

Strategies for PCR-testing and contact tracing during the first year of the covid-19 pandemic – a comparison between Sweden and five other European countries

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Sammanfattning på svenska

Den 30 juni 2020 tillsatte regeringen en kommission med uppdrag att utvärdera hur Sverige har hanterat pandemin med det nya coronaviruset Sars-CoV-2, det virus som orsakar sjukdomen covid-19. Denna delrapport jämför den svenska nationella strategin för testning och kontaktspårning med motsvarande strategier i jämförbara länder.

Testning och kontaktspårning är en av hörnpelarna för att kunna bryta spridningen av ett smittämne vid epidemiska utbrott. Sedan början av februari 2020 blev det därför, efter regeringsbeslut, obligatoriskt i Sverige att testa och kontaktspåra för covid-19 vid misstanke på sådan smitta. Testning och kontaktspårning lyftes också fram av WHO tidigt under pandemin som en kritisk faktor för att ett land skulle kunna begränsa spridningen av viruset.

För jämförelse med den svenska strategin under hela år 2020 valdes fem länder ut; Norge, Danmark, Finland, Spanien och England. De nordiska grannländerna har haft betydligt färre sjukdomsfall och mycket lägre dödlighet än Sverige, trots att de är relativt jämförbara med vårt land när det gäller samhällsstruktur, socio-ekonomi och befolkningstäthet (det senare med undantag för Danmark). Jämfört med Sverige har Spanien och England visserligen mycket större folkmängd och har fler stora städer med hög befolkningstäthet, men trots betydande restriktioner har de båda länderna haft minst lika hög sjuklighet och dödlighet.

Ett frågeformulär skickades ut till de nationella myndigheterna som ansvarar för smittskyddsarbetet i respektive land. Formuläret innehöll frågor om testning med så kallad PCR-test och kontaktspårning, men också om användningen av antikroppstestning och eventuell förekomst av regionala skillnader under olika perioder av 2020. Data avseende antalet genomförda PCR-tester, andelen positiva PCR-tester och antalet fall med covid-19 i respektive land, hämtades antingen från länderna själva eller från officiella websidor hos Europeiska Smittskyddsmyndigheten (ECDC) eller Public Health England (PHE).

PCR-testning

Under de första veckorna av pandemin var strategierna för testning och kontaktspårning likvärdiga i alla sex länder. Fokus lades på att upptäcka fall hos resenärer, och deras kontakter, från områden med dokumenterad smittspridning, d.v.s. framför allt från Kina och senare också från Österrike och Italien. Från mitten av mars ökade dock testningen i relation till antalet invånare snabbare i Norge, Danmark, Finland och Spanien än i Sverige och England. Antalet tester i Danmark ökade mest och var från mitten av april och året ut 2-3 gånger högre än i något av de övriga länderna. England nådde samma testningsnivåer som Norge, Finland och Spanien i början av maj, medan det dröjde till mitten av juni för Sverige att nå dit.

Under hela året var den svenska strategin att spridningen av covid-19 skulle minskas så mycket som möjligt genom testning, men att detta var beroende av tillgänglig testningskapacitet och att det inte fick leda till undanträngningseffekter i vården. Initialt skulle testningen av de som var svårt sjuka prioriteras, samt personal inom hälso- och sjukvård och äldreomsorg. Testningen både av högrisk-

grupper, framför allt av boende inom äldreården, och av personer i samhället som inte behövde slutenvård kom därför i gång senare än den gjorde i de övriga länderna.

WHO rekommenderade under våren att andelen PCR-tester positiva för Sars-CoV-2 borde ligga under 5%. En låg andel positiva kan betyda att inte bara svårt sjuka patienter testas och att det därför går att bedöma omfattningen av spridningen i samhället. Denna kunskap kan vara en viktig bas för strategiska beslut i hanteringen av epidemin. På grund av bristande testningskapacitet hade alla sex länder en hög andel positiva tester i början av pandemin, men redan från april-maj låg de fem "jämförelseländerna" på en nivå under 5% medan det tog till början av juli innan Sverige nådde dit.

Reglerna för en person som diagnosticerats med covid-19 var mindre strikta i Sverige än i de övriga länderna, vilka alla redan från början av epidemin krävde isolering i 7-14 dagar av den sjuke. Initialt i Sverige, skulle en covid-19 positiv person bara undvika sociala kontakter utanför familjen och inte använda allmänna kommunikationer till och med två dagar efter de blivit symtomfria. Från april skärptes detta så att den sjuke måste stanna hemma i minst 7 dagar och helst undvika kontakt även med övriga hushållet, men att egna promenader var tillåtet.

Kontaktspårning

Under hela 2020, rekommenderade samtliga fem jämförelseländer att spårning av nära kontakter skulle genomföras kring alla covid-19-positiva personer. I Sverige, trots att sjukdomen var smittspårningspliktig sedan början av februari, rekommenderades från mars att sådan skulle prioriteras till nära kontakter till positiva personer arbetande inom hälso- och sjukvård eller äldreården. Dessa rekommendationer utvidgades under juli, men fortfarande så att smittspårning skulle prioriteras till miljöer med stor risk för allvarliga konsekvenser vid en smittspridning. I alla sex länder följdes nära kontakter till en person med covid-19 under 1-2 veckor. I jämförelseländerna var regeln att den nära kontakten skulle isolera sig i hemmet, oavsett om personen hade några symtom eller ej. I Sverige rekommenderades under första halvan av året varken isolering eller testning av nära kontakter utan symtom, utan dessa fick instruktionen att hålla social distans och om möjligt arbeta hemifrån. Först från slutet av september rekommenderades även asymtomatiska hushållskontakter hemisolering i 7 dagar och PCR-testning.

Appar för kontaktspårning kom aldrig i bruk i Sverige, till skillnad från i de övriga länderna. Data från både Danmark och England talar för att sådana appar kunde leda till att ett ökat antal nära kontakter nåddes och därmed kunde isolera sig i hemmet. I en studie från England och Wales uppskattades att för varje covid-19-positiv person som använde sig av appen kunde 1 nytt fall avvärras. England var det enda land som kunde visa nationella data på hur kontaktspårningen fungerade. Från det att "Test & Trace"-organisation introducerades där i slutet på maj nåddes 80-90% av de positiva fallen för kontaktspårning. För varje positivt fall kunde 2-3 kontakter identifieras, av vilka mer än hälften av kunde nås och informeras om hemisolering.

Testning av antikroppar

Antikroppstestning mot Sars-CoV-2 inkluderades tidigt i den svenska strategin för att få en uppfattning av hur utbredd immuniteten mot viruset var i befolkningen, men också för att enskilda individer skulle kunna få veta om de hade haft infektionen, samt för att fortlöpande kunna undersöka hur lång immuniteten var efter genomgången infektion. I Norge, Danmark och Finland användes antikroppstester i huvudsak för enstaka undersökningar av förekomsten av antikroppar i representativa delar av befolkningen, medan det inte fanns några nationella rekommendationer i England, bara lokala riktlinjer. Spanien, slutligen, använde antikroppstester enbart som en del av den diagnostiska arsenalen.

Slutsatser

Sammantaget, fanns flera skillnader mellan den svenska strategin för testning och kontaktspårning under 2020, jämfört motsvarande rekommendationer i Norge, Danmark, Finland, Spanien och England. De viktigaste skillnaderna mellan Sverige och de övriga länderna var att:

- PCR-testning kom i gång långsammare
- det tog längre tid innan testningen kom i gång av boende i äldreården med symtom på covid-19, liksom av sjuka personer som inte behövde sjukhusvård
- PCR-testningens omfattning under en längre tid inte var tillräcklig för att kunna uppskatta spridningen av covid-19 i befolkningen
- reglerna för personer som smittats med covid-19 i början av pandemin var mindre strikta
- kontaktspårningen under mer än halva året inte omfattade alla, utan var prioriterad till vissa grupper
- nära kontakter till en person diagnosticerad med covid-19 inte behövde isolera sig, förrän i slutet av september när isoleringskrav började gälla för hushållskontakter
- appar för kontaktspårningen inte användes

Rapporten kan bara peka på att ovan beskrivna skillnader fanns och undersöker inte övriga skillnader mellan ländernas hantering av pandemin. Underlaget är inte heller tillräckligt för att kunna bedöma i vilken grad skillnaderna avseende testning och kontaktspårning kan ha påverkat utvecklingen av pandemin i Sverige. För att göra detta krävs vetenskapliga studier. Det är också viktigt att påpeka, att även om sjuklighet och dödlighet i covid-19 var mycket lägre i våra nordiska grannländer, så hade Spanien och England minst lika höga eller högre tal än Sverige. Detta illustrerar att många andra faktorer, förutom testning och kontaktspårning, har haft betydelse för hur omfattande spridningen av covid-19 var under 2020.

Introduction

On June 30, 2020, the Swedish government appointed a Committee of Inquiry in the form of a Commission. The Committee was commissioned to evaluate the measures taken by the Government and the administrative agencies to handle the pandemic outbreak of SARS-CoV-2, the new coronavirus that causes the disease covid-19, and the effects of its spread (***Evaluation of the measures to tackle the outbreak of the virus that causes the disease COVID-19. Dir 2020:74***). This report addresses the part of the commission's task that was to compare the work of testing and contact tracing in Sweden, with that of other relevant countries.

Timeline of the novel corona virus pandemic

To put the comparison between countries in perspective, it is important to establish the timeline of the first months of the pandemic in 2020, according to the European Centre for Disease Control (ECDC)

(https://cdn.knightlab.com/libs/timeline3/latest/embed/index.html?source=1JpInWBhopqsH40JLp1mppywwgAZAZgohFy7aELWaSPg&font=Default&lang=en&initial_zoom=2&height=650).

December 31, 2019	Wuhan, China, reports first cases
January 24, 2020	First EU cases (in France, travel history to China) (First Swedish imported case confirmed on January 31)
January 30, 2020	WHO declares nCoV-2019 outbreak as a public health emergency of international concern
February 11, 2020	nCoV-2019 name changed to SARS-CoV-2, and to covid-19 for the disease
February 22, 2020	Clusters of cases in Lombardy and additional cases from two other Italian regions, Piedmont and Veneto. Local transmission established
February 26, 2020	Case definition update by ECDC. Suspected cases who should be tested include patients with acute respiratory infection (mild or severe) who in the 14 days prior to onset of symptoms have had close contact with a confirmed or probable case of covid-19 infection or having stayed in areas with so-called presumed community transmission
March 11, 2020	Pandemic declaration by Director General of the World Health Organization (WHO)
March 25, 2020	All EU/EEA countries and more than 150 countries worldwide are affected by the SARS-CoV-2 virus
April 1, 2020	EU states that timely and accurate covid-19 laboratory testing is an essential part for slowing down the pandemic, supporting decisions on infection control strategies and patient management at healthcare facilities, and detecting asymptomatic cases that could spread the virus further if not isolated

Why and when “test and trace”

Testing is most valuable when the suspected illness is so severe that an etiologic diagnosis is necessary for a correct treatment of the affected person. Testing may also be of significant importance for the society, since an undiagnosed contagious disease can lead to outbreaks, or even epidemics, if contact tracing is not performed. Furthermore, broad testing, especially if the sampling is representative of the population, can be an important tool for following the course of an epidemic. However, for diseases with very short incubation periods, such as influenza, the process of contact tracing will most often be too slow to confine an outbreak. Similarly, if a disease is already widespread in the community, testing of persons who are not in need of medical care may be of limited value. Generally, again with influenza as an example, symptomatic diagnoses and recommendations of self-isolation for the affected person, and general recommendations to the public will be sufficient for managing the annual epidemic. Accordingly, although influenza is a notifiable disease it is not included in the Swedish Communicable Diseases Act as a disease which is dangerous to the public and therefore it is not mandatory to perform neither testing nor contact tracing of suspected cases.

However, the basis for these general principles is that the risk for spread of a disease from infected but asymptomatic individuals is limited. If there is a substantial risk that a disease is transmitted easily from those who are asymptomatic, diagnostic screening may be warranted for certain risk groups or situations.

Swedish Communicable Disease Act

The Swedish Communicable Diseases Act (SFS 2004:168) and the Communicable Diseases Ordinance (SFS 2004:255) include several notifiable diseases. These diseases fall into different categories: notifiable, notifiable and subject to mandatory contact tracing, considered dangerous to public health, or even dangerous to society.

In Ordinance SFS 2020:20, February 2, 2020, the Swedish government established that the rules of the Communicable Disease Act for notifiable diseases that are dangerous to the public health shall be applied also on infection with SARS-CoV-2, the virus (named 2019-nCoV at that time) which causes covid-19.

On July 1, the Swedish parliament decided on a government proposition (2019/20:144) to include covid-19 in the Communicable Diseases Act as a notifiable disease dangerous both to public health and dangerous to society. Therefore, since February 2, 2020, it has been mandatory for a person suspecting that she/he could be affected by covid-19 to seek medical care without delay, and for a doctor suspecting that a person may have covid-19 to take the tests necessary for a diagnosis. Further, if covid-19 was diagnosed, or even suspected, the doctor (or other health-care staff with such competence) had to perform contact tracing.

Thus, it has been mandatory to perform diagnostic tests and to initiate contact tracing for suspected covid-19 in Sweden since the beginning of February 2020.

Recommendations from the WHO

Already at the end of January, WHO stated that exportation of cases from China may appear in any country and that all countries should be prepared for containment, including active surveillance, early detection, isolation and case management, contact tracing and prevention of onward spread of SARS-CoV-2 infection, and to share full data with WHO ([Statement on the meeting of the](#)

[International Health Regulations \(2005\) Emergency Committee regarding the outbreak of novel coronavirus 2019 \(n-CoV\) on 23 January 2020 \(who.int\)](#)).

This was further stressed on March 11, when WHO declared SARS-CoV-2 to be a pandemic. Speaking at the COVID-19 media briefing the Director-General emphasized that "all countries can still change the course of this pandemic" if they "detect, test, treat, isolate, trace, and mobilize their people in the response" ([Timeline of WHO's response to COVID-19](#)).

Material and Methods

Countries and periods of time for comparison

The choice of relevant countries for comparison of strategies for testing and contact tracing, with the strategies used in Sweden, was discussed in one of the committee's expert groups, and it was deemed reasonable to include 3-5 countries in this comparison.

Sweden has had a significant morbidity and mortality in covid-19 since the start of the pandemic. (Table 1). In contrast, some countries, notably our Nordic neighbours Norway, Denmark, and Finland, have had much lower numbers of cases and deaths. The Nordic countries are relatively comparable when it comes to population density (except for Denmark which is more densely populated), structure, and socio-economic factors. It was therefore logical to include these three countries in the comparison. Two other European countries, Spain and England, were also included. Although these countries have larger populations, higher population density, and more large cities, they like Sweden had high morbidity and mortality during both the first and second wave of the pandemic. England, instead of UK, was chosen since it is the largest country in the UK and the different countries have their own public health agencies.

Table 1. Estimated number of excess deaths in 2020 in 29 high income countries, by sex*

Country	Total No (95% CI)	No (95% CI) male	No (95% CI) female
Sweden	9300 (8700 to 9800)	5100 (4700 to 5500)	4100 (3700 to 4500)
Norway	-70 (-470 to 320)	100 (-180 to 370)	-170 (-450 to 110)
Denmark	-160 (-610 to 300)	-40 (-360 to 290)	-120 (-440 to 200)
Finland	1000 (550 to 1500)	690 (360 to 1000)	320 (0 to 640)
Spain	84 100 (82 800 to 85 300)	41 100 (40 200 to 42 000)	43 000 (42 100 to 43 800)
England and Wales	85 400 (83 900 to 86 800)	45 000 (44 000 to 46 000)	40 400 (39 400 to 41 400)

* Islam N, Shkolnikov VM, Acosta RJ, Klimkin I, et al. Excess deaths associated with covid-19 pandemic in 2020: age and sex disaggregated time series analysis in 29 high income countries. *BMJ* 2021;373:n1137

The study period was decided to be the whole year of 2020, so that the first two waves of the pandemic could be included.

Questionnaire

A questionnaire, sent out to the six countries, included questions on testing and contact tracing

strategies, and results, during 2020. The testing part of the questionnaire sent to England was slightly modified since it is not a part of the EU and testing data therefore could not be obtained from ECDC (www.ecdc.europa.eu).

The questionnaire was divided in four parts, Nucleid acid testing (PCR) for Sars-CoV-2, Strategies for contact tracing for Sars-CoV-2/covid-19, Antibody testing for Sars-CoV-2, and Regional variation.

The complete questionnaires are available as an appendix, but the main points covered are stated below.

A. Nucleid acid testing (PCR) for Sars-CoV-2

1. Weekly testing data
2. Testing capacity
3. Testing strategies at different time points during 2020

- 3.1. *Time points of interest*, week 1-4, 2020, before first imported European case, week 5-8, before first reported cluster of cases in Europe, week 9-10, before pandemic declaration on March 11, week 11-13, before ECDC Rapid Test Recommendations on April 1, and each later change of the national strategy for testing

- 3.2. *What was the national strategy for testing at each of the specific time points stated above?*

- 3.2.1. Which considerations were the basis for the choice of testing strategy?
- 3.2.2. What were the indications for performing a PCR-test (excluding contact tracing)?
- 3.2.3. At which sites were testing performed?
- 3.2.4. Which sampling methods were used?
- 3.2.5. Do you have data of the magnitude of the epidemic spread at the end of each time point, and at the time for any later change?
- 3.2.6. What was the average "time taken to obtain a PCR-test" for persons in the community wanting to have a test performed?
- 3.2.7. What was the average "time taken to receive a Covid-19 test result" for a person tested in the community?
- 3.2.8. Which rules applied for a person in the community with a positive PCR-test?

B. Strategies for contact tracing for Sars-CoV-2

1. What was the national strategy/recommendation for contact tracing at the beginning of the pandemic?

- Was contact tracing was performed at all (yes/no)?
- If yes – how was contact tracing organised?
- Were all positive cases traced, or only in certain patient groups/settings, and in that case which groups/settings?
- How far backwards and forwards were the tracing aimed to be?
- Was the tracing performed by trained staff, by the patient him-/herself, or a mix of both?
- If contact tracing was performed by trained staff - are there data on how many these "contact-tracers were per 100.000 inhabitants?
- Which instructions were close contacts given?

2. Did the national strategy for contact tracing change during the pandemic?

- If yes, when, and in what way was changes made?

3. Were contact tracing apps used?

- If yes, when was the app developed? Are there any data on how well the app has contributed to the contact tracing?

4. Results of contact tracing for the periods of January-March, April-June, July-September, and October-December, 2020

- Average time from result of a test to when contact tracing was initiated?
- Average percentage of persons who were reached and asked to provide details of recent close contacts?
- Average number of persons traced for every positive case?

C. Antibody testing for Sars-CoV-2

- When was antibody testing initiated in your country?
- What was the initial national strategy for the use of antibody testing?
- Did the strategy for antibody testing change during the year, and in that case when, in which way, and what was the reason for this change?

D. Regional variation

- Were strategies for PCR-testing, antibody testing, and contact tracing the same in all parts/regions of your country, or were there significant differences over the year?
- If there were differences, please describe in what way regions differed and if these differences were present during the whole of 2020, or only during specified time periods?

Sources for test- and positivity data, and for responses to the questionnaire

The questionnaires were answered by a person or persons representing national institutions of the six countries.

Sweden: Public Health Agency of Sweden. Data provided by Sara Byfors and Moa Rehn.

Norway: Norwegian Institute of Public Health. Data provided by Frode Forland and obtained from <https://www.ecdc.europa.eu/en/publications-data/covid-19-testing>

Denmark: Statens Serum Institut (SSI). Data provided from Tyra Krause, SSI, and obtained from [Overvågningsdata for covid-19 i Danmark og Europa \(ssi.dk\)](https://overvaagningsdata.ssi.dk/).

Finland: Finnish Institute for Health and Welfare. Data provided by Professor Mika Salminen, Director, Health Security Department.

Spain: Spanish Ministry of Health. Data provided by Berta Suárez Rodríguez.

England: Public Health England. The number of persons tested and positive for coronavirus in England ("Pillar 2" - the public) for the period of 30 January to 27 May 2020 obtained from GOV.UK (www.gov.uk), and for the period of 28 May to 30 December 2020 obtained from "NHS Test and Trace statistics, 28 May to 30 December 2020: data tables" ([Weekly statistics for NHS Test and Trace \(England\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/statistics/weekly-statistics-for-nhs-test-and-trace-england)).

Responses to the questionnaire provided by Suzanne Gokool, Senior Scientist (Epidemiology), and her co-workers, on behalf of the UK IHR National Focal Point, National Infection Service, Public Health England.

Notification rates of covid-19, 2020

The 14-day notification rates included in the report for Sweden, Norway, Denmark, Finland, and Spain were obtained from the European Centre for Disease Control (ECDC) ([Data on 14-day notification rate of new COVID-19 cases and deaths \(europa.eu\)](https://ecdc.europa.eu/en/data-on-14-day-notification-rate-of-new-covid-19-cases-and-deaths)). The ECDC web-page does not include England as a separate country, only the whole United Kingdom (UK). The UK, where about 85% of the population lives in England, was therefore chosen for the comparison with the other five countries.

Results

Weekly data on PCR-testing and positivity rates of PCR-tests (Figures 1-4)

The weekly PCR-testing data per 100.000 inhabitants in the six countries, during 2020, can be seen in figures 1-2.

Swedish data from week 5-26 are based on unique individuals tested, but with the total number of positive tests for the "positivity rate", on total number of tests and positive tests during week 27-39, and on unique individuals and their respective test results during week 40-53.

Norway referred to the data reported to the ECDC, but it was not clear if the tests reported were based on the total number of persons or on unique individuals.

Danish data were based on the number of unique individuals tested who had not been tested positive at an earlier date, and the percent positive tests among this group.

Finnish and Spanish data were based on the total number of tests and the percent positive tests among those.

The numbers reported from England were based on tests, not on unique persons, and data presented for the first part of the year, until May 27, was not directly comparable with that for the rest of 2020 when NHS Test and Trace was implemented (see [Number of people tested for coronavirus \(England\): 30 January to 27 May 2020 - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/statistics/number-of-people-tested-for-coronavirus-in-england-30-january-to-27-may-2020) and [NHS Test and Trace \(England\) statistics: 24 December to 30 December - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/statistics/nhs-test-and-trace-in-england-statistics-24-december-to-30-december-2020) for details). Furthermore, the "weekly" data reported on these web-pages consists of "broken" weeks, Thursday one week to Wednesday the week after. To be able to compare with other countries data the week ending on Wednesday February 5, 2020, has been named "week 6", the week ending on February 12 for week 7, and so on.

However, although data are not exactly comparable, neither within nor between countries, that is unlikely to have affected the larger picture of how testing was implemented in the six countries, seen in figures 1-2.

In Sweden, Norway, Spain, Denmark and Finland, the number of PCR-tests began to increase during week 9-11, 2020 (Fig. 2). From week 12 the increase became higher, first in Norway, then followed by Spain, Finland and Denmark. From week 14, and especially from week 16, Denmark increased its PCR-testing very rapidly and during the rest of the year they performed approximately 2-3 times more tests per 100.000 inhabitants than in any of the other five countries. In Sweden the number of tests increased only slowly from week 12 and did not reach the same level as Denmark, Finland, and Spain until the middle of June. Testing in England started slower, but accelerated during the end of April – beginning of May and from that date the number of PCR-tests performed per 100.000 inhabitants were higher than in Norway, Finland, Spain and Sweden.

The percentage of positive PCR-test ("positivity rate") during a specific time period depends not only on the magnitude of the spread of covid-19 in the community, but also on the testing rate and on the focus of the testing, i.e. if testing is performed to diagnose illness in a symptomatic person or to screen asymptomatic persons. Thus, the positivity rate was the highest during the initial phase of the epidemic, when the few tests performed were directed towards the most severely ill patients (Fig. 3). During weeks 10-15 the peak positivity rate reached 40-45% in Spain and England, 15-20% in

Norway, Denmark, and Sweden, and 10% in Finland. The positivity rate declined rapidly after that in all countries, except Sweden. From the second part of May, all countries but Sweden had positivity rates below 5%, while it took till the beginning of July for Sweden to come below that level.

When the second wave started up in July in Spain, in September-October in Denmark, UK (England), and Sweden, and in November-December in Norway and Finland (Fig. 4), all six countries had developed higher testing capacities. However, despite this, the positivity rate was between 10-15% during most of the fall in Spain, between 10-20% during November-December in Sweden, and 10-15% in England during the last two weeks of the year (Fig. 3). In contrast, positivity rates in Norway, Finland and Denmark were never above 5% after week 20, 2020. The reason for the low positivity rate in Denmark, despite that their magnitude of 14-day notification rate per 100.000 inhabitants were as high as in UK (England), Spain and Sweden, during the last 4-6 weeks of the year (Fig. 4), was that the testing rate in Denmark was 2-3 times higher than in the other countries (Fig. 1).

Fig. 1. No. of tests per 100.000 inhabitants per week, in the six countries, weeks 5-53, 2020

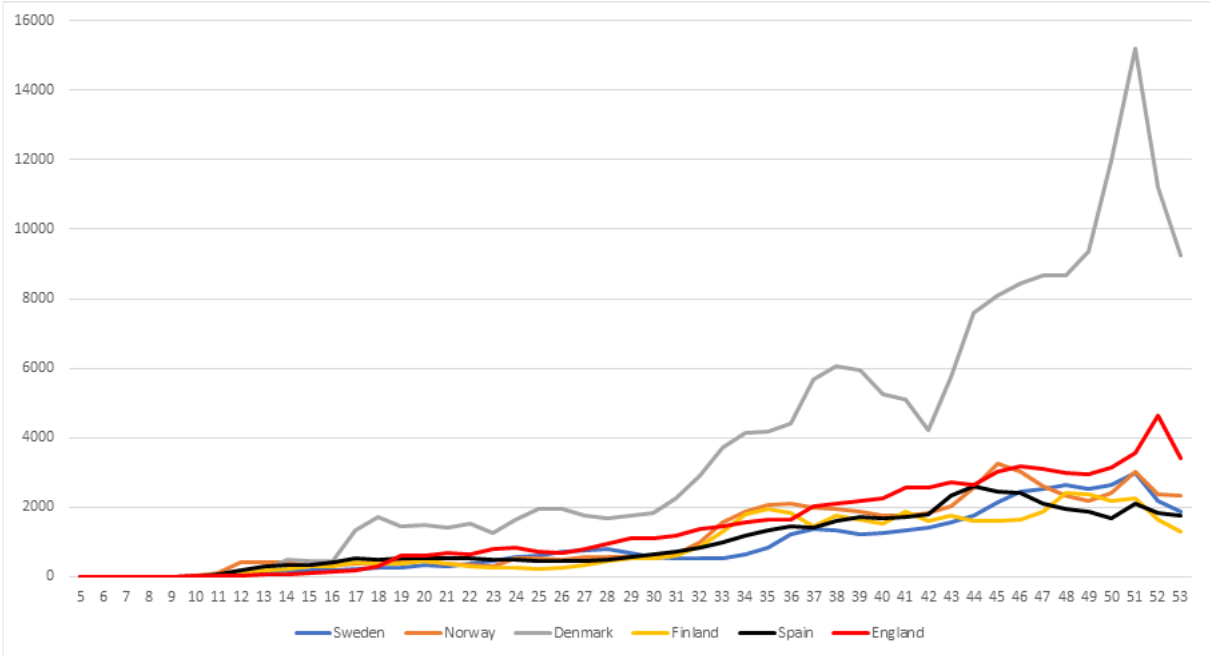


Fig. 2. No. of tests per 100.000 inhabitants per week, in the six countries weeks 5-16 and weeks 5-31, 2020

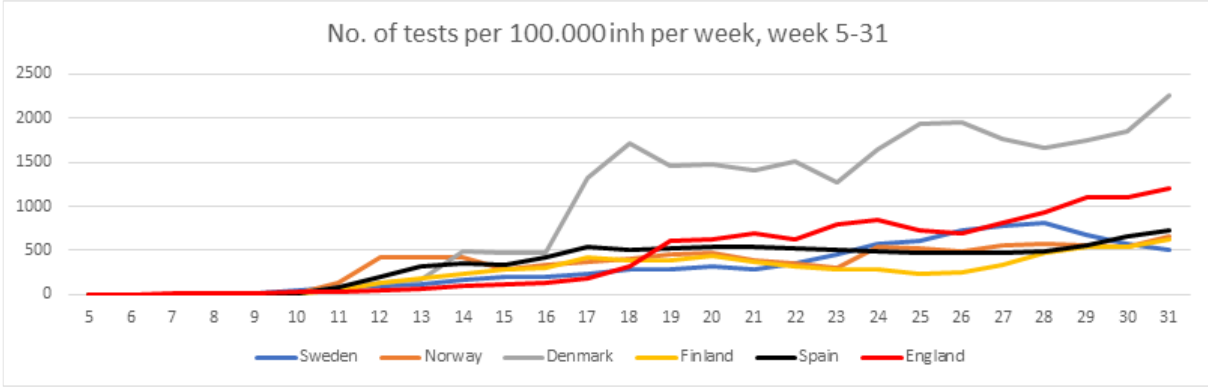
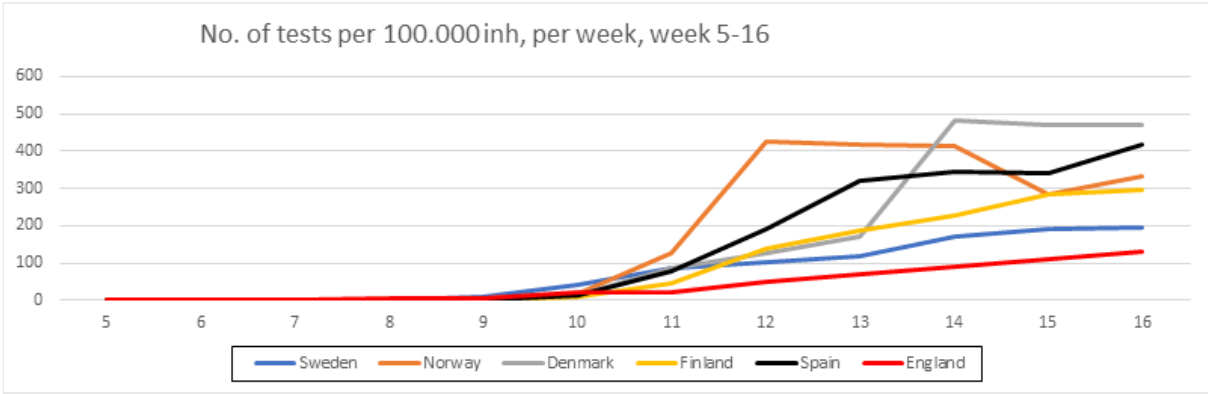


Fig. 3. Percent positive tests per week, in the six countries, weeks 5-53, 2020

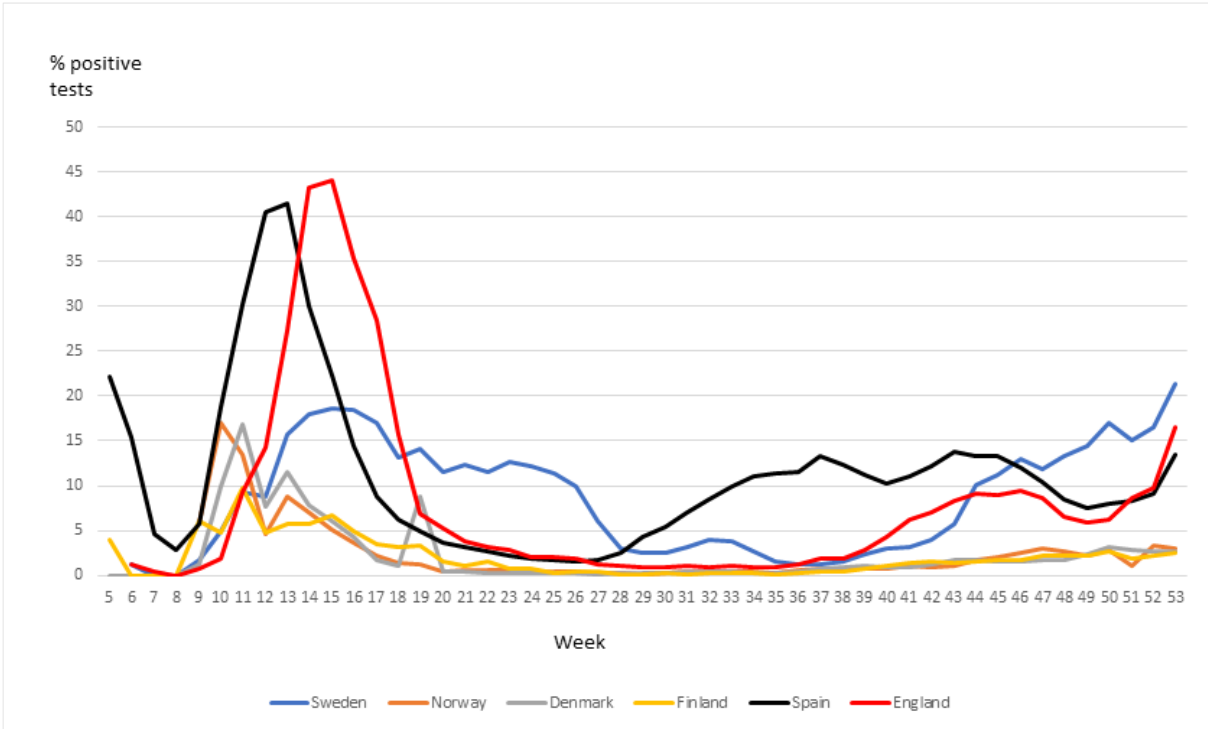
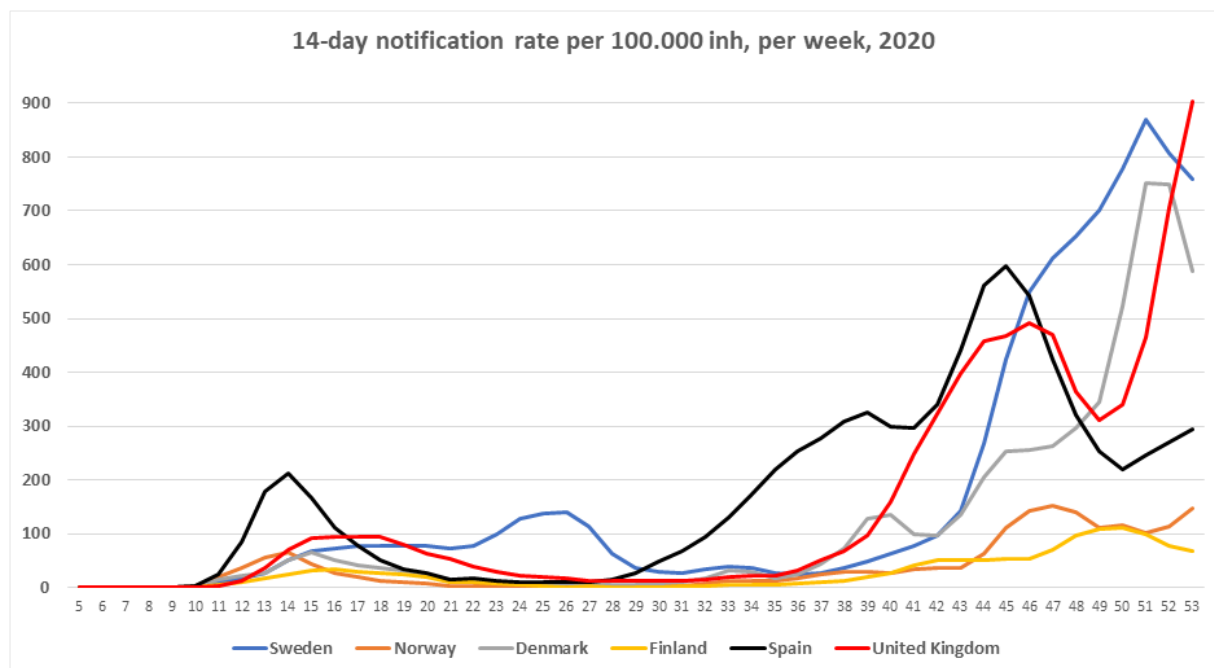


Fig. 4. 14-day notification rate per 100.000 inhabitants, per week, 2020*



* [Data on 14-day notification rate of new COVID-19 cases and deaths \(europa.eu\)](https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&plugin=1). The 14-day notification rate is provided for the United Kingdom since it was not available for England alone (about 85% of the population in the UK lives in England).

National strategies for PCR-testing and testing capacities at different time points (Table 2-3)

Based on the assumption that the preventive actions initiated during the initial phase of the pandemic were crucial for the possibility of limiting the spread of covid-19 in the community, a special focus was put on the national testing strategies chosen during the first 13 weeks of 2020; weeks 1-4, before first imported European case, weeks 5-8, before first reported cluster of cases in Europe, weeks 9-10, before the pandemic declaration on March 11, and weeks 11-13, before ECDC Rapid Test Recommendations on April 1, but every later major change of strategy was also of interest.

The Swedish national strategy throughout the first year of the pandemic was to reduce spread of covid-19 by testing as much as was possible, considering available testing capacity and without leading to negative effects on the necessary health-care resources. In addition, it became mandatory already on February 2, 2020, for doctors suspecting that a patient could be infected with covid-19 to perform diagnostic tests and to initiate contact tracing (Ordinance SFS 2020:20, see Introduction, "Swedish Communicable Diseases Act). It was also mandatory for doctors obtaining a positive test for covid-19 to report the finding to the Regional County Medical Officer and to the Swedish Public Health Agency. However, on March 26 the rules for mandatory reporting of infectious diseases was changed, so that only doctors at microbiological laboratories and doctors who suspected or verified that a person admitted to hospital or a home for the elderly was infected with covid-19 should report the finding (HSLF-FS 2020:10)

(<https://www.folkhalsomyndigheten.se/contentassets/4e0a7e97fe654fa2b9d28ace831c185f/hslf-fs-2020-10.pdf>). Further changes were made on April 28, when reporting was restricted to doctors at

microbiological laboratories and to doctors who performed autopsies (HSLF-FS 2020:23) (<https://www.folkhalsomyndigheten.se/contentassets/4e78ed361f164d29a9128481d1384477/hslf-fs-2020-23.pdf>). The main reason for these changes was to limit the pressure on the regional units of County Medical Officers who otherwise had to handle reports from both the laboratory and the clinical doctor. However, despite these modifications, it was still mandatory for clinical doctors to test and trace on the clinical suspicion, or verification, of covid-19.

Spain, like Sweden, responded that they had had a general strategy where the basis for the choice of testing strategy were scientific evidence and the epidemiological situation. The availability of tests and the test's reliability was also considered."

The responses of Norway, Denmark, Finland, and England are summarised in Table 2.

Up to week 10 the focus in all four countries were travellers, or close contacts to travellers, from areas with ongoing transmission of covid-19. During weeks 9-10 Denmark, Finland, and England noted that they had a focus on containment and contact tracing, and by weeks 11-13 the strategies in all four countries shifted towards mitigation strategies, to prevent further transmission of covid-19, to protect high-risk groups, and to prioritise the most severely ill persons for testing. Testing of asymptomatic persons are mentioned from April in Denmark, May in Norway, and in September in England, and during fall all four countries stated that they had a capacity permitting large-scale testing.

Sweden, Norway, Denmark, Finland, and England reported their respective approximate testing capacities per 100.000 inhabitants, during the whole year of 2020 (Table 3). For these countries, except for Denmark, there are also data on the approximate percentage used of that capacity. There seems to have been, at all times, a capacity for more tests than performed in all these countries. However, Sweden stated that the reported test capacity was based on how many samples the microbiological laboratories said they could handle. Several other factors such as lack of test materials, testing staff or transportation, may have limited the testing capacity at any given time. It is not unlikely that the same caveats were applicable also for the other countries.

Table 2. National considerations for choice of testing strategies at different time points, 2020

Time period	Weeks 1-4	Weeks 5-8	Weeks 9-10	Weeks 11-13	April - May	June- August	September-December
Sweden		To reduce spread of covid-19 by testing as much as possible considered available testing capacity and without leading to negative effects on the necessary health-care resources	Same	Same	Same	Same	Same
Norway	Travel or close contact with outbreak area	Same	Same	Increasing spread within Norway – priority to hospitalized patients	Serious situation at nursing homes (week 22) – testing of asymptomatic persons on admittance and on outbreaks.	Good testing capacity – test of all persons at risk for covid19.	
Denmark	Travellers / contact with Wuhan	Travellers / contact to areas where there has been transmission	Same, but also containment - finding close contacts	From containment to mitigation. Protection high-risk persons. Test prioritized for severe symptoms	Test Center Danmark opens (week 17), symptomatic and asymptomatic can get tested. All health personnel can get tested		Week 43, extension of the test-capacity. Mobile and flexible test facilities - local testing possible

Time period	Weeks 1-4	Weeks 5-8	Weeks 9-10	Weeks 11-13	April - May	June- August	September-December
Finland	Finding imported cases plus prevent transmission. Travellers from China	Same, plus still limited availability of diagnostic tests	Finding imported and secondary cases, preventing further transmission	Delaying community transmission. Entire world potential affected area	Mitigation of epidemic and preventing healthcare overloading. Adoption of Test-Trace-Isolate-Treat doctrine. Large-scale testing and tracing	Continued build-up of community testing and testing capacity at borders	
Spain	The bases for the choice of testing strategy were scientific evidence and epidemiological situation. The availability of tests and the tests' reliability was also considered	Same	Same	Same	Same	Same	Same
England		Travel to areas with transmission of Covid-19, or high risk of importation of infection	Travel, but also corona-virus action plan on 3 rd March; early detection and follow up of close contacts	Testing of symptomatic population to identify and prevent spread		Expansion of Adult Social Care testing	Sept: Expansion of asymptomatic testing and targeting of groups and areas of greatest risk. Ensuring testing is accessible to all. Nov: asymptomatic antigen testing begun

Table 3. Approximate testing capacity per 100.000 inhabitants, and the approximate percentage used of that capacity within brackets, in 2020

Country	Jan 1	Feb 1	March 1	April 1	May 1	June 1	Aug 1	Oct 1	Dec 1
Sweden	ND*	ND	255 (34)	400 (43)	1200 (23)	1350 (34)	1573 (33)	1885 (66)	3030 (83)
Norway	0	ND	550 (23)	550 (75)	920 (44)	1470 (21)	2752 (36)	3670 (48)	3670 (59)
Finland	0	18 (4)	90 (49)	325 (70)	542 (71)	902 (31)	2166 (41)	2888 (53)	2888 (83)
England	ND*	ND	ND	202 (45)	1243 (26)	2114 (38)	2673 (52)	3854 (59)	7236 (41)
Denmark**	0	0,2	14	600	1700	1300	2700	5375	9765
Spain	ND*	ND	ND	ND	ND	ND	ND	ND	ND

* ND = No data

** Danish data are partly based on the number of tests performed and the capacity might thus have been higher than stated. Percentage used of the capacity is therefore not relevant.

Indications for performing a PCR-test (Table 4)

The respective countries specific indications for performing a PCR-test for covid-19 during different time periods in 2020 are shown in Table 4.

During the first 8 weeks of the year the indication for a test in all six countries were travel to, or contact with person who had travelled to, Wuhan or other affected area, plus clinical criteria of acute respiratory symptoms and/or fever, or severe lower respiratory tract infection without known etiology. Norway also recommended health care workers who had had contact with a confirmed case or an infectious sample to be tested.

During weeks 9-10, due to increasing number of cases and still limited testing capacities, Sweden and Spain began to prioritize testing of persons with severe disease requiring hospital admission, with Norway, Denmark and Finland following this course during weeks 11-13. Parallel to this prioritization in weeks 11-13, the indications for testing were broadened in most countries. Sweden, Norway, Denmark, Spain, England now included testing of persons with respiratory tract symptoms working in health care, nursing homes/homes for the elderly and/or essential services. Norway, Denmark, and England also began testing of symptomatic persons living in nursing homes/homes for the elderly, while this category was not included in Sweden until a couple of weeks later. Indications in Norway also included all persons 65 years of age or older with respiratory tract infection, and in England PCR-screening of hospital and social care admissions was recommended.

A recommendation for testing of all persons with symptoms where covid-19 could be suspected came in Norway in April, in Finland and Spain in May, and during the summer in the remaining countries. During the second half of the year Norway, Denmark and England also included indications for testing of asymptomatic persons.

Table 4. Indications for performing a PCR-test (excluding contact tracing) at different time points, 2020

Time period	Weeks 1-4	Weeks 5-8	Weeks 9-10	Weeks 11-13	April	May	June-July	August-December
Sweden	WUH / +	ANY / / +	ANY* / + or Priority to	ANY* or + or + /	+ / or + /	Same + +	ALL	ALL + ***** (week 43)
Norway	ANY/ / +	WUH / / +	or ANY** / / +	+ / / / / 65+ / 	ALL (if possible)	Same	Same + asymptomatic persons in certain cases	1. ALL, 2. Asymptomatic + or last 10 days (week 33-34)
Denmark	WUH / +	ANY / +	or ANY/ +	+ / / / /	Same + referral to regional test unit if + / / /	Same 	Same + of /	ALL + asymptomatic can get a test for covid-19 without being referred (October)
Finland	ANY + or	Same	ANY*** / + /	ANY*** / + /	Same	ALL + of /	Same + testing at airports	Same
Spain	WUH / +	Same	/ or 	+ or + /	Same	ALL	Same	Same
England	WUH ^{\$} +	ANY ^{\$\$} / +	Same	ALL + / / / + + of hospital and social care admissions	Same	Same	Same + of weekly, and of (65+), every 28 days	Same + of of working age, every 28 days (august) + asymptomatic testing of all adults (november)

Footnotes to Table 4

§ Enhanced monitoring will be in place from all direct flights from Wuhan to the UK.

§§ Hubei province, or anywhere else in China (not including Macao or Hong Kong).

* Sweden week 9-10: China including Hong Kong, South Korea, Iran Northern Italy. Week 11: Austria (Tirol) added















** Norway week 9-10: China including Hong Kong, Iran, South-Korea, Northern Italy, Singapore, Japan, Iran, Austria (Tirol)

*** Finland week 9-10: Italy, South Korea and Iran added to affected areas by domestic decision, later also Austria.

**** Sweden week 43: Great Britain

Icons used in Table 4

WUH = travel to Wuhan, or other parts of China with known spread, **ANY** = travel to any affected area, **ALL** = all cases where covid-19 could be suspected, **65+** = person 65 years of age or older

-  = History of travel to areas with evidence of community transmission
-  = Close contact with confirmed case
-  = acute respiratory symptoms
-  = Clinical criteria of acute respiratory symptoms and/or fever
-  = severe disease referred to hospital/hospitalized
-  = severe lower tract infection/pneumonia of unknown aetiology/ARDS
-  = health care worker who has had contact with a confirmed case or infectious sample
-  = health care worker/ social-health personnel
-  = essential services
-  = persons in nursing homes/homes for the elderly/other at-risk groups
-  = care givers in nursing homes/homes for the elderly
-  = not being able to self-isolate
-  = high-risk person in household
-  = Screening

PCR-testing – testing sites, sampling methods, and waiting times for obtaining a test and for receiving test results (Tables 5-8)

Sites of testing varied both within and between countries (Table 5). Initially, testing was centralized to a few hospitals, but regional and local testing were begun already in March in Norway and Denmark, and in April in England and Sweden. Naso- and/or oropharyngeal exudates, or swabs from nose and/or throat sometimes combined with saliva, was the sampling methods used for persons in the community in all countries (Table 6).

In all six countries there was limited data on how long the waiting time was for a person to obtain a PCR test (Table 7). However, Finland reported that the waiting time in April was 2-4 days and that testing from June and onwards was available within 12 hours. In Sweden, data from 10 of the 21 regions showed that the median waiting time for obtaining a test performed in the community, excluding tests performed health-care institutions, went from 3 days in May to 1-2 days during the fall.

England introduced their Test & Trace strategy in the end of May 2020, and from that date it is possible to obtain detailed data on the time taken for receiving the result from a PCR-test. As can be seen in Table 8, the result of a PCR-test taken at a test-centre in England, in most months, was received within 24 hours in less than 50%, but within 48 hours in at least 80-90% of the cases. In Finland the waiting time for a test result was 24-36 hours from June and within 24 hours from September, and in Spain it varied between 3-4 to 1-2 days from June, and onwards (Table 8). Denmark reported that test results were received within 24 hours in 60% from September and in 80% from December. In Sweden, the results of a test taken at community test-centres, or at home, in 10 of the 21 regions, were received within 48 hours in only 14% of the cases in May but this increased to 50% from July and to 62% in December.

Table 5. Sites where testing was performed at different time point, 2020

Time period	Weeks 1-4	Weeks 5-8	Weeks 9-10	Weeks 11-13	Weeks 14-18	May-June	Early fall	Late fall
Sweden	At hospitals	Same	Same	Same	Hospitals, out-patient clinics, test-centers, drive-in-, and home-testing	Same	Same	Same
Norway	At some hospitals and communities	Same	Test stations at all hospitals and communities	Same	Same	Same	Same + all border crossings	Same
Denmark	At 2 hospitals after referral by telephone	At 6 hospitals after referral by telephone	Same + regional centers if no need of hospital	Same + mobile test facilities introduced	Same	Same	Same	Same + covid-19 consultation clinics and local test facilities
Finland	THL and one University hospital lab	THL and two University hospital labs	Same + roll out to all clinical microbiological labs started	THL, three University hospital labs	Multiple labs start testing	All hospital regions have growing test capacity. Private healthcare providers contribute	Same, growing capacity	Same
Spain	See below							
England	No data (ND)	ND	ND	Pillar 1 for NHS employees at NHS facilities. Pillar 2 for the public (Test & Trace): Local Test Sites (walk through); Regional Test Site (drive in); mobile testing sites; Satellite testing sites.	Same	Same	Same	Same plus subsequently distributed via all testing channels, post, via employers, pharmacies.

Spain: Tests were usually done in hospitals, primary care centers and long-term facilities. There were differences between regions. Some of them performed drive-in strategies and tests were even done in sport centers or municipally facilities. Sampling in vulnerable or disabled people was also performed at home. There was no self-testing.

Table 6. Sampling methods used for PCR-tests at different time points, 2020

Time period	Weeks 1-4	Weeks 5-8	Weeks 9-10	Weeks 11-13	Weeks 14 - 41	Weeks 42 -53
Sweden	Nasopharyngeal exudate in outpatients. For inpatients also sputum or lower respiratory tract samples.	Same	Same	Same	Same, and/or oropharynx, saliva, or nose samples for outpatients	Oropharynx plus saliva or nose-sample
Norway	Naso-/ oropharyngeal exudate	Same	Same	Same	Same	Same
Denmark	Tracheal secretion, BAL (Broncho-Alveolar Lavage), or other lower respiratory tract material on inpatients.	Same	Same + samples from throat in outpatients	Same	Same	Same
Finland	Nasopharyngeal swab	Same	Same	Same	Same	Same
Spain	Naso-/oropharyngeal exudate in outpatients. Lower respiratory tract samples on inpatients.	Same	Same	Same	Same	Same
England	No data (ND)	ND	ND	Combination of nose and throat exsudates	Same	Same

Table 7. Waiting times for persons in the community to obtain a PCR-test, at different time points, 2020

Time period	Weeks 1-13	April	May	June	July-Aug	Sept-Dec
Sweden	ND*	Same	Limited availability**. Access to test after 3 days in median.	Increasing availability**. Access to test after 3 days in median.	Increasing availability**. Access to test after 1 day in median	Testing with good availability**. Access to test after 2 days in median.
Norway	ND*	ND	ND	ND	ND	ND
Denmark	ND*	ND	ND	ND	ND	On average the waiting time for a test was within 24 hours (Oct)
Finland	Community testing was not available	Limited availability. Access to testing after 2-4 days	Testing more widely available, but access sometimes delayed	Testing widely available. Access to testing within 12 h.	Same	Same day testing widely available. Rapid antigen tests introduced (Fall 2020)
Spain	ND*	ND	ND	ND	ND	ND
England	ND***	ND	ND	ND	ND	ND

* No data.

** Data from 10 of 21 regions of testing performed in the community, excluding tests performed health-care institutions (Inera/177, Calculations performed within the Stockholm University's Covid-19 programme). Via a national web-place individuals could book appointment for a self-test at home, or a test at special test-centers. 2201 such tests were performed in May, 30 665 in June, 148 536 in July-August, 402 976 in September-October, and 715 735 in November-December.

*** With the exception of a period in Aug-Sept 2020, when demand was incredibly high, the time taken to obtain a PCR test was very short as capacity has met demand.

Table 8. Waiting times to receive a covid-19 test result for persons tested in the community, at the respective time points, 2020

Time period	Weeks 1-13	April	May	June	July-August	Sept-Nov	December
Sweden*	ND**	ND	14% within 48 h	17% within 48 h	50% within 48 h	51% within 48 h	62% within 48 h
Norway	ND**	ND	ND	ND	ND	ND	ND
Denmark	ND**	ND	ND	ND	ND	60% gets their test result within 24 h	80% gets their test result within 24 h
Finland	Community testing was not available	Test results were partly delayed up to 4-5 days.	Delays of a few days still seen in some regions	Within 24-36 h	Same	Within 12-24 h	Same
Spain***	ND**	ND	7 days	3-4 days	1-2 days	2-4 days	Same
England****	ND**	ND	>90% within 48 h	~ 75% within 24 h	~ 45% within 24 h and >90% within 48 h	10-50% within 24 h, 80-90% within 48h	10-50% within 24 h, 80-90% within 48h

* Data from 10 of 21 regions of testing performed in the community, excluding tests performed health-care institutions (Inera/177, Calculations performed within the Stockholm University's Covid-19 programme). Via a national web-place individuals could book appointment for a self-test at home, or a test at special test-centers. 2201 such tests were performed in May, 30 665 in June, 148 536 in July-August, 402 976 in September-October and 715 735 in November-December.

** No data.

*** Average time between consultation and diagnosis.

**** Results from "Pillar 2", i.e. community testing at local test centres.

National recommendations and regulations for persons diagnosed with positive PCR-tests, for containing and limiting the spread of covid-19 (Table 9)

In Sweden, during the first weeks of 2020, recommendations for persons diagnosed with covid-19 were issued by the respective regional County Medical Doctor (Table 9). From the beginning of March (week 11), the Swedish Association of County Medical Officers issued common rules for all 21 regions, stating that a PCR-positive person was to refrain from contacts with persons outside their own household and was not allowed to travel by public transport during time of illness plus two days after loss of symptoms. In April these rules were specified and somewhat sharpened, so that the PCR-positive person had to stay at home and should avoid contact also with persons in their own household but were allowed solitary outside walks. The duration of this partial isolation was to be at least 7 days, including at least 2 days without fever, in symptomatic patients, 7 days from the time of the PCR-test in asymptomatic persons, and at least 14 days for hospital treated patients and persons in homes for the elderly. These rules remained unchanged during the remaining of the year. In contrast, all the other five countries responded that they issued rules for strict isolation either in hospital, or at home, already from January-February 2020.

As can be seen in Table 9, the stated isolation period was in most cases between 7 and 14 days but varied during the year both between and within the countries, depending on factors such as if the person was symptomatic, immune-suppressed, hospital treated or living in a home for the elderly.

Table 9. Recommendations and regulations for persons diagnosed with a positive PCR-test, at different time points, 2020

Time period	Weeks 1-4	Weeks 5-8	Weeks 9-10	Weeks 11-13	Weeks 14 -17	Weeks 18 - 44	November
Sweden	*	*	*	** During illness plus two days after loss of symptoms: - refrain from contacts with persons outside own household - no travel by public transport	Same + must stay at home or solitary outside walks and avoid contact also with persons in own household, during; - at least 7 days (incl. no fever for 2 days) if symptomatic, 7 days from PCR-test if asymptomatic, and at least 14 days for hospital treated and persons in homes for the elderly	Same	Same
Norway	Isolation according to WHO criteria	Same	Isolation until 7 days without symptoms	Same	Isolation until 3 days without symptoms (minimum 8 days, but 14 days if immuno-supressed)	Week 18; Same + 10 days isolation for asymptomatic persons	Patients treated at home; isolation 10 days, if no fever
Denmark	Hospital isolation	Isolation at home	Isolation at home + no contact with rest of the household	Same + isolation until 48 hours after end of symptoms	7 days isolation for asymptomatic persons	Same	Same

* No national recommendations. Regional decisions by the County Medical Officer in the respective region (n=21) based on the Swedish Communicable Diseases Act.

** From week 11 common rules for all regions issued by the Swedish Association of County Medical Officer.

Table 9. Recommendations and regulations for persons diagnosed with a positive PCR-test, at different time points, 2020 (continued)

Time period	Weeks 1-4	Weeks 5-8	Weeks 9-10	Weeks 11-13	Weeks 14-17	Weeks 18-44	November
Finland	Hospital isolation	Hospital isolation	Hospital isolation	Mandatory isolation for duration of disease (mainly at home, severe cases in hospital)	Same	Same	Same
Spain	Isolation 14 days	Same	Same	Same	Same	* In community or long-term care; Isolation 3 days after resolution of fever, minimum 14 days from onset. Asymptomatic persons, 14 days isolation from diagnosis. Hospital treated should remain in isolation at home 14 days after discharge (incl. no fever for 3 days).	Same
England	Not applicable	7-day isolation period after onset of symptom	Same	Same	Same	Self-isolation period extended to 10 days for both symptomatic and asymptomatic persons (July) Legal requirement to self-isolate until 10 days after the point of symptom onset or, if asymptomatic when test taken, 10 days after date of test (Sept)	Same

* Spain stated that from May the “Strategy” was a dynamic document where changes were done depending on the scientific evidence and epidemiological situation.

Strategies for contact tracing for Sars-CoV-2/Covid-19

National strategies/recommendations for contact tracing at the beginning of the pandemic

All six countries included contact tracing in their initial strategy for managing the spread of Sars-CoV-2/covid-19. The number of persons performing contact tracing increased rapidly in all countries during the year, but only Norway and England could give national estimates of the size of this workforce (see below).

In Sweden, contact-tracing of covid-19 became mandatory on February 2, three days after the first Swedish case, when the Government decided that the same rules should apply for Sars-CoV-2/covid-19 as for diseases considered to be dangerous to public health and dangerous to society according to the Swedish Communicable Diseases Act (SFS 2020:20). The initial national strategy, until March 14, was to identify all possible close contacts to a confirmed case. According to the Communicable Diseases Act, contact tracing is the responsibility for the doctor who has ordered the test, but with covid-19 contact tracing was initially performed by trained staff at the 21 regional departments of communicable disease.

Contact tracing was recommended from 24 hours before the index's onset of symptoms. Asymptomatic persons were only traced if an index was diagnosed within healthcare, and then from 24 hours before the test was taken. A "close contact" was defined as a person living in the same household, or in similar conditions, a person not having used adequate protective equipment and having been in the same room and within 2 meters of the index patient, or as a passenger on the same airline flight as a confirmed case.

In Norway, contact tracing was recommended around all positive cases, regardless of setting. The 356 local health authorities (municipal medical doctors) are responsible for the contact tracing in Norway and their teams can be made up of both healthcare personnel and non-healthcare personnel. Each municipality undertook contact tracing using their own resources and protocols, although general advice on contact tracing, questionnaires, and templates for excel lists were provided by the Norwegian Institute of Public Health. The municipal contact tracing teams were also responsible for communicating instructions to contacts.

Contact tracing was recommended from 48 hours before symptom debut of the index case and forward until the case was in isolation. For asymptomatic cases, contact tracing was recommended from the positive test date, unless the case was detected as part of an outbreak investigation. In these cases, the recommendation was to start tracing up to 48 hours before test date, depending on the likely time for exposure.

In Denmark, all positive cases were investigated and close contacts were traced manually since there was no covid-19 database at the beginning of the pandemic. A contact tracing unit was established under the Danish Patient Safety Authority and a training course was developed, so that tracing was managed by trained staff. The Danish Defense Force, the police, and the Home Guards handled close contacts if the infected persons did not contact them.

Contact tracing was recommended from 48 hours before the index's onset of symptoms and until 48 hours after the symptoms had ceased, or if the index was asymptomatic from 48 hours before to 7 days after the test was taken.

In Finland, all contacts of cases were traced and evaluated for exposure. Tracing was performed by trained staff and many persons were rapidly trained for this task. Additionally, many patients did inform their contacts themselves.

In the beginning of the pandemic, tracing was performed from an index's onset of symptoms to 10 days post onset.

In Spain, all close contacts of a positive case were traced by trained staff from de surveillance services of the Autonomous Communities (AACC), at the beginning of the pandemic.

Cases were traced since the onset of symptoms. Close contacts were defined as any person that had provided care, including health workers who had not used adequate protective measures, any contact (<2 meters) that had been in the same place as a confirmed case while the case was presenting symptoms. Also, passengers in an airplane located within a radius of two seats around symptomatic cases during the flight and the crew who had had contact with such cases were defined as close contacts. Routine sample collection from contacts was not recommended, but any asymptomatic person meeting the definition of contact was informed and active surveillance initiated.

In England, the government published its official coronavirus action plan on 3rd March. The document provided information on the government's plans to contain the spread of the virus, how actions would develop as the virus spread and what people could do to protect themselves and their families. The plan on containment included detection of early cases and the follow up of close contacts. Once a case was detected, the public health agencies used "tried and tested procedures" for rapid tracing, monitoring and isolation of close contacts, with the aim of preventing further spread.

Contact tracing was initially performed from two days before the start of an index's symptoms through to seven days after their symptoms began.

Rules and recommendations for close contacts at the beginning of the pandemic

In Sweden, until week 11, all contacts were followed for 14 days. Symptomatic contacts should be tested and stay at home and await the results of testing. Asymptomatic contacts were not isolated and not tested, but should keep social distancing and, if possible, work from home during the incubation period.

In Norway all close contacts should be in quarantine for 10 days.

In Denmark, close contacts were advised to call the Danish Patient Safety Authority. They were then instructed to go into self-isolation, pay special attention to hygiene, pay special attention to cleaning, and pay special attention to symptoms of covid-19. If there were no symptoms within 14 days they could break the self-isolation.

In Finland contacts deemed to have been exposed were ordered into home quarantine for 14 days after the exposure and instructed to contact healthcare for testing in case they developed symptoms. Contacts in home quarantine were not allowed to leave ones dwelling for the 14 days or have any guests visit. Food and necessities should be delivered by family or friends, or if that was unavailable by municipal social services. Quarantine is a legally mandated order in Finland and sanctions are possible but very seldom used. Loss of income was 100% compensated during quarantine by the national social insurance.

In Spain, until week 12, all close contacts were actively monitored and were instructed to carry out home quarantine for 14 days from the last contact with the symptomatic case. All contacts that developed respiratory symptoms during their follow-up, within 14 days of exposure, were investigated to rule out infection.

In England close contacts should go into 7-day self-isolation period.

Changes of the national strategies for contact tracing during 2020

Sweden

Contact tracing

In week 11, due to extensive spread in the community of covid-19, contact tracing was prioritized to persons treated/working within health-care facilities or persons living/working within homes for the elderly/nursing homes, although the recommendation of tracing of contacts to corona-positive travellers from defined areas remained. Because of the varying incidence of covid-19, some regions had more extensive recommendations for contact tracing, and the Society of County Medical Officers still recommended testing of household contacts.

In week 15, the recommended time frame for contact tracing was changed from the initial 24 hours before onset of symptoms, to the day of onset of symptoms until the index was without fever for 48 h, or for at least 7 days of illness. During the summer (week 29) this was again changed, now back to 24 h before onset of symptoms until no fever for 48 h, or at least 7 days of illness. In addition, also contacts to asymptomatic positive persons diagnosed within healthcare should be traced from 24 h before the index test-date.

In week 29, the Public Health Agency of Swedish expanded the recommendations and stated that contact tracing was to be prioritized to environments where there was a high risk of severe consequences. Focus was to be on “priority group 1”, namely contacts within health care and long-term care facilities, then group 2 which included household contacts, and finally group 3 which was defined as “other risk environments” in society. However, depending on the regional situation the extent of tracing could vary between regions. By that time a close contact was defined as having been within 2 meters from an index, for more than 15 minutes during a 24-hour period.

During 2020, the number of persons who performed contact tracing grew fast and special tracing centres were started in many regions. A web-based education was available for all new tracers.

Rules and recommendations given to close contacts

The rules applicable for close contacts were changed several times during 2020.

From week 12 all contacts were followed for 14 days. Symptomatic contacts were to be tested, had to stay at home and await the results of testing. Asymptomatic contacts, however, were not isolated

and not tested, but should keep social distancing and, if possible, work from home during the incubation period.

At the end of September, week 40, rules were changed so that also asymptomatic household contacts must stay home 7 days from the index's first symptom/test date. Contacts were also recommended PCR-testing on day 5 after the index's test date. This rule was moderated in week 49, so that children in pre-school or elementary school did not have to stay home from school even if they were close contacts to a person positive for covid-19.

In week 52 the rapid increase of the mutant virus B. 1.1.7 (the "British" variant) led to an additional rule that all persons who had been in Great Britain (excluding transit) were regarded as suspicious cases of covid-19. They, and their house-hold contacts if working within the health-care sector, were instructed to stay home and test for coronavirus on day 1 and 5.

Norway

Contact tracing was a key element of the Norwegian response strategy. While minor changes were made to strategies for contact tracing, there were no significant changes to the approach to contact tracing since the beginning of the pandemic.

The Norwegian Directorate of Health estimated the numbers of contact tracers to be around 2500 in Norway as a whole, which would correspond to approximately 47/100 000 inhabitants.

Denmark

Contact tracing

The overall purpose of the contact tracing strategy was the same during the year, i.e. that all close contacts were to be isolated and tested. The Danish model for contact tracing is based on voluntary principle, so coercion cannot be used if citizens do not want to state where they have been and who they have been with.

The definition of a close contact was changed several times but in general referred to a person who lived with, had had direct physical contact, or close "face-to-face" contact within a 1 meter for more than 15 minutes with someone diagnosed with covid-19, or a person who had had unprotected and direct contact to infectious secretions from a person diagnosed with covid-19. In addition, healthcare professionals and others who had participated in the care of a patient with covid-19 and who had not used protective equipment in the prescribed ways were considered to be close contacts.

The time frame for contact tracing remained the same during the whole year, from 48 hours before onset of symptoms and until 48 hours after the symptoms have ceased, or if the index was asymptomatic from 48 hours before to 7 days after the test was taken.

In June 2020 the Danish Patient Safety Authority launched a nation covid-19 database which meant that all close contacts from then on were contacted by the Danish Patient Safety Authority and not as before, when they were only advised to call for instructions.

Rules and recommendations given to close contacts

The initial rules and recommendations remained much the same during the year. However, from May, when there were more available test facilities, all close contacts were advised to be tested on day 4 and 6 after exposure and if negative they could break their self-isolation.

Finland

Strategies for contact tracing and rules for close contacts remained the same during the year, with the ambition to trace all potential contacts for evaluation of potential exposure. The time frame for tracing, that in the beginning was from onset of an index's symptoms, was later changed to 2 days prior to symptom onset until 10 days post onset of symptom.

Several training programmes for contact tracers were set up, the biggest of them a web-based course organised by the Finnish Institute for Health and Welfare and the University of Eastern Finland.

Spain

Contact tracing

From week 13 (March 29) until week 19 (May 6) the surveillance services were overwhelmed by the increasing number of cases in the community. Close contacts were therefore instructed to carry out home quarantine for 14 days, from the last contact with the symptomatic case, instead of being actively monitored, and to call the unit in charge for their follow-up if they developed suggestive symptoms of covid-19. However, in hospitals and long-term facilities active contact tracing continued to be performed.

The "COVID-19 Detection, Early, Surveillance and Control Strategy", a document that includes the bases of contact tracing, was launched throughout Spain on May 11 (week 20). From that date contact tracing was again to be performed of all confirmed cases. The tracing was performed from 2 days before the onset of symptoms until the index was isolated.

The number of professionals in the surveillance units grew since the new strategy in May and although the organisation may have differed between the regions, staff from regional public health services and primary health care were involved, and since September also members of the Spanish Army.

Rules and recommendations given to close contacts

Although the rule of home quarantine for close contacts remained during the whole year, the duration changed; 14 days until week 24, 14 days that could be reduced if a negative PCR test was obtained, between week 25 – 39, and a minimum of 10 days between week 40 - 53. During the quarantine contacts were asked to take their temperature and record it twice a day. In case they presented with fever, or any other symptoms related to the disease, they were asked to call the person in charge for their follow-up.

England

Contact tracing

National Health Services (NHS) Test and Trace was launched on 28th May (week 22). The definition of a close contact included anyone who lived in the same household or had been in close contact (such as face-to-face within one metre, sexual contacts, or had been within 2 metres of someone for more than 15 minutes) with a person who had covid-19 symptoms or had tested positive for covid-19. It also included persons who had travelled in a small vehicle, or in a large vehicle or plane near someone who had tested positive for covid-19.

The time frame for contact tracing that initially was from two days before the start of symptoms to seven days after the index's symptoms began, was later changed to from 2 days before until 10 days

after the index first developed symptoms, or from 2 days before until 10 days after the date of the test if the index was asymptomatic.

The contact tracing system was also designed to prompt covid-19 positive persons to flag the people they had seen or places they had been that pose the highest risk. This includes health and social care settings and schools or childcare settings. If someone had visited a high-risk setting, this was escalated to experienced health protection experts in the relevant local area who carried out a detailed risk assessment.

From week 33, an enhanced contact tracing was conducted for all positive cases, which gathered information about where the covid-19 positive person had been in the seven days prior to the onset of symptoms.

The workforce engaged in contact tracing was split into three main tiers (the numbers given below of persons working in the respective tier are those valid for spring of 2021). Tier 1, health protection teams who were public health specialists, including approximately 1 000 staff, working with local government to provide oversight of the programme and handle the most complex cases. Tier 2, clinical contact caseworkers, about 3 500 healthcare professionals, who interview people who have tested positive for COVID-19 by phone. Tier 3, call handlers, about 10 700 specially trained persons who make outbound calls to close contacts. In total, in spring 2021, that would correspond to about 18 contact tracers per 100.000 inhabitants. In addition, contact tracing is performed by local public health specialists when someone who has tested positive for covid-19 works in, or has recently visited or attended, a complex setting such as a prison, school, care home, hospital, or court. There are also local contact tracing teams dealing mainly with cases where the national team has been unable to reach someone who has tested positive.

Rules and recommendations given to close contacts

NHS Test and Trace alerted contacts and told them that they needed to self-isolate. From week 40 (28th September) the duty to self-isolate was put on a legal footing with new Regulations whereby anyone notified by NHS Test and Trace, Public Health England or a Local Authority contact tracer that they were a close contact was legally required to self-isolate. The self-isolation period for positive cases and contact at the outset of the Regulations was 14 days but was reduced to 10 days on December 14.

Persons under 18 years of age did not have to be contact traced individually if a parent or guardian confirmed they had met their legal duty to inform the child to self-isolate. If the person who has tested positive agrees to inform other members of their household of their duty to self-isolate, NHS Test and Trace would not make phone calls to these other household members but would send an SMS or email notification to confirm the legal notification.

Use of contact tracing apps'

Sweden

Sweden did not use any contact tracing apps in 2020.

Norway

Two different contact tracing apps were developed in Norway. During spring of 2020 a contact tracing app was locally developed and launched ("Smittestopp"). By analysing anonymized and

aggregated data of population movement patterns the National Institute of Public Health (NIPH) could also evaluate infection control measures and monitor rates of transmission through society. However, the large quantities of personal data about app users, including continuous location data and information about app users' contact with others, collected by "Smittestopp" led to an integrity problem and NIPH therefore decided to suspend all use of the app and erase all data in June 2020.

In December 2020 a new contact tracing app, also called "Smittestopp", was launched. This contact tracing app is supplemental to the contact tracing conducted by municipalities, particularly in contexts where it is not possible to identify all contacts directly. However, it has so far not been possible to determine the added value of the app, although an evaluation is being considered.

Denmark

On June 18, 2020, Denmark launched a national contact tracing app. The app called "SmitteStop" was a supplement to contact tracing, completely on a voluntary basis and was intended to be used only during the Covid-19 pandemic. If a user tests positive for Sars-CoV-2, they can log into the app using their NemID (a common log-in credential for Danish digital banks, online government services, and some private companies) upon which an anonymous notification will be prompted to other users who have been in contact with the infected user for more than 15 minutes at a distance of 1 meter.

There are some data on how well the app has contributed to the contact tracing from October 2020. During that month 99.389 persons were tested because they reported that they had been a close contact to a covid-19 positive person, including persons who had received a notification from the SmitteStop-App, and of those 2.544 people (2,56 %) tested positive for covid-19 at their first test. The positivity rate was thus somewhat lower than the approximately 4% found among persons traced by the Danish Patient Safety Authority (Coronaopspringen), but still higher than the 1,5% overall positivity rate that month. In April 2021 the SmitteStop-app had been downloaded 2.270.105 times and 63.446 persons had received a notification (<https://www.ssi.dk/-/media/arkiv/subsites/covid19/modelberegninger/ekspertrapport-effekten-af-kontakttopsporing-10122020.pdf?la=da>).

Finland

A tracing app was launched in Finland, August 1, 2020. There is data on usage which shows active utilisation of the warning function, but due to the anonymous manner the app was set up it is difficult to evaluate its actual contribution. However, it is stated that preliminary surveys indicate that approximately the same proportion of cases had received the app-based warning as the proportion of the population that had downloaded the app.

Spain

An app, Radar-Covid was developed in September 2020, but there are no data about its contribution.

England

The NHS COVID-19 app has been widely available to download since September 24 in England and Wales. The app is available in 12 languages and has multiple features including contact tracing, local area alerts, ordering a test and venue check-in. Following the launch of the app, businesses were asked to display official NHS QR code posters to makes it easier for customers with the app to check-in. The app was designed to the highest standards of data privacy and data security and does not collect any personal information, such as the person's location. It uses low-energy Bluetooth (not GPS), and only requires the first half of users' postcode to ensure local outbreaks can be managed.

A study has investigated the impact of the NHS COVID-19 app for England and Wales, from its launch in September to the end of December 2020 (Wymant C, Ferretti L, Tsallis D, Charalambides M, et al.

The epidemiological impact of the NHS COVID-19 app. Nature 2021; 594:408–412). The app was used by approximately 16.5 million users (28% of the total population) and sent approximately 1.7 million exposure notifications: 4.2 per index case consenting to contact tracing. It was estimated that the number of cases averted by the app, using two complementary models, were 284,000 and 594,000, respectively. The Authors estimated that approximately one case of covid-19 was averted for each case consenting to notification of their contacts, and that for every percentage point increase in app uptake, the number of cases could be reduced by up to 2.3%.

Results of contact tracing

The countries were asked if there were national data on the average time from result of a test to when contact tracing was initiated, on the average percentage of persons who were reached and asked to provide details of recent close contacts, and on the average number of persons traced for every positive case. The answers were, with the exception for England, mostly negative.

In Sweden no attempts have been made to gather national data on the results of contact tracing because of the great variation in tracing capacity over time between the different regions, and the enormous amount of work. However, there may be data on a regional level.

Norway responded that they do not have sufficient quantitative data at the national level to track the indicators below over time.

In Denmark the Danish national Covid-19 database was released June 10, 2020, so there are only data from that point on. However, the many changes made in the practice of data collection makes it difficult to gather data on the results of contact tracing.

In Finland contact tracing data are not yet analysed at this level of detail.

Spain responded that between May and December 2020, the median number of contacts for each case was 3, with an interquartile range of 2-4.

England

There are no data from January-March 2020, as the Contact Tracing and Advisory Service (CTAS) was not yet operating.

Since the development of NHS "Test and Trace", there are data on the mean and median number of hours between the time that a positive test result was communicated to a test subject and the time that the subject's details were entered into CTAS as a case (see Table below). There are also data on the percentage of cases who either provided details of recent close contacts or stated that they did not have any recent close contacts (% cases completed), on the average number of contacts per case (mean contacts per case), and the percentage of contacts who were reached and asked to isolate (% contacts completed).

There are some caveats. Contacts in CTAS are those whose details are provided by a case. Some cases have many close contacts whose details are not recorded in CTAS, but who are asked to isolate by another organisation - this applies particularly to schools, in which the school asks a 'bubble' of students to isolate. Further, a policy change in November 2020 allowed contacts in a case's household to be marked as "completed" without direct contact from CTAS if the case informed CTAS that they would take responsibility for asking them to isolate. This caused a sudden increase in the reported percentage of completed contacts but did not necessarily correspond to a change in contact behaviour.

The results in the table below are provided for test dates in quarters 2,3 and 4, 2020. The data includes only tests obtained from NHS “Pillar 2”, which are PCR-tests performed within the general population.

Period	April - June	July – Sept	Oct - Dec
Mean No. of hours from case results to CTAS	11	19,1	7
Median No. of hours from case result to CTAS	9,1	7,3	6,1
% cases completed	82,1	82	89,5
% contacts completed	51,6	60,8	75,5
mean contacts per case	2,2	2,7	2,2

Antibody testing for Sars-CoV-2

Sweden

Antibody testing were first mentioned in a document on the national strategy for diagnosis of covid-19 on April 7, 2020 (week 15). The document stated that such serologic methods could be used for evaluating if a person had had covid-19 to follow the level of immunity in the population. However, by that time the methodology was still not fully developed. From the end of April (week 18), when the methodology was in place, the Swedish strategy was to secure resources for serologic tests of high quality in order to be able to show that a person working in health-care or other jobs of public importance was immune and not at risk for re-infection. Another aim was to evaluate the national evolution of the epidemic by doing cross-section analyses of different groups, and to increase knowledge of the functionality of corona antibodies and for how long immunity lasts after covid-19. This strategy remained unchanged during the rest of 2020 and during the second half of the year large-scale antibody testing was used both for individual diagnostic purposes and for population studies.

Norway

Antibody testing was stated to have been available from the beginning of the pandemic, but the exact date for when the methodology was in place is not given. Initially, there was no national strategy for widespread use of serologic testing, but antibody testing was included in routine rest-sera analysis from laboratories and became part of the regular cohort studies from the Norwegian Institute of Public Health. A national representative seroprevalence study was carried out in December from some 28 000 participants. Results showed only 0,9% seropositivity on antibody testing across the country.

Denmark

Antibody testing was used repeatedly to get an estimate of the seroprevalence in representative samples of the population in Denmark. The first national survey was carried out in May 2020 with 5.200 invited people. A second survey was carried out in August, a third in the autumn of 2020, and a fourth in March 2021. More than 140.000 people have been invited and more than 40.000 have participated (<https://covid19.ssi.dk/overvagningsdata/undersogelser/praevalensundersogelsen>). In addition, blood donors could get an antibody test taken from their donated blood since October 2020. There has also been a project called "Vi Tester Danmark", where almost 500.000 people participated. This project was not a representative survey but was initiated to analyse different aspects of the disease and included answering a questionnaire and an antibody test to take at home.

Finland

Neutralising antibody testing in Finland has been done as part of a national sampling survey study to estimate the hidden true attack rate, but it has not been deemed useful in the national control strategy. Thus, serologic testing has not been used for individual diagnostics routinely, although some private providers has offered the service and the Finnish Institute for Health and Welfare maintains it as a reference laboratory function in special cases.

Spain

A guideline for the interpretation of rapid serological tests as a diagnostic strategy for covid-19 was developed in the beginning of April (week 14). The rapid serological test was used primarily for patients with a symptom duration for more than 7 days, and a positive test was then considered diagnostic of covid-19, even if the PCR-test was negative. From week 19, the rapid tests were no longer used, but clinical criteria and a positive result for IgM by serology was still considered diagnostic until week 51 when antibody tests were stopped being used as a diagnostic tool.

England

In April Public Health England set up a Serology programme board with external academic input, who defined the potential uses for serology to assess: (a) exposure to the SARS-CoV-2 virus, (b) if an individual has immunity to SARS-CoV-2, (c) the prevalence and incidence in the general and target populations, as a tool to study infection, re-infection, and immunity in contact studies, and (d) how to differentiate between a vaccine and infection related response. Following formal published evaluations of commercial kits, antibody testing was expanded within the National Health Service (NHS) in the end of May. A home antibody test kit was released for the use in special population-based studies.

At first, the strategy for antibody testing was for surveillance and evaluation of commercial assays. Once the latter was established the NHS institutions were able to conduct their own testing. Many offered testing of staff on a voluntary basis and at local discretion to patients. Guidelines for the use of antibody testing have not been produced by Public Health England, only on a local level. Given the requirement for test development and evaluation, the policy was that no test was better than a bad test, serology testing has been more limited compared to PCR testing.

Regional variation of national strategies

The six countries response to the question if strategies for PCR-testing, antibody testing, and contact tracing were the same in all parts/regions of the country are less comprehensive than their responses on other parts of the questionnaire.

Sweden states that the epidemic evolution differed very much over time between the 21 regions. During periods of a general spread of covid-19 in the society many regions had to prioritize hard, which led to that they could not fully implement the national strategies and recommendations for testing and contact tracing. The regional variation in Sweden will be described in a separate report to the commission.

In Norway the strategies were generally the same all over the country, but the capacity and need for intensified testing, contact tracing and measures have varied, mainly due to the differences in prevalence and incidence of cases in different parts of the country. The strategy has been to knock down outbreaks with intensified testing, contact tracing, quarantine, and isolation whenever and wherever an outbreak occurs. Hundreds of local outbreaks have been controlled by this strategy, where local short-term measures have been installed and released again after few weeks.

Denmark only states that testing was increased over a period of time in areas with high incidences, for instance by introducing pop-up testing where it was not needed to book a time for the test.

In Finland the national testing guideline and strategy has been followed to a large extent throughout the country. Some regional variations existed but were relatively minor and only adaptations to local circumstances, e.g., in Lapland where a rapid POC tests (Ag-test) were adopted early on for testing in the fall of 2020 due to the test's easy administration and the long distances to labs and healthcare.

In Spain the Ministry of Health acted as coordinator. In the beginning of the pandemic the national strategy only included minimum criteria, which was open to regional variations, which may have led to regional differences in how and where testing was performed (see Table 5). However, these differences became less common after the publication of the new National Strategy in the beginning of May.

In England contact tracing was initially operated (from 28 May 2020) as a national service, only. From August 2020, local tracing partnerships were developed, whereby if the national service was unable to reach a positive case over a 24 working hour period, the individual's details would be passed to the relevant local authority. Local contact tracers could use a range of methods to contact the positive case, including in-person visits to people's houses where necessary. However, most cases were reached via the national system.

Summary, Discussion, and Conclusions

The present report shows that the Swedish strategies for testing and contact tracing of during the first year of the covid-19 pandemic differed in several aspects from those implemented in Norway, Denmark, Finland, Spain, and England. Although the initial focus in all six countries were similar, to test travellers coming from infected areas and to perform contact tracing of all persons diagnosed with covid-19, the different strategies became apparent from around mid-March, and onwards, when the number of cases increased rapidly.

PCR-testing

From the second half of March PCR-testing, in relation to the population, increased more rapidly in Norway, Denmark, Finland, and Spain, than in Sweden. The largest increase was seen in Denmark, where from mid-April, and during the rest of 2020, testing rates were two-three times higher than in any of the other countries. Although England started out a little slower than the other countries, they reached similar testing rate levels as Norway, Finland, and Spain in the beginning of May, while it took Sweden until June to do the same. However, from summer and during the second half of 2020 the testing rates in Sweden increased in a similar way as in Norway, Finland, Spain, and England.

The rate of covid-19 positive PCR-tests reflects both the epidemiological situation and the testing rate. On May 12, 2020, WHO advised governments that before reopening, rates of positivity in testing of should remain at 5% or lower for at least 14 days ([WHO-2019-nCoV-Adjusting_PH_measures-Criteria-2020.1-eng.pdf](#)). The reason for this advice was that a high positivity rate may indicate that only the most severely ill patients are tested, which makes it difficult to know how much the virus is spreading within the community. Contrary, a low rate of positivity in testing data can be seen as a sign that there is a sufficient testing capacity for the size of the outbreak and that enough testing is performed to make strategic decisions concerning for example restrictions. Since it took time to build up adequate testing capacities it is not surprising that all six countries showed positivity rates well, and for some even high, above 5% during the first months of the pandemic. However, by mid-April in Norway and Finland, and one month later also Denmark, were below the 5%-level and stayed there all through the year. Also, Spain and England managed to come below 5% by the second half of May, while it took until the beginning of July for Sweden to do so. During the second wave, first Spain, then England and Sweden again had increasing positivity rates well above 5%, while Denmark despite similar notification rates as these three countries remained below the 5%-level thanks to the very high testing rates in that country.

In Sweden the general strategy for PCR-testing during the whole year of 2020 was “to reduce spread of covid-19 by testing as much as possible considered available testing capacity and without leading to negative effects on the necessary health-care resources”. This strategy may be one reason for why broader testing started out later than in the other countries. Local testing sites seemed to have been developed later in Sweden than in Norway, Denmark, and England, which probably was related to that Sweden prioritized testing of severely ill persons that needed hospital care earlier, and for a longer period, than in the other countries.

In most of the six countries, including Sweden, priority for testing was also from an early date given to healthcare and social-health personnel, and to care givers in nursing homes/homes for the elderly if they showed symptoms compatible with covid-19. However, while testing of symptomatic persons living in nursing homes/homes for the elderly was recommended during March in Norway, Denmark, and England, this was not included in the Swedish recommendations until the beginning of April. Testing of broader patient groups, including all persons who had symptoms that could be caused by Sars-CoV-2, opened in England in March, in Norway and Denmark during April, in Finland and Spain

during May, but not until the end of June in Sweden. Already during March, England started to screen persons admitted to hospital or social services, and Denmark and Finland began to screen healthcare/social-health personnel and care givers in nursing homes/homes for the elderly in April and May, respectively. In Sweden there was no national recommendation for screening of persons admitted to hospital or homes for the elderly, but from the end of May this was mentioned as an option based on regional or local directives. Neither was there any national recommendation for testing of asymptomatic persons (excluding contact tracing in some cases) in Sweden, in contrast to in Norway, Denmark and England where this was recommended during the second half of 2020.

From the answers to this questionnaire, it is not possible to evaluate if PCR-testing resources may have been more limited in Sweden than in the other countries. As can be seen in Table 3, the microbiological laboratories seemed to have had an over-capacity during the whole year in Sweden, as well as in the other three countries where this could be estimated. However, at least in Sweden limitations of test resources were frequently discussed in the press during the spring. Such limitations may have been of regional character or have been caused by a lack of test materials, testing staff, testing facilities, or transportation.

Neither is it possible to evaluate if waiting times for persons in the community to obtain a PCR-test or the time it took to receive a covid-19 test result had an impact on the testing rates, because of the scarcity of national data. In Finland a person in the community could have access to testing within 12 hours from June, in Denmark within 24 hours on average from October, and in Sweden, based on data from 10 of 21 regions, within 1-2 days in median during the second half of 2020. Only England could provide detailed data on the waiting time to receive a test result, which from May and onwards was within 48 hours in at least 80-90% of the cases. Finland reported that their waiting time for a test result was even shorter, within 12-36 hours during the second half of the year and Denmark reported that by the end of the year 80% of the test results in were delivered within 24 hours.

The recommendations and regulations for persons diagnosed with a positive PCR-test were stricter in the other countries, than in Sweden, with isolation in hospital or at home as the rule since beginning of the pandemic. The duration of isolation for community cases was 7-10 days, except for in Spain where it was 14 days. In contrast, the first national recommendations in Sweden, in March, only stated that a positive case in Sweden was to refrain from contacts with persons outside their own household and that they should not travel by public transport during their illness plus two days after end of symptoms. A month later this was changed so that a positive case in the community must stay at home for at least 7 days, including no fever for at least 2 days, and should also avoid contact with persons in their own household, but were allowed solitary outside walks.

Contact tracing

Contact tracing for covid-19 in Sweden became mandatory for Sars-CoV-2 according to the Communicable Disease Act in the beginning of February and was probably strictly applied during the first few weeks of the pandemic. However, already in the beginning of March, the national recommendations began prioritizing contact tracing of persons within health-care facilities or homes for the elderly/nursing homes. Although these recommendations were expanded in July, they still stated that contact tracing was to be prioritized to environments where there was a high risk of severe consequences in case of transmission Sars-CoV-2. In contrast, Norway, Denmark, and Finland recommended tracing of close contacts around all positive cases, regardless of setting during the whole year. Spain stated that they also performed contact tracing around all positive cases, except for a six-week period during April and beginning of May when the tracing services were overwhelmed by the rapid increase of covid-19. England responded that they published a

coronavirus action plan in the beginning of March, which included the follow up of close contacts, but that a more detailed and ambitious strategy was launched with the NHS Test & Trace organisation in the end of May.

Although the definition of a “close contact” varied somewhat, within and between countries, it most often included a person who was living in the same household, had direct physical contact, or who had not used adequate protective equipment when being in the same room and within 1-2 meters of the index patient for 15 minutes during the last 24 hours, or someone who had travelled in a large vehicle such as a plane and sitting near a confirmed case.

Also, the “time frame” for contact tracing varied, within and between the six countries over the year. In Finland and Spain contact tracing was initially recommended from the time of the index’s symptom onset but was later changed in both countries to 48 hours before onset. In Norway, Denmark, and England tracing was recommended from 48 hours before the onset during the whole year, while in Sweden the initial recommendation of 24 hours before the index’s onset of symptoms was changed in April to the time of onset, and then in July back again to 24 hours before onset. For asymptomatic cases the time of the index’s PCR-test was generally used, instead of the time of onset of symptoms. For ending of contact tracing all countries used similar time points of 7-10 days after the index’s onset of symptoms, although 48 hours without fever was required in some, or 7-10 days after the PCR-test was taken if the index was asymptomatic.

In all countries, except for in Sweden, close contacts were followed for between 7-14 days, which meant strict home isolation for both symptomatic and asymptomatic contacts. However, Denmark and Spain reported that it became possible during the late part of spring for close contacts to break their self-isolation earlier if they obtained a negative PCR-test. In Sweden, asymptomatic contacts were neither isolated nor tested, but were instructed to keep social distancing and, if possible, work from home during the incubation period. This was not changed until the end of September, when recommendations stated that asymptomatic household contacts must stay home for 7 days from the index’s first symptom, or test date, and were recommended PCR-testing on day 5 after the index’s test date. In the end of the year these rules were modified so that children in pre-school or elementary school did not have to stay home from school even if they were close contacts to a person positive for covid-19 in the same household.

That asymptomatic contacts in Sweden were not told to self-isolate during a large part of the year may have contributed negatively to the transmission rate of covid-19. To what extent asymptomatic or pre-symptomatic persons infected with Sars-CoV-2 can transmit the virus has been difficult to establish because of the varying and often mild symptoms and has thus been widely debated. Although the ECDC states that “A person who is infected can also transmit the virus up to two days before they show symptoms; the extent to which such asymptomatic infections contribute to the overall transmission is not currently clear.” ([Questions and answers on COVID-19: Basic facts \(europa.eu\)](#) (accessed on August 22, 2021), this may be questioned after the recent publication of a systematic review and meta-analysis of over 350 studies, where the authors estimated that more than one-third of covid-19 infections are truly asymptomatic (*Sah P, Fitzpatrick MC, Zimmer CF, Abdollahi E, et al. Asymptomatic SARS-CoV-2 infection: A systematic review and meta-analysis. PNAS 2021; 118, No. 34, e2109229118*).

Contact tracing apps were not used in Sweden, but in the other five countries. In Denmark the app was launched in June, in Finland in August, in Spain and in England in September, and in Norway in December. Both Denmark and England reports that they have indications that the apps have contributed positively to the tracing of contacts, while this has not yet been evaluated in the other three countries. The data from England is especially interesting, where a study of the impact of the

NHS COVID-19 app for England and Wales estimated that approximately one case of covid-19 was averted for each case consenting to notification of their contacts, and that for every percentage point increase in app uptake, the number of cases could be reduced by up to 2.3% (Wymant C, Ferretti L, Tsallis D, Charalambides M, et al. *The epidemiological impact of the NHS COVID-19 app. Nature* 2021; 594:408–412).

Only England, from the development of NHS “Test and Trace” in the end of May, could provide detailed national data on the results of contact tracing. The data from quarter 2-4, 2020, show that the contact tracing system for PCR-tests obtained within the general population was able to reach 80-90% of the cases, and that more than half of the contacts were reached and asked to isolate. On average, there were 2-3 contacts for each positive case.

Contact tracing is considered a key tool for breaking transmission chains, but the procedure is extremely time and resource consuming, and engages as reported from England a workforce of tens of thousands just in that country. In addition, it has been difficult to show the effectiveness and cost-effectiveness of contact tracing scientifically since it has had to rely on observational data and modelling techniques. Therefore, contact tracing has been subject to controversial public and scientific debates. However, a recent study of the effects of a coding error in the NHS Test and Trace system, leading to that around 20% of all covid-19 cases during six weeks failed to have timely contact, showed that this random breakdown of contact tracing led to more illness and death (Fetzer T and Graeber T. *Measuring the scientific effectiveness of contact tracing: Evidence from a natural experiment. PNAS* 2021; 118, No. 33: e2100814118). By chance, some areas of England were more severely affected than others which made it possible to estimate that, relative to cases that were initially missed by the contact tracing system, cases subject to proper contact tracing were associated with a reduction in subsequent new infections of 63% and a reduction in subsequent covid-19–related deaths of 66%.

Antibody testing

The national strategies for antibody testing differed between the countries, from in England where there were only local guidelines and serologic testing was much more limited compared with PCR testing, to in Sweden where the strategy already in mid-April mentioned that it could be used for following the level of immunity in the population. Since the end of April, when the methodology was fully in place, the Swedish strategy was to use antibody testing to be able to show that a person working in healthcare or other jobs of public importance was immune, to be able to evaluate the national evolution of the epidemic, and to increase knowledge of the functionality of corona antibodies and the duration of immunity after covid-19. Norway and Denmark used antibody testing to estimate of the seroprevalence of covid-19 in representative samples of the population, and in Finland it was used as part of a national sampling survey study to estimate the hidden true attack rate, but neither of these countries deemed such testing useful in the national control strategy of the virus. In contrast to the other five countries, Spain used antibody testing as a part of the diagnostic strategy for covid-19. A rapid serological test was developed in early April and used primarily for patients with symptom duration for more than 7 days. About a month later this was replaced by an IgM test, which together with clinical criteria was considered diagnostic for covid-19 until mid-December when serologic testing was stopped being used as a diagnostic tool.

Regional variation of national strategies

It is likely that there were regional variations concerning to what extent the national recommendations were followed over the year, but it seems to have been to a varying degree in the six countries. In Sweden many regions had to prioritize hard during periods of high transmission of covid-19, which led to that they could not fully implement the national strategies and

recommendations for testing and contact tracing. In contrast, Norway, Denmark, and Finland states that the national guidelines were followed to a large extent, although there occasionally may have been minor variations in relation to for example local outbreaks or specific geographic settings. Spain reports that there probably was a significant regional variation until their new national strategy was launched in the beginning of May. The response from England does not include to what extent there may have been regional variation before the launch of the Test and Trace strategy in the end of May, but after that the national guidelines seem to have been strictly followed.

Strengths and limitations

It is important to point out that this work is not a scientific study. The questionnaire used was not validated and the data presented are based only on the responses given by a few persons and on the publicly available websites of ECDC (www.ecdc.europa.eu) and Gov.UK (www.gov.uk). However, the responding person or persons are representatives for the national institutions in the respective countries, that were highly involved or even responsible for the pandemic strategies. All six countries, in the middle of the pandemic, accepted to participate and took the time to answer all questions which is gratefully acknowledged. It is also fully understandable that the answers, for the same reason, varied in detail and volume and that the time to answer follow-up questions was limited.

Furthermore, although the way each country's testing data were reported or presented on the websites may differ somewhat, with for example some countries including all PCR-tests performed and other only one PCR-test per each unique individual, this is unlikely to have any impact on the overall testing curves in figures 1-3. The same limitation may apply for how the number of cases of covid-19 was reported.

Finally, the responses given can only point out that certain differences in national strategies between countries during the first pandemic year existed, but it is not possible to casually associate any such difference with the number of cases of covid-19 in the respective country.

Conclusions

In conclusion, the Swedish strategies for testing and contact tracing of covid-19 during 2020, differed in several aspects from that of other comparable countries. The most important of these differences were that:

- PCR-testing in Sweden, in relation to the population, increased slower and did not reach the same level as in Norway, Finland, Spain, and England until midsummer. PCR testing rates in Denmark were much higher than in all the other countries during most part of the year.
- testing of high-risk persons in nursing homes/homes for the elderly did not start until in April in Sweden, compared to in March in Norway, Denmark, and England.
- testing of broader patient groups was not included in the Swedish recommendations until in the end of June, compared to in March in England, in April in Norway and Denmark, and in May in Finland and Spain.
- the positivity rate of PCR-tests did not go below 5% in Sweden until the beginning of July, compared to in mid-April in Norway and Finland, and in May in Denmark, Spain, and England.

- the rules for the isolation of PCR-positive persons were less strict in Sweden than in the other countries.
- despite that contact tracing for covid-19 became mandatory according to Swedish Communicable Disease Act in February, this was not reflected in the national recommendations until the second half of 2020. In contrast, the strategy of the other countries was to trace all close contacts all through 2020.
- in Sweden, contrary to the other countries, asymptomatic close contacts were not recommended self-isolation/home quarantine, at least not until in the end of September when all household members to a positive case were instructed to self-isolate for 7 days.
- contact tracing apps were not used in Sweden, in contrast to the other countries. Both Denmark and England could present results indicating that their apps had contributed positively to the contact tracing.
- in Sweden, but not in the other countries, antibody testing was included as a part of the national strategy to control the spread of covid-19.

To evaluate if, and to what extent, any of these differences may have contributed to the high transmission of covid-19 in Sweden is beyond the scope of this report. Scientific studies would be required for that. However, it must be emphasized that although covid-19 morbidity and mortality was much lower in our neighbouring Nordic countries, they were at least as high, or higher, in Spain and in England. This illustrates that several other factors, beside testing and contact tracing, were of importance for the spread of covid-19, in 2020.