PERSPECTIVES FROM THE FIELD

A clinician's view from the frontline: UV light and other strategies to reduce aerosol transmission of COVID-19 and protect health workers

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To be clear, when we say COVID-19 is spread by droplets, we mean droplets of all sizes, including aerosols.

That coronaviruses can be spread by the aerosol route has been shown in multiple studies. The Amoy Gardens outbreak of SARS-CoV-1 demonstrated airborne viral spread as sufficient viral aerosols were drawn into apartments though floor drains connected to sewage outlets (1). There was early evidence for possible MERS-CoV contamination of air, and a call for investigation of airborne transmission as well as concern about adequacy of current infection control procedures following MERS (2). Other larger reviews of MERS-CoV and SARS-CoV-1 disease have also argued that a reasonable proportion of transmission was through the airborne route (3). In the emerging research on SARS-CoV-2, just this week, Chinese researchers are calling for more awareness of transmission through exhaled air during non-invasive respiratory support (4).

As we clinicians gear up to battle COVID-19 on the hospital front lines, we are armed by guidelines from the WHO and Australia. Flat surgical masks are recommended PPE for most heath care worker / COVID-19 patient interactions, including taking nasopharyngeal swabs. Only in high risk scenarios, such as intubation or CPR, are we recommending respirators such as the P2 or N95 mask, and increased room ventilation. This may already be unachievable in many settings, but may also be inadequate to protect health care workers. In Italy, doctors are dying after being forced to work without PPE at all. Most countries are facing the same situation, with vastly inadequate stockpiling of PPE.

There is a common misconception that droplets must come from coughing or sneezing, or that aerosols are only produced during moments of classically aerosol generating procedures such as intubation will only generate aerosols. Coronaviruses are known to spread by all three methods, airborne inhalation, short range spray and larger fomites (5). Influenza can spread through tidal breathing, without any cough or sneeze (6). There is no clear knowledge of aerosolised viral loads produced by patients with COVID-19 through breathing or coughing, nor the amount typically required to infect a patient. We do know SARS-CoV-2 can persist in air for up to 3 hours (7). The superiority of respirators over surgical face masks has been demonstrated for other respiratory diseases not thought to be typically spread through airborne routes (8). Additionally, this has suggested that in infectious respiratory diseases distinct separation of aerolisation from spread by larger and less airborne particles may be more of an academic than practical distinction, with lung generated particles existing along a spectrum.

In the high pressure environment we are about the face in many place worldwide, wards and ICUs will go into overflow. In Australia, we are only weeks behind the US and Italy. We already have shortage of PPE, even knowing that current recommendations may not be adequate to prevent all spread.

Beyond the desperate need for both government and private individuals to coordinate the production of more and better PPE, there are other measures we can take. We should bear aerosol transmission in mind as we make fast decisions about makeshift spaces to treat patients in. Crucially, for in an aerosol born virus, there may be methods to decrease the viral load. Remembering always that N95 masks are defined as filtering out 95% percent of particles, and 5% of a large viral load presents a theoretical risk to transmission. Chinese recommendations from clinical experience at Zhejiang Hospital in 2020 include N95 masks for any contact, the use of plasma air sterilisers run continuously in any environment with human activity and ultraviolet lamps on for one hour, three times a day, as well as disinfection of fecal matter and sewage by treating with chlorine containing disinfectant prior to disposal (9).

There are people better suited to suggesting what these load reduction strategies might be - all along the spectrum between infectious diseases specialists and engineers and architects. But one goal must be to decrease viral load in the air. We need to consider the impact of ventilation, UV radiation, even in their most seemingly basic forms such as open windows and sunlight.

It seems like a moment to reflect that the natural environment this virus evolved in, and likely has evolutionary advantages for, are the caves that bats inhabit. Both feature poor air ventilation and lack of sunlight.

It's hard to prove how much aerosolised transmission is required for infection because there's no easy way to measure the dose of inoculum. But we can prove the opposite - that less transmissions occur in more ventilated places or places exposed to ultraviolet radiation. Or alternatively that masks with better filtration decrease rates of infections.

Leading down this line of thinking, are other questions for research, if there is even the time for research.

Are ICU rooms with COVID-19 patients creating environments with high viral load? Is the rate of room ventilation less than the rate of virus production with each breath? Is there a theoretical risk of autoinoculation? Is this why we see the common presentation of COVID-19 as a peripheral multilobular pneumonia, as aerosolised particles are more likely to make it to the end of the respiratory tract than contamination via the mouth (10)? If fecal matter is capable of generating its own virus containing aerosols, is there transmission between a person's gastrointestinal system and their lungs?

Is it better to have screening clinics in outdoor places rather than inside hospitals? Are retrospective studies possible, given that we already have variations country to country? Is drive through testing best?

What role does aerosol transmission play in family settings? And what basic public health ventilation recommendations might possibly make a difference. Family members have a 84% infecting another family member (11). One study of family clusters showed spouses were 64% likely to become infected, twice as likely as their children (12), which would be consistent with a greater degree of air sharing.

We have data from the SARS-CoV-1 outbreak showing health care workers composed 19% of cases in China to 57% in Vietnam (13). For a sense of scale, at what is likely an early moment in the SARS-CoV-2 outbreak, on March 15, 2020, there were 2026 health care workers in Italy infected with COVID-19 (14). Given the high numbers of health care workers infected in this and previous coronavirus outbreaks, it would be negligent to ignore the potential proportion of spread through the airborne route and what additional measures are being taken to counter it.

As health care workers prepare to go to battle, resources will be stretched to their absolute. Let's remember everything we already know about this disease, that droplets are not just from touch or sneezing. We need to give health care workers the absolute biggest chance.

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