**SARS-CoV-2 routes of transmission and recommendations for preventing acquisition: joint British Infection Association (BIA), Healthcare Infection Society (HIS), Infection Prevention Society (IPS) and Royal College of Pathologists (RCPath) guidance.**

# Appendices

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## Appendix 1: Glossary

**ACE-2 receptor:** a protein, which is found on surface of many cells (including lung cells). The protein normally regulates different functions in the body such as blood pressure. Some coronaviruses such as SARS-CoV and SARS-CoV-2 have proteins which can attached the virus to ACE-2. In this case, ACE-2 acts as a receptor to allow the virus to enter the cell.

**Aerosol generating procedure:** a medical procedure which produces aerosols particles from the respiratory tract. The particles are small enough to be considered ‘airborne’ and can lead to a transmission of infection to a person who conducts a procedure (usually a healthcare worker). Some examples include intubation of a patient, suctioning, dental procedures, some surgeries where high speed devices are used and bronchoscopy.

**Aggregated:** grouped or linked together. In this guidance the term is used describe the event to combine the data from all available studies without conducting a formal statistical analysis.

**AGP:** see aerosol generating procedures

**Caco2 cells:** cells which were once taken from a patient with colorectal cancer. Unlike normal human cells, these cells are ‘immortalised’ because due to a mutation, they are able to divide indefinitely. For viruses, e.g. SARS-CoV-2, the cells are inoculated in the laboratory setting (see viral culture) to determine if the virus is able to infect other cells.

**Collison drum:** or Collison nebuliser, is a laboratory device used for generating aerosols from liquids. The liquid can be inoculated with micro-organisms, which can then be assessed for their ability to survive in the air, depending on the size of aerosols produced.

**COVID-19:** Coronavirus Disease, a respiratory disease caused by infection with SARS-CoV-2 virus, which was first identified in December 2019.

**Culturable virus:** a virus which was has an ability to infect other cells in viral culture. A viral sample for an experiment is usually obtained from different body tissues or environment with an aim to determine whether the virus obtained in a sample is infectious.

**Denominator:** a divisor – a number below a line in a fraction, in statistics the number represents a total number of samples or individuals in the experiment.

**Epidemiological:** relating to a study of epidemiology – a field of medicine which investigates the frequency and determinants (e.g. causes or risk factors) of health-related issues. These could be infectious and non-infectious diseases, injuries, natural disasters and other.

**Fomite:** inanimate objects, which are contaminated with infectious agents (e.g. viruses) and can transfer them to a person who subsequently becomes infected. Examples include clothes, door handles, toilet seats, eating utensils etc.

**HCW:** Healthcare Workers; the term may refer to a person who delivers care (e.g. nurse or doctor), but more broadly includes any member of staff e.g. cleaners or receptionists, including non-paid staff such as volunteers and chaplains who work in healthcare setting.

**IgM:** Immunoglobulin M, a type of immunoglobulin (also known as antibody), is a molecule that is produced as a response of immune system following an exposure to pathogen. IgM appears early in an infection and plays a lesser role in subsequent infections. The significance of IgM in this guidance is that this molecule is too large to be able to cross placenta, therefore IgM found in an infant at birth suggests an *in utero* exposure to pathogen; foetus is able to produce IgM from about 20 weeks. Maternal IgM can be passed to an infant via milk through breastfeeding.

**Impinger:** a device for collecting small particles suspended in the air e.g. dust or microorganisms. In the collection process, a pre-defined amount of air is pumped into a tube and reacts with a liquid medium inside.

**Infectious dose:** also minimum infectious dose, the amount of virus that is necessary to cause a disease. For example, only 10-100 viral particles are sufficient to cause norovirus infection. The infectious dose for SARS-CoV-2 is currently unknown, although it has been proposed that this is around 1000 copies.

**Inoculum:** a substance used for inoculation – in research or diagnostics, a process of transferring microorganisms onto a medium where they can grow and reproduce.

**Intrapartum:** at birth, a time period which starts with the onset of labour and ends with the delivery of the placenta.

**MERS:** Middle East Respiratory Syndrome, a disease caused by MERS-CoV virus.

**MERS-CoV:** Middle East Respiratory Syndrome Coronavirus, a beta-coronavirus causing Middle East Respiratory Syndrome, which was first discovered in Saudi Arabia. It is a close cousin of SARS-CoV and SARS-CoV-2.

**MeSH:** Medical Subject Headings, a set of terms, which are used to index biomedical literature. Together with keywords, MeSH terms are used for searching articles relevant to the topic of interest.

**Meta-analysis:** performing of an analysis by combining data from more than one study in order to determine an overall result.

**Neonatal:** relating to a newborn.

**NIOSH:** an aerosol sampler which was developed by National Institute for Occupational Safety and Health (USA). The sampler collects airborne particles, which contain bacteria, fungi and viruses. The obtained samples can then be used to assess the concentration of a given microorganism in the air and therefore to determine safety of the environment.

**Ocular:** relating to the eye.

**PCR:** polymerase chain reaction, a laboratory technique which allows taking a small sample of DNA (molecule containing a genetic material) and rapidly produce a large number of copies. This technique can also be used for diagnostic purposes, e.g. viral detection. In this instance, a primer (a small molecule that contains a DNA sequence of interest) is used and defines which part of DNA is going to be amplified. If the same DNA sequence exists in a test sample, PCR will reproduce a lot of copies which will be detectable. A variant of PCR known as RT-PCR can be used to detect RNA sequence (see RNA).

**Placenta:** an organ that develops in the uterus during pregnancy. The placenta delivers air and nutrients to the foetus and removes its waste products.

**Postpartum:** a period usually defined as six weeks from giving birth.

**PRISMA diagram:** a flow chart which illustrates different parts of systematic review process, in particular it maps out a number of articles which were included and excluded at each step.

**Products of conception:** any human tissue derived during pregnancy, e.g. placenta, umbilical cord and the cord blood.

**Reproductive number:** or basic reproduction number (R0), is the number of individuals that are expected to get an infection from one infected person. If R0 >1, the infection is able to spread within the population and the higher the number, the more difficult it is to control. The reproductive number depends on many factors such as infectiousness of the organism, the length of time an infected person can spread the disease, number of people in contact with an infected person, number of immune people and different control mechanisms.

**RNA:** Ribonucleic acid, is a molecule which is usually derived from DNA. RNA contains a small portion of genetic material, needed for creation of a specific product. Most organisms use DNA to store their genetic material and make RNA when these products are needed. Some viruses use RNA, which gives them an additional advantage as once they enter the cell, their RNA is ready to be ‘translated’ into the products they encode for. Coronaviruses, including SARS-CoV-2 use RNA to store their genetic code.

**SARS:** Severe Acute Respiratory Syndrome, a disease caused by SARS-CoV virus.

**SARS-CoV:** Severe Acute Respiratory Syndrome Coronavirus. The virus was the cause of the SARS epidemic, which began in China in 2003 and spread around the world, mostly affecting East Asian countries. The virus is closely related to SARS-CoV-2 and to a slightly more distant cousin MERS-CoV.

**SARS-CoV-2**: Severe Acute Respiratory Syndrome Coronavirus-2. The virus is the cause of the COVID-19 pandemic, which was first identified in China in 2019 and quickly spread around the world. The virus is closely related to SARS-CoV and to a slightly more distant cousin MERS-CoV.

**TCID50:** fifty percent tissue culture infective dose, is the measure of infectious virus concentration used in cell culture. It is defined as the amount of virus that is required to kill or cause pathogenic effect in 50% of the culture cells.

**Vero E6 cells:** immortalised cells derived from a kidney of green monkey. Unlike other cells, Vero E6 do not produce a molecule called interferon. Interferons are signalling molecules which are released from a cell after it was infected with a virus, so that the neighbouring cells can heighten their anti-virus defences. Because this molecule is not released in Vero E6 cells, they are often used for researching or detecting viable viruses.

**Vertical transmission:** a direct mother to child transmission that occurs before, during or shortly after birth. Transmission can occur via placenta, infected tissues during delivery or through breast milk.

**Viable virus:** see culturable virus

**Viral culture:** a laboratory technique which uses virus inoculated into cells, with the aim to test whether the virus has an ability to survive, reproduce and infect other cells.

**Viral load:** number of viral particles in a sample taken from an individual or environment. The amount of virus is important because the higher the number of particles in the environment, the higher the likelihood of a person becoming infected. See infectious dose.

## Appendix 2: Guideline Development

1. ***Introduction***

The need for a guideline within this area was agreed between HIS, BIA, IPS, RCPath and BSAC at the beginning of the first wave of COVID-19 affecting UK in March 2020. The need arose from the concerned healthcare workers reporting the lack of evidence in this area. Further meetings between the participating bodies confirmed the need for the establishment of a COVID-19 Rapid Guidance Working Party. Members were chosen to reflect the range of stakeholders. Feedback from the members of respective societies was used to establish a basis for review questions. The final structure of these questions in PECO format was agreed collectively during subsequent teleconference meetings. After the agreement was reached, if the need for new questions arose, these were considered for inclusion at subsequent meetings. No payment was made to anyone involved in this guideline.

1. ***Conflict of interest***

Conflict of interest was registered from all Working Party members and during the ongoing review up until the point of completion. In the event of a potential conflict being identified, the Working Party agreed that the member should not contribute to the section affected.

## Appendix 3: Search strategy

*PECO Question:* What are the routes of transmission of beta-coronaviruses between humans?

Note: as specified by the protocol, SARS-CoV and MERS-CoV transmission would be considered only if sufficient evidence did not exist concerning SARS-CoV-2 transmission. The review included a total of 130 primary studies describing SARS-CoV-2, without the need to include evidence from other viruses. Instead, brief information relating to SARS and MERS viruses was introduced at each introductory section.

Population: Any person at risk of exposure in the community or healthcare setting

Exposure: Exposure to the betacoronavirus via any route

Comparison: No comparison group

Outcomes: Evidence of transmission to another person

Study design: Any study reporting primary data

***Literature search terms:***

*EMBASE/MEDLINE*

1 coronavirus.mp. or exp Coronavirinae

2 exp SARS coronavirus/ or coronovirus.mp. or exp Coronavirus infection/

3 severe acute respiratory syndrome.mp. or severe acute respiratory syndrome/ or respiratory distress syndrome/

4 Severe acute respiratory syndrome coronavirus 2.mp.

5 SARS-CoV-2.mp.

6 SARSCoV-2.mp.

7 SARSCov2.mp.

8 SARS-Cov2.mp.

9 SARS-CoV9.mp.

10 COVID19.mp.

11 nCoV-2019.mp. or SARS-related coronavirus/

12 COVID-19.mp.

13 2019-nCoV.mp.

14 2019nCoV.mp. or Betacoronavirus/

15 HCoV-19.mp.

16 novel coronavirus.mp.

17 wuhan virus.mp.

18 wuhan coronavirus.mp.

19 hubei virus.mp.

20 hubei coronavirus.mp.

21 huanan virus.mp.

22 huanan coronavirus.mp.

23 wuhan pneumonia.mp.

24 hubei pneumonia.mp.

25 huanan pneumonia.mp.

26 CoV.mp.

27 2019 novel.mp.

28 Ncov.mp.

29 n-cov.mp.

30 Seafood market pneumonia.mp.

31 air/ or air.mp.

32 airway.mp. or airway/

33 airborne particle/ or airborne.mp.

34 air borne.mp.

35 airbourne.mp.

36 air bourne.mp.

37 airborn.mp.

38 air born.mp.

39 breath$.mp. or breathing/

40 talk$.mp.

41 cough$.mp. or coughing/

42 sneezing/ or sneez$.mp.

43 aerosol.mp. or aerosol/

44 droplet.mp.

45 spray.mp.

46 flush.mp. or flushing/

47 respiratory droplet.mp.

48 fecal-oral.mp.

49 faecal-oral.mp.

50 food contamination/ or foodborne.mp.

51 foodborn.mp.

52 foodbourne.mp.

53 environment.mp. or environment/

54 environmental contamination.mp.

55 surface.mp.

56 touch.mp. or touch/

57 AGP.mp.

58 aerosol generating procedure.mp.

59 droplet nuclei.mp. or disease transmission/

60 ingest.mp.

61 fomite.mp. or fomite/

62 contact.mp.

63 suction.mp. or suction/

64 inhalation/

65 airborne particle/

66 drink.mp.

67 mouth/

68 cigarette/

69 kiss.mp.

70 ventilation.mp. or air conditioning/

71 saliva/

72 body fluid.mp. or body fluid/

73 body fluid.mp.

74 spit.mp.

75 sputum.mp.

76 transmission.mp. or virus transmission/

77 transmissibility.mp.

78 spread.mp.

79 \*basic reproduction number/

80 route.mp.

81 mode.mp.

82 cross infection/ or crossinfection.mp.

83 expos$.mp.

84 viral load.mp. or virus load/

85 infectivity.mp.

86 infectiousness.mp.

87 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30

88 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75

89 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86

90 88 and 89

91 87 and 90

92 limit 91 to yr="2020 -Current"

93 limit 92 to (animals and animal studies)

94 \*in vitro study/

95 92 not 93

96 95 not 94

## Appendix 4: PRISMA diagram

***Summary of the data extraction and literature review process:***

**Total studies retrieved from search strategy: 1765**

Medline: 784, EMBASE: 926.

Epistemonikos: 55

Number excluded at title/abstract sift: 1545

Number included in full text sift: 200

Number excluded: 116

Number full text not found: 2

Number remaining after full text search: 82

Additional articles identified from other databases, reference lists and stakeholders’ comments: 65

**Total included: 137**

Total included: 62 (23 UBA)

## Appendix 5: Quality assessment

### a) QA checklist

The checklist used for assessing the quality of the included case series/studies was can be found [here](https://joannabriggs.org/sites/default/files/2019-05/JBI_Critical_Appraisal-Checklist_for_Case_Series2017_0.pdf).

### b) QA results

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **authors** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** | **Q6** | **Q7** | **Q8** | **Q9** | **Q10** |
| Alzamora, 20205 | ♦ | ▲ | ▲ | ♦ | ♦ | ● | ● | ■ | ▲ | ♦ |
| Bai, 20206 | ● | ● | ● | ● | ■ | ▲ | ● | ● | ▲ | ● |
| Burke, 20207 | ● | ● | ● | ▲ | ■ | ▲ | ▲ | ▲ | ▲ | ● |
| Cai, 20208 | ■ | ■ | ■ | ▲ | ■ | ▲ | ▲ | ▲ | ▲ | ● |
| Chan, 20209 | ■ | ● | ● | ■ | ■ | ▲ | ● | ● | ▲ | ● |
| Chen, 202010 | ■ | ● | ● | ■ | ■ | ▲ | ● | ● | ▲ | ● |
| Chen, 2020b11 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ● | ♦ |
| Chen, 2020c12 | ▲ | ● | ● | ■ | ■ | ▲ | ▲ | ● | ▲ | ● |
| Chen, 2020d13 | ▲ | ● | ● | ■ | ■ | ▲ | ● | ● | ▲ | ● |
| Chen, 2020e14 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Chen, 2020f15 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Cheng, 202016 | ● | ● | ● | ● | ■ | ● | ● | ● | ▲ | ● |
| Colavita, 202020 | ♦ | ● | ♦ | ♦ | ♦ | ▲ | ● | ● | ▲ | ♦ |
| Cui, 202021 | ● | ● | ● | ■ | ■ | ● | ▲ | ● | ▲ | ● |
| Dong, 202022 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Dong, 2020b23 | ● | ● | ● | ■ | ■ | ● | ● | ● | ♦ | ● |
| Fan, 202024 | ▲ | ● | ● | ▲ | ▲ | ● | ● | ● | ▲ | ♦ |
| Fan, 2020b25 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Gan, 202027 | ● | ● | ■ | ■ | ● | ● | ▲ | ● | ● | ● |
| Ghinai, 202028 | ● | ● | ● | ♦ | ■ | ● | ● | ● | ● | ♦ |
| Hamner, 202030 | ● | ● | ▲ | ♦ | ● | ▲ | ▲ | ● | ● | ● |
| Han, 202031 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Heinzerling, 202032 | ● | ● | ● | ▲ | ● | ▲ | ● | ● | ▲ | ● |
| Huang, 202033 | ▲ | ● | ● | ▲ | ■ | ▲ | ● | ● | ▲ | ● |
| Huang, 2020b34 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ♦ | ● |
| Iqbal, 202035 | ♦ | ● | ♦ | ♦ | ♦ | ▲ | ● | ● | ▲ | ♦ |
| Jiang, 202036 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ♦ | ♦ |
| Jiang, 2020b37 | ● | ● | ● | ■ | ● | ▲ | ● | ● | ♦ | ● |
| Jiehao, 202038 | ● | ● | ● | ● | ● | ● | ● | ● | ▲ | ● |
| Khan, 202039 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Kong, 202040 | ● | ● | ● | ● | ● | ● | ● | ▲ | ● | ● |
| Le, 202041 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Lee, 202042 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ♦ | ♦ |
| Li, 202043 | ▲ | ● | ● | ■ | ■ | ● | ● | ▲ | ▲ | ● |
| Li, 2020b44 | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ● |
| Li, 2020c45 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Li, 2020d46 | ● | ● | ● | ♦ | ● | ● | ● | ● | ▲ | ● |
| Li, 2020e47 | ● | ● | ● | ● | ● | ▲ | ● | ● | ▲ | ● |
| Li, 2020f48 | ● | ● | ● | ■ | ■ | ● | ● | ● | ● | ● |
| Li, 2020g49 | ♦ | ● | ● | ♦ | ♦ | ♦ | ● | ● | ● | ♦ |
| Li, 2020h50 | ● | ● | ● | ■ | ■ | ● | ■ | ● | ▲ | ● |
| Li, 2020i51 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ● | ● |
| Li, 2020j52 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Ling, 202053 | ● | ● | ● | ♦ | ■ | ▲ | ● | ♦ | ● | ● |
| Liu, 202054 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Liu, 2020b55 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Liu, 2020c56 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Liu, 2020d57 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ♦ | ♦ |
| Lowe, 202058 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Lu, 202059 | ● | ● | ● | ♦ | ● | ▲ | ▲ | ● | ● | ● |
| Luo, 202060 | ● | ● | ● | ■ | ■ | ▲ | ▲ | ● | ● | ● |
| McMichael, 202061 | ● | ● | ● | ■ | ■ | ● | ● | ● | ● | ● |
| Ng, 202063 | ● | ● | ● | ♦ | ● | ▲ | ♦ | ● | ● | ● |
| Okada, 202065 | ■ | ● | ● | ■ | ■ | ● | ● | ● | ♦ | ♦ |
| Pan, 202068 | ● | ● | ● | ■ | ■ | ▲ | ● | ♦ | ▲ | ● |
| Park, 202069 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ● | ♦ |
| Park, 2020b70 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ● | ● |
| Penfield, 202071 | ● | ● | ● | ● | ● | ● | ● | ▲ | ▲ | ● |
| Peng, 202072 | ■ | ● | ■ | ■ | ■ | ● | ● | ● | ▲ | ● |
| Peng, 2020b73 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ♦ | ♦ |
| Phan, 202074 | ■ | ● | ● | ● | ● | ● | ● | ● | ▲ | ♦ |
| Pierce-Williams, 202075 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Pung, 202076 | ● | ● | ● | ● | ● | ● | ▲ | ● | ● | ● |
| Qian, 2020b77 | ■ | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Qiu, 202078 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Qiu, 2020b79 | ■ | ● | ● | ■ | ■ | ▲ | ▲ | ▲ | ▲ | ● |
| Rothe, 202080 | ■ | ● | ● | ▲ | ▲ | ▲ | ▲ | ● | ● | ● |
| Schwartz, 202082 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ● | ● |
| Schwierzeck, 202083 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Scott, 202084 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ● | ● |
| Seah, 202085 | ● | ● | ● | ■ | ■ | ▲ | ▲ | ▲ | ▲ | ● |
| Song, 202086 | ■ | ● | ● | ■ | ■ | ● | ● | ● | ● | ● |
| Sun, 2020b87 | ● | ● | ● | ● | ● | ● | ▲ | ● | ▲ | ● |
| Tan, 202088 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Tan, 2020b89 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Tang, 202090 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ● | ♦ |
| To, 202091 | ● | ● | ● | ● | ▲ | ● | ● | ▲ | ▲ | ● |
| Wang, 2020b94 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Wang, 2020c95 | ● | ● | ● | ■ | ■ | ▲ | ● | ▲ | ▲ | ● |
| Wang, 2020d96 | ▲ | ● | ● | ■ | ■ | ▲ | ▲ | ▲ | ▲ | ● |
| Wang, 2020e97 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Wang, 2020f98 | ● | ● | ● | ● | ● | ■ | ▲ | ● | ▲ | ● |
| Wei, 202099 | ● | ● | ● | ● | ● | ▲ | ▲ | ▲ | ● | ♦ |
| Wei, 2020b100 | ● | ● | ● | ■ | ■ | ● | ● | ● | ● | ● |
| Wu, 2020101 | ● | ● | ● | ■ | ■ | ▲ | ▲ | ▲ | ▲ | ● |
| Wu, 2020b102 | ● | ● | ● | ● | ■ | ● | ● | ● | ▲ | ● |
| Wu, 2020c103 | ● | ● | ● | ▲ | ▲ | ● | ● | ● | ● | ● |
| Wu, 2020d104 | ■ | ● | ● | ■ | ■ | ▲ | ● | ● | ▲ | ● |
| Xia, 2020106 | ■ | ● | ● | ■ | ■ | ▲ | ▲ | ● | ▲ | ● |
| Xia, 2020b107 | ● | ● | ● | ■ | ▲ | ● | ● | ● | ● | ● |
| Xiao, 2020108 | ● | ● | ● | ■ | ■ | ● | ▲ | ● | ▲ | ● |
| Xiao, 2020b109 | ▲ | ● | ● | ■ | ■ | ▲ | ● | ● | ● | ● |
| Xie, 2020110 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ▲ | ● |
| Xing, 2020111 | ● | ● | ● | ● | ● | ▲ | ● | ● | ▲ | ● |
| Xu, 2020112 | ● | ● | ● | ● | ● | ● | ● | ● | ▲ | ● |
| Yan, 2020113 | ● | ● | ● | ● | ● | ● | ● | ● | ▲ | ● |
| Yang, 2020114 | ● | ● | ● | ■ | ■ | ▲ | ● | ● | ● | ● |
| Yang, 2020b115 | ● | ● | ● | ■ | ■ | ▲ | ● | ● | ● | ● |
| Yong, 2020116 | ● | ● | ■ | ● | ● | ■ | ■ | ● | ● | ● |
| Yu, 2020117 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Yu, 2020b118 | ● | ● | ● | ■ | ■ | ● | ● | ● | ● | ● |
| Zambrano, 2020119 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ▲ | ♦ |
| Zeng, 2020120 | ● | ● | ● | ♦ | ■ | ▲ | ● | ● | ▲ | ● |
| Zeng, 2020121 | ● | ● | ● | ● | ● | ● | ● | ● | ▲ | ● |
| Zhang, 2020122 | ● | ● | ● | ♦ | ■ | ▲ | ▲ | ● | ▲ | ● |
| Zhang, 2020b123 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ● | ● |
| Zhang, 2020c124 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Zhang, 2020d125 | ● | ● | ● | ■ | ■ | ▲ | ● | ● | ▲ | ● |
| Zhang, 2020e126 | ● | ● | ● | ■ | ■ | ▲ | ▲ | ● | ▲ | ● |
| Zhang, 2020f127 | ♦ | ● | ♦ | ♦ | ♦ | ■ | ■ | ● | ● | ♦ |
| Zhang, 2020g128 | ● | ● | ● | ● | ● | ▲ | ● | ● | ● | ● |
| Zhang, 2020h129 | ♦ | ● | ♦ | ♦ | ♦ | ▲ | ▲ | ● | ▲ | ♦ |
| Zhang, 2020i130 | ♦ | ● | ♦ | ♦ | ♦ | ▲ | ● | ● | ▲ | ♦ |
| Zheng, 2020131 | ● | ● | ● | ● | ■ | ● | ● | ● | ● | ● |
| Zhou, 2020132 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Zhu, 2020133 | ● | ● | ● | ■ | ■ | ● | ● | ● | ▲ | ● |
| Sun, 2020134 | ♦ | ● | ♦ | ♦ | ♦ | ▲ | ▲ | ▲ | ▲ | ♦ |
| Vivanti, 2020136 | ♦ | ● | ♦ | ♦ | ♦ | ▲ | ● | ● | ▲ | ♦ |
| Cho, 2020137 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ♦ | ♦ |
| Essa, 2020138 | ♦ | ● | ♦ | ♦ | ♦ | ▲ | ● | ● | ♦ | ♦ |
| Liapis, 2020139 | ♦ | ● | ♦ | ♦ | ♦ | ▲ | ● | ● | ▲ | ♦ |
| Politis, 2020140 | ♦ | ● | ♦ | ♦ | ♦ | ● | ● | ● | ● | ♦ |
| Charlotte et al, 2020142 | ● | ■ | ■ | ● | ● | ● | ▲ | ● | ● | ● |
| de Man, 2020143 | ● | ■ | ■ | ● | ● | ▲ | ▲ | ▲ | ● | ● |
| Gunther, 2020147 | ▲ | ● | ● | ▲ | ▲ | ▲ | ▲ | ● | ● | ● |
| Kang, 2020148 | ▲ | ● | ● | ● | ● | ▲ | ♦ | ● | ● | ♦ |
| Khanh, 2020149 | ● | ● | ● | ● | ▲ | ♦ | ▲ | ● | ● | ● |
| Miller, 2020155 | ● | ● | ● | ● | ● | ■ | ■ | ▲ | ■ | ● |
| Pfefferle, 2020157 | ● | ▲ | ● | ● | ● | ● | ● | ● | ● | ♦ |
| Shen, 2020158 | ● | ● | ● | ● | ● | ▲ | ● | ● | ● | ● |
| Jang, 2020162 | ■ | ● | ● | ■ | ▲ | ▲ | ▲ | ● | ● | ● |
| Qian, 2020163 | ● | ■ | ■ | ● | ▲ | ▲ | ▲ | ● | ● | ● |
| Stein-Zamir, 2020164 | ● | ● | ● | ● | ▲ | ▲ | ▲ | ● | ● | ● |
| Cabero-Martinez, 2020165 | ● | ▲ | ▲ | ● | ● | ▲ | ▲ | ● | ● | ● |
| Eyre, 2020166 | ● | ▲ | ● | ● | ▲ | ● | ▲ | ● | ● | ● |
| Hunter, 2020167 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ● | ● |
| Jeon, 2020168 | ● | ▲ | ▲ | ■ | ■ | ▲ | ▲ | ● | ● | ♦ |
| Kluytmans, 2020169 | ● | ● | ▲ | ● | ▲ | ▲ | ▲ | ● | ■ | ● |
| Lahner, 2020170 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Lai, 2020171 | ● | ● | ● | ● | ▲ | ● | ● | ● | ● | ● |
| Lee, 2020172 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ■ | ● |
| Maltezou, 2020173 | ● | ● | ● | ■ | ■ | ▲ | ▲ | ▲ | ■ | ● |
| Murakami, 2021174 | ● | ● | ● | ● | ▲ | ■ | ■ | ● | ▲ | ● |
| Paltansing, 2021175 | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ■ | ● |
| Rivett, 2020176 | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ● | ● |
| Roxby, 2020177 | ● | ● | ● | ● | ● | ▲ | ▲ | ■ | ● | ● |
| Sikkema, 2020178 | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ▲ | ● |
| Treibel, 2020179 | ● | ● | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ● |
| Villanueva, 2020180 | ● | ● | ■ | ● | ● | ▲ | ▲ | ▲ | ▲ | ● |
| Wee, 2020181 | ● | ● | ▲ | ● | ■ | ▲ | ▲ | ▲ | ● | ● |
| Wong, 2020182 | ● | ● | ▲ | ● | ● | ♦ | ♦ | ● | ● | ● |
| Wang, 2020183 | ● | ● | ● | ■ | ■ | ● | ● | ● | ● | ● |
| Arons, 2020184 | ● | ▲ | ▲ | ● | ■ | ▲ | ▲ | ● | ● | ● |
| Graham, 2020185 | ● | ▲ | ▲ | ● | ▲ | ● | ● | ● | ▲ | ● |
| Kimball, 2020186 | ● | ● | ● | ● | ▲ | ▲ | ● | ■ | ▲ | ● |
| Ng, 2020187 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ▲ | ● |
| Lessels, 2020188 | ● | ● | ● | ● | ● | ▲ | ● | ● | ● | ● |
| Baker, 2020189 | ● | ● | ● | ● | ● | ▲ | ▲ | ● | ▲ | ● |
| Dora, 2020190 | ● | ● | ● | ● | ▲ | ● | ● | ● | ● | ● |
| Patel, 2020191 | ● | ▲ | ▲ | ● | ● | ▲ | ▲ | ▲ | ● | ● |
| Roxby, 2020192 | ● | ● | ● | ● | ● | ▲ | ▲ | ■ | ● | ● |
| Asad, 2020193 | ▲ | ● | ● | ▲ | ▲ | ▲ | ▲ | ● | ● | ● |
| Taylor, 2020194 | ● | ● | ● | ▲ | ▲ | ▲ | ▲ | ● | ▲ | ● |
| Sun, 2020c195 | ● | ■ | ■ | ■ | ■ | ▲ | ▲ | ♦ | ▲ | ● |

●yes, ■unclear, ▲no, ♦not applicable

## Appendix 6: Evidence tables

### a) characteristics of included studies

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Study Design** | **Country** | **Population** | **Transmission route** | | **Comparator** | **Outcomes** |
| Ahmed, 20204 | Environmental survey | Australia | Environment | Faecal | | No comparator | Environmental contamination |
| Alzamora, 20205 | Case study | Peru | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Bai, 20206 | Case series | China | Adults in community | Not described | | No comparator | No of cases |
| Burke, 20207 | Case series | USA | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Cai, 20208 | Case series | China | Mall visitors and staff | Fomites | | No comparator | No of cases |
| Chan, 20209 | Case series | China | Family | Not described | | No comparator | No of cases |
| Chen, 202010 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Chen, 2020b11 | Case study | China | COVID-19  +ve patient | Ocular | | No comparator | No of individuals with +ve samples |
| Chen, 2020c12 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Chen, 2020d13 | Case series | China | COVID-19  +ve patient | Faecal, urine | | No comparator | No of individuals with +ve samples |
| Chen, 2020e14 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Chen, 2020f15 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Cheng, 202016 | Case series | Taiwan | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Cheng, 2020b17 | Environmental survey | Hong Kong | Room of COVID-19 patient | Air | | No comparator | Environmental contamination |
| Chia, 202018 | Environmental survey | Singapore | Environment | Air, fomites | | No comparator | Environmental contamination |
| Chin, 202019 | Laboratory experiment | China | Different fomites | Fomites | | No comparator | Virus survival |
| Colavita, 202020 | Case study | Italy | COVID-19  +ve patient | Ocular | | No comparator | No of individuals with +ve samples |
| Cui, 202021 | Case series | China | Female COVID+ve patients | Faecal  Sexual | | No comparator | No of +ve samples |
| Dong, 202022 | Case study | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Dong, 2020b23 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Fan, 202024 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Fan, 2020b25 | Case study | China | COVID-19  +ve patient | Faecal | | No comparator | No of individuals with +ve samples |
| Faridi, 202026 | Environmental survey | Iran | ICU rooms with COVID-19 patients | Air | | No comparator | Environmental contamination |
| Gan, 202027 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Ghinai, 202028 | Case series | USA | Contacts of COVID-19 patients | Cluster | | No comparator | No of cases |
| Guo, 202029 | Environmental survey | China | ICU & general wards | Air, fomites | | No comparator | Environmental contamination |
| Hamner, 202030 | Case series | USA | Adults attending choir practice | Droplet, fomites | | No comparator | No of cases |
| Han, 202031 | Case series | Korea | COVID-19 patients | Faecal, urine, vertical | | No comparator | No of cases |
| Heinzerling, 202032 | Case series | USA | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Huang, 202033 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Huang, 2020b34 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Iqbal, 202035 | Case study | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Jiang, 202036 | Case study | China | COVID-19 patients | Faecal | | No comparator | No of individuals with +ve samples |
| Jiang, 2020b37 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Jiehao, 202038 | Case series | China | COVID-19 children | Faecal, urine | | No comparator | No of individuals with +ve samples |
| Khan, 202039 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Kong, 202040 | Case series | Korea | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Le, 202041 | Case series | Vietnam | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Lee, 202042 | Case series | Korea | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Li, 202043 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Li, 2020b44 | Case series | China | Male COVID-19 patients | Sexual | | No comparator | No of +ve samples |
| Li, 2020c45 | Case study | China | COVID-19 patients | Faecal | | No comparator | No of individuals with +ve samples |
| Li, 2020d46 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Li, 2020e47 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Li, 2020f48 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Li, 2020g49 | Case series | China | Healthcare workers | Ocular | | No comparator | No of cases |
| Li, 2020h50 | Case study | Korea | COVID-19 patients | Faecal | | No comparator | No of individuals with +ve samples |
| Li, 2020i51 | Case series | China | Restaurant guests | Droplet | | No comparator | No of cases |
| Li, 2020j52 | Case study | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Ling, 202053 | Case series | China | Convalescent COVID adult patients | Faecal, urine | | No comparator | No of individuals with +ve samples |
| Liu, 202054 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Liu, 2020b55 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Liu, 2020c56 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Liu, 2020d57 | Case study | Taiwan | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Lowe, 202058 | Case study | Australia | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Lu, 202059 | Case series | China | Restaurant guests | Droplet | | No comparator | No of cases |
| Luo, 202060 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| McMichael, 202061 | Case series | USA | Family | Not described | | No comparator | No of cases |
| Medema, 202062 | Environmental survey | Netherlands | Sewage water in main cities | Faecal | | No comparator | No of +ve samples |
| Ng, 202063 | Case series | Singapore | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Liu, 202064 | Environmental survey | China | Environment | Air | | 2 blank controls | Environmental contamination |
| Okada, 202065 | Case series | Thailand | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Ong, 202066 | Environmental survey | Singapore | Environment of COVID +ve patients | Air, fomites | | No comparator | Environmental contamination |
| Ong, 2020b67 | Environmental survey | Singapore | Environment of COVID +ve patients | Fomites | | No comparator | Environmental contamination |
| Pan, 202068 | Case series | Hong Kong | COVID-19 patients | Faecal, urine | | No comparator | No of individuals with +ve samples |
| Park, 202069 | Case study | Korea | Paediatric COVID-19 patient | Faecal | | No comparator | No of individuals with +ve samples |
| Park, 2020b70 | Case series | Korea | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Penfield, 202071 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Peng, 202072 | Case series | China | COVID +ve patients | Faecal, urine | | No comparator | No of individuals with +ve samples |
| Peng, 2020b73 | Case study | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Phan, 202074 | Case series | Vietnam | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Pierce-Williams, 202075 | Case series | USA | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Pung, 202076 | Case series | Singapore | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Qian, 2020b77 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Qiu, 202078 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Qiu, 2020b79 | Case series | China | COVID +ve patients | Sexual | | No comparator | No of +ve samples |
| Rothe, 202080 | Case series | Germany | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Santarpia, 202081 | Environmental survey | USA | Environment of COVID +ve patients | Fomites, air | | No comparator | Environmental contamination |
| Schwartz, 202082 | Case series | Canada | Aircraft crew & passengers | Droplet  Air | | No comparator | No of cases |
| Schwierzeck, 202083 | Case series | Germany | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Scott, 202084 | Case series | USA | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Seah, 202085 | Case series | Singapore | COVID +ve patients | Ocular | | No comparator | No of individuals with +ve samples |
| Song, 202086 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Sun, 2020b87 | Case series | China | COVID +ve patients | Ocular | | No comparator | No of individuals with +ve samples |
| Tan, 202088 | Case study | Vietnam | COVID +ve patient | Faecal | | No comparator | No of individuals with +ve samples |
| Tan, 2020b89 | Case series | China | Child COVID +ve | Faecal | | No comparator | No of individuals with +ve samples |
| Tang, 202090 | Case study | China | COVID +ve patient | Faecal | | No comparator | No of individuals with +ve samples |
| To, 202091 | Case series | China | COVID +ve patients | Faecal, urine | | No comparator | No of individuals with +ve samples |
| Van Doremalen, 202092 | Laboratory experiment | USA | Surfaces | Fomites | | SARS-CoV-2 vs SARS-CoV | Environmental contamination |
| Wang, 202093 | Environmental survey | China | Environment | Fomites, faecal | | No comparator | Environmental contamination |
| Wang, 2020b94 | Case study | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Wang, 2020c95 | Case series | China | COVID +ve patients | Faecal | | No comparator | No of individuals with +ve samples |
| Wang, 2020d96 | Case series | China | COVID +ve patients | Faecal, urine | | No comparator | No of +ve samples |
| Wang, 2020e97 | Case study | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Wang, 2020f98 | Case series | China | Household contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Wei, 202099 | Case series | Singapore | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Wei, 2020b100 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Wu, 2020101 | Case series | China | COVID +ve patients | Faecal | | No comparator | No of +ve samples |
| Wu, 2020b102 | Case series | China | COVID +ve patients | Ocular | | No comparator | No of individuals with +ve samples |
| Wu, 2020c103 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Wu, 2020d104 | Case series | China | COVID +ve patients | Faecal | | No comparator | No of individuals with +ve samples |
| Wurtzer, 2020105 | Environmental survey | France | Wastewater samples during pandemic | Faecal | | No comparator | No of +ve samples |
| Xia, 2020106 | Case series | China | COVID +ve patients | Ocular | | No comparator | No of individuals with +ve samples |
| Xia, 2020b107 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Xiao, 2020108 | Case series | China | COVID +ve patients | Faecal | | No comparator | No of individuals with +ve samples |
| Xiao, 2020b109 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Xie, 2020110 | Case series | China | COVID +ve patients | Ocular | | No comparator | No of individuals with +ve samples |
| Xing, 2020111 | Case series | China | Paediatric COVID +ve patients | Faecal | | No comparator | No of individuals with +ve samples |
| Xu, 2020112 | Case series | China | COVID +ve patients | Faecal | | No comparator | No of individuals with +ve samples |
| Yan, 2020113 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Yang, 2020114 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Yang, 2020b115 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Yong, 2020116 | Case series | Singapore | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Yu, 2020117 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Yu, 2020b118 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Zambrano, 2020119 | Case study | Honduras | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Zeng, 2020120 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Zeng, 2020121 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Zhang, 2020122 | Case series | China | COVID +ve patients | Faecal | | No comparator | No of individuals with +ve samples |
| Zhang, 2020b123 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Zhang, 2020c124 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Zhang, 2020d125 | Case series | China | COVID +ve children | Faecal | | No comparator | No of individuals with +ve samples |
| Zhang, 2020e126 | Case series | China | COVID +ve patients | Faecal | | No comparator | No of individuals with +ve samples |
| Zhang, 2020f127 | Case study | China | Nurse | Ocular | | No comparator | No of cases |
| Zhang, 2020g128 | Case series | China | Contacts of COVID-19 patients | Not described | | No comparator | No of cases |
| Zhang, 2020h129 | Case study | China | COVID +ve patients | Faecal | | No comparator | No of individuals with +ve samples |
| Zhang, 2020i130 | Case study | China | COVID +ve patients | Faecal, urine | | No comparator | No of individuals with +ve samples |
| Zheng, 2020131 | Case series | China | COVID +ve patients | Faecal, urine | | No comparator | No of individuals with +ve samples |
| Zhou, 2020132 | Case series | China | COVID +ve patients | Ocular | | No comparator | No of individuals with +ve samples |
| Zhu, 2020133 | Case series | China | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Zhou, 2020134 | Environmental survey | United Kingdom | Environment | Air, fomites | | No comparator | Environmental contamination |
| Sun, 2020135 | Case study | China | COVID +ve patients | Urine | | No comparator | No of individuals with +ve samples |
| Vivanti, 2020136 | Case study | France | Pregnant woman + neonate | Vertical | | No comparator | No of cases |
| Cho, 2020137 | Case study | Korea | Blood transfusion recipients | Blood transfusion | | No comparator | No of cases |
| Essa, 2020138 | Case study | Germany | Blood transfusion recipients | Blood transfusion | | No comparator | No of cases |
| Liapis, 2020139 | Case study | Greece | Blood transfusion recipients | Blood transfusion | | No comparator | No of cases |
| Politis, 2020140 | Case study | Greece | Blood transfusion recipients | Blood transfusion | | No comparator | No of cases |
| Alsved, 2020141 | Environmental survey | Sweden | Air close to COVID-19 +ve patients | Air | | No comparator | Environmental contamination |
| Charlotte, 2020142 | Case series | France | Adults attending choir practice | Air/droplet | | No comparator | No of cases |
| De Man, 2020143 | Case series | Netherlands | Residents and HCWs in nursing home | Air/droplet | | No comparator | No of cases, environmental contamination |
| Ding, 2020144 | Environmental survey | China | Air close to COVID-19 +ve patients | Air | | No comparator | Environmental contamination |
| Dohla, 2020145 | Environmental survey | Germany | Air in COVID-19 +ve households | Air | | No comparator | Environmental contamination |
| Fears, 2020146 | Laboratory experiment | USA | SARS-CoV-2 samples aerosolised | Air | | No comparator | Environmental contamination |
| Gunther, 2020147 | Case series | Germany | Employees in meat processing plant | Air/droplet | | No comparator | No of cases |
| Kang, 2020148 | Case series | Hong Kong | Residents and staff of a high-rise building | Faeces | | No comparator | No of cases |
| Khanh, 2020149 | Case series | Vietnam | Passengers/crew from a long-distance flight | Air/droplet | | No comparator | No of cases |
| Lednicky, 2020150 | Environmental survey | USA | Air close to COVID-19 +ve patients | Air | | No comparator | Environmental contamination |
| Lednicky, 2020b151 | Environmental survey | USA | Air in respiratory area in health centre | Air | | No comparator | Environmental contamination |
| Lei, 2020152 | Environmental survey | China | Air in hospital with COVID-19 patients | Air | | No comparator | Environmental contamination |
| Ma, 2020153,154 | Environmental survey | China | EBC and air of COVID-19 patients | Air | | No comparator | Environmental contamination |
| Miller, 2020155 | Case series | USA | Adults at the choir rehearsal | Air/droplet | | No comparator | No of cases |
| Nissen, 2020156 | Environmental survey | Sweden | Ventilation openings and ducts in hospital with COVID-19 patients | Air | | No comparator | Environmental contamination |
| Pfefferle, 2020157 | Case series | Germany | Adults following contact with index case | Air/droplet | | No comparator | No of cases |
| Shen, 2020158 | Case series | China | Adults travelling to worshipping temple | Air/droplet | | No comparator | No of cases |
| Wei, 2020159 | Environmental survey | China | Air in hospital with COVID-19 patients | Air | | No comparator | Environmental contamination |
| Wu, 2020160 | Environmental survey | China | Air in hospital with COVID-19 patients | Air | | No comparator | Environmental contamination |
| Zhou, 2021161 | Environmental survey | China | Air in hospital with COVID-19 patients | Air | | No comparator | Environmental contamination |
| Jang, 2020162 | Case series | S. Korea | Persons undertaking fitness classes | Not described | | No comparator | No of cases |
| Qian, 2020163 | Case series | China | Individuals involved in clusters of cases | Not described | | No comparator | No of cases |
| Stein-Zamir, 2020164 | Case series | Israel | High school students and staff | Not described | | No comparator | No of cases |
| Cabero Martinez, 2020165 | Case series | Spain | HCWs in haematology department | Not described | | No comparator | No of cases |
| Eyre, 2020166 | Case series | UK | Asymptomatic staff in hospital | Not described | | No comparator | No of cases |
| Hunter, 2020167 | Case series | UK | Symptomatic HCWs in and outside hospital | Not described | | No comparator | No of cases |
| Jeon, 2020168 | Case series | Korea | HCWs after contact with COVID-19 patients | Not described | | No comparator | No of cases |
| Kluytmans, 2020169 | Case series | Netherlands | Symptomatic HCWs in two hospitals | | Not described | Different risk factors analysed | No of cases |
| Lahner, 2020170 | Case series | Italy | HCWs in hospital | | Not described | No comparator | No of cases |
| Lai, 2020171 | Case series | China | Infected HCWs | | Not described | No comparator | No of cases |
| Lee, 2020172 | Case series | Korea | HCWs after contact with COVID-19 patients | | Not described | No comparator | No of cases |
| Maltezou, 2020173 | Case series | Greece | HCWs, occupational exposure to SARS-CoV-2 | | Not described | No comparator | No of cases |
| Murakami, 2021174 | Case series | USA | Healthcare workers in emergency department | | Not described | No comparator | No of cases |
| Paltansing, 2021175 | Case series | Netherlands | HCWs in hospital | | Not described | Different risk factors analysed | No of cases |
| Rivett, 2020176 | Case series | UK | HCWs in hospital | | Not described | No comparator | No of cases |
| Roxby, 2020177 | Case series | USA | Staff in the independent & assisted living facility | | Not described | No comparator | No of cases |
| Sikkema, 2020178 | Case series | Netherlands | HCWs in hospitals | | Not described | No comparator | No of cases |
| Treibel, 2020179 | Case series | UK | HCWs in hospital | | Not described | No comparator | No of cases |
| Villanueva, 2020180 | Case series | Philippines | HCWs in hospital | | Not described | No comparator | No of cases |
| Wee, 2020181 | Case series | Singapore | HCWs in hospital | | Not described | No comparator | No of cases |
| Wong, 2020182 | Case series | Hong Kong | HCWs in hospital | | Not described | No comparator | No of cases |
| Wang, 2020183 | Case series | China | HCWs in hospital | | Not described | No comparator | No of cases |
| Arons, 2020184 | Case series | USA | Staff and residents in nursing home | | Not described | No comparator | No of cases |
| Graham, 2020185 | Case series | UK | Staff and residents in nursing homes | | Not described | No comparator | No of cases |
| Kimball, 2020186 | Case series | USA | Staff and residents in nursing home | | Not described | No comparator | No of cases |
| Ng, 2020187 | Case series | Singapore | HCWs in hospital | | Not described | No comparator | No of cases |
| Lessels, 2020188 | Case series | South Africa | HCWs in hospital | | Not described | No comparator | No of cases |
| Baker, 2020189 | Case series | USA | HCWs in hospital | | Not described | No comparator | No of cases |
| Dora, 2020190 | Case series | USA | Staff and residents in skilled nursing facility | | Not described | No comparator | No of cases |
| Patel, 2020191 | Case series | USA | Staff and residents in skilled nursing facility | | Not described | No comparator | No of cases |
| Roxby, 2020192 | Case series | USA | Staff in the independent & assisted living facility | | Not described | No comparator | No of cases |
| Asad, 2020193 | Case series | UK | HCWs in hospital | | Not described | No comparator | No of cases |
| Taylor, 2020194 | Case series | USA | Staff and residents in skilled nursing facility | | Not described | No comparator | No of cases |
| Sun, 2020195 | Case series | China | Nurses infected with SARS-CoV-2 | | Not described | No comparator | No of cases |

### b) summary of findings tables

### Droplet transmission vs airborne transmission

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Outcome measure** | **No of participants** | | **Incidence** | | | **Reviewer’s comments** |
| **Exposure** | **Control** | **No of +ves** | **Control** | **Evidence of transfer (author interpretation)** |
| Hamner, 202030  Miller, 2020155 | No of cases | 60 | - | 52 | - | Hamner: Multiple opportunities for droplet and fomite transmission, aerosol transmission cannot be excluded  Miller: transmission due to aerosol inhalation | Also included in surfaces  Description of an outbreak, first published by Hamner et al and later by Miller et al who undertook a separate investigation (although also obtained data from Hamner). Miller et al contacted the newspaper journalist and county health department, they were also with contact with one of the attendees and the investigation mostly involved questionnaires. Being done remotely, some information may have been incomplete, but what worries me most is the potential for desirability bias in the reporting from the attendees as people have died and this outbreak was largely criticised by press. Their conclusions are that aerosols were primary route of infection based on reporting that there was no close contact between the members and a very limited fomites. They also base their assumptions on the study that shows short-range aerosols to be mostly involved in infection stating that ‘there is no direct evidence of transmission by ballistic droplets for any disease in the literature’. Their model is thus based on the assumption that the transmission was due to aerosols. They also state that since many developed symptoms in a short period of time, the inhaled viral load must have been very high. |
| Li, 2020i51  Lu, 202059 | No of cases | 83 (in the same dining room) | - | 9 | - | **Lu:** Most probable droplet transmission facilitated by air conditioning  **Li:** likely aerosol transmission, evidence for no close contact and no fomite transmission | Reported by two different studies, slightly different interpretation of results. 83 guests ate lunch in the restaurant, one guest (index) was pre-symptomatic, later diagnosed as +ve. 9 people from three families got sick, two families overlapping 53 and 73min with the family of index patient – both at neighbouring tables directly in the line of the flow of air conditioning. Airborne not likely as none of the staff and none of the guests who were not in the line of the air conditioning got sick. 20 were in direct flow, another 10 were at the tables <2m from index table but not in the flow of AC |
| 20 (in direct flow) | 10 (not in direct flow) | 9 | 0 |
| Schwartz, 202082 | No of cases | Approx. 340 | - | 0 | - | Data suggest droplet rather than airborne transmission | One symptomatic (dry cough) COVID+ve individual on the 15hr flight, his wife asymptomatic and developed symptoms the next day. Both wore masks and had mild symptoms. No passengers or crew were infected. Authors suggested that airplane transmission reports may be biased with contacts sharing exposure before boarding the plane. |
| Charlotte, 2020142 | No of cases | 27 | - | 19 (70%) | - | Likely both airborne and droplet route, close contact amplified by singing and lack of ventilation | 2 hr choir practice. 45m2 room (<1.6m2/person), not ventilated. Less than 6ft (1.8m) distance between cases during practice. Social interaction was avoided (no handshakes, no food available, no breaks). There were 7 (26%) confirmed cases (either PCR +ve or hospitalised for COVID) and 12 (44%) probable cases (presented by GP as displaying COVID-19 symptoms but not tested with PCR). There was possibly more than one index case. |
| De Man, 2020143 | No of cases | 55 | - | 34 (62%) | - | Aerosol transmission due to a type of ventilation with air being recirculated rather than brought in from outside | Exposed: 17/34 HCWs, 17/21 residents from one psychogeriatric unit. Control: 0/106 HCWs and 0/95 residents from six other units. Outbreak occurred when weekly incidence in the country was very low, approx. 5% of the incidence at the national peak. Authors reported that HCWs were allocated to specific units and wore surgical masks for all resident contact but not with each other. Residents did not wear masks, and some had contact with each other. Air in the affected unit was recirculated and outdoor air only entered when CO2 reached 1000ppm, also cooled by AC with recirculated air. The remaining units ventilated with outdoor air. **Note:** no cases in remaining units which to me means no transmission because there was no contact with the virus rather than because of differences in ventilation, therefore excluded from analysis in this guidance |
| Gunther, 2020147 | No of cases | Exposed up to 8m: 26 | Exposed 8 to 29m:52 | 17 (65.4%) | 3 (5.8%)  RR:11.3 [3.6-35], p<0.0001\* | Unfavourable working conditions e.g. low temperature, low air exchange, air recirculation and demanding physical work, close distance between workers facilitated aerosol transmission | Super-spreading event during one shift in a meat-processing plant where all transmissions occurred from one index case. Authors concluded that 2m distance was not sufficient in conditions observed in this facility. The authors mentioned two ongoing outbreaks in two different plants eventually affecting 94/279 (33.7%) and 1413/6139 (23%). The focus was on one shift where 140 workers were exposed to one index case who had a low-risk contact with a worker from another facility COVID-19. The employee was allowed to work while awaiting test results. Positivity was high for employees whose working position was within 8m distance of the index case’s working position (data in appendix Table S2). Authors also reported that car-pooling, bedroom and apartment sharing also correlated with +ve testing, however considering that 7/10 of these employees also had workstations within 8m of index case suggested that transmission at work was more likely. |
| Khanh, 2020149 | No of cases | Total passengers + crew  183 | - | 15 (8.2%) | - | Authors suggest droplet or aerosol. | Data to the left without the index case. This was very early in pandemic where travellers from some but not all countries were PCR-screened or quarantined before the flight. The passenger travelled from the UK where cases at that point were still relatively rare, on board for 10hr flight. Face covering not mandatory – temperature and symptom screening were the only preventative measures in place. All flight passengers and crew traced were tested, quarantined and checked 2x/d for symptoms. 16/16 crew and 168/201 passengers traced. Probable index case was in business class separated by toilet/service area from economy and premium economy classes and served by separate flight attendants. Mildly symptomatic one day before the flight. 1/16 crew and 14/168 were PCR +ve, 12 of whom were in business class. No known SARS-CoV-2 exposure for other passengers either before or after he flight, timing of symptom development suggestive of in-flight exposure. |
| No of cases | Total passengers  167 | - | 14 (8.4%) | - |
| No of cases | Total crew  16 | - | 1 (6.3%) | - |
| No of cases | Total in business class 20 | Total in other class 147 | 12 (60%) | 2 (1.4%)  RR:44 [11-183], p<0.0001\* |
| No of cases | <2m from index case in business class 12 | >2m from index case in business class 8 | 11 (91.7%) | 1/8 (13%)  RR:7.3 [1.2-46.2], p=0.0339\* |
| Pfefferle, 2020157 | No of cases | High risk contact 34 | Low risk contact 98 | 2 (5.9%) | 0 (0%) | Authors conclude that based on low infectivity and the relatively low number of mutant variants, transmission occurs due to high dose of infectious virus via droplet route. | Contact tracing of high and low-risk contacts of COVID-19 cases. Index patient returned from Trentino, Italy, which at the time of his return was not considered a high-risk area for virus transmission. Relatively mild symptoms, admitted to hospital as precautionary measure. 131 work contacts + 1 household contact identified, of whom 34 were considered high risk contact (including household). High risk contacts tested and low risk contacts voluntarily tested + symptom monitoring. Subsequently 2 cases infected, one of which was severe with ICU admission and one with only sore throat. Viral loads monitored in all three patients: viral load declined 1000-fold for index patient and 200-fold in the mildly symptomatic case in 5 days following positivity but only 8-fold in severe case who stayed +ve for prolonged period. Virus obtained from the mildly symptomatic secondary case was viable in Vero E6 cells |
| Shen, 2020158 | No of cases | 299 (excluding index case) | - | 23 (7.7%) | - | Airborne transmission due to pattern of the transmission spread on a bus B: cases close to index case + randomly scattered around the bus, but less likely when close to windows or doors. | Outbreak among the Buddhists traveling to the temple on two buses. Follow-up investigation included phone and in-person interviews with travellers. PCR or WGS done for all persons involved in an outbreak as well as their close contacts. There were a total 293 lay Buddhists, 5 monks and 2 bus drivers. Bus journey was 50min each way (2x=100min), buses were air conditioned (recirculated air) and had 4x openable windows. All remained in their seats through both journeys. Worship event took place outside and lasted 150min, also included 30min lunch where all participants mixed in a large room. Masks not worn and no precautions taken as this was at the start of an outbreak in China. Presumed one index case who had contact with people from Wuhan 2 days before the event. Index case reported mild cough the night before the event. No cases on bus A (n=6, 0%), 7/172 (4.1%) travelling via other mode of transport or monks at the temple infected, all reported close contact with index case. |
| No of cases | 67 (bus B with index case on board) | All others including bus A 232 | 23 (34%) | 7 (3%)  RR:11.4 [5.1-25.4], p<0.0001\* |

\* MedCalc RR calculator (in blue)

### Presence of SARS-CoV-2 in air

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Setting** | **Outcome measure** | **No of samples** | **No (%) PCR +ve** | **No (%) Viable in culture** | **Evidence of interpersonal transmission** | **Reviewer’s comments** |
| **Contaminated samples** | | | | | | | |
| Cheng, 2020b17 | Hospital room with COVID-19 patient | No of contaminated samples | 4 | 0 | NR | NR | Air taken in 4 scenarios: normal breathing, deep breathing, speaking, coughing. |
| Faridi, 202026 | Hospital rooms with COVID+ve patients | No of contaminated impingers | 4 | 0 | NR | NR | 4 impingers placed 1.5-1.8m from the floor & 2-5m away from COVID-19 patients for 1hr. Some patients coughed or were intubated |
| Guo, 202029 | Hospital rooms with COVID-19 patients | No of contaminated samples | 40 ICU  16 General ward | 14 (35%) ICU  2 (12.5%) General ward | NR | NR | Air samples mostly contaminated around patient areas and downstream, although upstream also observed. Virus traveling up to 4m. |
| Santarpia, 202081 | Hospital rooms with COVID-19 patients | % of contaminated samples | NR | P: 100% l  H: 66.7% | 0 | NR | P: Personal space – patient’s isolation area; H: Hallway outside the patient’s isolation area; highest load in samplers near patients  Authors suggested aerosols exist even without cough and AGPs |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Zhou, 2020b134 | Hospital areas with COVID-19 patients | No of contaminated air samples | 31 | 14 (38.7%) | 0 | NR | 1m3 samples were collected using Coriolis air sampler in different clinical areas including COVID-19 ward, emergency department and theatres during tracheostomy. |
| Alsved, 2020141 | Hospital room of COVID-19 patients | No of contaminated samples | 8 | 0 | n/a | NR | Air taken using high-airflow liquid cyclone operated at 200 L/min for 10 min, at distance of 0.8m from two COVID-19 patients who were: a) normal breathing b) reading a book, loud c) singing d) singing with mask on. All in a sitting position. Both patients were 2d after symptom onset, samples taken 10min after each activity. |
| Ding, 2020144 | Hospital room of COVID-19 patients | No of contaminated samples | 46 | 1 (2.2%) | NR | NR | Four different bioaerosol samplers were used: Andersen one-stage viable impactor (sampled at 10 L/min for 30 min), AirPort MD MD8 (50 L/min for 20 min) ASE-100 (500 L/min for 2 min) biological aerosol special special-collection liquid liquid), WA-15 (14 L/min for 30 min). Air was taken in rooms at 0.5m from patient at 0.8m or 1.2m height or 0.6m height at the bottom of bed, in bathrooms at 0.5m height, in corridor at 0.6m height, nursing station at 0.8m and roof near air outlets at 0.2m. The only weakly positive sample was collected by ASE-100 with 10m3 air volume in a corridor close to the patient rooms. There was also one positive surface swab taken from the exhaust louvre in a bathroom which authors considered to be likely from aerosolised faeces/urine or less likely from breathing. |
| Dohla, 2020145 | Room in COVID-19 household | No of contaminated samples | 15 | 0 | - | NR | A total of 21 households tested of which 15 tested air samples. There were 43 adults of whom 26 (60.5%) tested +ve and 15 children of whom 4 (27%) tested +ve and 6 (40%) were not tested. Air cyclone sampler (Coriolis Micro-Air) was positioned in a middle of the most frequently occupied room, set for 300/L and collected sample for 10min with close contact speaking <2m not allowed. Authors reported that no rooms had a ventilation equipment. |
| Lednicky, 2020150 | Room in COVID-19 hospital | No of contaminated samples | 4 | 4 | 4 | NR | In room housing 2x COVID-19 patients, with 6x air changes/hr, over 3hrs, using water vapour condensation system for collecting airborne particles without damage: in-house VIVAS taken at 2m x3 one with HEPA filter and BioSpot VIVAS taken at 4.8m x 3 one with HEPA. Viability tested using LLC-MK2 and Vero E6 cells. Viral RNA collected on 4/4 samples collected without HEPA, 2 samples with HEPA filters -ve. Culture cells occulated with virus from four +ve samples all +ve for viable virus and showing cytopathic changes under light microscope. Viable virus count: 6 &27 viral genomes/ L for 4.8m and 18 and 74 for 2m. |
| Lei, 2020152 | Rooms in hospital with COVID-19 patients | No of contaminated samples | NR | 2 | NR | NR | Samples collected near patients in ICU (n=4, 3 on ventilator) and isolation room (n=5), all considered persistently infected: had IgG antibodies against SARS-CoV-2 present and tested +ve at least from one screening sample (NO, sputum, anal, stool, urine, serum, conjunctiva). Air samples collected near patients at 1m away and 1.3m high (ICU and isolation room) and bathroom <1m (isolation room some of bathroom samples measured 1hr after use). A total of 7 samples were collected daily using cyclonic collection devices: NIOSH (x3) and aerosol particle liquid concentrator (Ding Blue x4). All samplers set at 14L/hr for 30min. No +ve samples in ICU, 1x +ve in isolation room bathroom, 1x samples +ve with Ct=44.7. viability not tested. |
| Ma, 2020153,154 | Areas in hospital and quarantine hotel with COVID-19 patients | No of contaminated samples | 26 | 1 (3.8%) | NR | NR | This study was published in CID but was available under slightly different title and less data as pre-print, hence two references. Samples taken from hospital and quarantine hotel in various areas. Samples collected using impingers into 3ml culture liquid. Impingers were set at 15L/min in closed rooms (e.g. toilets) and 400L/min in open areas (e.g. corridors). The positive sample was in toilet with an estimated amount of virus of 6.07 × 103 viruses/m3 Also found evidence of virus on the ventilation duct entrance. |
| Wei, 2020159 | Rooms in hospital with COVID-19 patients | No of contaminated samples | 6 | 0 (0%) | NR | NR | Negative pressure rooms in COVID-19 ward 1,2 or 3 bed occupancy n=13 beds, all occupied, 12 air exchanges/hr. on a day of sampling patient ill for 5-24days: 2/13 asymptomatic, 11/13 mild disease. 9/10 patients who were tested that day were +ve either NP or stool sample. Air samples taken using FSC-1V set at 100L/hr for 15min, placed at 0.6m away from patient at 1m height. Swabs of air exhaust outlets also taken. PCR tested. |
| Wu, 2020160 | Rooms in hospital with COVID-19 patients | No of contaminated samples | 44 | 0 (0%) | n/a | NR | Samples taken from different areas within the hospital, including high risk (patient rooms, fever clinic, nursing station, buffing room for donning off PPE) and low risk (restrooms, offices, buffer rooms for donning on PPE). Air samples collected through natural precipitation methods, referred to methodology according to the Chinese standard which states: *Level-six impact air sampler or other verified air samplers can be chosen for air sampler method. Place the sampler in the center of the room at a height of 0.8 m~1.5 m during testing. Operate according to the sampler instruction manual. Each sampling time shall not exceed 30min.* |
| Zhou, 2021161 | Hospitals with COVID-19 patients | No of contaminated samples | 44 | 3 (6.8%) | NR | NR | Four hospitals with COVID-19 patients sampled air in corridors, waste storage rooms, ICU, toilets, medical preparation, clinical observation rooms, and general wards. Air samples collected using the Air-nCoV-Watch (ACW) system with house-made impinger samplers (Wa-15 or WA-400, sampling at 15 and 400L/min respectively). Impingers were set at 15L/min in closed rooms (e.g. toilets) and 400L/min in open areas (e.g. corridors). Samples taken over 40min. Estimated virus load: min 9 copies, max 2.19×102/m3 |

|  |
| --- |
| **Contaminated air vents/filters** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| De Man, 2020143 | Nursing home unit (filters from air conditioning units) | No of contaminated samples | 2 | | 1/2 (50%) | | NR | | | yes | | 1/2 air conditioning units, samples taken from the mesh of the filters. Air-conditioners were located in shared living space. |
| Nursing home unit (filters from ventilation cabinets) | No of contaminated samples | 16 | | 4 (25%) | | NR | | | yes | | 4 filters from 3/8 ventilation cabinets (each cabinet containing 2 filters) samples taken from the mesh of the filters. Each ventilator contained 2 filters, one filtering air outside to in and one inside to out (16) we are told 4 of 16 filter blocks were positive therefore this must have included a filter for external air. |
| Nissen, 2020156 | Vent openings, COVID-19 wards | No of contaminated samples | 19 | | 7 (37%) | | No changes detected, not possible to determine viability | | | NR | | Swabs taken on 4 separate days in 19 rooms occupied by COVID-19 patients and in outpatient clinic. First two samplings only included vent openings, the third also included ducts/filters and the fourth used fluid traps at both ends of the ducts. Viability tested in Vero E6 cells |
| Vent ducts, COVID-19 wards | No of contaminated samples | 19 | | 4 (21%) | | NR | |
| Main exhaust filters, 50m from wards | No of contaminated samples | 9 | | 8 (88.9%) | | NR | |
| Wei, 2020159 | Air exhaust outlets in rooms with COVID-19 patients | No of contaminated samples | | 6 | | 3 (50%) | | NR | NR | | Negative pressure rooms in COVID-19 ward 1,2 or 3 bed occupancy n=13 beds, all occupied, 12 air exchanges/hr. on a day of sampling patient ill for 5-24days: 2/13 asymptomatic, 11/13 mild disease. 9/10 patients who were tested that day were +ve either NP or stool sample. Swabs of air exhaust outlets taken from each room. PCR tested. | |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Contaminated rooms** | | | | | | | |
| Chia, 202018 | Hospital rooms with COVID-19 patients | No of rooms contaminated | 3 | 2 | NR | NR | Three NIOSH samples per room (general ward) located 0.7, 0.9 and 1.2m from the floor and 1-2.1 away from COVID patients for 4hrs. |
| Ong, 202066 | Hospital rooms with COVID-19 patients | No of rooms contaminated | 3 | 2 | NR | NR | Air outlets outside the room |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Lednicky, 2020b151 | Hallway in a respiratory infection health centre | No of rooms contaminated | 1 | 1 | 1 | NR | Sampler positioned in a hallway approx. 3m away from the area where patients with respiratory infection entered/exited the hallway. Using VIVAS system for taking air samples, positioned at 1.5m for 1hr. Patients entering and exiting were required to wear face covering. SARS-CoV-2 virus detected among other respiratory viruses, although low copies (0.87 copies/L), also viable in Vero E6 cells which showed cytopathic changes 2 days post-inoculum. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Contaminated exhaled breath** | | | | | | | |
| Ding, 2020144 | Exhaled condensate | No of contaminated samples | 2 | 0 | - | NR | Used AT-150 to obtain samples. Patient 1 developed symptoms 13 days before sampling and last tested +ve 7 days before sampling, patient 2 developed symptoms 6 days before sampling and was still +ve 8 days after sampling. |
| Expired air | No of contaminated samples | 2 | 0 | - | NR | Not reported how these were collected. Patient 1 developed symptoms 13 days before sampling and last tested +ve 7 days before sampling, patient 2 developed symptoms 6 days before sampling and was still +ve 8 days after sampling. |
| Ma, 2020153,154 | Exhaled breath condensate | No of contaminated samples | 52 | 14 (27%) | NR | NR | This study was published in CID but was available under slightly different title and less data as pre-print, hence two references. Taken from a total of 49 COVID-19 patients using BioScreen samplers previously validated for collecting influenza virus. Patients asked to exhale via a long straw for 5min (normal breathing). The estimated amount of excreted virus was 1.03 × 105 to 2.25 × 107 copies/h. |
| Zhou, 2021161 | Exhaled breath condensate | No of contaminated samples | 9 | 2 (22.2%) | NR | NR | Samples collected from 10 patients (1 excluded, later died) who at the time of data collection were throat -ve for SARS-CoV-2 (COVID-19 recovered). EBC collected using BioScreen II device via long straw. Estimated viral shedding at 7.35–7.77x104/hr despite throat -ve and ready for discharge. Authors also collected samples from 4 COVID-19 -ve patients with flu symptoms who all had EBC -ve and who were excluded from analysis |
| **Viral load** | | | | | | | |
| Cheng, 2020b17 | Hospital room with COVID-19 patient | Viral particles/m3 | 4 | 0 | NR | NR | 4 scenarios: normal breathing, deep breathing, speaking, coughing |
| Chia, 202018 | Hospital rooms with COVID-19 patients | Viral particles/m3 | 3 | 1.84x103-3.38x103 |  |  | Three NIOSH samples per room (general ward) located 0.7, 0.9 and 1.2m from the floor and 1-2.1 away from COVID patients for 4hrs. |
| Ning, 202064 | Hospital for COVID-19 patients, patient areas | Viral particles/m3/hr | 11 | 0-113 | NR | NR | Highest in ICU (two samples tested, yielding 31 and 113, but these were deposits rather than aerosols) |
| Hospital for COVID-19 patients, medical areas | Viral particles/m3/hr | 13 | 0-42 | NR | NR | Possibility of airborne transmission if the areas are small, not well ventilated and overcrowded |
| Public areas: inside & outside the hospital | Viral particles/m3/hr | 11 | 0-11 | NR | NR | Possibility of airborne transmission if the areas are small, not well ventilated and overcrowded |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Zhou, 2020b134 | Hospital areas with COVID-19 patients | Viral particles/m3 | 14 | 10-1000 | 0 | NR |  |

### Survival of SARS-CoV-2 in air

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Author** | **Surface** | **SARS-CoV-2** | **SARS-CoV** | **Comments** |
| Van Doremalen, 202092 | Time virus viable in air | >3hrs | >3hrs | Aerosol transmission plausible for both viruses. The differences in epidemiology of these viruses are probably due to other factors e.g. asymptomatic transmission, higher viral loads |
| Fears, 2020146 | Time virus viable in air | >16hrs | - | A single, unrepeated experiment: virus aerosolised, and suspension maintained in the air by a custom-made drum. Samples taken at 10min, 30min, 2hrs, 4hrs and 16 hours after generation and suspension. Samples collected by impingers and analysed by PCR and SEM. NO UV light source was used. The virus retained its reproductive ability up to 16hrs, at which point it did not reach its half-life and maintained the with a minimal decrease in virus concentration. SEM examination showed that the virus maintained its characteristics 16hrs after the aerosolisation (size, shape, morphology and aspect ratios). |

### Transmission via fomites

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Setting** | **Surface tested** | **Outcome measure** | **No of samples** | **No (%) of PCR +ve** | **No (%) of viable in culture** | **No (%) of intrapersonal transmission** | **Reviewer’s comments** |
| **Contaminated surfaces** | | | | | | | | |
| Guo, 202029 | Areas housing COVID-19 patients | Different surfaces (floors, high touch, etc.) | No of contaminated surfaces | 124 ICU  114 General | 54 in ICU  9 in general ward | NR | NR | Possible transmission via fomites |
| Ong, 202066 | Areas housing COVID-19 patients | Different surfaces incl. toilet, floors and high touch | No of surfaces contaminated | 25 | 15 | NR | NR | Surfaces in patient room & toilet mostly contaminated: 12/14 & 3/5; anteroom and floor no contamination |
| Santarpia, 202081 | Areas housing COVID-19 patients | Different surfaces | % of surfaces contaminated | NR | 80.4% | NR | NR | 76.5% personal items and 81% toilet samples contaminated, less shedding on D8 and 9 than D5-7 |
| Wang, 202093 | Areas housing COVID-19 patients | Surfaces | No of surfaces contaminated | 36 | 0 | - | NR | Cleaned w/ 1000mg/L Cl 4hrs in ICU and 8hrs in general wards |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Zhou, 2020b134 | Areas housing COVID-19 patients | Surfaces | No of surfaces contaminated | 218 | 114 | 0 |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Contaminated PPE** | | | | | | | | |
| Ong, 202066 | Clinical areas with COVID-19 patients | PPE (gown, visor, mask, shoes) | No of items contaminated | 10 | 1 | NR | NR | Only shoes contaminated |
| Ong, 2020b67 | Clinical areas with COVID-19 patients | PPE (goggles, respirators, shoes) | No of items contaminated | 90 | 0 | - | NR | Usual care, no aerosol generating procedures |
| Wang, 202093 | Clinical areas with COVID-19 patients | PPE (respirators and gloves) | No of items contaminated | 9 | 0 | - | NR |  |
| **Total** | | | No of items contaminated | **109** | **1 (0.9%)** | **NR** | **NR** |  |
| **Contaminated rooms** | | | | | | | | |
| Chia, 202018 | Clinical areas with COVID-19 patients | Surfaces in ICU and general wards (not specified) | No of contaminated rooms | 30 | 17 | NR | NR | No differences when stratified by symptoms, but higher contamination in the first week of illness |
| **Viral load** | | | | | | | | |
| Cheng, 2020b17 | Clinical areas with COVID-19 patients | Bedside bench | Viral load on surface | 2 | 6.5x102/ml once  0 once | NR | NR |  |
| **Intrapersonal transmission** | | | | | | | | |
| Cai, 20208 | Shopping centre | Surfaces (not specified) | Number of cases | NR | NR | NR | 28 | Lack of contact between cases suggests indirect transmission via fomites |

### Survival of SARS-CoV-2 on different surfaces

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Author** | **Surface** | **SARS-CoV-2** | **SARS-CoV** | **Comments** |
| Chin, 202019 | Paper (printing & tissue) | <3hrs | - | Except for surgical mask, virus more stable on smooth vs porous surfaces |
| Wood | <2d | - |
| Cloth | <2d | - |
| Glass | <4d | - |
| Bank note | <4d | - |
| Surgical mask | <7d | - |
| Plastic | <7d | - |
| Van Doremalen, 202092 | Copper | <4hrs | 8hrs | Aerosol and fomite transmission plausible for both viruses. The differences in epidemiology of these viruses are probably due to other factors e.g. asymptomatic transmission, higher viral loads |
| Cardboard | 24hrs | 8hrs |
| Plastic | 72hrs | 72hrs |
| Stainless steel | 72hrs | 48hrs |

### Vertical transmission

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Author** | **Number of exposed babies** | **Number of COVID-19 positive mothers** | **Number of infected babies** | **Types of tissues tested by PCR for COVID-19 RNA presence** | | | | | |
| **Cord blood** | **Amniotic fluid** | **Placenta** | **Serum** | **Breast milk** | **Vaginal secretions** |
| Alzamora, 20205 | 1 | 1 | 1i | NR | NR | NR | NR | NR | NR |
| Chen, 202010 | 9 | 9 | 0 | 0/6 | 0/6 | NR | NR | 0/6 | NR |
| Chen, 2020c12 | 5 | 5 | 0 | NR | NR | NR | NR | NR | NR |
| Chen, 2020e14 | 4 | 4 | 0 | NR | NR | NR | NR | NR | NR |
| Chen, 2020f15 | 3 | 3 | 0 | NR | NR | 0/3 | NR | NR | NR |
| Dong, 202022 | 1 | 1 | 1ii | NR | NR | NR | NR | NR | NR |
| Fan, 2020b25 | 2 | 2 | 0 | 0/2 | 0/2 | 0/2 | NR | 0/2 | 0/2 |
| Han, 202031 | NR | NR | NR | NR | NR | NR | NR | 0/1 | NR |
| Iqbal, 202035 | 1 | 1 | 0 | NR | 0 (1) | NR | NR | NR | NR |
| Khan, 202039 | 17 | 17 | 2iii | NR | NR | NR | NR | NR | NR |
| Lee, 202042 | 4 | 4 | 0 | 0/1 | 0/1 | NR | NR | NR | NR |
| Li, 2020d46 | 2 | 3 | 0 | NR | NR | NR | NR | NR | NR |
| Li, 2020j52 | 1 | 1 | 0 | NR | NR | NR | NR | NR | NR |
| Liu, 202054 | 19 | 19 | 0 | 0/19 | 0/19 | NR | NR | NR | NR |
| Liu, 2020b55 | 3 | 3 | 0 | NR | NR | NR | NR | NR | NR |
| Liu, 2020c56 | 13 | 14 | 0 | NR | NR | NR | NR | NR | NR |
| Lowe, 202058 | 1 | 1 | 0iv | NR | NR | NR | NR | NR | NR |
| Penfield, 202071 | 32 | 32 | 0 | NR | NR | 3/11ix | NR | NR | NR |
| Peng, 2020b73 | 1 | 1 | 0 | 0/1 | NR | 0/1 | 0/1 | 0/1 | NR |
| Pierce-Williams, 202075 | 64 | 65 | 0 | NR | NR | NR | NR | NR | NR |
| Wang, 2020b94 | 1 | 1 | 1v | 0/1 | NR | NR | NR | NR | NR |
| Wang, 2020e97 | 1 | 1 | 0 | 0/1 | 0/1 | 0/1 | NR | NR | NR |
| Yan, 2020113 | 86 | 86 | 0 | 0/10 | 0/10 | NR | NR | NR | 0/6 |
| Yang, 2020114 | NR | 20 | 0 | NR | NR | NR | NR | NR | NR |
| Yang, 2020b115 | 6 | 6 | 0 | 0/4 | 0/4 | NR | NR | NR | NR |
| Yu, 2020117 | 7 | 7 | 1vi | 0/1 | NR | 0/1 | NR | NR | NR |
| Zambrano, 2020119 | 1 | 1 | 0 | NR | NR | NR | NR | NR | NR |
| Zeng, 2020120 | 6 | 6 | 2vii | NR | NR | NR | NR | NR | NR |
| Zeng, 2020121 | 33 | 33 | 3viii | 0/NR | 0/NR | 0/NR | NR | NR | NR |
| Zhang, 2020c124 | 10 | 10 | 0 | NR | NR | NR | NR | NR | NR |
| Zhu, 2020133 | 10 | 10 | 0 | NR | NR | NR | NR | NR | NR |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Vivanti, 2020136 | 1 | 1 | 1 | NR | 1/1 | 1/1 | NR | NR | NR |
| **Total:** | **365** | **368** | **12** | **0/46** | **1/45** | **4/20** | **0/1** | **0/10** | **0/8** |
| **No of studies** | **32** | **32** | **32** | **10** | **9** | **7** | **1** | **4** | **2** |

i – baby separated from mother at birth, chest x-ray normal at this time, not tested at birth but +ve 16hrs later; ii – no tissues tested, but at 2hrs post-delivery SARS-CoV-2 antibodies were present in neonate, suggesting in utero exposure, neonate tested negative; iii – suspected vertical transmission, but authors stated that no convincing evidence of vertical transmission was found; iv – baby breastfed from the start, parents using contact precautions; v – baby tested +ve 36hrs after birth, no testing done at birth; vi - tested +ve after 36hrs, placenta and cord blood -ve, authors suggest no vertical infection; vii - two infants had elevated antibodies, but tested -ve for COVID-19; viii - 3 babies developed COVID-19: 2 of three within 2 days, the third baby septic and born w/ foetal distress but also infected Enterobacter, tested +ve for COVID-19 later. No babies were tested for COVID at birth and no samples blood cord, placenta and amniotic fluid +ve. Authors concluded vertical transmission cannot be ruled out; ix – authors suggested intrapartum exposure, although they also asserted that due to the mixing fluids and tissues during the delivery, contamination of placenta from maternal sources is also possible.

### Transmission from infected body fluids – faecal matter

### Interpersonal transmission

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Outcome measure** | **No of participants** | | **Incidence** | | | **Reviewer’s comments** |
| **Exposure** | **Control** | **No of +ves** | **Control** | **Evidence of transfer (author interpretation)** |
| Kang, 2020148 | No of cases | 4 | 217 | 4 | 0 | Drainage pipes of vertically aligned toilets probably served as transport routes of faecal aerosols between the flats. | An outbreak of 9 cases occurring in 3 vertically aligned flats, with bathrooms connected by drainage stacks and vents (no. 1502, 2502, 2702, first two digits indicating floor number and last two digits a position of the flat on the floor) during the time when social distancing was implemented. Bathroom floors had drains, which as with Amoy Gardens outbreak, were not used and were left dried out in some flats. By date of symptom onset, index cases (n=5) were in flat 1502, also travelled to Wuhan 14 days before symptoms appeared. Symptom onset for other flats at least 6 days later, had no travel history, no close contact with suspected COVID-19 cases and mostly stayed at home in the preceding week. Families did not know each other, and video surveillance showed to contact in the elevator. 5x environmental samples from 1502 and 1x sample from unoccupied 1602 were +ve whilst 160 environmental samples and 7 air samples taken from public areas and -02 flats in the building were -ve. 5/6 +ve samples were taken from master bathrooms and 1/6 was from master bedroom. To further test their hypothesis, authors released a tracer gas into the 1502 toilet - substantial gas concentration was subsequently found in 1602, 2502, 2702 as well as in 2102. |

1. **Presence of viral RNA in faecal matter**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Sample** | **Outcome measure** | **No of samples** | **No of PCR +ve samples** | **No of samples viable in culture** | **No of documented transmissions** | **Reviewer’s comments** |
| **Anal swab** | | | | | | | |
| **No of individuals** | | | | | | | |
| Cui, 202021 | Anal swab | No of positive individuals | 35 | 1 | NR | NR |  |
| Fan, 2020b25 | Anal swab | No of positive individuals | 1 | 1 | NR | NR | Up to D28 |
| Jiang, 202036 | Anal swab | No of positive individuals | 1 | 1 | NR | NR | Persistently +ve |
| Li, 2020c45 | Anal swab | No of positive individuals | 1 | 1 | NR | NR |  |
| Peng, 202072 | Anal swab | No of positive individuals | 7 | 2 | NR | NR |  |
| Tan, 202088 | Anal swab | No of positive individuals | 1 | 1 | NR | NR | Up to D23 |
| Xu, 2020112 | Anal swab | No of positive individuals | 10 | 8 | NR | NR | Up to 1 month |
| Zhang, 2020e126 | Anal swab | No of positive individuals | 16 | 10 | NR | NR | 4/16 +ve on day 0, 6/16 +ve on day 5 |
| **Total:** |  |  | **72** | **25 (35%)** | **NR** | **NR** |  |
| **No of samples** | | | | | | | |
| Wu, 2020101 | Anal swab | No of positive samples | 120 | 12 | NR | NR | clearance in digestive tract occurs after the OP swabs -ve |
| **Total:** |  |  | **120** | **12 (10%)** | **NR** | **NR** |  |
| **Stool** | | | | | | | |
| **No of individuals** | | | | | | | |
| Chen, 2020f15 | Stool | No of positive individuals | 42 | 28 | NR | NR |  |
| Han, 202031 | Stool | No of positive individuals | 2 | 2 | NR | NR |  |
| Jiehao, 202038 | Stool | No of positive individuals | 6 | 5 | NR | NR |  |
| Li, 2020h50 | Stool | No of positive individuals | 13 | 2 | NR | NR | Up to 15 days after discharge |
| Ling, 202053 | Stool | No of positive individuals | 66 | 11 | NR | NR | Convalescent patients |
| Pan, 202068 | Stool | No of positive individuals | 2 | 0 | NR | NR |  |
| Park, 202069 | Stool | No of positive individuals | 1 | 1 | NR | NR | 1 child known COVID-19 +ve, stool positive until D17, after symptoms resolved |
| Tan, 2020b89 | Stool | No of positive individuals | 10 | 3 | NR | NR | From D16 onwards |
| Tang, 202090 | Stool | No of positive individuals | 1 | 1 | NR | NR | Multiple exposures, stool +ve 17-24 days after exposure, otherwise asymptomatic |
| To, 202091 | Stool | No of positive individuals | 15 | 4 | NR | NR |  |
| Wang, 2020c95 | Stool | No of positive individuals | 17 | 11 | NR | NR | Up to 40 days |
| Wu, 2020d104 | Stool | No of positive individuals | 74 | 41 | NR | NR | Samples +ve up to mean 28d after symptom onset, max 47d |
| Xiao, 2020108 | Stool | No of positive individuals | 73 | 39 | NR | NR | 39/73 patients had +ve stool samples for up to 12d, persisted after respiratory samples -ve |
| Xing, 2020111 | Stool | No of positive individuals | 3 | 3 | NR | NR | Up to 20d after NP samples \_ve |
| Zhang, 2020122 | Stool | No of positive individuals | 14 | 5 | NR | NR | Delay of few days after OP samples +ve |
| Zhang, 2020d125 | Stool | No of positive individuals | 3 | 3 | NR | NR | OP swabs -ve but anal swabs +ve from day 10 onwards |
| Zhang, 2020i130 | Stool | No of positive individuals | 1 | 1 | NR | NR |  |
| Zheng, 2020131 | Stool | No of positive individuals | 96 | 55 | NR | NR | Low at the onset and increasingly more prevalent up to 3 weeks from the onset |
| **Total:** |  |  | **439** | **215 (49%)** | **NR** | **NR** |  |
| **No of samples** | | | | | | | |
| Wang, 2020d96 | Stool | No of positive samples | 153 | 44 | 2/4 | NR | Multiple samples from patients, first +ve faecal sample on D7 |
| Wu, 2020101 | Stool | No of positive samples | 244 | 24 | NR | NR | clearance in digestive tract occurs after the OP swabs -ve |
| Zhang, 2020h129 | Stool | No of positive samples | NR | NR | 1/1 | NR | Culturable virus isolated |
| **Total:** |  |  | **397** | **68 (17%)** | **3/5 (60%)** | **NR** |  |
| **Sewage** | | | | | | | |
| Ahmed, 20203 | Sewage | No of positive samples | 9 | 2 | 0/2 | NR | A different assay used returned no positive samples |
| Medema, 202062 | Sewage | No of positive samples | 18 | 15 | NR | NR | Results in table 3: samples collected in Feb were before epidemic and were all -ve. Once the epidemic started 15/18 were +ve by at least one of four probes |
| Wang, 202093 | Sewage | No of positive samples | 5 | 4 | 0/4 | NR | PCR +ve but not viable in culture |
| Wurtzer, 2020105 | Sewage – untreated | No of positive samples | 23 | 23 | NR | NR |  |
| Sewage – treated | 8 | 6 | NR | NR |  |
| **Total:** |  |  | **65** | **50 (77%)** | **0/6** | **NR** |  |

### Transmission from infected body fluids – ocular tissues and secretions

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Sample** | **Outcome measure** | **No of samples** | **No of PCR +ve samples** | **No of samples viable in culture** | **No of documented transmissions** | **Reviewer’s comments** |
| **Tears** | | | | | | | |
| Seah, 202085 | Tears | No of people with positive samples | 17 | 0 | - | - | 0/64 samples -ve, no patients had ocular symptoms |
| Xie, 2020110 | Tears | No of people with positive samples | 33 | 2 | NR | NR | Authors speculated that low number of cases was due to most samples taken >week after symptoms started. The positive samples were collected 4 and 5 days after symptoms |
| **Total:** |  |  | **50** | **2 (4%)** |  |  |  |
| **Ocular discharge** | | | | | | | |
| Zhang, 2020f127 | Ocular discharge | No of people with positive samples | 72 | 1 | NR | NR |  |
| **Total:** |  |  | **72** | **1 (1.4%)** |  |  |  |
| **Conjunctival swab** | | | | | | | |
| Chen, 2020b11 | Conjunctival swab | No of people with positive samples | 1 | 1 | NR | NR |  |
| Sun, 2020b87 | Conjunctival swab | No of people with positive samples | 72 | 1 | NR | NR | 2/72 had conjunctivitis, 1 of 2 tested +ve, mean day eyes tested 18D |
| Wu, 2020b102 | Conjunctival swab | No of people with positive samples | 28 | 2 | NR | NR | 12/28 had ocular symptoms |
| Xia, 2020105 | Conjunctival swab | No of people with positive samples | 30 | 1 | NR | NR | Average time from symptom to swab taken approx. 7 days |
| Zhou, 2020132 | Conjunctival swab | No of people with positive samples | 63 | 3 |  |  | 2/3 probable and one definite. None of 3 patients displayed ocular symptoms. 1/63 patients had ocular symptoms but tested -ve |
| **Total:** |  |  | **194** | **8 (4%)** |  |  |  |
| **Ocular swab** | | | | | | | |
| Colavita, 202020 | Ocular swab | No of people with positive samples | 1 | 1 | NR | NR |  |
| **Total:** |  |  | **1** | **1 (100%)** |  |  |  |

### Evidence for virus entering via ocular surface

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Author** | **Outcome measure** | **No exposed** | **No infected** | **Comments** |
| Li, 2020g49 | No of positive individuals | 2 | 2 | Two case studies: 1) anaesthetist tended to undiagnosed COVID-19 patient with routine PPE (no goggles), developed conjunctivitis on D3 and developed pneumonia days later; 2) nurse from fever clinic developed conjunctivitis and later developed pneumonia  Both suspected transmission via conjunctiva, subsequently infecting respiratory tract via nasolacrimal duct system |
| Zhang, 2020f127 | No of positive individuals | 1 | 1 | Occupational transmission, nurse reported wearing respirator at all times but sometimes without goggles and touching her eyes. Developed conjunctivitis (+ve for COVID) and later developed pneumonia. Not possible to determine the source of virus |

### Transmission from infected body fluids – sexual body fluids

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Sample** | **Outcome measure** | **No of samples** | **No of PCR +ve samples** | **No of samples viable in culture** | **No of documented transmissions** | **Reviewer’s comments** |
| **Semen** | | | | | | | |
| Li, 2020b44 | Semen | No of positive samples | 38 | 6 | NR | NR | NR |
| **Vaginal** | | | | | | | |
| Cui, 202021 | Vaginal swab | No of positive samples | 35 | 0 | NR | NR | NR |
| Qiu, 2020b79 | Vaginal fluid | No of positive samples | 10 | 0 | NR | NR | NR |

### Transmission from infected body fluids – urine

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Sample** | **Outcome measure** | **No of samples** | **No of PCR +ve samples** | **No of samples viable in culture** | **No of documented transmissions** | **Reviewer’s comments** |
| **No of positive individuals** | | | | | | | |
| Han, 202031 | Urine | No of positive individuals | 2 | 1 | NR | NR |  |
| Jiehao, 202038 | Urine | No of positive individuals | 2 | 0 | n/a | n/a |  |
| Ling, 202053 | Urine | No of positive individuals | 58 | 4 | NR | NR |  |
| Pan, 202068 | Urine | No of positive individuals | 2 | 0 | n/a | n/a |  |
| Peng, 202072 | Urine | No of positive individuals | 7 | 1 | NR | NR |  |
| To, 202091 | Urine | No of positive individuals | 10 | 0 | n/a | n/a |  |
| Zhang, 2020i130 | Urine | No of positive individuals | 1 | 0 | NR | NR |  |
| Zheng, 2020131 | Urine | No of positive individuals | 67 | 1 | NR | NR |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sun, 2020135 | Urine | No of positive individuals | 1 | 1 | 1 | NR |  |
| **Total:** |  |  | **150** | **8** | **1** | **NR** |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **No of positive samples** | | | | | | | |
| Chen, 2020f15 | Urine | No of positive samples | 10 | 0 | n/a | n/a |  |
| Wang, 2020d96 | Urine | No of positive samples | 72 | 0 | n/a | NR |  |
| **Total:** |  |  | **82** | **0** | **NR** | **NR** |  |

### Blood transfusion and organ transplantation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Author** | **Outcome measure** | **No exposed** | **No infected** | **Comments** |
| **Blood transfusion** | | | | |
| Cho, 2020137 | Number of cases | 1 | 0 | Donor pre-symptomatic at the time of donation, subsequently diagnosed with COVID-19 five days later |
| Essa, 2020138 | Number of cases | 1 | 0 | Donor tested positive 5 days after donation, recipient (immunocompromised) had minor symptoms a day after transfusion, but these were not necessarily the result of infection. All lab tests came back with no evidence of SARS-CoV-2 acquisition. |
| Liapis, 2020139 | Number of cases | 2 | 0 | Donor symptomatic and tested +ve 2 days after donation, two recipients (one older person) received blood products both with no evidence of infection |
| Politis, 2020140 | Number of cases | 1 | 0 | Donor asymptomatic, tested +ve later as a part of screening strategy, blood transfused to an immunocompromised patient, recipient -ve and no evidence of antibodies later |
| **Organ transplantation** | | | | |
| No studies | | | | |

### Dynamics of SARS-CoV-2 transmission

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, year** | **Index case(s)** | | **Type of exposure** | | **Number exposed** | **Number infected** | | **Subsequent cases\*** | | **Comments** | |
| Bai, 20206 | 1 family member traveling from Wuhan | | Family gatherings | | 5 | 5 | | NR | | One apparently asymptomatic patient met up with family to visit someone in hospital. No cases of COVID in the area then | |
| Burke, 20207 | 10 patients w/ travel history | | Household | | 19 | 2 | | 0 | |  | |
| Community | | 104 | 0 | | n/a | | Defined as at least 10min contact at 6 feet or less | |
| Healthcare | | 100 | 0 | | n/a | | defined as at least 10min contact at 6 feet or less in the shared room or up 2 two hrs in the same airspace (e.g. examination room after COVID patient was seen) | |
| Healthcare workers | | 222 | 0 | | n/a | | Anyone who came to contact with patient or their infectious material | |
| Cheng, 202016 | 100 COVID +ve patients | | Household | | 151 | 10 | | NR | |  | |
| Family gatherings | | 76 | 5 | | NR | |
| Healthcare | | 698 | 6 | | NR | |
| Other | | 1836 | 1 | | NR | |
| Dong, 2020b23 | Multiple index cases | | Exposure from family | | NR | 59 | | NR | | A total of 101 cases with no exposure to Wuhan or other endemic areas, infected locally. Cases stratified into the type of exposure. | |
| Exposure in public places | | NR | 28 | | NR | |
| Exposure at work | | NR | 12 | | NR | |
| Exposure not identified | | NR | 2 | | NR | |
| Gan, 202027 | NR | | Household | | NR | 914 | | NR | | Not possible to determine index cases and no of exposed individuals. This is a breakdown of 1052 cases where it was possible to determine their source of infection. | |
| Family gatherings | | 12 | |
| Public transport | | 7 | |
| Other gatherings | | 6 | |
| Public spaces | | 5 | |
| Work | | 2 | |
| Ghinai, 202028 | 1 returning from China | | Household | | 1 | 1 | | 0 | | Community and healthcare contacts were those of the wife or the husband she infected | |
| Community | | 152 | 0 | | n/a | |
| Healthcare | | 195 | 0 | | n/a | |
| Han, 202031 | 1 family member | | Household | | 6 | 4 | | NR | | One family member infected others, not possible to determine who was the index case and where the infection came from | |
| Heinzerling, 202032 | 1 undiagnosed patient | | Healthcare | | 121 | 3 | | NR | | Patient not suspected of COVID, managed with standard precautions, underwent multiple AGPs. Those infected spent more time w/ patient, performed physical examinations and were present during AGPs | |
| Huang, 202033 | 1 patient travelling from Wuhan | | Family gathering | | 7 | 1 | | NR | | One who got sick stayed with index patient for approx. 30 min; in a poorly ventilated room with doors and windows closed | |
| Gatherings with friends | | 15 | 6 | | NR | | Those who got sick were sitting in a direct flow of the air conditioning in the restaurant where they had dinner | |
| Huang, 2020b34 | 1 family member, returning from Wuhan | | Household | | 2 | 2 | | n/a | | Three cases infected at dinner transmitted the virus to one household member and 3 relatives at another family dinner | |
| Family gatherings | | 8 | 3 | | 4 | |
| Jiang, 2020b37 | 2 patients travelling from Wuhan | | Household | | 4 | 2 | | 4 | | The infected household contacts further infected 2 family members from another household 2/4 and one member of the third household (who went on and infected 1 of 4 of his household) | |
| Kong, 202040 | 16 patients | | Household or family gathering | | NR | 7 | | NR | | Not possible to determine the exact number of household and family contacts | |
| Gathering with friends | | NR | 3 | | NR | |
| Le, 202041 | 1 patient in contact w/ Wuhan | | Household | | 6 | 1 | | NR | | One grandmother living with husband and two children, infected neonate who stayed with them for few days, parents of the neonate not infected | |
| Li, 202044 | 1 patient changing trains at Wuhan station | | Family gatherings | | 2 | 2 | | NR | | One patient travelled via Wuhan station where he most likely was infected. He infected his two daughters, a son-in-law he was caring for in hospital and the neighbouring patient. The neighbouring patient infected | |
| Caring for family in hospital | | 1 | 1 | | 0 | |
| Neighbouring patient | | 1 | 1 | | 1 | |
| Li, 2020e47 | 1 patient | | Household | | 5 | 4 | | NR | | index patient travelled to his home where he infected 4/5 household members | |
| Li, 2020f48 | 105 patients | | Household | | 392 | 64 | | NR | | Other exposure routes not explored | |
| Liu, 202054 | Wife returning from Wuhan | | Household | | 1 | 1 | | 0 | |  | |
| Luo, 202060 | 1 patient returning from Wuhan | | Public bath | | NR | 8 | | NR | | Index patient showered in a public bath centre (already symptomatic w/ cough), patients who were infected visited the centre 1-6 days after the index patient. Authors suggest the survival of virus in hot, humid environments | |
| McMichael, 202061 | Not identified | | Residents in facility A | | Approx. 130 (118 tested) | 101 | | | | One care home resident found infected, had no travel history or contact w/ known COVID case. By the time COVID suspected, at least 45 staff and residents displayed symptoms. Not possible to determine the index case or who infected whom. | |
| Staff in facility A | | NR | 50 | | | |
| Visitors to facility A | | NR | 16 | | | |
| Ng, 202063 | 2 patients on a flight from Wuhan to Singapore | | Passengers on the flight | | 92 | 2 | | 0 | | Everyone wore masks, one tested positive and one inconclusive (tested +ve for one gene but not another), both on D3 | |
| Okada, 202065 | 2 patients on 2 flights from Wuhan | | Travel with the same tour group | | 34 | 0 | | n/a | | Index patients not symptomatic at the time of boarding, so no PPE used, flights approx. 4hrs | |
| Passengers on flight 2 rows before and after | | 30 | 0 | | n/a | |
| Crew members | | 18 | 0 | | n/a | |
| Airport health officer | | 2 | 0 | | n/a | |
| Park, 2020b70 | Not identified | | 11th floor employees | | 216 | 94 | | | | Outbreak in a call centre on 11th floor. Commercial/residential building. Commercial: floors 1-11 (call centre with outbreak 7-9 &11), residential floors 12-19. Most of the infected people from the 11th floor were on the same side of the building. 225 household contacts of 97 patients followed up, 34/225 +ve. Residents and employees had frequent contact in the lobby and elevators. | |
| Employees on other floors | | 706 | 3 | | | |
| Residents | | 201 | 0 | | | |
| Visitors | | 20 | 0 | | | |
| Phan, 202074 | 1 patient returning from Wuhan | | Family sharing hotel room | | 2 | 1 | | NR | | The family travels to four cities in Vietnam, close contacts were those on a plane, train and taxis | |
| Close contacts | | 28 | 0 | | n/a | |
| Pung, 202076 | A tour group from China | | Shop assistants | | 17 | 5 | | 3 | | At least 5/20 in the tour group symptomatic. Shop assistants reported assisting the tourists, 4/5 applying medicinal oil to their hands (30min visit), 1/5 assisting in a jewellery store (1hr visit). | |
| 17 conference attendees from China | | Conference attendees | | 94 | 7 | | 13 | | Internal conference for an international company: 17 attendees were from China and at least 1 from Wuhan – not possible to determine the index case. Close interactions with cases during dining, breakout sessions and team building activities (with physical contact). Other close contacts (e.g. hotel staff) monitored but did not develop symptoms | |
| Chinese couple from Wuhan attending church | | Attended the same church service | | 140 | 3 | | 0 | | Two +ve cases attended the service as the index couple, another +ve case attended the church later but sat in the seat occupied by one of the index cases | |
| Qian, 2020b77 | 2 infected in a temple | | Family gatherings | | 4 | 3 | | 3 | | Four cases exposed via family visit later had a family dinner with 3 relatives – all three subsequently infected | |
| Qiu, 202078 | 29 index cases | | household | | NR | 31 | | 5 | | Total of 24 clusters. Family gatherings: 2/4 infected family members later infected 2 of their household contacts. Work: infected the colleague who later infected 3 of his household members. Public transport: One of the passengers later transmitted the virus to his sister over dinner | |
| Family gatherings | | NR | 4 | | 2 | |
| Work | | NR | 1 | | 3 | |
| Public transport | | NR | 7 | | 1 | |
| Rothe, 202080 | Pre-symptomatic business partner from China | | Work | | NR | 2 | | 2 | | Pre-symptomatic index case infected two people, two other people had no contact with index, thus infected by the cases | |
| Schwierzeck, 202083 | 1 index patient | | Nosocomial | | NR | 47 | | | | 28 HCWs, 12 patients and 7 accompanying persons infected. Type of exposure was either cumulative 15-minutes face-to-face contact without usage of PPE (patients or their carers) or HCWs exposed during treatment or nursing in a distance of ≤ 2 meters, without PPE (HCWs) | |
| Scott, 202084 | 1 index, returned from Wuhan | | Sharing the car to/from work | | 5 | 0 | | n/a | | No cases infected despite close contact. Authors concluded it may have been due to mild symptoms (non-productive cough only) | |
| HCWs | | 3 | 0 | | n/a | |
| Household | | 2 | 0 | | n/a | |
| Intimate contact | | 1 | 0 | | n/a | |
| HCWs, medium risk exposure | | 5 | 0 | | n/a | |
| Song, 202086 | 4 index cases with direct or indirect contact with Wuhan | | Household | | 20 | 19 | | | | Not possible to determine if index cases infected others | |
| Wang, 2020f98 | 85 index patients | | Household | | 155 | 47 | |  | | 85 index patients distributed among 76 households | |
| Wei, 202099 | 6 index patients (6 clusters) | | Singing practice | | NR | 1 | | NR | | Six clusters, cluster A excluded from data extraction as already included in Pung, 2020. Household included three separate clusters, each with one index and one infected case. In the church cluster, infected cases sat one row behind the index patient | |
| Household | | NR | 3 | | NR | |
| Church service | | NR | 2 | | NR | |
| Gathering with friends | | NR | 1 | | NR | |
| Wei, 2020b100 | Two surgical patients | | Hospital environment | | NR | 14 some infected via contact with staff, not possible to determine | | | | Staff had either direct or indirect contact with patients, no staff wore PPE as patients were pre-symptomatic and not suspected COVID-19 +ve | |
| Wu, 2020c103 | Not determined | | Department store | | NR | 25 | | 15 | | There were 6 employees affected – not possible to determine whether there was only one index case between them. The areas where they worked were on the same floor and close to each other. There were further 19 cases of customers infected. These 25 further infected 15 cases | |
| Xia, 2020b107 | Index case with travel history to Wuhan | | Family gathering | | 15 | 7 | | 2 | | Multiple exposures for the family, having meals together, sometimes staying in the house, one case with whom index had dinner a few times infected 2 of her household members | |
| Friends gathering | | 60 | 0 | | 0 | |
| Xiao, 2020b109 | 2 index cases, infected at the gym | | Friends gathering | | NR | 3 | |  | | Two cases had multiple exposures at the gym (COVID cases were linked to the gym later), both had contact with one case, and the three of them travelled together to another city. On arrival, one index case had dinner with four friends, 2/4 were later found infected – 3hr exposure with possibilities for transmission via droplets and direct contact when touching each other’s hands. | |
| Yong, 2020116 | 2 index cases from Wuhan | | 1. Church A service | | NR | 5 (or 4) | | 0 (or 1) | | Five people infected. One case – not possible to determine whether infected from index cases or another infected person. One case responsible for outbreak 2 | |
| 2. Family gathering | | NR | 6 | | 1 | | One case responsible for infecting their family member and also for starting outbreak 3 | |
| 2. Church B service | | NR | 9 | | 7 | | Nine cases infected in the church who then infected another 7 cases | |
| Yu, 2020b118 | 2 family members travelled from Wuhan | | Family gatherings | | 2 | 2 | | n/a | | Two pre-symptomatic patients travelled from Wuhan and stayed with the family, | |
| Zhang, 2020b123 | Not identified | | Supermarket employees | | 120 | 11 | | 12 | | 8,437 people screened, 120 employees (full time and temporary), 8,224 customers and 93 close family contacts of the infected cases. | |
| Customers | | 8224 | 2 | | NR | |
| Zhang, 2020g128 | Index patient returning to China | | Household | | 2 | 1 | | n/a | | One woman returning from Singapore to China found +ve. All close contacts isolated. Passengers included those in the same row or up to 2 rows from patient. Flight attendant served the patient on a plane. Retrospective tracing revealed index had contact with COVID+ve cases in China before traveling to Singapore | |
| Passengers on a plane | | 5 | 0 | | n/a | |
| Flight attendant | | 1 | 0 | | n/a | |
| 5 Wuhan passengers | | Non-Wuhan passengers | | 220 | 1 | | n/a | | 110 Wuhan passengers travelled together as a part of a tour group to Singapore and Malaysia (10hr + 4 hr flights). 5 were found +ve and probable index cases. The non-Wuhan passenger sat next to infected case on a returning flight. | |
| Flight attendants | | 11 | 0 | | n/a | |
| Wuhan passengers | | 105 | 6 | | NR | |
| Jang, 2020162 | 6 Fitness instructors | | Fitness dance class | | 217 | 54 (24.8%) | | 34+10 | | A cluster of cases traced back to fitness instructor workshop (Latin dancing) where participants trained intensely for 4hrs. 8/27 (29.6%) subsequently tested +ve. 6 of these instructors were from one area where a total of 112 cases (identified by PCR, 30 asymptomatic at the time of confirmation) related to dancing classes were identified in 12 different facilities. Some instructors confirmed mild symptoms and teaching classes (50min 2x week) around 1 week after the workshop. Besides 54 infected attendees, there were also 9 household members and the follow up of close contacts of infected instructors and attendees identified further 34/814 cases (tertiary cases), and further 10/418 cases from them (quaternary cases). The remaining 7th instructor (from different area) might have been the index case. Authors concluded that large class sizes (5-22 participants), small rooms and the intensity of the exercise might have contributed towards the transmission. Authors also reported that smaller sized yoga/pilates classes were not associated with any transmission events, which they hypothesised was due to lower intensity of exercise (not known if any attendees or instructors were +ve) | |
| Qian, 2020163 | Not determined (n=318) | | Individuals involved in clusters of cases | |  | 1245 | | NR | | Description of 318 clusters (3 or more cases) from provinces other than Hubei in China, involving a total of 1245 cases up to 11 February 2020. Cases categorised into six infection venues: homes (reported in n=254 clusters), transport (n=108), restaurants (n=14), entertainment (n=7), shopping (n=7) and miscellaneous (n=26). Clusters also categorised into family members (n=129), relatives (n=133), socially connected (n=29) and not socially connected (n=24); there were only three involving multiple relationships. Not socially connected cases were least frequent (not possible to extract how many cases). Authors reported that most cases occurred in small outbreaks (3-5 cases) with only 5/318 (1.6%) involving more than 10 cases, and that the majority of clusters (80%) were within households. Also, the outbreaks occurred indoors with only one document outbreak documented outdoor. Authors note the close contact, fomites and the possibility of long range airborne particles as potential routes mentioned in literature but do not make any inferences on transmission routes in clusters they reported. | |
| Stein-Zamir, 2020164 | 2 students from different grades | | Students, staff and their contacts in one high school | | 1161 students  151 staff | 153 (13.2%) students  25 (16.6%) staff | | 87 | | Outbreak in high school 10 days after re-opening. 2 cases diagnosed a day apart from each other, but not epidemiologically linked, triggered testing of the entire school and the contacts. There was an extreme heatwave shortly after the return and students were exempt from wearing masks for 3 days. The two index cases attended school on the 3 days and were reported to be mildly symptomatic at that time, tested +ve approx. a week later. Investigation revealed that classrooms were overcrowded, and social distancing was not possible. Most cases 135/153 (88%) occurred in grades 7-9. Grades 7-9 and 10-12 are situated in separate wings of the building, teachers usually teach across different grades. Also reported that AC was running because of the heatwave. 87 additional cases linked to the school outbreak were observed in the community. | |
| Cabero Martinez, 2020165 | Not identified | HCWs in haematology unit | | 106 | | | 8 (7.5%) | | NR | | Authors report an outbreak where 8/106 (7.5%) HCWs and one patient were infected. Authors did not provide details of the index case, but the first identified case was a nursing assistant. Authors reported that two of the 8 HCWs (25%) acquired the virus from their colleagues. Additionally, all contacts of a patient who tested positive were isolated but none of them developed symptoms. |
| Eyre, 2020166 | Multiple index cases | HCWs in hospital | | 10,034 | | | 1,128 (11.2%) | | NR | | Authors reported the results of two screening policies which were available to the HCWs in a hospital: symptomatic screening which was available from the start and asymptomatic screening that was offered additionally starting from the middle of the first wave of pandemic. Pre-test questionnaire was obtained to identify risk factors for acquisition. A total of 1128/10,034 (11.2%) of asymptomatic staff tested PCR or serum +ve, which meant they acquired a virus at some point during the first wave of pandemic. Some of these staff were previously identified from symptomatic screening. Working in COVID-19 area was a risk factor OR (2.47 [1.99-3.08] p<0.001), although authors also reported that transmission still occurred in low COVID-19 areas and suggested that this was due to staff-staff transmission.  After adjusting for COVID-19 areas, exposure to a confirmed household contact was the biggest risk factor with 38.5% of staff who reported this exposure testing +ve (AOR 4.82 [3.45-6.73] p<0.001), exposure to suspected household contact with 16.1% of staff who reported this exposure testing +ve (AOR 1.75 [1.372.24] p<0.001, and contact with COVID-19 confirmed patients without PPE with 17.0% of staff who reported this exposure testing +ve (AOR 1.44 [1.24-1.67] p<0.001) |
| Hunter, 2020167 | Multiple index cases | HCWs in hospital | | 1654 | | | 240 (14.5%) | |  | | Authors reported the results of symptomatic screening offered to hospital staff as well as GPS and during the start of the first wave of pandemic in the UK (March, 10th-31st 2020, social distancing measures in the UK implemented March 20th). A total of 240/1654 (14.5%) symptomatic staff tested positive during this time. Authors reported no difference in positivity rate between the staff who were in patient facing roles (nurses, doctors, allied professionals, porters, 128/834, 15%) non-patient but high risk roles (laboratory and domestic staff, 14/86, 16%) and low risk roles (administrative, secretariat, IT, 20/109, 18%), which suggested that nosocomial transmission from patients to staff was not an important factor. Authors concluded that the transmission observed between the HCWs reflected the pattern of community rather than nosocomial spread and that the isolation protocols and PPE provided to staff were sufficient to protected them from potentially infectious patients. |
| Jeon, 2020168 | 13 index patients | HCWs exposed to undiagnosed index cases | | 184 | | | 0 | | NR | | Authors reported a total of 184 HCWs exposed to one of 13 index patients. Index patients were not confirmed as COVID-19 positive at the time of care. Interviewing patients, searching hospital records and CCTV were used to identify potential contacts who were categorised and managed according to the exposure risk. 58/184 (32%) of the staff in lower risk categories were not tested, but authors reported that none of the staff developed symptoms and that none of the tested staff tested positive after exposure. This included 13 of staff who were categorised as high risk exposure defined as direct physical or close contact with COVID-19 patient not wearing a face mask or performing AGP where PPE was not worn. |
| Kluytmans, 2020169 | Not reported | Symptomatic HCWs | | 1353 | | | 86 (6%) | | NR | | Authors describe a symptomatic screening programme implemented in two hospitals in March 2020 few days after the first case was identified in the Netherlands. A total of 86/1353 (6% of screened or 0.9% of all employees, n=9705) were found infected. All experienced relatively minor symptoms with only 2/86 requiring hospitalisation (no critical illness). Only 3/86 (3.5%) infected staff reported contact with COVID-19 patient and 21/86 (24%) had no patient contact during their work. 54/86 (63%) of staff reported working while being symptomatic, which was likely due to the case definition at that time which included travel to China or Italy – authors reported that only 3/86 (3.5%) met these criteria and only a half would have met the criteria even if travel history was not considered. Authors reported that the relatively high prevalence of positivity seen across more than 50 departments reflected a hidden community spread rather than acquisition from patients or other healthcare workers. |
| Lahner, 2020170 | Not reported | HCWs in hospital | | 2057 | | | 58 (2.7%) | |  | | Authors report data collected retrospectively in one Italian hospital which was a hub of COVID-19 disease during the first wave in Italy. All staff underwent PCR screening, all staff were also offered antibody testing later and approx. 50% volunteered to be tested. 58/2057 (2.7%) were positive. Only 29 (50%) of staff reported exposure to COVID-19 +ve patient for 26/58 (44.8%), no exposure was traced and for 3/58 (5.2%) exposure was outside work. Working on COVID-19 ward was still a significant factor for acquisition. |
| Lai, 2020171 | Not reported | HCWs in hospital | | NR | | | 110 | | NR | | Authors describe characteristics of HCWs of one Wuhan hospital who became infected with SARS-CoV-2 (n=110). PPE used was surgical masks, latex gloves and gowns in low risk areas; respirators, long-sleeved gowns, gloves, shoe convers in high risk areas. Of 110 cases, 17 (15.5%) worked in fever clinics/wards, 73 (66.4% ) worked in other departments and 20 (18.2%) did not interact with patients. From staff interviews, 65 (59.1%) attributed infection to contact with patients who were later diagnosed with COVID-19, 12 (10.9%) to contact with colleagues, 14 (12.7%) to contact with family or friends and 19 (17.3%) could not recall their exposure history. |
| Lee, 2020172 | 2 index patients with delayed diagnosis | HCWs exposed to undiagnosed patients | | 179 HCWs | | | 2 (1.1%) | | NR | | Authors report an outbreak early in the pandemic (mid-February) in one hospital in Korea. 14 cases were involved and 2 were HCWs. There were two index cases who at the time were not suspected to be infected with SARS-CoV-2. Two HCWs tested positive, which triggered an investigation. The remaining 10 cases were contacts of the two patients, none diagnosed in hospital. All staff and patients were PCR tested and 177 staff with contact with cases were isolated. There were no other positive cases. |
| Maltezou, 2020173 | Not reported | HCWs exposed to undiagnosed patients | | Total: 3398  Low: 1599  Moderate: 765  High: 1031 | | | 66 (1.9%)  46 (2.9%)  7 (1%)  13 (1.3%) | | NR | | Authors describe a series of HCWs with an occupational exposure to SARS-CoV-2 during the first wave and lockdown in Greece. Data taken from Hellenic National Public Health Organization; all healthcare organisations were obligated to report occupational exposure regardless of the risk level; all staff recommended to wear FFP2 for COVID suspected or confirmed patients and FFP3 for AGPs, patients with respiratory symptoms wore masks when entering hospital thus occupational exposure due to unsuspected/asymptomatic cases. Total 3398 HCWs were occupationally exposed (1725 exposures to patients and 1660 another HCW, 10 to visitor)  1599/3398 (47.1%) classified as low-risk, 765 (22.5%) as moderate-risk, and 1031 (30.4%) as high-risk exposures. Sixty-six (1.9%) developed COVID-19. In high risk exposure group (n=1031) patient was a risk source in 331 (32.1%) HCWs while remaining 700 were due to another staff (67.9%). |
| Murakami, 2021174 | Not reported | HCWs exposed to undiagnosed patients | | 138 | | | 7 (5.1%) | | NR | | Authors reported the results of PCR and LFT testing among healthcare workers, who come in close contact with patients in the emergency department, for approximately a month after the peak of the first wave. Of approx. 200 staff, 138 volunteered to participate. None tested PCR positive but there were 7 who seroconverted. History of risk factors taken from all HCWs showed no significant exposure risks between +e and -ve staff including number of contacts with cases in or outside work, wearing PPE or number of hours worked. Authors acknowledge that incidence of infection in HCWs was higher than in general population and that the occupational exposure is a risk. |
| Paltansing, 2021175 | Multiple index cases | HCWs in hospital | | 632 | | | 88 (13.9%) | | NR | | Authors describe transmission dynamics in one hospital early in the pandemic (3rd April-11th May). Besides implemented PPE, staff were not allowed to work in more than one location, social distancing was implemented in break rooms and staff were asked to isolate for at least 24hrs after symptom resolution. 88/632 (13.9%) mildly symptomatic HCWs and 215/5448 (3.9%) mildly symptomatic patients tested positive, all +ve HCWs were questioned about possible infection source, HCWs also divided into risk categories: direct patient contact, indirect patient contact, no patient contact. WGS was done on isolates from 30 HCWs and 20 patients, 4 clusters were identified, one of which involved 31 cases. Authors reported that the epidemiological and WGS analysis strongly suggested transmission occurring between the healthcare workers as well as from HCWs to patients. |
| Rivett, 2020176 | Multiple index cases | HCWs in hospital | | NR | | | NR | | NR | | Authors report two streams of entry into a screening programme: 1. HCW able to refer themselves or their household members if they were symptomatic, 2. Asymptomatic screening any HCW working in the area with a high occupational risk or working in the area caring for patients at high risk of developing severe infection (i.e. those who should be shielding), all testing was voluntary. Staff working in red/amber wards were more likely to test +ve than those from green wards. Authors reported one cluster of cases in a green ward with vulnerable population and suggested potential HCW-HCW or HCW-patient transmission. In red wards, where transmission was high authors suggested patient-HCW, HCW-HCW or community transmission. Lack of behavioural data prevent the authors to form more firm conclusions. |
| Roxby, 2020177 Roxby, 2020192 | Not identified | Contact with +ve residents | | 62 | | | 2 (3.2%) | | NR | | A small outbreak in the facility providing an independent and assisted living care. This was early in the pandemic before any preventative measures were implemented. The facility provides 83 apartments, and the residents move around independently, some need help with medication and daily tasks. Initially two residents tested positive which triggered testing for all staff and residents on March 10th and 7 days later (staff not retested, no exposure). 3/80 (3.8%) residents and 2/62 (3.2%) staff tested positive (1x dining room assistant and 1x health aid) in the first week. Another resident tested positive a week later. All residents asymptomatic except one who reported a mild cough which resolved before the test. Authors reported that the relative low transmission rate was due to residents requiring less contact with healthcare staff and more social distancing in this this type of facility comparing to a typical nursing home. Also, preventative measures introduced early after the first residents found positive: confined to their rooms, no communal meals, no visitors, exclusion of symptomatic staff. |
| Sikkema, 2020178 | Not identified, likely multiple introductions into the country | NR | | 96 | | | 1796 (5%) | | NR | | A total of 55HCWs from 9 different hospitals in the southern part of the Netherlands were positive for SARS-CoV-2 virus within 10 days following the day the first case occurred in the country. Screening of symptomatic HCWs, interviews and WGS conducted in 3/9 of these hospitals to determine transmission patterns. A total of 1796 of 12 022 (15%) of HCWs were screened of whom 96 (5% of the tested sample) were positive. 20/96 \*21%) reported no patient contact in their job. A total of 10 (10%) reported recent foreign travel, 60 (63%) reported carnival attendance with >50 people, 31 (32%) reported attendance at other event with <50 people. A total of 31 (32%) reported a close contact with known +ve case in the previous 14 days, only 3 (3%) reported contact with patient, other reported contacts with a colleague 18 (19%), household member 1 (1%) or other outside hospital 9 (9%). WGS obtained from 50/96 staff isolates and 10 patient isolates. These were grouped into three clusters with patients matching staff clusters and all clusters involving three hospitals. One cluster was linked to area where carnivals recently took place (+ves either attended carnivals or resided in the area) and another linked to travel to northern Italy (although not all +ve had a history of travel, suggesting local transmission to the community). No consistent link between HCWs or patients in any of the hospitals’ wards. Authors concluded that community rather than hospital transmission most likely contributed to a high prevalence of the virus in HCWs. |
| Treibel, 2020179 | NR | Investigating the risk of nosocomial transmission | | NR | | | 44 | | NR | | Reported results of COVIDsortium in one NHS trust re asymptomatic staff. Participants (self-declared fit to work) were screened and questionnaires were taken weekly unless ill, self-isolating, on holiday or redeployed. Data presented for five timepoints, with the first taken in a week of the national lockdown staring on 23rd March. 28 of 396 (7∙1%) of HCWs tested +ve in week 1, 14/284 (4∙9%) in week 2, 4/263 (1∙5%) in week 3, 4/267 (1∙5%) in week 4, 3/269 (1∙1%) in week 5. A total of 44 HCWs +ve, some of whom tested +ve more than once, approx. 12 (27%) reported no symptoms a week before and after the test. Authors reported that 50 HCWs self-isolated with symptoms during this time – not tested thus not possible to know how many were +ve. Data mirrored the curve observed for number of +ve cases in London area and number of COVID-19 inpatients in the trust around this time. Authors concluded that relatively low number of asymptomatic and symptomatic HCWs, despite continuing presence of COVID-19 patients in hospital, suggests the trend represented community rather than hospital transmission to HCWs. |
| Villanueva, 2020180 | One cluster: one doctor, another cluster: housemate, no index identified for other cases | After contact with COVID-19 cases | | 97 | | | 8 (8.2%) | | At least 2 in one cluster | | Reactive (close contact or high exposure to the virus) or symptomatic screening with PCR at the start of the pandemic. A total 324 testes were performed from a total of 1213 staff (number of staff screened not reported). 97/324 (30%) were categorised as moderate (close or prolonged contact with one, either patient or HCW, not wearing a mask) or high (close or prolonged unprotected contact, or in room with AGP) risk. The rest were low risk (close or prolonged exposure, both wearing masks). A total of 8/97 (8.2%) were positive: 4x nurses, 3x lab technicians and 1x doctor of which only one was caring for patients on COVID-19 ward, classified as low risk exposure. There was a small cluster of one doctor and two nurses who worked together as a TB team, it is not possible to determine how the doctor got infected but he subsequently infected the two nurses on his team either at work or in the apartment which they shared during the community quarantine and 17d later another one of his team tested +ve. Another cluster was the lab technicians who were working together in HIV clinic and were exposed to an infected housemate. Transmission may have been low due to appropriate PPE and other measures implemented, but highlights that HCW exposure not necessarily due to patients |
| Wee, 2020181 | Not determined | Assessing community and nosocomial exposure | | 72 | | | 14 | | NR | | Authors report the results of 16-week staff surveillance where all HCWs were to report symptoms to staff clinic and where investigations were undertaken to prevent outbreaks and clusters. Over the study period 2250/9322 (24%) of staff presented to the staff clinic with symptoms and 14/2250 (0.6% of symptomatic or 0.2% total staff) were +ve. There were a total of 130 HCWs who came in contact with these infected cases, 72 of whom were high risk unprotected contact requiring quarantine. 10/14 workers did not have patient contact and were exposed in the community. 4/72 (5.6%) infected from another HCW: one from a family member (no contact at work), two in a shared accommodation (no contact at work), the remaining cases was HCW infected in the office by another HCW |
| Wong, 2020182 | Undiagnosed index patient | In close, unprotected contact with index patient | | 71 7 close contact | | | 0 | | - | | Investigation following the diagnosis of one unrecognised COVID-19 patient who was nursed in an open-ward cubicle. Contact tracing identified 71 staff and 49 patients. 7/71 staff were close contact (<2m contact of 15min or more or AGPs without N95 respirator, face shield/ goggles, gown and gloves), 10/49 patients stayed on a ward for 35 hours during which time index patient was on 8L/min oxygen therapy. Close contacts quarantined, casual contacts under surveillance for 28d. No secondary cases occurred up to 37d later. Authors concluded that surgical masks and hand/environmental hygiene sufficient to prevent transmission. |
| Wang, 2020183 | 2 index patients, possibly others | Close unprotected contact with patients or HCWs | | NR | | | 27 | | NR | | This was an initial stage of the outbreak in Wuhan when COVID-19 pneumonia was still unknown. Investigation was conducted following two unidentified index patients cared without PPE. 12 confirmed and 2 suspected HCWs developed COVID-19 – these were either direct contacts with patients or exposed to infected HCWs. 13 further cases identified in other departments possibly linked to other index patients. Exposure history for 25 confirmed HCWs: 7 (28%) from patients, 3 (12%) from suspected patients, 3 (12%) from HCWs, 4 (16%) from Gala and meetings, 8 (32%) not known. |
| Arons, 2020184 Kimball, 2020186 | Presumed 1 index HCW | Nursing home residents | | 89 | | | 57 (64%) | | NR | | Outbreak reported in two separate articles, one published earlier and slightly less comprehensive. Outbreak in a nursing home at the start of the pandemic. A healthcare worker tested positive, reported working while symptomatic a few days before testing, first symptomatic resident (same unit as HCW) 2 days later. Six days after HCW confirmed, 7 residents tested positive. At follow-up, a week later, a total of 76 residents were tested for SARS-CoV-2 23 +ve of whom 13/23 asymptomatic at the time of testing. Further two were in hospital with COVID-19 compatible symptoms. Further testing revealed more cases. A total of 57/89 (64%) were infected: confirmed either in one of the screening sessions or by clinical or post-mortem examination. of 138 staff, 55 developed symptoms, 51 were tested, 26 were positive. Of 26 +ve staff, 17 were nursing staff and 9 worked on multiple units (therapists etc), asymptomatic staff not tested. Two clusters identified but with one nucleotide difference hence one introduction to the facility. |
| Nursing home staff | | 138 | | | 26 (18.8%) | |  | |
| Graham, 2020185 | Not determined | Nursing home residents | | 313 | | | 131 (41.8%) | | NR | | Outbreaks in four nursing homes in London, first occurring Mid-March 2020. Since it was at the start, PCR confirmation was difficult to obtain until approx. 1 month later. A total of 394 residents were included in the investigation. Authors reported that mortality between 1st March and 1 May was 26% with a peak in first week of April. Trend similar across all four care homes. 103 residents died, 99 had death certificates examined and 53/103 (51%) were either COVID-19 confirmed or suspected, for remaining 46 the death occurred earlier in outbreak and some cases might have been unconfirmed, 12/46 were due to pneumonia. The remaining 4: death certificate not available but all 4 tested +ve. When testing widely available: 313 residents tested, 126 (4.2%) +ve, further 5 (1.6%) +ve a week later. WGS showed different clusters across all homes suggesting multiple introductions into each facility. |
| Ng, 2020187 | Patient with respiratory distress, COVID-19 not suspected | Healthcare workers | | 41 | | | 0 | | NR | | A patient not suspected of COVID-19 was admitted to hospital and was nursed for four days without protection, numerous AGPs performed. Patient tested +ve on a day of extubation. A total of 41 HCWs were exposed to AGP without protection for at least 10 min with <2m distance. Respirators not worn for AGPs. All exposed HCWs isolated and surveyed for symptoms 2x/day, also received PCR test 1-5 days and 14 days after the exposure. None developed symptoms and all tests -ve. |
| Lessels, 2020188 | Suspected index patient in A&E | Healthcare workers | | 1711 | | | 80 (4.7%) | | NR | | Outbreak investigation which started following an identification of a number of COVID-19 cases and 3 associated deaths. Investigation included a review medical records, ward visits, interviews and WGS. Total of 119 cases confirmed, 39 patients and 80 staff. Suspected a single introduction (phylogenetic analysis) from an index patient in A&E who infected another patient. The second patient admitted to ICU, infection spread quickly across five wards facilitated by frequent patient transfers. Suspected that outbreak also involved a neighbouring nursing home and an outpatient dialysis unit (total 135 cases if including these two facilities). Authors suggest indirect contact and fomites as a possible mode of spread, they also acknowledged that the size of the outbreak could have been reduced if the opportunities for recognising some cases were not missed. As a result they suggested strict IPC measures and highlighted that PPE by itself was not sufficient. 1711 staff tested (approx. 86% of the total) and 80 were +ve (4.7%). 2/39 cases possibly not a part of an outbreak but isolated cases. Investigation focused on transmission to patients, concluded that most likely occurred from patient to patient via HCWs, however they mention multiple exposures to patients and HCWs, the fact that some HCWs had no contact with patients and thew possibility of transmission in the community. Authors also report that a rushed intubation of one undiagnosed case involving several HCWs did not result in infection (no symptom and tested -ve) – concluded that current PPE appropriate and that hand and environmental hygiene may have been more important. Also mention importance of social distancing and contact tracing. |
| Baker, 2020189 | Undiagnosed index patient | Healthcare workers | | 43 | | | 2 | | NR | | One patient hospitalised for 13 days before suspected and diagnosed. Contact and droplet precautions introduced on D13 when patient developed respiratory failure, tested and found +ve on that day. Mild, atypical symptoms missed at admission. 44 HCWs exposed – defined as at least 10 min contact <2m, patient not wearing mask, HCWs not wearing masks for first 7 days and universal masking implemented due to raising COVID-19 concerns in the country. Of 44 HCWs, 8 developed symptoms, 3x tested +ve although one was considered a household contact. 2/43 (4.7%) likely infected from index case, both considered to have a prolonged, face-to face contact without PPE. One HCW bathed patient daily, mostly unmasked face to face contact. Another examined the patient daily (approx. half of the time was masked) and placed NG tube unmasked. |
| Dora, 2020190 | Index resident | Residents | | 99 | | | 19 (19%) | | NR | | Two residents in skilled nursing facility tested +ve at the end of March. Investigation involved resident and staff testing for approx. 1x weekly for a month following the first two cases. Involved two buildings with no shared areas but authors reported that contact with outside persons when receiving care possible (e.g. via dialysis). Three weeks before the first cases occurred, symptom and exposure surveillance for staff and visitors started; two weeks before first cases, admissions suspended, residents screened for respiratory symptoms and placed on droplet and contact precautions if symptomatic. 119/99 residents found +ve in a course of 1 month, 8/136 +ve staff of whom 4 were symptomatic. No explanation how HCWs or residents were infected, not possible to determine how index case became infected |
| Healthcare workers | | 136 | | | 8 (6%) | | NR | |
| Patel, 2020191 | Index resident | Residents | | 127 | | | 35 (27.6%) | | NR | | Outbreak in a skilled nursing facility providing short- and long-term rehabilitation and hospice care. Index case developed symptoms and was nursed in the facility until D3 when she was transferred to hospital with hypoxia and subsequently tested positive on D5. Inquiry in the facility started on D5 to investigate and contain a potential outbreak. PCR test offered to all residents in the facility and 70 staff working on the unit where index case resided. A total of 33/127 (26%) residents tested +ve, 8/127 were symptomatic and tested elsewhere with 6/8 being positive. Remaining 119 tested as part of outbreak investigation 27 +ve and further 2 +ve at follow-up. 70 staff offered testing (of approx. 120 staff, 58%), 42 volunteered and 19 (45%) were +ve which was approx. 16% of the entire workforce. 11/19 cases were symptomatic. Did not explore how cases were infected but hypothesised that HCWs likely a vector for transmission in these settings and that part-time workers working in more than facility may be responsible for the spread between the facilities. |
| Healthcare workers | | 42 | | | 19 (45%) | | NR | |
| Asad, 2020193 | Index patient, most likely infected by HCW | Healthcare workers | | NR | | | 23 | | NR | | Cluster of cases in a hospital. Investigation undertaken to determine the route and source of transmission. A patient became symptomatic and subsequently tested positive shortly after discharge from ICU to medical ward. Likely infected from symptomatic or asymptomatic HCW in ICU although authors said patient-to-patient transmission from unknown case also possible. Patient nursed on a ward for 41d before developing symptoms and hospital visitations stopped and UK was in a national lockdown. Follow up identified symptomatic 23 staff and 5 patients infected on a medical ward, reported 17 ICU staff self-isolating around this time likely that index case infected by one of them. Of 23 symptomatic staff 16 were +ve, 3 were -ve (likely false negative as symptoms compatible) and 4 were not tested. 7/23 were in direct contact with index patient others had contact with symptomatic and pre-symptomatic staff and patients. Authors concluded that transmission propagated by staff as close contact between staff was common. |
| Taylor, 2020194 | Not identified | Residents | | 259 | | | 165 (64%) | | NR | | Due to ongoing concerns and to prevent possible outbreaks, staff and residents in skilled nursing facilities were screened weekly. Authors report the results of the screening for the period of April-July. Continued transmission attributed to lapses in infection control, delays in reporting test results to staff and incomplete staff participation in testing (71%, n=480). 73/114 (64%) of staff were involved in direct care with residents, others had limited or no direct contact. WGS (sequenced 25 specimens from facility A and 80 from facility B) showed two unrelated clusters in each facility. In first facility 22/25 specimens were nearly identical and three cases (2x HCWs and 1x resident) were unrelated. In facility B 80/80 were nearly identical. Two genetically distinct specimens in HCWs in facility A highlight the community acquired infections in HCWs. Transmission between the HCWs also likely CWs and 1x residentas some staff had no patient contact. |
| Healthcare workers | | 341 | | | 114 (33%) | | NR | |
| Sun, 2020c195 | Multiple cases, no reported | Healthcare workers | | NR | | | 32 | | NR | | Retrospective review of 32 nurses infected with SARS-CoV-2 in Wuhan. 21/32 (65.6%) were nosocomial infections, 5/32 (15.6%) were community and 6/32 (18.8%) were unknown but 4 of whom had no direct contact with COVID-19 patients. |

\* Defined as those with no exposure to index case, infected from the person infected by index case

Household – living at the same property, family gathering – meeting with other family members, e.g. family meals (in or out), family visits, traveling together

## Appendix 7: Excluded studies table

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| **Citation** | **reason** |
| Abduljalil J.M., Abduljalil B.M. Epidemiology, genome, and clinical features of the pandemic SARS-CoV-2: a recent view. New Microbes New Infect, 2020; 35:no pagination | no primary data |
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| Chen P., Zhang Y., Wen Y. et al. Epidemiological and clinical characteristics of 136 cases of COVID-19 in main district of Chongqing. J Formos Med Assoc, 2020; 119(7):1180-1184 | no data on transmission |
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| Wilson M.E., Chen L.H. Travellers give wings to novel coronavirus (2019-nCoV). J Travel Med, 2020; 27(2):taaa015 | no primary data |
| Wilson N.M., Norton A., Young F.P. et al. Airborne transmission of severe acute respiratory syndrome coronavirus-2 to healthcare workers: a narrative review. Anaesthesia, 2020; 75(8):1086-1095 | no primary data |
| Wolfel R., Corman V.M., Guggemos W. et al. Virological assessment of hospitalized patients with COVID-2019. Nature, 2020; 581(7809):465-469 | no primary data |
| Wong D.H.T., Mak S.T., Yip N.K.F. et al. Protective shields for ophthalmic equipment to minimise droplet transmission of COVID-19. Graefes Arch Clin Exp Ophthalmol, 2020; 258(7):1571-1573 | no primary data |
| Wong S.C.-Y., Kwong R.T.-S., Wu T.C. et al. Risk of nosocomial transmission of coronavirus disease 2019: an experience in a general ward setting in Hong Kong. J Hosp Infect, 2020; 105(2): 119–127 | no data on transmission |
| Wu Y.C., Chen C.S., Chan Y.J. Overview of The 2019 Novel Coronavirus (2019-nCoV): The Pathogen of Severe Specific Contagious Pneumonia (SSCP). J Chin Med Assoc, 2020; 83(3):217-220 | no primary data |
| Wu, F., Xiao, A., Zhang, J. et al. SARS-CoV-2 titers in wastewater are higher than expected from clinically confirmed cases. medRxiv preprint, 2020 | no data on transmission |
| Xia J., Liao C., Li Y. et al. Transmission of corona virus disease 2019 during the incubation period may lead to a quarantine loophole. medRxiv preprint, 2020 | no data on transmission |
| Xu R., Cui B., Duan X. et al. Saliva: potential diagnostic value and transmission of 2019-nCoV. Int J Oral Sci, 2020; 12(1):11 | no primary data |
| Xu T., Zhu Z., Cui M. et al. Clinical features and dynamics of viral load in imported and non-imported patients with COVID-19. Int J Infect Dis, 2020; 94:68-71 | no data on transmission |
| Yang C. Does hand hygiene reduce SARS-CoV-2 transmission? Graefes Arch Clin Exp Ophthalmol, 2020; 258(5):1133-1134 | no primary data |
| Yang C., Ma Q.Y., Zheng Y.H. et al. Transmission routes of 2019-novel coronavirus (2019-nCoV). CJPM, 2020; 54(4):374-377 | no primary data |
| Yang C.H., Jung H. Topological dynamics of the 2015 South Korea MERS-CoV spread-on-contact networks. Sci Rep, 2020; 10(1):4327 | not COVID-19 |
| Yang H.Y., Duan G.C. Analysis on the epidemic factors for the Corona Virus Disease. CJPM, 2020; 54(0):E021 | no primary data |
| Yang H.Y., Xu J., Li Y. et al. The preliminary analysis on the characteristics of the cluster for the Corona Virus Disease. Chin J Epidemiol, 2020; 10;41(5):623-628 | no primary data |
| Yang R., Gui X., Xiong Y. Patients with respiratory symptoms are at greater risk of COVID-19 transmission. Respir Med, 2020; 165:105935 | no data on transmission |
| Yang Y., Soh H.Y., Cai Z.G. et al. Experience of Diagnosing and Managing Patients in Oral Maxillofacial Surgery during the Prevention and Control Period of the New Coronavirus Pneumonia. Chin J Dent Res, 2020; 23(1):57-62 | no data on transmission |
| Yang Z., Wang M., Zhu Z. et al. Coronavirus disease 2019 (COVID-19) and pregnancy: a systematic review. J Matern Fetal Neonatal Med, 2020; 1-4 | no primary data |
| Yao M., Zhang L., Ma J. et al. On airborne transmission and control of SARS-Cov-2. Sci Total Environ, 2020; 731:139178 | no primary data |
| Yao Y., Tian Y., Zhou J. et al. Epidemiological characteristics of SARS-CoV-2 infections in Shaanxi, China by 8 February 2020. Eur Respir J, 2020; 55(4): no pagination | no data on transmission |
| Ye F., Xu S., Rong Z. et al. Delivery of infection from asymptomatic carriers of COVID-19 in a familial cluster. Int J Infect Dis, 2020; 94:133-138 | no data on transmission |
| Ye Q., Wang B., Mao J. et al. Epidemiological analysis of COVID-19 and practical experience from China. J Med Virol, 2020; 10.1002 | no primary data |
| Yen M.-Y., Schwartz J., Chen S.-Y. et al. Interrupting COVID-19 transmission by implementing enhanced traffic control bundling: Implications for global prevention and control efforts. J Microbiol Immunol Infect, 2020; 53(3):377–380 | no primary data |
| Yen M.Y., Schwartz J., King C.C. et al. Recommendations for protecting against and mitigating the COVID-19 pandemic in long-term care facilities. J Microbiol Immunol Infect, 2020; 53(3):447-453 | no primary data |
| Yeo C., Kaushal S., Yeo D. Enteric involvement of coronaviruses: is faecal-oral transmission of SARS-CoV-2 possible? Lancet Gastroenterol Hepatol, 2020; 5(4):335-337 | no primary data |
| Yin S., Peng Y., Ren Y. et al. The implications of preliminary screening and diagnosis: Clinical characteristics of 33 mild patients with SARS-CoV-2 infection in Hunan, China. J Clin Virol, 2020; 128:104397 | no data on transmission |
| Yoo J.H., Hong S.T. The outbreak cases with the novel coronavirus suggest upgraded quarantine and isolation in Korea. J Korean Med Sci, 2020; 35(5):e62 | no data on transmission |
| Yu G.Y., Lou Z., Zhang W. Several suggestion of operation for colorectal cancer under the outbreak of Corona Virus Disease 19 in China. Chin J Gastrointest Surg, 2020; 23(3):9-11 | no primary data |
| Yu X., Sun S., Shi Y. et al. SARS-CoV-2 viral load in sputum correlates with risk of COVID-19 progression. Crit Care, 2020; 24(1):170 | no data on transmission |
| Yu Y.X., Sun L., Yao K. et al. Consideration and prevention for the aerosol transmission of 2019 novel coronavirus. Chin J Ophthalmol, 2020; 56:E008 | no primary data |
| Zaigham M., Andersson O. Maternal and perinatal outcomes with COVID-19: A systematic review of 108 pregnancies. Acta Obstet Gynecol Scand, 2020; 99(7):823-829 | no primary data |
| Zeng L.K., Tao X.W., Yuan W.H. et al. First case of neonate infected with novel coronavirus pneumonia in China. Chin J Pediater, 2020; 58:E009 . | no data on transmission |
| Zhang H. Early lessons from the frontline of the 2019-nCoV outbreak. Lancet, 2020; 395(10225):687 | no primary data |
| Zhang J., Tian S., Lou J. et al. Familial cluster of COVID-19 infection from an asymptomatic. Crit Care, 2020; 24(1):119 | no data on transmission |
| Zhang J.-F., Yan K., Ye H.-H. et al. SARS-CoV-2 turned positive in a discharged patient with COVID-19 arouses concern regarding the present standard for discharge. Int J Infect Dis, 2020; 97:212-214 | no data on transmission |
| Zhang M.-Z. New coronavirus pneumonia COVID-19 and ocular surface transmission. Int Eye Sci, 2020; 20(3)401-403 | no primary data |
| Zhang Z., Zhang L., Wang Y. COVID-19 indirect contact transmission through the oral mucosa must not be ignored. J Oral Pathol Med, 2020; 49(5):450-451 | no primary data |
| Zhang R., Li Y., Zhang A.L. et al. Identifying airborne transmission as the dominant route for the spread of COVID-19,” by Renyi Zhang, Yixin. Proc Natl Acad Sc. U.S.A, 2020; 117, 14857–14863 | major flaws in data collection & analysis |
| Zhao C., Viana A. Jr., Wang Y. et al. Otolaryngology during COVID-19: Preventive care and precautionary measures. Am J Otolaryngol, 2020; 102508 | no primary data |
| Zhao S., Ling K., Yan H. et al. Anesthetic Management of Patients with COVID 19 Infections during Emergency Procedures. J Cardiothorac Vasc Anesth, 2020; 34(5):1125-1131 | no data on transmission |
| Zhao Z., Li X., Liu F. et al. Prediction of the COVID-19 spread in African countries and implications for prevention and control: A case study in South Africa, Egypt, Algeria, Nigeria, Senegal and Kenya. Sci Total Environ, 2020; 729:138959 | no primary data |
| Zheng Y., Xiong C., Liu Y. et al. Epidemiological and clinical characteristics analysis of COVID-19 in the surrounding areas of Wuhan, Hubei Province in 2020. Pharmacol Res, 2020; 157:104821 | no data on transmission |
| Zimmermann M., Nkenke E. Approaches to the management of patients in oral and maxillofacial surgery during COVID-19 pandemic. J Craniomaxillofac Surg, 2020; 48(5):521-526 | no primary data |
| Zimmermann P., Curtis N. Coronavirus infections in children including COVID-19: An overview of the epidemiology, clinical features, diagnosis, treatment and prevention options in children. Pediatr Infect Dis J, 2020; 39(5):355-368 | no primary data |

## Appendix 8: GRADE table

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Outcome** | **Type of outcome** | **No of studies** | **No of participants/ samples** | **Quality of studies** | **Overall classification of evidence** | **Overall effect** | **Overall decision for likelihood of transmission** |
| **Airborne vs droplet transmission** | | | | | | | |
| Epidemiological evidence for airborne vs droplet transmission of SARS-CoV-2 | Primary outcome | 11 | 60,30,155 90,51,59 ~340,82 27,142 256,143 79,147 183,149 132,157 299158 | Low qualityi | Inconsistent | 5 of 11 studies concluded that the evidence supported airborne transmission51,143,147,155,158  3 of 11 studies concluded that evidence supported droplet route59,82,157  2 of 11 studies concluded that it was either droplet or airborne but were not able to confirm or exclude one or the other30,149 and one of 11 studies concluding that it was likely a mixture of both.142 | Droplet: probable  Airborne: possible (in some circumstances, especially AGPs) |
| Presence of SARS-CoV-2 in air | Secondary (surrogate) outcome | 14 | No of samples: 4,174,26 56,29 NR,81 31,134 8,141 46,144 15,145 4,150 NR,152 26,153,154 6,159 44,160 44161  No of rooms:  3,18 3,66 | Not assessedii | Inconsistent | 8 of 14 studies found presence of viral RNA in air samples.  2 of 2 studies found presence of viral RNA in rooms. |  |
| Presence of viable SARS-CoV-2 in air | Secondary (surrogate) outcome | 3 | NR,81 31,134 4150 | Not assessedii | Weak | 1 of 3 studies found presence of viral RNA in air samples. |  |
| Presence of SARS-CoV-2 in air vents/ exhausts/ ducts/ filters | Secondary (surrogate) outcome | 3 | 18,143 47,156 6159 | Not assessedii | Weak | 3 of 3 studies found presence of viral RNA in air vents/ exhausts/ ducts/ filters,  1 of 3 attempted to measure viability but results were inconclusive |  |
| Presence of SARS-CoV-2 in exhaled breath | Secondary (surrogate) outcome | 3 | Exhaled breath condensate:  2,144 52,153,154 9161  Expired air:  2144 | Not assessedii | Weak | 2 of 3 studies found presence of viral RNA in exhaled breath condensate,  0 of 1 studies found presence of viral RNA in exhaled breath |  |
| Duration of viable SARS-CoV-2 in air | Secondary (surrogate) outcome | 2 | NR,92 NR146 | Not assessedii | Weak | 2 of 2 studies found evidence that virus can survive in air for up to 392 and 16146 hrs |  |
| SARS-CoV-2 load in the air | Secondary (surrogate) outcome | 4 | 4,15 3,18 35,64 14134 | Not assessedii | Inconsistent | 3 of 4 studies found evidence of viral RNA with up to 1000 copies/m3 |  |
| **Fomite transmission** | | | | | | | |
| Epidemiological evidence for transmission of SARS-CoV-2 via fomites | Primary outcome | 2 | NR,8 6030 | Low qualityi | Weak | 2 of 2 studies provide some evidence for transmission via fomites | Possible |
| Presence of SARS-CoV-2 on surfaces | Secondary (surrogate) outcome | 7 | Contaminated surfaces: 238,29 25,66 NR,81 36,93 218134  Contaminated PPE: 10,66 90,67 993  Contaminated rooms: 3018  Viral load: 217 | Not assessedii | Moderateiii | 4 of 5 studies found evidence of viral RNA on surfaces, one study showed no results but also reported frequent cleaning  1 of 3 studies found evidence of viral RNA on PPE. Only 1/109 samples contaminated with virus  1 of 1 studies found evidence of viral RNA in rooms  1 of 1 studies found evidence of viral RNA 6.5x102/ml once and 0 next time |
| Presence of viable SARS-CoV-2 on surfaces | Secondary (surrogate) outcome | 1 | 114134 | Not assessedii | Weak | 1 of 1 studies found no evidence of viable virus on surfaces |
| Survival of viable SARS-CoV-2 on surfaces | Secondary (surrogate) outcome | 2 | NR,19 NR92 | Not assessedii | Weak | 2 of 2 studies found evidence that virus can survive on different surfaces. The time of survival depends on type of surface |
| Epidemiological evidence for vertical transmission of SARS-CoV-2 | Primary outcome | 32 | Total 3682,7,9,11,12,19,21,  28,32,36,39,43,49,51,52,53,55,  68,70,72,91,94,110-112,114,116-118,121,130,136 | Low qualityi | Moderateiii | 8/30 studies found 12/368 babies infected. However, except in one study, these studies did not test for COVID-19 at birth, so there is a high risk that transmission occurred peripartum. One study provided evidence that vertical transmission was plausible |  |
| Evidence for presence of SARS-CoV-2 RNA in maternal/neonatal tissues and products of conception | Secondary (surrogate) outcome | 14 | Total 467 for cord blood22,39,51,70,91,94, 110,112,114  Total 45 for amniotic fluid7,22,32, 39,51,94,110,112,118,136  Total 20 for placenta12,22,68,70,94, 114,118,136  Total 1 for serum70  Total 10 for breast milk7,22,28,70  Total 8 for vaginal secretions22,110 | Low qualityi | Moderateiii | 2 of 13 studies found evidence for virus presence in these tissues. One study found 3 placentas with viral RNA but also reported that contamination could have occurred during delivery. One study reported viral RNA found in amniotic fluid prior to the rupture of the membranes and in placenta which appeared to be damaged as a result of infection |
| **Transmission from body fluids** | | | | | | | |
| Epidemiological evidence for transmission of SARS-CoV-2 from faecal matter | Primary outcome | 1 | 221148 | Low qualityi | Weak | 1 of 1 studies provided evidence of interpersonal transmission via faecal aerosols | Unlikely |
| Evidence of presence of SARS-CoV-2 RNA in faecal matter | Secondary (surrogate) outcome | 32 | No of individuals with positive anal swabs: total 7221,25,  36,45,72,88,112,126  No of positive anal swabs: 120101  No of individuals with positive stool: total 43915,31,38,50,53,  68,69,89-91,95,104,108,111,  121,125,130,131  No of positive stool samples: total 39796,101,129  No of positive sewage samples: total 654,62,93,105 | All studies low qualityi except,4,62,93,105 which were not assessedii | Moderateiii | 31 of 32 studies found evidence of virus in anal swabs, stools or sewage. One study which did not find evidence of this was conducted on stool samples of two patients. |
| Evidence of presence of viable SARS-CoV-2 virus in faecal matter | Secondary (surrogate) outcome | 4 | No of stool samples with viable virus: total 596,129  No of sewage samples with viable virus: total 64,93 | Low qualityi, 96,129  not assessedii 4,93 | Weak | 2 of 2 studies found evidence of viable virus in stool  0 of 2 studies found evidence of viable virus in sewage |
| Epidemiological evidence for transmission of SARS-CoV-2 from urine | Primary outcome | 0 | n/a | n/a | No evidence | No evidence | Unlikely |
| Evidence of presence of SARS-CoV-2 RNA in urine | Secondary (surrogate) outcome | 11 | No of individuals with positive urine sample: total 15031,  38,53,68,72,91,130,131,135  No of positive samples: total 8215,96 | Low qualityi | Moderateiii | 5 of 9 studies found evidence of viral RNA in urine of 8/150 individuals  0 of 2 studies found evidence of viral RNA in urine samples (0/82) |
| Evidence of presence of viable SARS-CoV-2 virus in urine | Secondary (surrogate) outcome | 1 | 1135 | Low qualityi | Weak | 1 of 1 studies found evidence for viable virus in one individual |
| Epidemiological evidence for transmission of SARS-CoV-2 via ocular surface | Primary outcome | 2 | 2,49 1127 | Low qualityi | Weak | 2 of 2 studies found evidence for transmission via ocular surface in 3/3 individuals | Possible |
| Epidemiological evidence for transmission of SARS-CoV-2 from ocular secretions | Primary outcome | 0 | n/a | n/a | No evidence | No evidence | Unlikely |
| Evidence of presence of SARS-CoV-2 RNA in ocular secretions | Secondary (surrogate) outcome | 9 | No of individuals with positive tear samples: total 5082, 110  No of individuals with positive ocular discharge samples: 72127  No of individuals with positive conjunctival swab samples: total 19411,87,102,106,132  No of individuals with positive ocular swabs: total 120 | Low qualityi | Moderateiii | 1 of 2 studies found evidence for viral RNA in tears of 2/50 individuals  1 of 1 studies found evidence for viral RNA in ocular discharge of 1/72 individuals  5 of 5 studies found evidence for viral RNA in tears of 8/194 individuals  1 of 1 studies found evidence for viral RNA in tears of 1/1 individuals |
| Evidence of presence of viable SARS-CoV-2 virus in ocular secretions | Secondary (surrogate) outcome | 0 | n/a | n/a | No evidence | No evidence |
| Epidemiological evidence for transmission of SARS-CoV-2 from sexual body fluids | Primary outcome | 0 | n/a | n/a | No evidence | No evidence | Unlikely |
| Evidence of presence of SARS-CoV-2 RNA in sexual body fluids | Secondary (surrogate) outcome | 3 | Semen: 3844  Vaginal fluid: 3521  Vaginal swab: 1079 | Low qualityi | Weak | 1 of 1 studies found evidence for viral RNA in semen of 6/38 of men  0 of 2 studies found evidence for viral RNA in vaginal fluid or swabs of 45 women |
| Evidence of presence of viable SARS-CoV-2 virus in sexual body fluids | Secondary (surrogate) outcome | 0 | n/a | n/a | No evidence | No evidence |
| **Blood transfusion and organ transplant** | | | | | | | |
| Epidemiological evidence for transmission of SARS-CoV-2 via blood transfusion | Primary outcome | 4 | 0/5 persons infected137-140 | Low quality | Weak | No evidence of transmisison |  |
| Epidemiological evidence for transmission of SARS-CoV-2 via organ donation | Primary outcome | 0 | n/a | n/a | No evidence | No evidence |  |
| **Transmission dynamics** | | | | | | | |
| Epidemiological evidence of SARS-CoV-2 transmission occurring within households | Secondary (surrogate) outcome | 18 | 11197,16,27,28,31,34,37,41,  47,48,52,78,84,86,98,99,128, 163 | Low qualityi | Moderateiii | Evidence shows that transmission usually occurs with close contact, although distance and duration has not been established.  Transmission in healthcare settings is low and is usually due to no or inappropriate wear of PPE.  Transmission in care homes high.  Transmission patterns suggest that most cases occur in socially connected cases, indoor environments, when social distancing was not possible and when face covering was either not implemented or not observed. Activities resulting in higher tidal volume (e.g. exercise, singing) increase the risk of transmission. | Suggest close contact transmission |
| Epidemiological evidence of SARS-CoV-2 transmission occurring between family and friends | Secondary (surrogate) outcome | 15 | 1796,16,23,27,33,34,40,43,  74,77,78,107,116,118,163 | Low qualityi | Moderateiii |
| Epidemiological evidence of SARS-CoV-2 transmission occurring in workplaces | Secondary (surrogate) outcome | 6 | 12223,27,70,76,78,80 | Low qualityi | Moderateiii |
| Epidemiological evidence of SARS-CoV-2 transmission occurring in supermarkets and shopping centres | Secondary (surrogate) outcome | 4 | 2276,103,123,163 | Low qualityi | Weak |
| Epidemiological evidence for SARS-CoV-2 transmission occurring during church service | Secondary (surrogate) outcome | 3 | NR76,99,116 | Low qualityi | Weak |
| Epidemiological evidence for SARS-CoV-2 transmission occurring in acute healthcare settings | Secondary (surrogate) outcome | 8 | NR7,16,28,32,43,83,84,100 | Low qualityi | Moderateiii |
| Epidemiological evidence for SARS-CoV-2 transmission occurring in care homes | Secondary (surrogate) outcome | 1 | NR61 | Low qualityi | Weak |
| Epidemiological evidence for SARS-CoV-2 transmission occurring in other settings | Secondary (surrogate) outcome | 13 | NR8,23,27,60,63,65,70,74,  78,82,128,162,164 | Low qualityi | Weak |

I – low quality due to study design – case studies/series

II – studies not assessed for quality (environmental surveys and experiments in laboratory settings)

III – low quality studies, but a relatively large number and show consistent results

|  |  |
| --- | --- |
| **Classification of the evidence** | |
| Strong | Further research unlikely to change confidence in the estimate of the effect |
| Moderate | Further research may impact the estimate of the effect and may change its strength |
| Weak | Further research very likely to impact the estimate of the effect and change its strength |
| Inconsistent | Current studies show conflicting evidence, further research will very likely change the estimate of the effect |

## Appendix 9: Consultation

| Section | **Comments** | **Working party response** |
| --- | --- | --- |
| **Dr. Bin GAO, Tianjin 4th Centre Hospital, Tianjin, China** | | |
| Page3, Line13, Page23, Line26 | To avoid touching your face and eyes with hands is difficult and to do so with clean hands is safe from transmission. | We appreciate that it may be hard at times to avoid touching face and eyes. However, it is known that this may be a common entry route for respiratory pathogens, and we follow opinion of many infection prevention professionals who advise that this should be avoided. |
| Page4, Line14 | To be more clear (suggested change: except around aerosol generating procedures (AGPs). | This was added |
| Page4, Line16 | Per needs of editing (suggested change: remove aerosol generating procedures and insert AGP | This was changed |
| Page6, Line22 | May be more clear (suggested change: replace healthcare settings with health and care settings) | This was changed |
| Page11, Line3 | An error? The 4th to 133rd references marked here according to total 130 references had been cited. | This was changed |
| Page13, Line15 | Per needs of editing (suggested change: add ICU in brackets) | This was changed |
| Page17, Line1 | Per requirement of syntax | This was changed |
| **Professor Philip Carling, Boston University School of Medicine, United States** | | |
| General | Thank you very much for providing me with the opportunity to review this document.  This guidance is timely, thoroughly researched and the results are thoughtfully and clearly stated. | We thank you for your generous comment |
| Executive summary,  Droplet Transmission | Would consider the word “established” rather than “probable” since this mode of transmission is clearly the primary mode of COVID transmission | We agree with the comment that droplet transmission is likely the predominant route via which the SARS-CoV-2 virus is transmitted. However, whilst the clinical experience tells us this is likely the case, we feel that the current evidence does not establish this beyond doubt. Please also note that in the scarcity of evidence for the airborne transmission, this working party made recommendations for droplet rather than airborne precautions. |
| Executive summary,  Airborne Transmission | While an area of ongoing debate, this reviewer would suggest the term “probable” more accurately reflects the current science than “possible”. Furthermore, the use of the term “probable” better distinguishes its relevance in comparison to the category “transmission via fomites” which is very likely epidemiologically less relevant than “airborne transmission” | Considering the lack of strong epidemiological evidence, we think that airborne transmission better fits the ‘possible’ category described as: ‘weak epidemiological evidence suggestive that the infection occurred via the route in question OR strong non-epidemiological evidence that viable virus (i.e. virus that was shown to infect cells in culture) was detected in samples related to a route in question’ |
| Executive summary, Transmission via fomites (p. 15) | As my primary area of research interest, I found that the section related to transmission via fomites extremely thorough and particularly well analysed. Although it is likely that there will never be ideally clear quantification of the risk of transmission of COVID from surfaces, it is likely a mode of transmission if the contamination is of high density, the surface is non-porous and the transmission contact occurs shortly after contamination. | Thank you for your comment, we think that our classification as ‘possible’ reflects your opinion |
| Concluding Comment | Given the importance of the subject and the amount of work that went into developing this document, it is hoped that the authors will consider establishing a structure to allow for regular update based on the peer reviewed scientific literature which continues to evolve at an extremely rapid rate. | We agree with your suggestion and as per section 5.9, we plan to review the evidence and, if need arises, updating the guidance. |
| **This responder wishes to remain anonymous, United Kingdom** | | |
| General | The lay element and the sections that have more general relevance aren't as well separated out as they could be, which means that overall it's not easy to skim read and find the sections you would want the 'non expert' reader to know about. | We will be producing the lay member materials which will be published along this guidance. We hope that this will make it easier for lay members to access the guidance. |
| Executive Summary, Lines 25-26  P24, HR6, Line 15  P19, Line 1  General | The helpful and positive aspects of the guidance were:  "Transmission from COVID-19 patients to HCWs in hospitals appears to be low, unless HCWs do not use appropriate Personal Protective Equipment (PPE)." – helpful  "Use respirators designed for filtering airborne particles for any AGPs regardless of a patient’s COVID-19 status."- hard to do with all the NIV, even for NON COVID and inadequate side rooms, but it is good that it's a strong statement.  "COVID-19 Rapid Guidance Working Party consider SARS-CoV-2 transmission from infected faecal matter to be unlikely." - helpful  It is a good summary of the publications, and a good place to start. | Thank you for your generous comments |
| Pg24, HR3, Lines 3-9 | For care of patients not suspected or confirmed to have COVID-19 - there is no mention of facemasks as part of standard PPE. | This is now addressed |
| Exec Summary Pg2, Line 17 | The group justifies their categorisation of transmission via different routes using a new 2020 bespoke classification for intrauterine transmission, which led them to conclude that droplet transmission is probable.  Probable...billions lost from economy, facemasks throughout society, tens of thousands of deaths both directly and indirectly...and the best explanation for this is that it is probable droplet transmission. The guidance uses a 2020 classification. There must already be established classifications for infection transmission. How can there still not be definitive answer to this question?  It would be preferable to say either droplet transmission is confirmed or change the categorisation so the document can say something stronger.  To the layperson - probable is slightly better than 50:50 or we do not really know.  It needs to be clearer what the purpose of the guidance is. Who their audience is? To stop anyone getting infected - body armour approach. To keep R number in society (universities) under 1 - a pragmatic approach. A different approach / advice is needed.  e.g., yes, someone may have got infected by sitting on the same seat as someone previously who had COVID. But this becomes non-significant to the R number. So in society one may not disinfect every chair, but in hospital, where zero nosocomial spread is expected - you might. | Unfortunately, there is no other framework (neither for this virus nor for other infectious microorganisms), which could be used to capture the probability of transmission via different routes.  The existing frameworks either mention the likelihood that infection occurred (but do not mention the route by which exposure occurred) or are limited to vertical transmission. The adapted system was derived from ‘Neonatal infection acquired intrapartum’ section of the cited document, although we note that we used the term ‘intrauterine transmission’ erroneously.  As per response to another reviewer, we think that the current epidemiological evidence did not establish beyond doubt that transmission occurred via droplet route. Whilst the general opinion is that this is most likely the predominant route of transmission, which we also reflect in our recommendations, we cannot with all confidence state that we found a definitive proof of this occurring in current literature. This fact is true regardless whether we do or do not use the above-mentioned framework.  The comment to lay member was passed on and was considered when structuring the accompanying materials for the public.  As mentioned in section 5.3 the purpose was to evaluate different routes by which the SARS-CoV-2 virus can be transmitted and to identify the gaps in the literature. Section 5.7 clarifies that the guidance was intended for any healthcare professional but that it may be useful to others, including the public. As such, we provided general comments which should be observed by everyone at all times. These emphasise the importance of hand hygiene and maintaining adequate distance and discourage the use of unnecessary PPE. We feel these are sufficient to prevent transmission in general situations.  The more comprehensive recommendations for persons working in health and care settings are listed separately. |
| Exec Summary, Pg2, Line 26 | "Transmission in care homes appears to be very high and needs particular considerations"- what sort of consideration? How can your advice help? This enormously important area should be addressed in the guidance. | This section was rephrased. Unfortunately, the reasons for high transmission in this setting have not been addressed in the literature. We also note that these institutions are different from each other and we cannot comment on specific barriers to maintaining appropriate IPC. We therefore recommend that care homes follow our guidance and that they explore and address their individual issues which prevent them from doing so. |
| General | The guidance concentrates on blood and bodily fluid PPE advice, yet that is not how you think the virus is spread.  The noise to signal ratio in this document is high. Rather than having an updated infection control manual, we need advice for this pandemic. | We rephrased the wording in recommendations to make some of the points we were trying to make clearer:  Whilst we think that body fluids do not present the risk to HCWs due to SARS-CoV-2, we need to stress that gloves need to be worn for protection from blood and body fluids in general. This is the principle of standard precautions to ensure healthcare workers do not become infected by pathogens other than SARS-CoV-2  Similarly, we need to stress the importance of general IPC because our experience and anecdotal evidence suggest that infection prevention so far was one-directional, focusing on HCWs protecting themselves. As a result, the rate of infections due to common nosocomial pathogens increased in general hospital patients as well as those being cared on COVID wards |
| Exec Summary, Pg2, Line 23 | Close contact conclusion - it is probable that transmission occurs with close contact. Is this really the best you can say? | Although this seems a little bit obvious, we think it is an important statement to make, especially considering that so many transmissions occur between family members and friends. We rephrased it to make it clearer |
| Recommendations | The document is an evidence-based focus on causes of virus transmission but the recommendations - wear a facemask here, medical mask there, respirator here - do not have the same attempt at rigour.  On what basis are the PPE /infection control recommendations made? How does it link to the evidence?  Especially given you cannot confidently say how the virus is transmitted.  This should either be a pure science rigorous paper that makes no recommendations and leaves that to others or it should seek to be something useful that makes recommendations. | We hope that the statement added in the executive summary makes it clearer that by determining the routes of transmission we can determine appropriate ways of protecting everyone |
| **Dr Sadia Shakoor, Aga Khan University & Hospitals, Pakistan** | | |
| Page 3 line 15 GR8 | I agree with the guidance for the general public that airborne respiratory protection is not required, especially if other guidance is followed (or enforced in public places). However, I feel that it is important to further explain that airborne transmission potential is present in rare circumstances, especially in closed spaces without adequate ventilation and with infectious persons in close quarters. Such circumstances may exist in crowded settings or work environments that constitute ‘public spaces’ – such as shops and malls, gyms/ other community congregate settings etc. I would suggest that the guidance be rephrased as: *Do not use masks and respirators specifically designed for protection against airborne organisms.* ***Available evidence suggests that transmission via the airborne route is inefficient and highly unlikely in well-ventilated, open spaces.***  The good practice point that follows also supports this further. | This was changed as suggested |
| Page 4 lines 4-19 (HR4-6) | Please consider the following:  1. Patient placement is an extremely important feature of droplet precautions, and as such should be outlines here for all healthcare staff (including administrators) and especially for re-purposed healthcare facilities in the event of COVID surge. Therefore, suggest updated recommendation with this aspect highlighted: *For care of patients suspected or confirmed to have COVID-19, use contact and droplet precautions* ***(single room, or isolation ward with proper bed distance and with closed doors)***  2. The PPE outlined is the minimal recommended, therefore please highlight this: *For care of patients suspected or confirmed to have COVID-19, use contact and droplet precautions (single room, or isolation ward with proper bed distance and with closed doors) , and adhere to using following* ***minimal*** *PPE for all activities*  3. It would be helpful to describe eye protection in some detail for the guidance to be as discerning as possible: c. Eye protection ***(face shield or goggles)***  4. As with community settings transmission modes may vary; studies showing longer viability in air are available and this should be considered when recommending medical mask alone which can compromise healthcare worker safety especially in patients who are coughing excessively (not common, but possible) and in patients housed in poorly ventilated rooms or wards. Additionally, should hospital space or housing patients become problematic the 3 feet droplet precaution rule may become compromised, increasing the likelihood of airborne transmission due to closed spaces (especially in winters in facilities lacking HVAC) and therefore a recommendation of FFP2 should be made with the condition that at a minimum a face mask with a face shield must always be used if FFP2/ N95 are not available.  Therefore, the following should be added to the recommendation: ***Where available it is preferable to use an N95/FFP2 or higher grade respirator is preferable to a medical mask for routine care of confirmed COVID-19 patients***  5. While body fluids listed in HR6 are indeed those with low viral loads if at all of SARS-CoV-2, the guidance oversimplifies the issue of recommended protection as AGPs may still require N95 in patients who tested positive especially for ocular procedures (the list includes ‘ocular excretions’). In keeping with earlier comments regarding a preference for FFP2 where available, and in keeping with possibility of transmission from a positive patient in whom a procedure cannot be avoided (e.g. emergency procedures such as removal of intraocular foreign body), a provision should be made for avoidance of unnecessary additional protection in non-AGPs. Please consider: *Risk of SARS-CoV-2 transmission from body fluids (faeces, urine, ocular excretions and sexual body fluids) is unlikely, use contact precautions and appropriate PPE and refrain from using additional precautions (e.g. respirator masks)* ***when exposed to non-aerosol generating procedures involving these body fluids****.* | 1. This was changed as suggested  2. We wanted to highlight that no other PPE is necessary, and we think the word ‘minimal’ may be taken as an invitation for HCWs to wear other PPE, which would be inappropriate  3. This was changed as suggested  4. The evidence search found that there is a weak epidemiological evidence for airborne transmission in community settings and no evidence for healthcare settings (unless AGPs are performed). At the moment, it is also not possible to determine whether the virus found in the rooms of COVID-19 patients is viable. In the light of this, we have recommended respirator use should be limited to performing AGPs.  5. This was changed as suggested |
|  | As an editing note, HR6 guidance should appear before HR5 | The recommendations have changed order following this and other feedback |
| **Dr Giuseppe E Bignardi, Retired Microbiology Consultant, United Kingdom** | | |
| Section 8 | Epidemiological evidence of SARS-CoV-2 transmission occurring within households.  An overall attack rate of 25% is reported. Would have been useful to know if this was the unmitigated attack rate (with no control measures) or the attack rate in countries at a time when infection control precautions had been issued to household members (minimising time in same rooms, separate bedrooms, and bathrooms when possible, face coverings when in the same room, hand hygiene). | This information is now included in the report. However, as mentioned in section 6.4, we did not attempt a meta-analysis, therefore the attack rates presented here should only be used as approximate estimations of the frequency at which these transmission events occurred. We thought it was important to highlight that the majority of cases seemed to occur in household within the households and between family/friends |
| Section 8 | Epidemiological evidence of SARS-CoV-2 transmission occurring in supermarkets and shopping centres. &  Epidemiological evidence for SARS-CoV-2 transmission occurring during church service.  Again, would have been helpful to know whether the reported attack rates were unmitigated attack rates or the attack rates experienced after the introduction of control measures (reduced crowding, recommended distance, use of face coverings).  Would be useful to know if the reported attack rates were in communities with a high uptake of Covid-19 national apps: in the absence of mobile phone apps under-ascertainment might be significant. | This information is now included in the report, please also see the comment above. |
| **Julie McNally, Royal Orthopaedic Hospital NHS Trust, United Kingdom** | | |
|  | Document is well designed with valuable information. No alterations necessary. | Thank you for your generous comments |
| **Dr Jeorge Orendi, University Hospitals of North Midlands NHS Trust, United Kingdom** | | |
| General | I have enclosed the MS-Word file with name “HIS Consultation SARS-CoV-2 routes of transmission” provided with the consultation, with suggested changes tracked and visible in the ‘Show Markup’ mode | Thank you, the comments within the document were addressed |
| General | The authors have completed an excellent and extensive manuscript with a review of routes of transmission as well as recommendations on prevention of transmission in healthcare settings and in the general community | Thank you for your generous comment |
| Title | The paper provides guidance on prevention of transmission as well as a review of routes of transmission; both should be referred to in the title | This was addressed |
| Executive Summary | As reviewed in Richman-D et al. in: Clinical Virology, 4th Ed., 2017, ASM Press, Chapter 52. Coronaviruses, the enforcement of droplet an contact precautions was strongly associated with protection against SARS-CoV-1 and MERS-CoV, and the unusual stability of the virus likely predisposed it to spread via direct or indirect contact. Risk factors associated with SARS outbreaks in hospital wards were narrow space between beds, lack of availability of washing or changing facilities for staff, performance of resuscitation on the ward, and the use of oxygen therapy or BIPEP (bilevel positive-airway-pressure ventilation); (YU-I et al. 2007; Clin Infect Dis 44:1017-25). Similar to SARS-CoV-1, SARS-CoV-2 is a betacoronavirus that via a spike protein binds specifically to a metalloprotease expressed on many human cell types: angiotensin-converting enzyme 2 (ACE2). Hence, the modes of transmission is likely to be similar. Modes of transmission were also studied in experimental animal models using mammals susceptible to severe disease caused by the same coronavirus strains, such as cynomolgus macaques, African green monkeys, common marmosets and transgenic mice. The authors of the current manuscript reviewed the literature of reports providing compelling evidence of the likely role of fomite transmission. Taken together with the unusual stability of the virus, I believe that the transmission route of fomites should be characterised as “likely” instead of “possible”. | These are excellent points, although we still think that strong epidemiological evidence for fomite transmission is lacking. Therefore, we think that fomite transmission better fits the ‘possible’ category described as: ‘weak epidemiological evidence suggestive that the infection occurred via the route in question OR strong non-epidemiological evidence that viable virus (i.e. virus that was shown to infect cells in culture) was detected in samples related to a route in question’  However, we still acknowledge the importance of fomites as a possible route of transmission and we make specific recommendations to prevent transmission via this route. |
| Executive Summary | On page 2 I have suggested ordering the different transmission routes by likelihood of occurrence/frequency, and added a further one (blood transfusion and organ transplant).  Suggested change re hospital transmission: Similar to the virulent coronavirus strains responsible for SARS and MERS in humans, SARS-CoV-2 has been merciless in exploiting lapses in infection control measures within healthcare settings, relating to the use of Personal Protective Equipment (PPE), hand hygiene, and environmental cleaning. | This was re-ordered as suggested  We acknowledge in the guidelines that increased risk of transmission of SARS-CoV-2 has been seen in such situations, e.g., where optimal PPE has not been used |
| HR3 | I have suggested some changes, as shown in MS-Word file. Suggested addition: \*) When residents in the region with symptoms suspect for COVID-19 are offered testing for COVID-19, and the incidence per 100,000 is higher than XX, or the test positivity rate is higher than YY %, then treat all patients as suspected for COVID-19 irrespective of symptoms (see HR4). | We have not reviewed the evidence for this and therefore we would not be able to make this recommendation. |
| HR4 | I have suggested some changes, as shown in MS-Word file. Suggested changes  a. For aerosol generating procedures (AGP): Protective long-sleeved gown, which is tied around your neck and waist  b. For AGP: Gloves with cuffs covering the cuffs of the gown  c. For AGP: FFP-3 mask or equivalent  d. For non-AGP care/procedure: apron, which is tied around your neck and waist, and bare below the elbow to facilitate good hand hygiene and prevention of transmission of multi-drug resistant bacteria  e. For non-AGP care/procedure: Gloves; change gloves and apron and apply hand hygiene between patients  f. Eye protection: visor or goggles; remove after a session; spectacles provide insufficient protection  g. For non-AGP care/procedure: Medical-grade mask; remove after a session.  h. Adherence to the recommended procedure for donning and doffing PPE, with hand hygiene applied before and after | We think these points are now addressed in the table |
| Survival of viable virus on different types of surfaces (page 16-17) | I have suggested some changes, as shown in MS-Word file.  Suggested change: change from ‘possible’ to ‘likely’ | As per comment in executive summary, we do not think we can classify fomite transmission as ‘probable’ |
| Conclusions | Whilst SARS-CoV-1 also binds to the ACE2 receptor, MERS-CoV binds to dipeptidyl peptidase-4 (DPP4; CD26). The level of infectiousness of a virus depends on many virus, host and environmental factors; a higher affinity for a receptor does not necessarily make a virus more infectious as compared to another virus. | This issue was addressed |
| Miss Sally Welham, British Thoracic Society, United Kingdom | | |
| HR4 | We note that it clashes with PHE guidance as HR4 recommends healthcare workers to wear long sleeved gowns (sleeves covered by gloves) for routine care of all COVID positive patients, whereas in PHE guidance healthcare workers are advised that disposable aprons are sufficient. PHE say gowns required only for AGPs. | This recommendation was revised to better fit with PHE guidance |
| **Mrs Ellie Wishart, Ecolab, United Kingdom** | | |
| Page 3, line 9  Page 3, line 27  Page 23, line 15  Page 24, line 5 | Recommend to replace the term ‘hand sanitizer’ with alcohol-based hand rub (ABHR), bringing in line with WHO terminology also. Sanitisers are considered to achieve a 3-log reduction and therefore this is not an appropriate term. ABHR are classified as disinfectants and are registered as biocides under Biocide Product Regulations (BPR) in Europe. Disinfectants are considered as achieving a 4-log reduction in microorganisms. | This issue was addressed |
| **Professor Philip Howard, OBE, British Society for Antimicrobial Chemotherapy (BSAC)** | | |
| Specific Recommendations | HR5 – Should the list of bodily fluids also include saliva? | We considered your suggestion for including saliva as a separate body fluid, but we think takes part in droplet transmission as it is a part of mouth/nose secretions which are ejected during exhalation |
| **Mrs Maria Cann, MRSA Action, United Kingdom** | | |
| Executive Summary | Row 8 Insert 'the' to read 'Advice for the public...'  Row 9 Delete 'now' and replace with 'subsequently'. Delete erroneous 'to' at end of line, so it reads 'provide the guidance on how' | These were addressed |
| Executive Summary | Row 21 Change transmission from different body fluids to 'possible' as effective standard precautions would be necessary to prevent transmission via carers/HCWs, the consultation document makes reference to airborne aerosols arising from infected faecal matter. Furthermore, the consultation document makes reference to the flushing of toilets being involved in transmission, therefore guidance should advise on the closing of toilet lids for carers/HCWs and the public.  Flushing the toilet as reported in an outbreak. (Reference 138, 146) Despite recognising 4 SARS-CoV virus to be spread primarily via the droplet route, the WHO study acknowledges that airborne transmission in some circumstances was likely, mainly occurring when aerosolisation of respiratory droplets occurred, although transmission of aerosolisation of other infectious materials (e.g. faeces or urine through flushing) was also possible.  138. World Health Organisation. Consensus document on the epidemiology of severe acute respiratory syndrome (SARS). WHO/CDS/CSR/GAR/2003.11  146. Tang S., Mao R.M. et al. Aerosol transmission of SARS-CoV-2? Evidence, prevention and control. Environ Int, 2020; 144:106039 | Whilst the opening section mentions that this route is theoretically possible, an assumption which is based on one outbreak of SARS and the unpublished data from SARS-CoV-2, we found little evidence from the published studies that this is happening. Considering the lack of epidemiological evidence for this route of transmission and the weak evidence for the presence of viable virus in body fluids we consider that this route, if possible, is not very efficient and therefore occurs rarely and in certain circumstances. This explains our reasoning for ‘unlikely’ category.  Based on the current evidence, we do not know whether closing the lid of the toilet for flushing could reduce the SARS-CoV-2 transmission. The situations described for SARS-CoV and SARS-CoV-2 did not mention this issue but instead described the waste matter travelling vertically via wastewater systems to other flats/apartments situated in the same building. |
| General | Should vaccination and the potential effects of reducing transmission be cited in the document? If it is outside of the scope of the document MRSA Action UK feel that there should be a statement to this effect and further guidance issued when more is known about the impact of vaccination on prevention of transmission. | We do not think that vaccination is within the scope of this guidance. However, as recommended, we included some reflections about the impact of vaccine. |
| General | MRSA Action UK welcomes the guidance on routes of transmission and acknowledges the need to provide information for the public and healthcare / key workers. Information needs to be produced in a wide range of accessible formats to ensure the whole population can understand the risks and actions needed to mitigate risks. | Thank you, we agree with this, we will be producing materials for the public which will be published on the Societies’ websites together with the guidance for healthcare professionals |
| **Dr Sara Romano-Bertrand, French Society for Hospital Hygiene (SF2H), France** | | |
| Line 7 p4 | HR4 - Gloves with cuffs covering the cuffs of the gown: SF2H guidelines for glove’s use are the same as standard precautions for COVID patient (please see: https://www.sf2h.net/wp-content/uploads/2020/06/Avis-SF2H-gants-5juin2020.pdf). Currently, French recommendations of Contact Precautions do not include systematic gloves wearing (https://www.sf2h.net/wp-content/uploads/2009/01/SF2H\_prevention-transmission-croisee-2009.pdf)  For the specific case of SARS-CoV-2, we consider that:  - Hydroalcoholic solution is efficient against SARS-CoV-2,  - gloves over-use increases environmental contamination (doi: 10.1016/j.jhin.2004.03.010, https://www.oralhealthgroup.com/features/gloves-spread-disease-and-have-created-an-infection-control-dilemma/…)  - gloves overuse increases risk of dermatitis and induce difficulties on application of hand hygiene guideline: 10.1080/10937404.2017.1304741 , https://infectioncontrol2019.co.uk/wp-content/uploads/2017/08/Helen-Dunn-Gloves-and-Hand-Hygiene.pdf)  - Glove disposal induces environmental contamination (DOI: 10.1016/j.jhin.2018.10.015 DOI:https://doi.org/10.1016/j.ajic.2010.06.007)  Thus for glove's use, SF2H defends that it is more efficient to strictly respect standard precautions regardless of a patient’s COVID-19 status, as proposed in HR3 recommendation page 3 of the current document: “Gloves for all activities where there is a risk of exposure to blood or body fluids or when handling 25 contaminated devices. Immediately remove the gloves at the end of activity and decontaminate 26 your hands using soap and water or alcohol gel before the gloves are worn and immediately 27 after they are removed” | Thank you for your comments. However, as this guidance has been written by UK based societies, it is important that we follow our national PHE guidance which states that gloves should be warn as part of standard PPE when looking after COVID-19 patients. We do accept that the use of gloves should be in combination with maintaining good hand hygiene. |
| **Dr. Abdullah Yusuf National Institute of Neurosciences & Hospital, Bangladesh** | | |
| Page 12, Line 19 | Airborne transmission is not possible if it is in open air, well ventilated air. In our Institute, we have collected Covid19 Samples more than 8000 cases. Some of our lab staffs stand beside the patients without full PPE with coverall, gloves and so one, but only 3 pcs of surgical masks and a hand sanitizer which does not cause any infection to them. | Thank you for your comment, we believe your results are in line with our findings from other studies on airborne transmission. Our conclusions based on these findings were that whilst viral RNA was found in air samples of COVID-19 patients, there was no evidence of the viable virus and that epidemiological evidence is inconsistent. |
| Page 19, Line 22 | I have handled a conjunctivitis patient and have found no transmission of COvid19 to the other family members though the family members do not take proper protection. | We believe that this also is in line with our findings. We found no evidence that ocular secretions, regardless whether ocular symptoms were present, were not contaminated with viral RNA and therefore we considered this route of transmission unlikely.  On the other hand, we noted that SARS-CoV-2 virus can use ocular surface as a point of entry. This route via ocular surface, which we considered possible, would not require ocular secretions to be contaminated. Instead, the most likely vector for the virus entering this route would be contaminated hands or splashes/aerosols in contact with an eye surface. |
| **Prof Jon Cohen, Brighton and Sussex Medical School, United Kingdom** | | |
| Page 15 line 11 et seq | I suggest that the section on fomites is not sufficiently clear about the relative risk, in particular in respect of common domestic fomites (plates, cutlery etc) which is still a concern to some people. I completely accept the evidence, which has been expertly summarised here, that virus can be detected on, and recovered from some fomites. However, I would respectfully suggest that what is completely lacking is any evidence that, outside of experimental conditions, the infection can actually be acquired from these routes. This is of some economic consequence as well if these recommendations were to be interpreted as needing a slavish adherence to “disinfection” despite essentially no evidence of risk. I would respectfully submit that the recommendation in this section be downgraded to unlikely, and that some specific advice be included in respect of domestic situations. | Thank you for your comment. We included a definition of fomites which we hope will make it clearer for the readers that the items mentioned in this comment are included. We believe that ‘possible’ category better fits the description of fomite transmission, since we have found evidence that viable virus was present on surfaces. Since the majority of the cases occurred with close contact, we believe that epidemiological evidence, whilst inconclusive also does not let us to distinguish whether contact occurred via droplet or fomite route. Therefore, as a result, we are not able to exclude fomites are a potential route of transmission. We would also like to draw your attention to the new paragraph included in the epidemiological evidence section, which was included following the feedback from one of the respondents. |
| **Dr Toney Thomas Poovelikunnel, Beaumont Hospital & RCSI, Republic of Ireland** | | |
| Title | Routes of transmission of SARS-CoV-2, prevention of transmission and acquisition: joint … (As the guidance suggests how to prevent transmission). | Thank you, this was addressed. |
| Ex summary, P3, L26-28  P24, L4-6 | Conjoined sentence that may not appropriately convey the intended meaning. Suggestion to split it to two parts.  Immediately remove the gloves at the end of activity and decontaminate your hands using soap and water or alcohol gel. Decontaminate hands before the gloves are worn and immediately after they are removed. | Thank you, the recommendations was rephrased and this is no longer an issue |
| P4, L9-d  P24, L15-d | Medical grade mask.  Specify EN 14683:2019, Type IIR and the equivalent UK (BSI), FDA standard. | This was addressed in the recommendations |
| Results, P10 | Suggest a PRISMA type flow diagram to account for inclusions and exclusions | The PRISMA diagram was included in appendix 4 with the reference in section 6.3. Following your comment, we also included the reference to appendix 4 in section 7. |
| **Royal College of Physicians** | | |
|  | The document also references full length gowns for all COVID-19 patients, yet our current PHE guidance refers to aprons unless risk of bodily fluid contact. Perhaps the reality is that the PPE recommended by PHE is inadequate to protect frontline workers including care home staff. | Thank you for your comment, this has been acknowledged and recommendation was changed so that it is now in line with PHE guidance. |
|  | Our experts have some concern about the conclusion that if a health care worker develops COVID-19 its due to non-compliance with PPE. Or exposure via AGPs in undiagnosed patients where FFP masks and other mitigation is not in place. This is not chiming with the reality of front-line staff. | Our intention was not to criticize the non-compliance of healthcare staff. Instead, we intended to highlight the circumstances when undiagnosed COVID-19 patients were cared for as we think this is the time staff are most vulnerable and likely to acquire the infection. We have changed the wording of the statement to reflect this. Additionally, we recognise that at the start of pandemic healthcare workers may have been inadequately protected due to PPE shortages.  We have been reviewing the evidence for staff screening and management and we believe the data presented in this guidance are accurate and represent what has been discussed in the literature. We appreciate that many front-line staff feel that the risk from patients to healthcare workers is higher. However, we would like to draw your attention to the fact that healthcare workers could be infected from each other as well as within the community. The literature reviewed suggests that these are significant factors that are usually not considered. |
|  | Published guidance has clearly been reviewed but our experts’ question whether feedback from colleagues has been reviewed. Our experts noted one of the acute medics had noted infection rates in colleagues in a survey at 63%. Our experts would like to challenge the implication this is poor infection control compliance. |
| **Anonymous** | | |
|  | The elimination of “fomite” transmission in both these publications on the same incident is poorly described, essentially “no evidence was identified”. What they do not consider is the role of waiters’ hands, collecting used items and then distributing food, cutlery, and crockery. Some used items could be highly contaminated with saliva, particularly if shellfish or shell crab were eaten. It is reasonable that the same waiter(s) attended all three tables and attending to a group of tables in a line one after another is a reasonable thing to do. Contamination of waiters’ hands seems likely; hand hygiene between collecting used items and distributing new items seems unlikely.” | The Working Party would like to acknowledge that this hypothesis is plausible and could only be confirmed or rejected by observing the closed-circuit TV recording from the restaurant, which is not available for public view. The Working Party decided to include this statement as a potential evidence in support of fomite transmission |