Lavezzo(2020)(74)(survey2)		29	13	2343	44.8%	(26.5–64.3)	0.6%	(0.3 – 0.9%)
Kimball(2020)(75)	SARS-CoV-2 CDC assay protocol	23	13	76	56.5%	(34.5 – 76.8%)	17.1%	(9.4 – 27.5%)
Olalla(2020)(76)	VIASURE SARS-CoV-2 from CerTest Biotec and LightMix Modular SARS-CoV (COVID19), Roche	2	1	498	50.0%	(1.3 – 98.7%)	0.2%	(0 – 1.1%)
Guery(2020)(77)	Detection kit for 2019 novel coronavirus RNA, PCR Fluorescence Probing, (Daan Gene Co.)	3	2	136	66.7%	(9.4 – 99.2%)	1.5%	(0.2 – 5.2%)
Roxby(2020)(78)(redts-staffd1)		6	3	142	40.0%	(9.4 – 99.2%)	2.1%	(0.4 – 6.0%)
Lytras(2020)(79)(UK)		13	13	357	100%	(75.3 – 100%)	3.6%	(2.0%–6.1%)
Lytras(2020)(79)**(**Spain)		25	25	394	100%	(86.3 – 100%)	6.3%	(4.1%–9.2%)
Lytras(2020)(79)(Turkey)		2	2	32	100%	(15.8 – 100%)	6.3%	(0.8%–20.8%)
Hoehl(2020)(80)	LightMix Modular SARS and Wuhan CoV E-gene, and LightMix Modular Wuhan CoV RdRP-gen (TIB MOLBIOL)	2	2	114	100%	(15.8 – 100%)	1.8%	(0.2 – 6.2%)
Cao(2020)(81)	Real-time fluorescence RT-PCR	300	300	9899828	100%	(98.8 – 100%)	0.0%	0%
Baggett(2020)(82)		147	129	408	87.8%	(81.3 – 92.6%)	31.6%	(27.1 – 36.4%)
Imbert(2020)(83)	Abbott m2000 RT-PCR	111	57	210	51.4%	(41.7 – 61%)	27.1%	(21.3 – 33.1%)
TOTAL		**2659**	**1081**	**9942968**	**40.65%**	**(38.8 – 42.5%)**	**0.01%**	**(0.01 – 0.012)**

Supplement 8: Graph of Outcome Behaviour in different populations

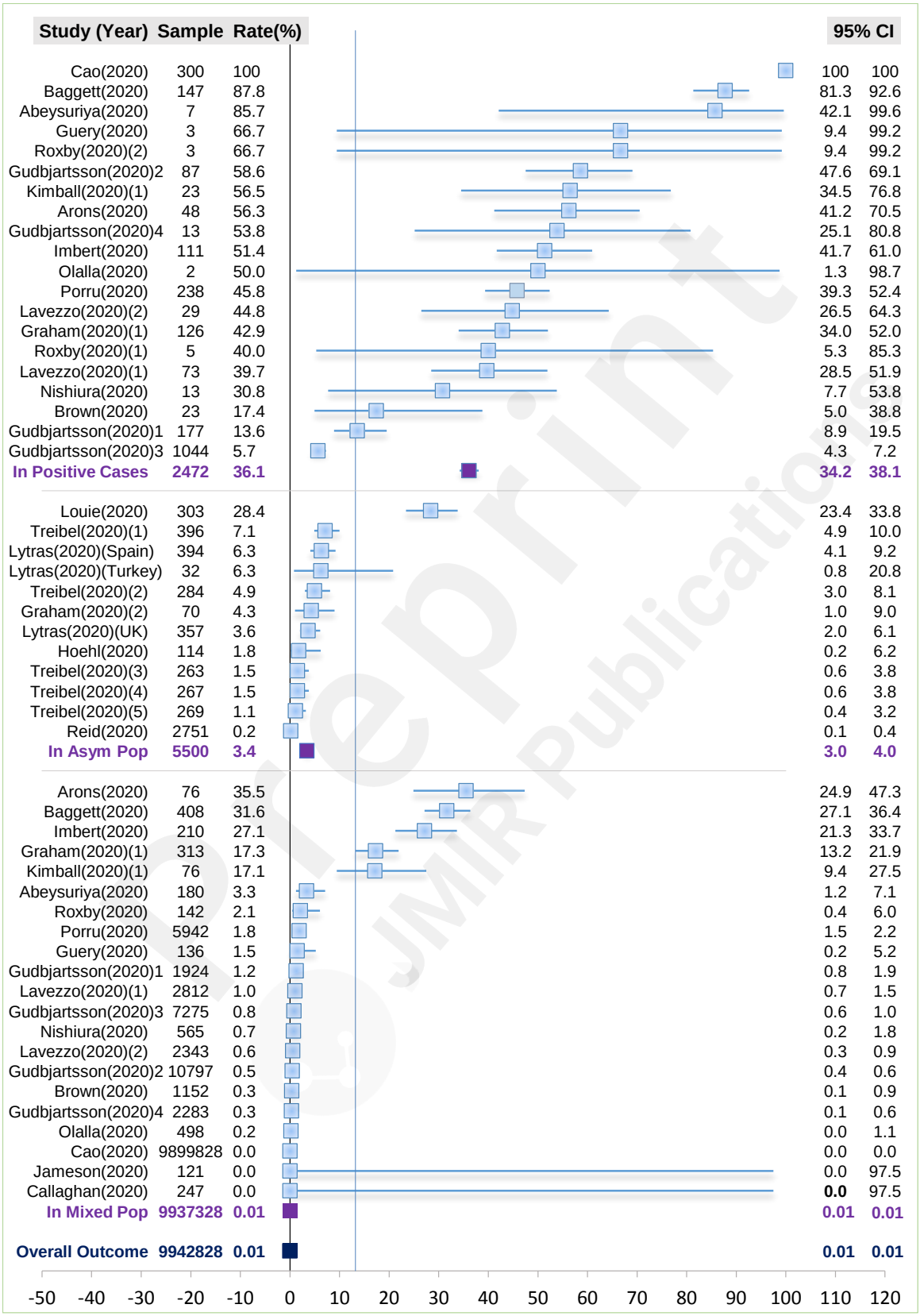


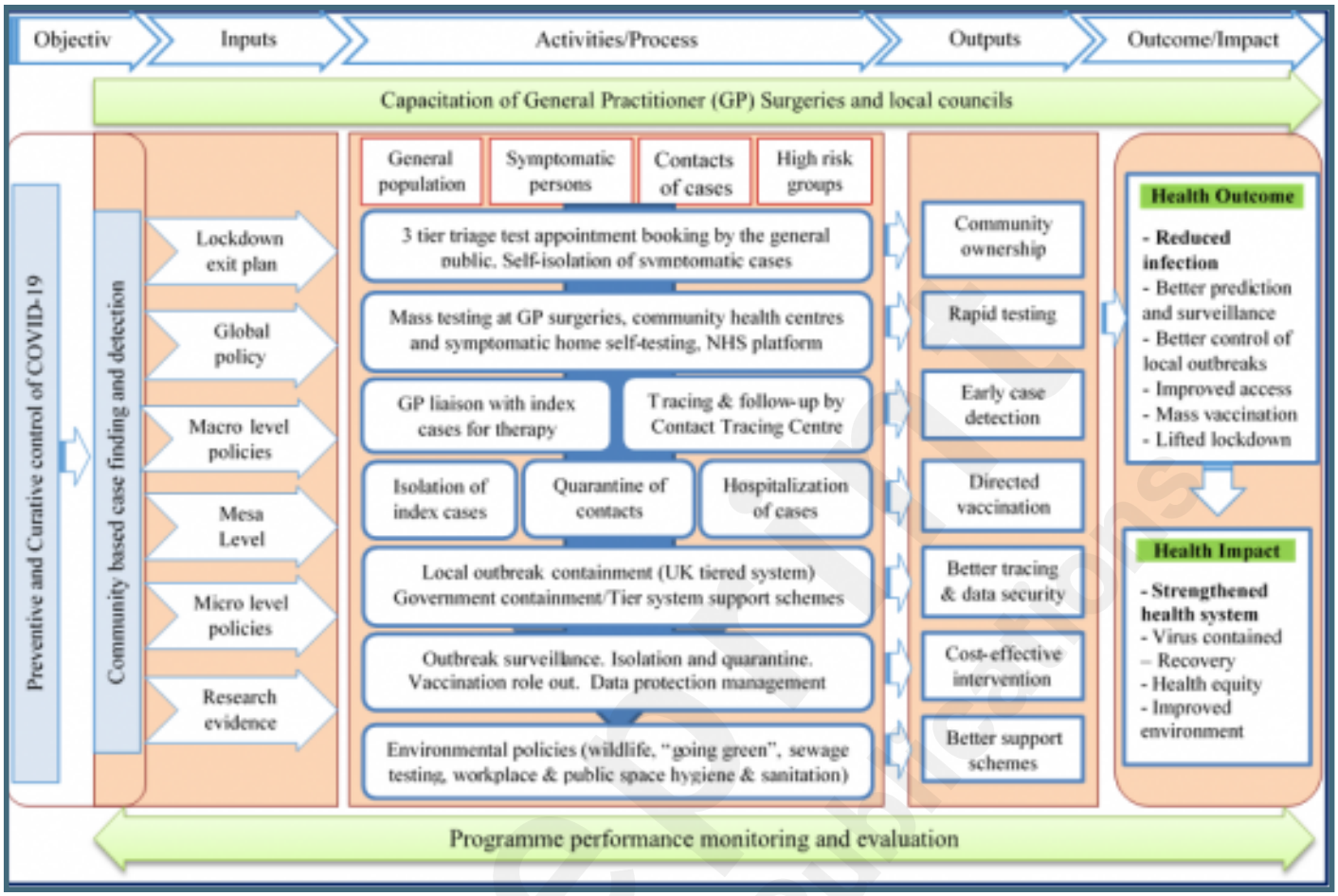
Figure 7: Asymptomatic SARS-CoV-2 carriers among detected cases, asymptomatic and mixed sample populations. The overall outcome is contributed by the first 2 sections from below
Asymp Pop: Asymptomatic population, Pop: Population

Supplementary Files

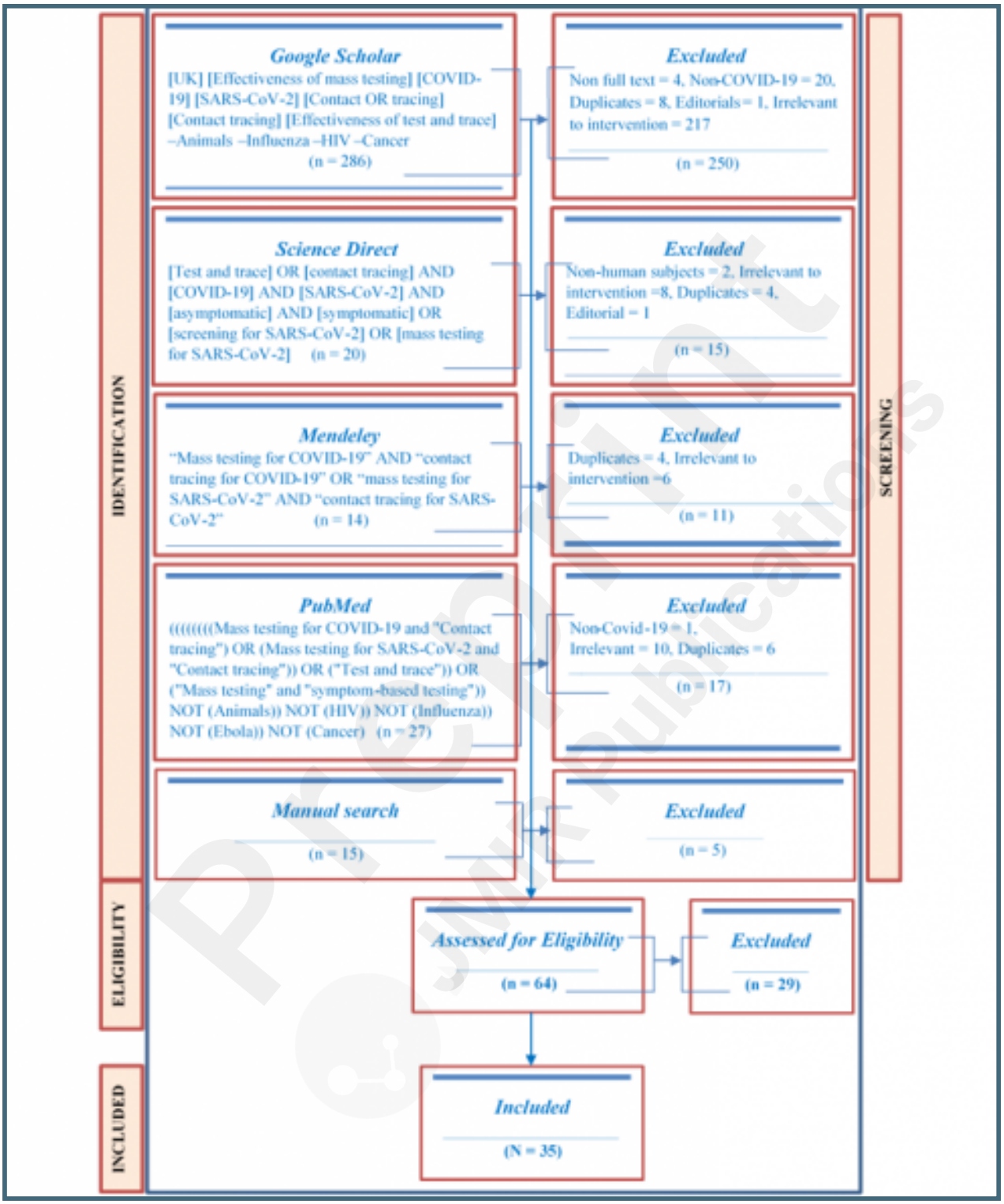
Synthesis without meta-analysis checklist.
URL: https://asset.jmir.pub/assets/d9db7a6390fa97b5fb8e0ce71b9cf9a7.pdf

Figures

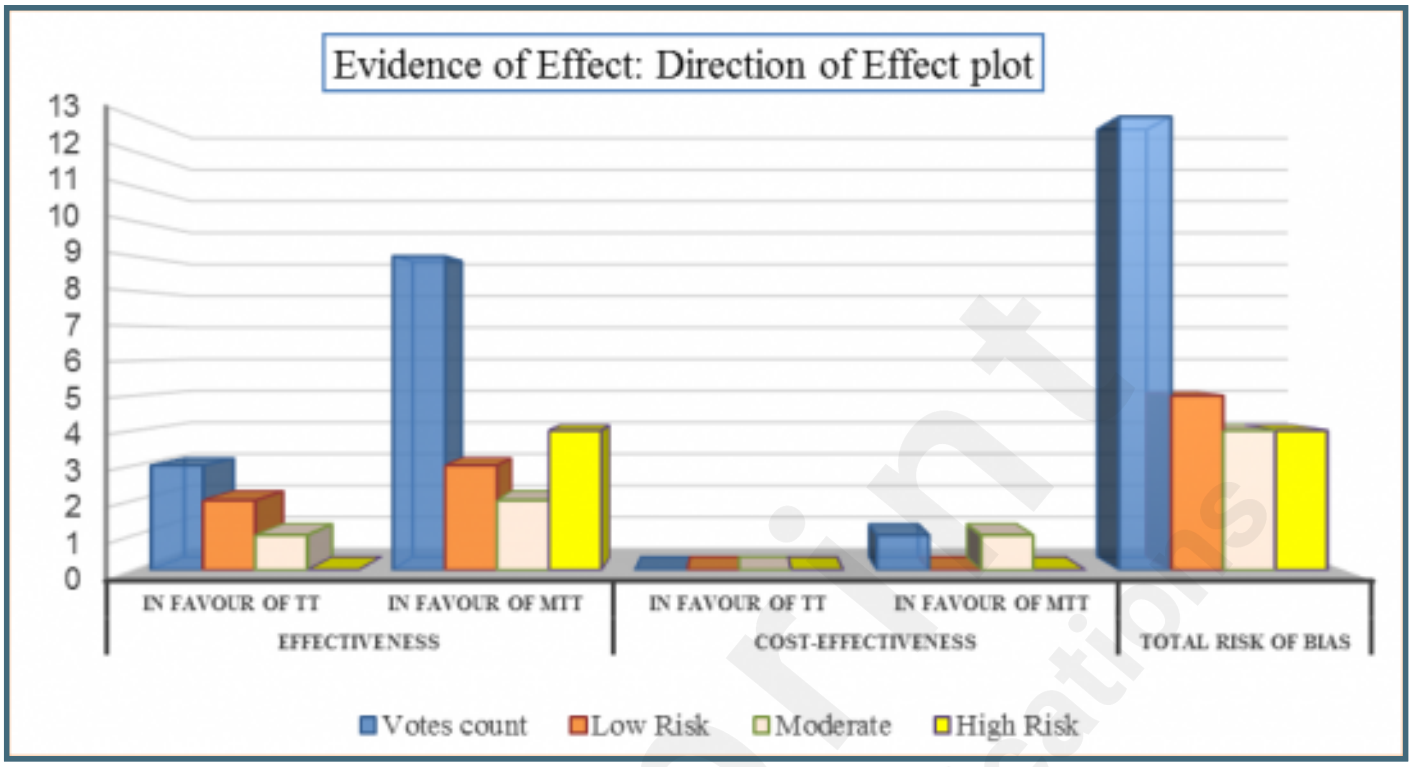
Conceptual framework for decentralised mass testing and contact tracing.



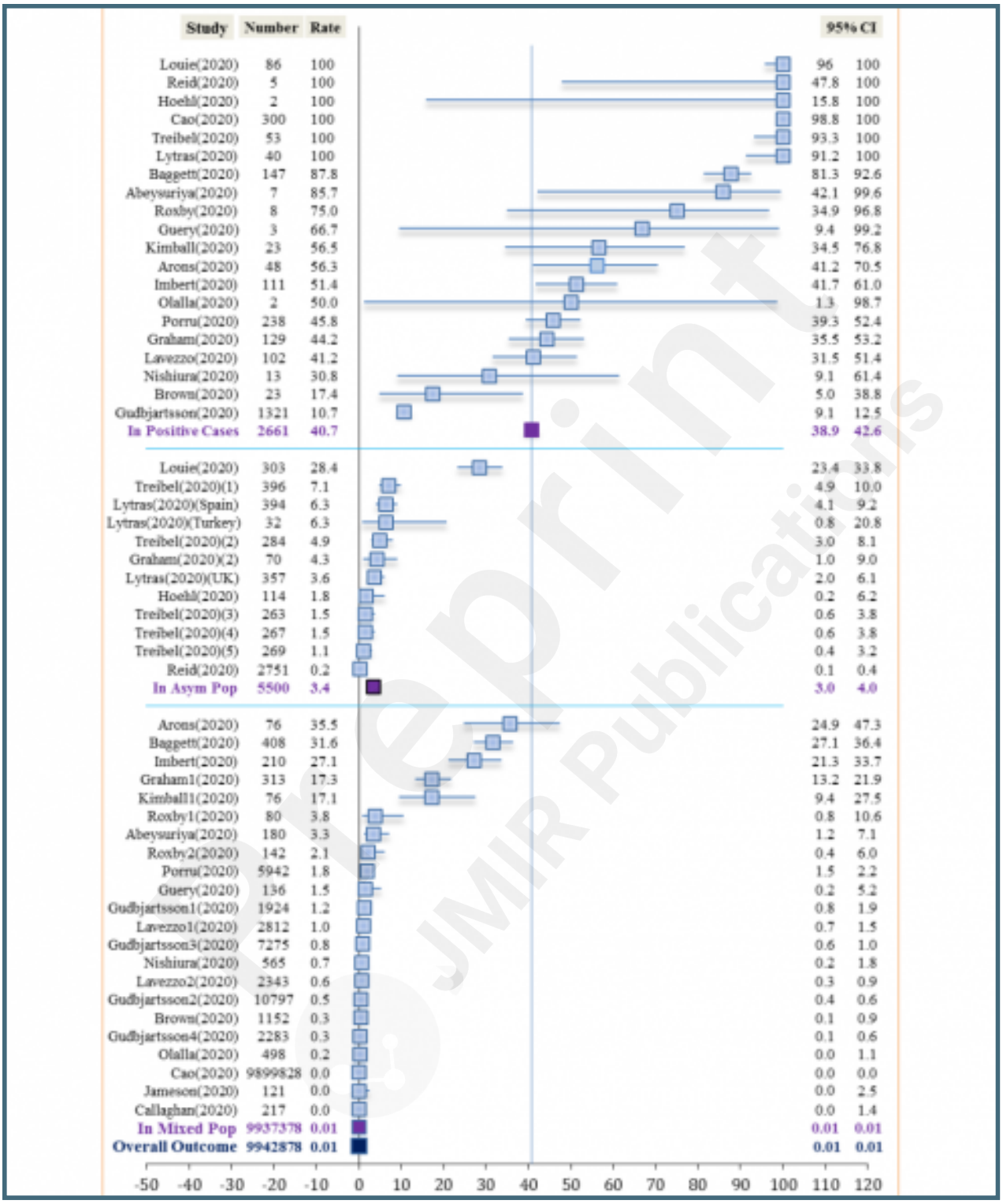
Literature search strategy flow chart.



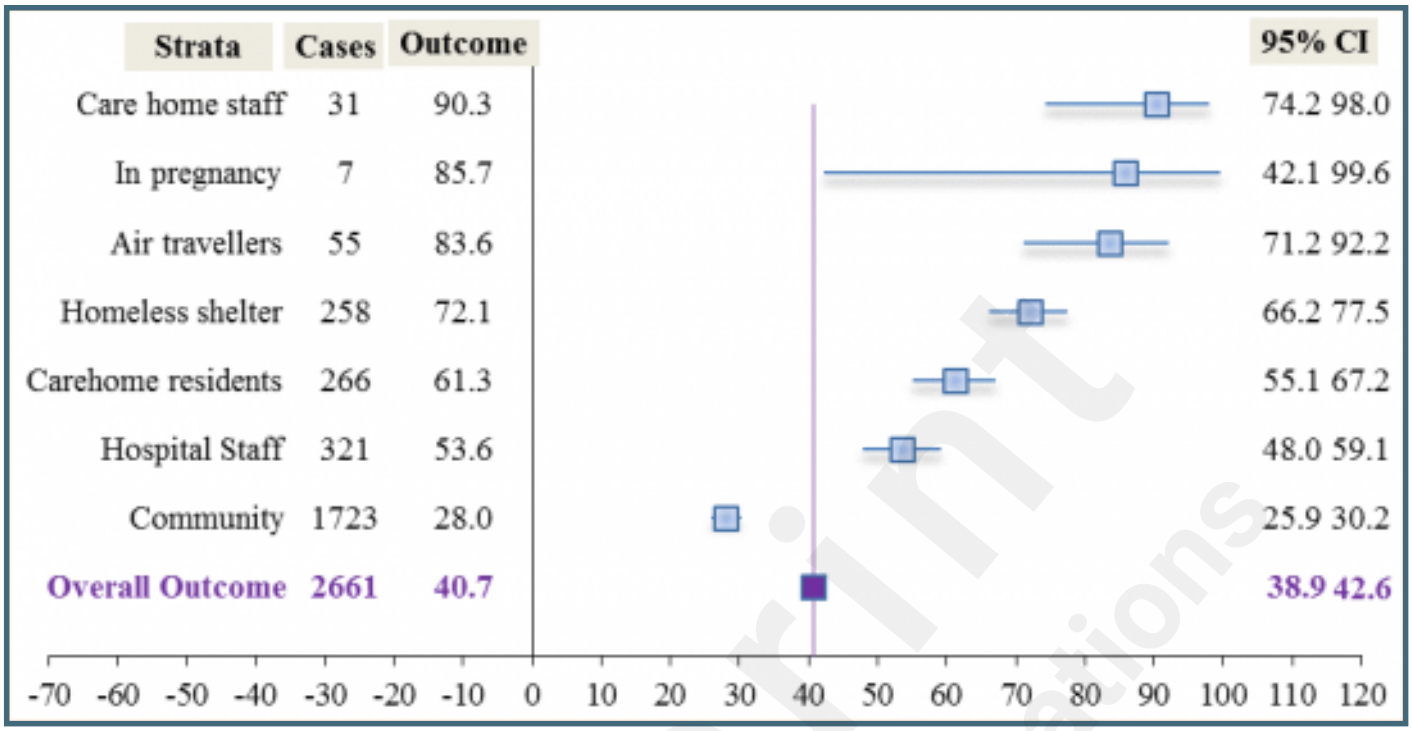
Direction of effect plot.



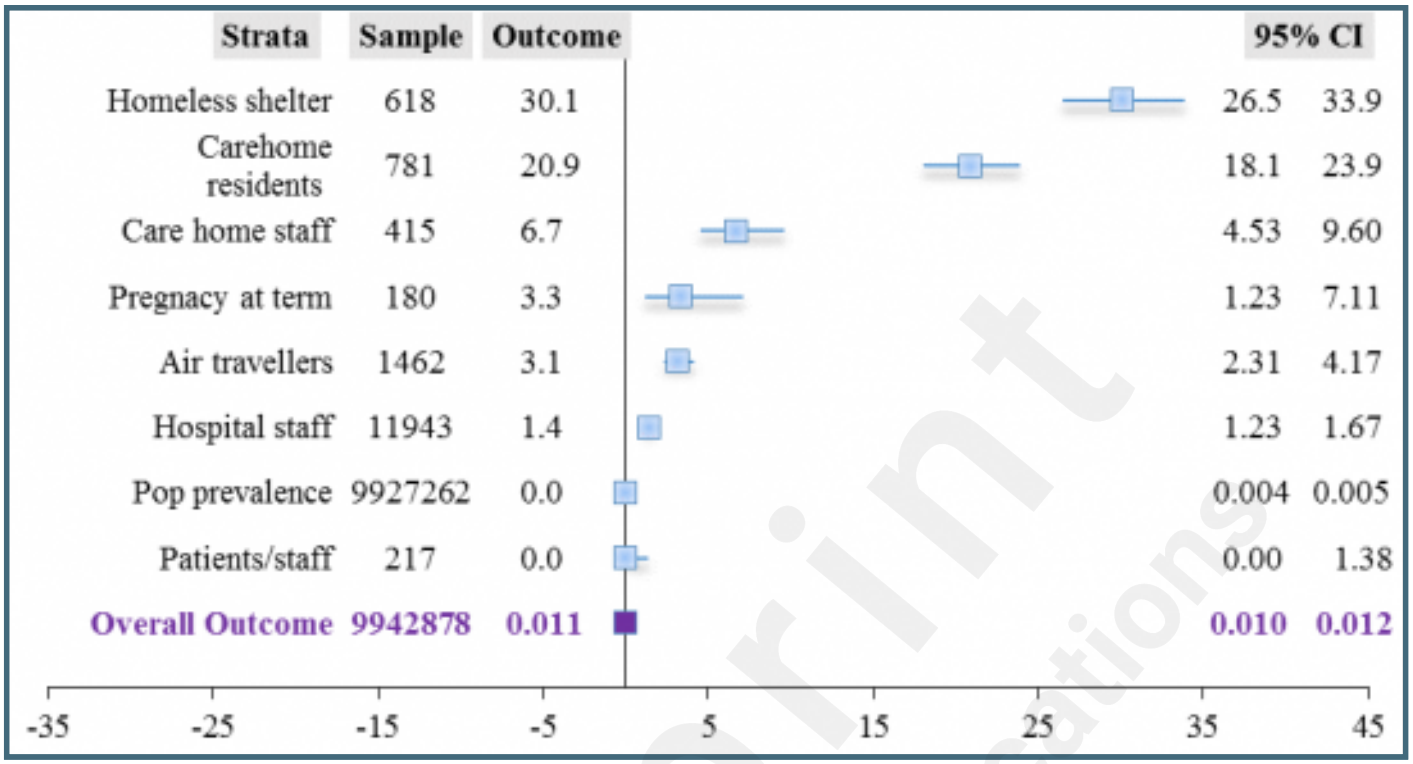
Proportion of asymptomatic SARS-CoV-2 carriers.



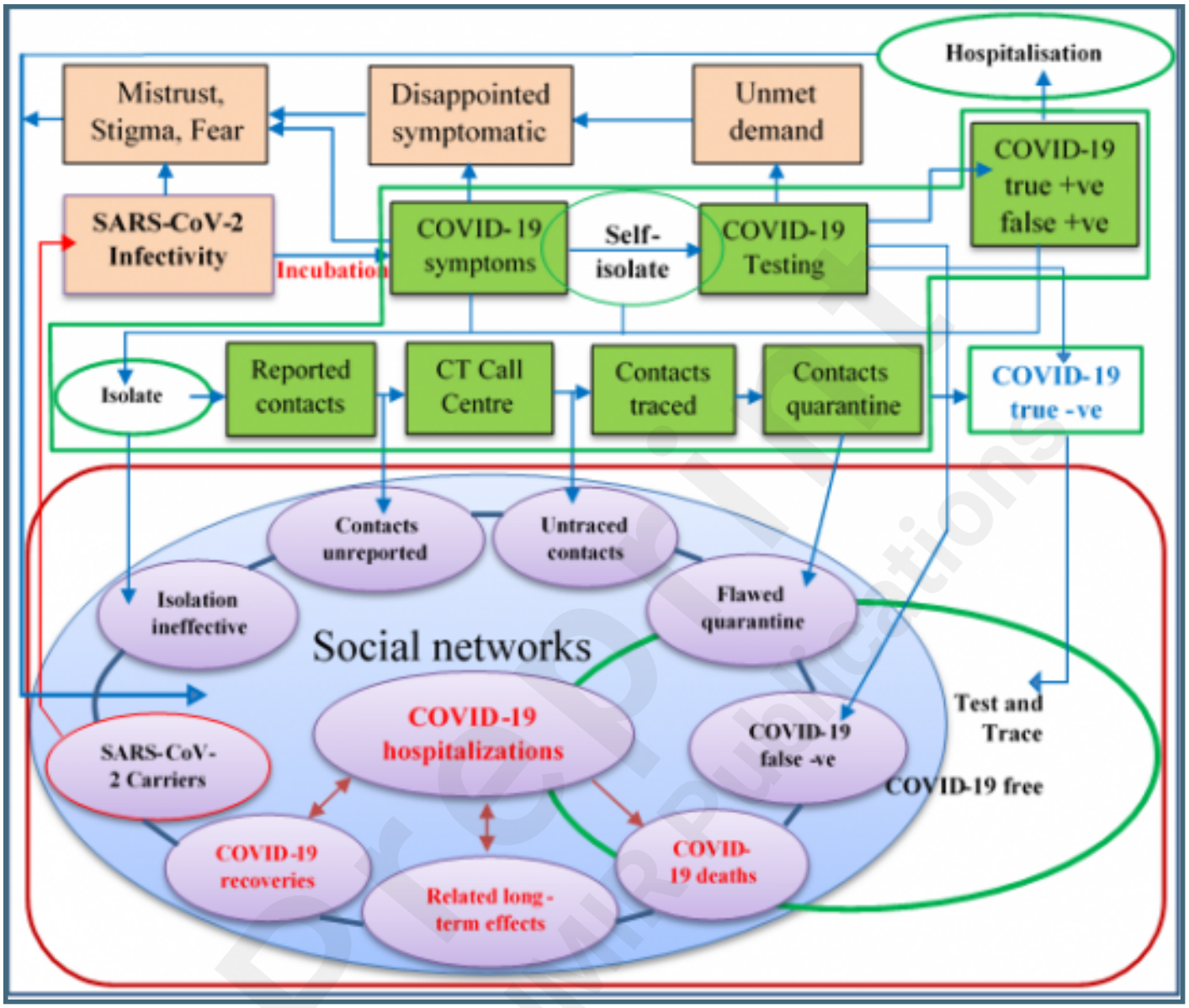
Proportion of asymptomatic SARS-CoV-2 carriers among positive cases.



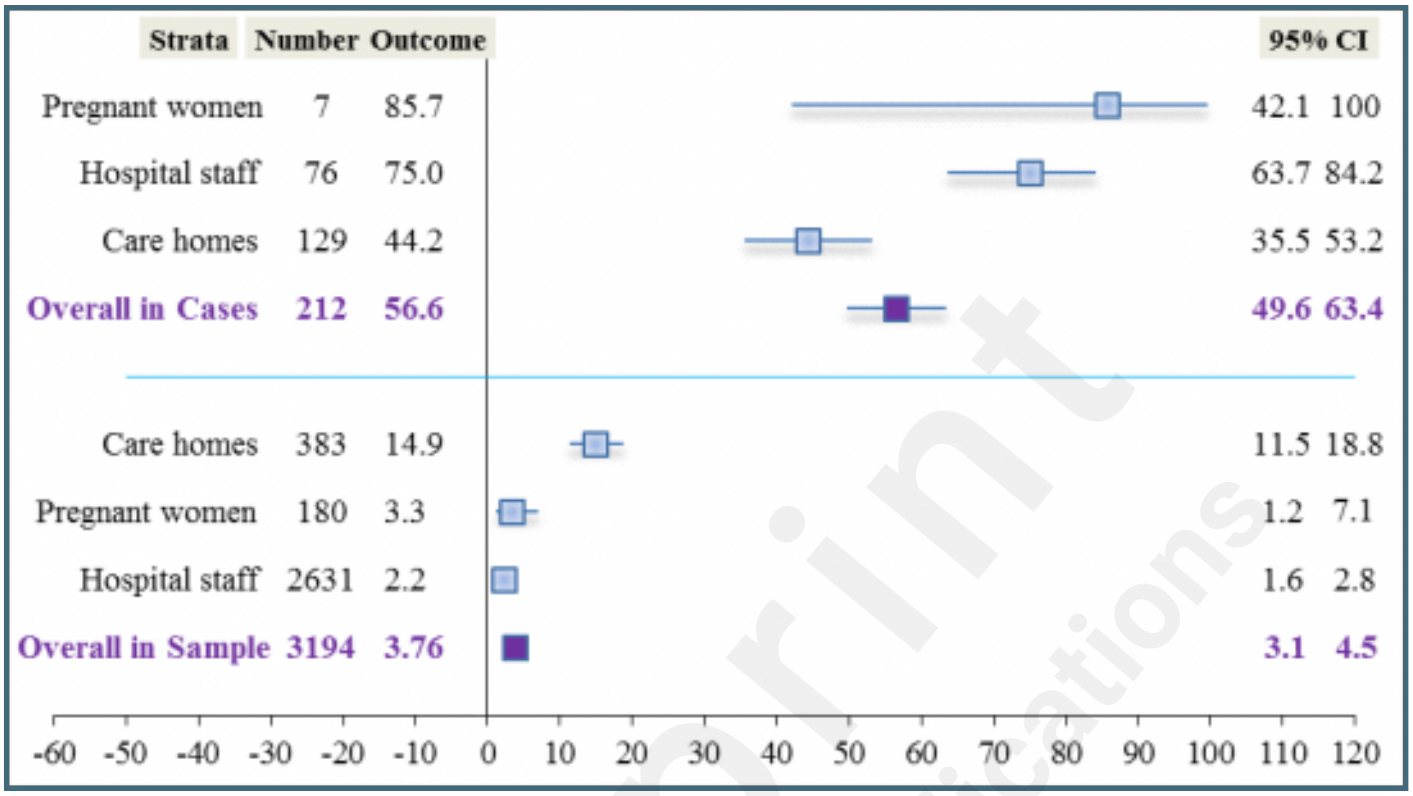
Proportion of asymptomatic carriers in sampled population.



Conventional test and trace system.



Proportion of asymptomatic SARS-CoV-2 carriers within the UK.



Multimedia Appendixes

Characteristics of included studies.
URL: https://asset.jmir.pub/assets/5800aae8ce4fbb9b7db6d5958d4d0909.pdf

Characteristics of excluded studies.
URL: https://asset.jmir.pub/assets/231bcbc03956424bf91d87e61621dd5d.pdf

Quality assessment of modelling studies.
URL: https://asset.jmir.pub/assets/573447da4f3ef090c2a547cd2385d153.pdf

Quality assessment of cohort study.
URL: https://asset.jmir.pub/assets/625f9d79e04ac4b00679d1a4eec42379.pdf

Quality assessment of cross-sectional studies.
URL: https://asset.jmir.pub/assets/de9dd467f2681592a74d82116a1908c1.pdf

Certainty of evidence for the primary objective.
URL: https://asset.jmir.pub/assets/8f113f263d6e5f4b386627da944e1fb6.pdf

Details of mass testing.
URL: https://asset.jmir.pub/assets/bc46d45c516b8b708b1443b4c1239d6c.pdf