What is the evidence for airborne transmission of COVID-19?

"The current global stockpile of PPE is insufficient, particularly for medical masks and respirators; the supply of gowns and goggles is soon expected to be insufficient also. Surging global demand – driven not only by the number of COVID-19 cases but also by misinformation, panic buying, and stockpiling – will result in further shortages of PPE globally. The capacity to expand PPE production is limited, and the current demand for respirators and masks cannot be met, especially if widespread inappropriate use of PPE continues." WHO March 2020

The clear implications of this statement by WHO is that all countries will run out of PPE unless healthcare workers behave responsibly. If they use respirators for a wide range of patient interactions, including for patients who are asymptomatic, on a 'just in case principle' then we will reach a situation where there would be no respirator masks available for healthcare workers who are required to work in conditions where Aerosol Generating Procedures (AGP) are a genuine risk i.e. ICU and theatres.

Although there is a huge amount of concern being generated about the risk of airborne transmission of COVID-19 this is not currently based on robust evidence. A recent paper (van Doremalen et al 2020) has been assumed to provide evidence that COVID-19 is transmitted by aerosols. This is not the case. The paper describes an experimental study in which aerosols were generated using a three-jet nebuliser and high concentrations of virus and the airborne particles fed into a small test chamber. The air and surfaces in the chamber were then sampled. The fact that they found viral RNA in the air is not surprising because it was placed intentionally into this confined space. Although the viral RNA was recovered from the air (for up to 3 hrs) and surfaces (for up to 72hr) the counts declined rapidly, and in a similar way to SARS-CoV (which was tested in the same experiment). As this was an experiment it does not reflect a clinical environment where aerosolised particles would be rapidly diluted by the large volume of room air and natural ventilation. The very high viral loads used in the tests would be uncommon in most patients with COVID-19 and are only likely to occur during procedures recognised to generate aerosols from the respiratory tract. The similar distribution and survival profiles on surfaces for both viruses, supports the view that COVID-19 behaves like SARS-CoV and environmental contamination by respiratory droplets is an important factor in transmission.

A study from Singpore (Ong et al 2020) sampled air and surfaces in the rooms of 3 patients with COVID-19. They found extensive environmental contamination in the room of a patient with mild respiratory involvement but also virus in their stool, including from the toilet sink and door handles. Air samples were all negative as were environmental samples taken after routine cleaning and twice daily of high touch surfaces with chlorine. Both studies were published as a letters and therefore have not been subjected to peer review.

These studies tell us that COVID-19 behaves like SAR-CoV and are associated with significant contamination of the environment. The solution to this problem is:

- regular cleaning of the environment, especially high touch surfaces, with detergent and chlorine-based solutions
- healthcare workers recognising that gloves will not protect them unless they are rigorous in avoiding touching their own mucous membranes with their hands – regardless of whether they are wearing gloves.

Evidence for risk of infection associated with Aerosol Generating Procedures (AGP)

Aerosols are generated when an air current moves across the surface of a film of liquid, creating small particles at the air–liquid interface. The faster that the air travels over the respiratory mucosa the greater the risk of aerosols containing infectious agents being generated. An aerosol-generating procedure is

defined as '*any medical procedure that can induce the production of aerosols of various sizes, including droplet nuclei*' (WHO 2014).

There are gaps in relation to evidence for the risk of acute respiratory pathogens in general and COVID-19 in particular, however, a systematic review by Tran et al (2012) provides evidence for procedures associated with a high risk of transmission of SARS. This review compared the risk of transmission of acute respiratory infections to HCWs exposed to patients undergoing aerosol generating procedures with the risk to HCWs caring for patients not undergoing aerosol generating procedures. In the 10 included studies exposure to the following AGP were reported to increase the risk of transmission to healthcare workers:

Procedure HCW exposed to	**Risk of transmission to HCW (Odds Ratio)**	**Type of study (no. studies) 95% CI**
Tracheal intubation	6.6	Cohort (4) 2.3-18.9 Case control (4) 4.1, 10.6
Tracheostomy	4.2	Case control (1) 1.5, 11.5)
Non-invasive ventilation	3.1	Cohort (2)1.4-6.8
Manual ventilation before intubation	2.8	Cohort (1) 1.3, 6.4)

No significant risk of transmission of SARS was associated with other AGP:

- endotracheal aspiration
- suction of body fluids
- bronchoscopy
- nebulizer treatment
- administration of O2 or high flow O2
- manipulation of O2 mask or BiPAP mask
- defibrillation
- chest compressions
- insertion of nasogastric tube
- collection of sputum

In a rapid review of the efficacy of masks for protection against COVID-19 (Greenhalgh et al 2020) found that standard surgical masks were effective for non AGP, although currently evidence is based on studies of similar respiratory viruses (including SARS-CoV) rather than COVID-19. Importantly, this review also concluded that masks are only one component of a set of complex protection measures. In a previous Cochrane review (Jefferson et al 2011) the evidence did not indicate N95 respirators provided greater protection that simple surgical masks in decreasing transmission of acute respiratory disease.

References

WHO Infection prevention and control during health care when COVID-19 is suspected Interim guidance. 19 March 2020. https://apps.who.int/iris/bitstream/handle/10665/331498/WHO-2019-nCoV-IPCPPE_use-2020.2-eng.pdf
Van Doremalen NEJM 17th March 2020 https://www.nejm.org/doi/full/10.1056/NEJMc2004973
Greenhalgh https://www.phc.ox.ac.uk/files/covid-19-evidence-service/covid-cat-ppe-masks-7.pdf
Ong NEJM 4th March 2020 https://jamanetwork.com/journals/jama/fullarticle/2762692?resultClick=1
WHO 2014 https://www.ncbi.nlm.nih.gov/books/NBK214359/pdf/Bookshelf_NBK214359.pdf
Tran PLos One 2012 https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0035797&type=printable
Jefferson 2011 Cochrane http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=21735402.