COVID-19 Global Trends and Analyses

Health Care Workers, Aerosol Spread

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Know-C19
The global total number of reported cases surpassed 22.5 million and deaths reached 780,000 on 20 August, for a global case-fatality rate (CFR) of 3.5%. On average, one million new cases are reported every four to five days.

The top five countries (U.S., Brazil, India, Russia and South Africa) account for 60% of the global total of cumulative cases.

In the United States, the total number of cases has surpassed 5.7 million and 178,000 deaths. The majority of new cases are aged between 20 and 39 years.

India has the highest number of daily new cases in the world, reporting more than 60,000 on seven days in the past two weeks.

Almost every country in Europe is experiencing significant new spikes and second waves.

High numbers of new daily cases continue to be reported in the Philippines (4,000 to 6,000) and Indonesia (>2,000). Indonesia’s Papua province, bordering Papua New Guinea, has reported 3,432 cases.

South Korea has experienced clusters of new cases, averaging 30-60 cases a day, since the end of May. However, since 14 August, daily new cases have exceeded 100 every day reaching 297 on 19 August, the highest number since 7 March, five months ago.

Since 16 July, Papua New Guinea has reported 336 new cases and three deaths, most linked to the Port Moresby General Hospital. An all-time high of 55 cases was reported on 12 August.

After 100 days without local transmission, New Zealand has reported a cluster of 79 cases in Auckland. In this cluster, 74% of cases are among the South Auckland Pasifika (Polynesian) community and a further 10% in the Maori community.

In Victoria, daily new case numbers have steadily climbed into the high triple digits to reach a peak of 725 cases on 5 August. However, during the past week there has been a steady decline in new daily cases to 179 on 21 August with the seven-day average at around 250, a 50% decline in less than 2 weeks.

There are now 7,595 cases active cases and 1,067 are under investigation in Victoria. There are 3,669 cases that may indicate community transmission.

There are currently more than 1,237 active cases linked to more than 100 residential aged care facilities. Of the 363 deaths in Victoria, 244 (67%) have been linked to aged care facilities.

The Doherty Institute has released genomic data that indicate that around 90% of second wave cases originated from a family of four quarantined in Rydges Hotel. A further 10% are linked to people quarantined in Stamford Hotel.
Protection of Health Care Workers

- As of 18 August, 2,414 (14%) of Victoria’s 17,238 cumulative cases were healthcare workers (HCW); 1,036 (13.5%) of 7,595 active cases are in HCWs.
- In mid-July, Amnesty collated and analysed a wide range of available data showing that more than 3,000 health workers had died after contracting COVID-19 in 79 countries, although the figure is likely to be a significant underestimate due to under-reporting. By mid-August, more than 900 HCWs had died in the US.
- A prospective study in the US and UK that recruited almost 100,000 HCWs found that compared with the general community, front-line HCWs were at increased risk for reporting a positive COVID-19 test (adjusted hazard ratio 11·61, 95% CI 10·93–12·33).
- Several studies have found that many HCWs are infected through community transmission and may continue to work while asymptomatic or pre-symptomatic. This reinforces the need for HCWs to wear PPE in every clinical department within hospitals and other health-care settings.
- An updated Cochrane systematic review has found evidence that covering more parts of the body leads to better protection but usually comes at the cost of more difficult donning or doffing and less user comfort and may therefore even lead to more contamination. Modifications to PPE design, such as tabs to grab, may decrease the risk of contamination. Face-to-face training in PPE use may reduce errors more than folder-based or online training.
- A number of studies have suggested that weekly testing of all hospital-based HCWs might reduce their contribution to transmission by 25-33%.
- A study of HCWs in New York City found high rates of acute stress disorder, depression and anxiety with the highest levels in nurses.

Aerosol Transmission of SARS-CoV-2

- The mechanisms of how SARS-CoV-2 may spread in aerosol form are not yet fully understood, though its recognition as a mode of transmission is important.
- Following an open letter from researchers around the globe, the WHO has updated its advice to include scientific evidence of aerosol spread.
- Severity of aerosol transmission is heavily dependent on environmental factors such as temperature, relative humidity, ventilation, and radiation from sunlight. Airplanes, cars, public transport, and offices, hotels and apartments lacking windows that can be opened are potentially high-risk settings.
- Preventive measures include use of natural ventilation, avoiding re-circulation of air, avoiding direct air flow from another person, minimising the number of people sharing the same environment and widespread face mask use. A recent study found that scarf-like masks conferred the least protection and prevention of droplet spread. These include neck fleece and bandanas.
RECOMMENDATIONS FOR THE AUSTRALIAN COVID-19 RESPONSE

1. In contexts where community transmission is high, universal precautions (which aim to protect health care workers) should recognise that some HCWs may be infected through community transmission and may continue to work while asymptomatic or pre-symptomatic posing a risk to patients and other staff.

Therefore, HCWs in all clinical settings and common areas, such as tearooms and change rooms, in hospitals need to follow a comprehensive package of IPC, including effective PPE (at a minimum close-fitting surgical masks) at all times.

2. Policy makers need to support health-care facilities in interpreting guidance during the various phases of a pandemic that is characterised by fluctuating local incidence of SARS-CoV-2 to mitigate the impact of the pandemic on their workforce and clients.

3. Given that recent studies have demonstrated their low efficacy, health authorities should warn the public that scarves, neck fleece and bandanas are not suitable alternatives to disposable surgical masks and cloth masks that adhere to recommended specifications.
GLOBAL EPIDEMIOLOGY AND TRENDS

- The **global** total number of reported cases surpassed 22.5 million and deaths reached 790,000 on 19 August, with a global case-fatality rate (CFR) of 3.5%. On average, one million new cases are reported every four to five days.

- The top five countries (**U.S., Brazil, India, Russia and South Africa**) account for 60% of the global total of cumulative cases.

- Eight **Latin American** countries (Brazil, Peru, Mexico, Colombia, Chile, Argentina, Bolivia and Ecuador) account for 26% of the global total.

- In the **United States**, the total number of cases has surpassed 5.7 million and 177,000 deaths. The number of new daily cases has been declining from more than 70,000 at the end of July to between 40,000 and 50,000 in late August. However, the number of daily deaths has been increasing to more than 1,000 for the past three weeks. The majority of new cases are aged between 20 and 39 years.

- **India** has the highest number of daily new cases in the world, reporting more than 60,000 on seven days in the past two weeks.

- Elsewhere in **South Asia**, daily new cases are in decline in Pakistan and Afghanistan, remain high in Bangladesh, and Nepal is experiencing a clear second wave. Sri Lanka continues to report very low numbers of cases.

- Almost every country in **Europe** is experiencing significant new spikes and second waves. The seven-day average of new cases in Spain is more than 4,500 and in France more than 2,000. Greece is experiencing a clear second wave while Germany, the UK, the Netherlands, Austria, Czech Republic, Poland, Belgium, Denmark, Iceland, and Ireland are reporting spikes in new infections.

- The trends in the **Middle East** are mixed. The Gulf countries are reporting downward trends in new daily cases while Israel, Lebanon, Iran, and Iraq are experiencing ongoing transmission. Jordan, which has effectively controlled their outbreak, is now reporting spikes of between 20 and 50 daily new cases. Israel (population 8.7 million) has now reported more cases than neighbouring Egypt (population 102 million).

1. [https://coronavirus.jhu.edu/data/new-cases](https://coronavirus.jhu.edu/data/new-cases)
2. [https://www.worldometers.info/coronavirus/#countries](https://www.worldometers.info/coronavirus/#countries)
Asia Pacific-Region

- High numbers of new daily cases continue to be reported in the Philippines (4,000 to 6,000) and Indonesia (>2,000). Indonesia’s Papua province, bordering Papua New Guinea, has reported 3,432 cases.

- Vietnam’s first community transmission case was reported after 99 days in Da Nang on 25 July. As of 19 August, Vietnam’s Ministry of Health confirmed a total of 989 cases of COVID-19 in five cities. There are 492 active cases and 26 deaths have been reported having had no deaths prior to this recent outbreak.

- Hong Kong and Japan are experiencing second waves more severe than the first waves. Hong Kong is showing a downward trend; however, new cases continue to increase in Japan.

- South Korea has experienced clusters of new cases, averaging 30-60 cases a day, since the end of May. However, since 14 August, daily new cases have exceeded 100 every day reaching 279 on 16 August, the highest number since 7 March, five months ago. Officials say all but 11 of the new cases were local transmissions and most were in the Seoul area. More than 400 infections have been linked to Sarang Jeil church, whose leader, Jun Kwang-hun, is among those who have tested positive for Covid-19.

- Since 16 July, Papua New Guinea has reported 336 new cases and three deaths, most linked to the Port Moresby General Hospital. An all-time high of 55 cases was reported on 12 August.

- After 100 days without local transmission, New Zealand has reported a cluster of 79 cases in Auckland. In this cluster, 74% of cases are among the South Auckland Pasifika (Polynesian) community and a further 10% in the Maori community.

Australia

- In Victoria, daily new case numbers have steadily climbed into the high triple digits to reach a peak of 725 cases on 5 August. The seven-day rolling average of daily new cases in Victoria was 513 on 6 August. However, during the past week there has been a steady decline in new daily cases to 179 on 21 August with the seven-day average at around 250, a 50% decline in less than 2 weeks.

- Sydney has experienced a number of clusters, linked to pubs, restaurants, churches and schools. In the past week, daily new cases have averaged single digits. However, there continue to be small numbers of cases with no known source contact.

- Victoria’s “second wave” (or first wave of widespread community transmission) is dominated by locally acquired infections, including many residential aged care facilities, family, workplace, and school clusters, and community transmission of unknown source.

- There are now 7,595 cases active cases and 1,067 are under investigation in Victoria. 363 deaths have been reported. There are 3,669 cases that may indicate community transmission.

- The number of Victorians who have been tested surpassed 2 million on 19 August (300 per 1000 population). The test positivity rate in Victoria is averaging 0.87%.

- There are currently more than 1,237 active cases linked to more than 100 residential aged care facilities. Of the 363 deaths in Victoria, 244 (67%) have been linked to aged care facilities.

- The Doherty Institute has released genomic data that indicate that around 90% of second wave cases originated from a family of four quarantined in Rydges Hotel. A further 10% are linked to people quarantined in Stamford Hotel.
Transmission chains originating from a family of four quarantined in Rydges Hotel, Melbourne

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SCIENCE AND RESEARCH
UPDATES | COVID-19 AND
HEALTH CARE WORKERS

Risk of Infection
As of 18 August, 2,414 (14%) of Victoria’s 17,238 cumulative cases were healthcare workers (HCW); 1,036 (13.5%) of 7,595 active cases are in HCWs.

In an early case series from Wuhan, China, 29% of patients with SARS-CoV-2 were HCWs and were assumed to have acquired the infection in hospital⁷. Figures from China’s National Health Commission show that more than 3,300 health-care workers had been infected as of early March and, according to local media, by the end of February at least 22 had died. Deaths among HCWs infected with SARS-CoV-2 are unusual and have mostly affected those older than 50 years⁸. Tragically, in Italy for example, HCWs rehired from retirement to help at the frontline have commonly experienced the highest mortality when compared with their working-age counterparts⁹.

In mid-July, Amnesty collated and analysed a wide range of available data showing that more than 3,000 health workers had died after contracting COVID-19 in 79 countries, although the figure is likely to be a significant underestimate due to under-reporting¹⁰. According to Amnesty’s monitoring, the countries with the highest numbers of health worker deaths thus far, are: Russia (545), UK (England and Wales: 540, including 262 social care workers), USA (507), Brazil (351), Mexico (248), Italy (188), Egypt (111), Iran (91), Ecuador (82) and Spain (63).

By mid-August, more than 900 frontline HCWs had died of Covid-19 in the U.S, according to an interactive database managed by the Guardian and Kaiser Health News¹¹. The tally includes doctors, nurses and paramedics, as well as crucial support staff such as hospital janitors, administrators and nursing home workers. Early tallies suggest that the majority of the deaths were among people of colour, and many were immigrants.

The risk profile for SARS-CoV-2 exposure and infection among HCWs differs substantially from other groups. In designated COVID-19 wards or hospitals, HCWs are at high risk of infection. Potential exposure to SARS-CoV-2 is inherent to their work and is prevented only by excellent adherence to all IPC measures, including the use of appropriate PPE. There is uncertainty about what is optimal PPE, but it is clear that standardised and rigorous application of PPE and other IPC measures can dramatically reduce nosocomial transmissions¹².

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Focusing on adherence to PPE implies that the optimal PPE for all potential contact situations is known and available. However, the effect of optimal PPE and other IPC measures is being debated because robust evidence to match PPE and IPC interventions to the risk profile of a given exposure is scarce.

Exposures to SARS-CoV-2 via community cases and infected colleagues can be frequent depending on the phase of the outbreak. A detailed study of the prevalence of SARS-CoV-2 among mildly symptomatic HCWs in Dutch hospitals showed that many infections were most likely acquired in the community. Risk assessment of health-care worker exposure is going to be most useful in epidemic phases with low rates of community transmission. In all other situations, all HCWs should be considered at moderate to high risk of contracting SARS-CoV-2, especially when extended IPC measures, including some use of PPE, cannot be implemented for all patient contacts and staff interactions. Data showing that viral shedding and potential SARS-CoV-2 transmission could occur 2–3 days before symptom onset highlight the importance of wearing adequate PPE in hospitals during phases of high SARS-CoV-2 incidence. Therefore, risk-appropriate PPE and optimal adherence to IPC measures will reduce the risk of health-care worker infection to that encountered in the community.

**Prospective Assessment of Risk**

**Risk of COVID-19 among front-line health-care workers and the general community: a prospective cohort study**

A prospective, observational cohort study was conducted in the UK and the USA of the general community, including front-line health-care workers, using self-reported data from the COVID Symptom Study smartphone application (app) from March 24 (UK) and March 29 (USA) to April 23, 2020. Participants were voluntary users of the app and at first use provided information on demographic factors (including age, sex, race or ethnic background, height and weight, and occupation) and medical history, and subsequently reported any COVID-19 symptoms. The researchers used Cox proportional hazards modelling to estimate multivariate-adjusted hazard ratios (HRs) of the primary outcome, which was a positive COVID-19 test.

Among 2,035,395 community individuals and 99,795 front-line HCWs, 5,545 incident reports of a positive COVID-19 test were recorded over 34,435,272 person-days. Compared with the general community, front-line HCWs were at increased risk for reporting a positive COVID-19 test (adjusted HR 11·61, 95% CI 10·93–12·33). To account for differences in testing frequency between front-line HCWs and the general community and possible selection bias, an inverse probability-weighted model was used to adjust for the likelihood of receiving a COVID-19 test (adjusted HR 3·40, 95% CI 3·37–3·43). Secondary and post-hoc analyses suggested adequacy of PPE, clinical setting, and ethnic background were also important factors.

**Summary:** In the UK and the USA, risk of reporting a positive test for COVID-19 was increased among front-line HCWs. Health-care systems should ensure adequate availability of PPE and develop additional strategies to protect health-care workers from COVID-19, particularly those from Black, Asian, and minority ethnic backgrounds.

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16 [https://www.thelancet.com/journals/lanpub/article/PIIS2468-2667(20)30164-X/fulltext](https://www.thelancet.com/journals/lanpub/article/PIIS2468-2667(20)30164-X/fulltext)
Protecting Health Care Workers

Monitoring approaches for health-care workers during the COVID-19 pandemic

An adequate level of staffing is crucial to maintain patient care during the ongoing COVID-19 pandemic. Frontline health-care staff assess and manage patients with COVID-19, patients presenting with emergencies not related to COVID-19, and patients with essential routine care needs. One of the greatest risks to the health-care system is a high rate of SARS-CoV-2 infection among HCWs and the consequent lack of skilled staff to ensure a functioning local or regional response to the pandemic. This risk has been increased by the need for rapid scaling up of ICU capacity in affected regions, the redeployment of clinical staff to frontline positions (eg, ICUs or COVID-19 wards), and the recruitment of less experienced staff (eg, newly qualified students or health-care staff moving from their specialty) to the workforce in response to the pandemic.

HCWs could acquire SARS-CoV-2 at work through direct or indirect contact with infected patients or other health-care workers, or as a result of ongoing community transmission. Community transmission of SARS-CoV-2 is targeted by public health measures, whereas infection by patient or HCW contact is primarily addressed by facility-based IPC measures. However, sources of infection might not be clear and this uncertainty can have negative effects on the clinical workforce. IPC measures are extensive in hospitals managing patients infected with SARS-CoV-2 and, broadly speaking, include rigorous cleaning and disinfection to reduce environmental contamination and the use of PPE.

National and international recommendations for risk assessment and management of hospital health-care staff working with patients infected with SARS-CoV-2 are detailed and publicly available. This guidance can become rapidly unsuitable when the situation at the frontline of health-care delivery is continuously changing. Therefore, broad recommendations need to be translated into locally applicable and pragmatic solutions.

Clear strategies to support and appropriately manage exposed and infected HCWs are essential to ensure effective staff management and to engender trust in the workplace. These management strategies should focus on risk stratification, suitable clinical monitoring, low-threshold access to diagnostics, and decision making about removal from and return to work. Policy makers need to support health-care facilities in interpreting guidance during a pandemic that will probably be characterised by fluctuating local incidence of SARS-CoV-2 to mitigate the impact of this pandemic on their workforce.

Personal Protective Equipment

Preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff -- Cochrane Review, April 2020

Types of PPE

The use of a powered, air-purifying respirator with coverall may protect against the risk of contamination better than a N95 mask and gown (risk ratio (RR) 0.27, 95% confidence interval (CI) 0.17 to 0.43) but was more difficult to don (non-compliance: RR 7.5, 95% CI 1.81 to 31.1). In one RCT (59 participants), people with a long gown had less contamination than those with a coverall, and coveralls were more difficult to doff (low-certainty evidence).

17 https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30458-8/fulltext
Gowns may protect better against contamination than aprons (small patches: mean difference (MD) −10.28, 95% CI −14.77 to −5.79).

**Modified PPE versus standard PPE**
The following modifications to PPE design may lead to less contamination compared to standard PPE: sealed gown and glove combination (RR 0.27, 95% CI 0.09 to 0.78), a better fitting gown around the neck, wrists and hands (RR 0.08, 95% CI 0.01 to 0.55), a better cover of the gown-wrist interface (RR 0.45, 95% CI 0.26 to 0.78, low-certainty evidence), added tabs to grab to facilitate doffing of masks (RR 0.33, 95% CI 0.14 to 0.80) or gloves (RR 0.22, 95% CI 0.15 to 0.31).

**Donning and doffing**
One-step removal of gloves and gown may lead to less bacterial contamination (RR 0.20, 95% CI 0.05 to 0.77) than separate removal. Double-gloving may lead to less viral or bacterial contamination compared to single gloving (RR 0.34, 95% CI 0.17 to 0.66). Additional spoken instruction may lead to fewer errors in doffing (MD −0.9, 95% CI −1.4 to −0.4) and to fewer contamination spots (MD −5, 95% CI −8.08 to −1.92). Extra sanitation of gloves before doffing with quaternary ammonium or bleach may decrease contamination, but not alcohol-based hand rub.

**Training**
The use of additional computer simulation may lead to fewer errors in doffing (MD −1.2, 95% CI −1.6 to −0.7). A video lecture on donning PPE may lead to better skills scores (MD 30.70, 95% CI 20.14 to 41.26) than a traditional lecture. Face-to-face instruction may reduce noncompliance with doffing guidance more (odds ratio 0.45, 95% CI 0.21 to 0.98) than providing folders or videos only.

**Authors' conclusions**
We found low- to very low-certainty evidence that covering more parts of the body leads to better protection but usually comes at the cost of more difficult donning or doffing and less user comfort, and may therefore even lead to more contamination. More breathable types of PPE may lead to similar contamination but may have greater user satisfaction. Modifications to PPE design, such as tabs to grab, may decrease the risk of contamination. For donning and doffing procedures, following CDC doffing guidance, a one-step glove and gown removal, double-gloving, spoken instructions during doffing, and using glove disinfection may reduce contamination and increase compliance. Face-to-face training in PPE use may reduce errors more than folder-based training.

**Knowledge, Perception, and Level of Confidence**
COVID-19 care among healthcare workers involved in cardiovascular medicine: a web-based cross-sectional survey in Japan

This study aimed to investigate the knowledge, perception, and level of confidence regarding COVID-19 care among HCWs involved in cardiovascular medicine. A cross-sectional, web-based study about COVID-19 was performed between April 22 and May 7, 2020, among 311 HCWs in cardiovascular departments. The demographic information, COVID-19-related knowledge, and perception and level of confidence toward COVID-19 care were assessed.

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• Overall, there was a lack of knowledge about the infection-prevention measures for COVID-19, such as how to isolate patients with COVID-19, how to use PPE, and how to prevent infection during aerosol-generating procedure.

• The knowledge about how to use PPE and how to prevent infection during aerosol-generating procedures was significantly lower among non-physician HCWs than physicians.

• Approximately 60% of the HCWs stated “No” when asked “Do you think you have received enough training for COVID-19 care?” The majority of HCWs were not satisfied with the supply of PPE for COVID-19 care. Notably, only two HCWs answered “confident” and 50 HCWs answered “somewhat confident” when asked about the confidence toward COVID-19 care.

• The study demonstrated the lack of knowledge about appropriate infection-prevention measures for COVID-19, such as how to use PPE, how to isolate patients with COVID-19, and how to prevent infection during aerosol-generating procedures.

• Most HCWs, especially non-physician HCWs, showed a low level of confidence toward COVID-19 care. Poor confidence was associated with the lack of knowledge about infection-prevention measures.

• At the time of this survey, cluster outbreaks in hospitals and the spread of infection among HCWs had become a major problem in Japan. Hence, strengthening the training for HCWs on optimal preventive and protective measures for infection is an urgent need to maintain the efficiency of cardiovascular care during the COVID-19 pandemic.

Testing Health Care Workers

The World Health Organization has called for increased molecular testing in response to the COVID-19 pandemic, but different countries have taken very different approaches. Researchers used a simple mathematical model to investigate the potential effectiveness of alternative testing strategies for COVID-19 control. Weekly screening of healthcare workers (HCWs) and other at-risk groups using PCR or point-of-care tests for infection irrespective of symptoms is estimated to reduce their contribution to transmission by 25-33%, on top of reductions achieved by self-isolation following symptoms. Widespread PCR testing in the general population is unlikely to limit transmission more than contact tracing and quarantine based on symptoms alone, but could allow earlier release of contacts from quarantine. Immunity passports based on tests for antibody or infection could support return to work but face significant technical, legal and ethical challenges. Testing is essential for pandemic surveillance but its direct contribution to the prevention of transmission is likely to be limited to patients, HCWs and other high-risk groups.

Psychological impact of COVID-19 on Health Care Workers

During this pandemic, front-line HCWs are confronted with the clearest and immediate effects of COVID-19. While other workforces are required to work from home or reduce their physical interactions at work, the availability of healthcare workers has become of utmost importance. Constant awareness of the devastating effects of COVID without an effective vaccine to be delivered in the next few months can cause psychological stress.

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Psychological stress has been observed in previous infectious disease outbreaks such as SARS and Ebola, where HCWs experienced acute stress reactions\textsuperscript{21}.

In the epicentres of this pandemic, research has shown an increase in reported distress and depression among HCWs. In China, more than 70\% of HCWs reported distress, while in New York death by suicide has been reported in frontline workers\textsuperscript{22, 23}.

A key concern among HCWs is not only contracting the disease, but the potential of transmitting it to family and loved ones. A cross-sectional web survey in the US found that 74\% of HCWs had this concern, and over 60\% were concerned about maintaining social distancing from family and about the lack of control and uncertainty during the COVID-19 pandemic\textsuperscript{24}. Fear of transmitting COVID-19 to others is a consistent theme among research into the psychological effects of COVID-10 on HCWs. Other sources of distress included a potential shortage of personal protective equipment (PPE).

Of the 657 HCWs that completed the survey, the percentages of participants who screened positive for acute stress, depression and anxiety was quite high, however it is noted that nurses were most psychologically affected (Figure below).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{chart.png}
\caption{Percentage of HCWs screened positive for acute stress, depression and anxiety.}
\end{figure}

\textsuperscript{21} https://www.who.int/bulletin/volumes/94/3/15-158543/en/
\textsuperscript{22} https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2763229
\textsuperscript{24} https://www.sciencedirect.com/science/article/pii/S0163834320300839
**SCIENCE AND RESEARCH UPDATES | ROLE OF AEROSOLS IN THE TRANSMISSION OF SARS-CoV-2**

**Airborne Transmission of COVID-19**

As many countries are currently going through second waves of coronavirus epidemics, it is important to re-assess the dynamics of how the virus is transmitted. There are the more typically known sources of transmission which involve viral droplets expelled from an infected individual either landing on another person (direct transmission) or on a surface or object (indirect transmission). However, as the pandemic has progressed, many researchers are calling for another form of transmission to be recognised and accounted for when considering prevention strategies: aerosol spread.

Aerosol or airborne transmission is the inhalation of viral laden droplets or aerosols by an individual. The spread of COVID-19 through aerosols is of great concern when considering the role of asymptomatic and pre-symptomatic individuals who may not transmit the virus through the well-known mechanisms of droplet or surface contamination. Previous research has estimated that at least 15% of transmission has occurred through asymptomatic cases\(^{25}\). Viral particles can be expelled from an infectious individual through speaking, singing, breathing, coughing, or sneezing. In the absence of symptoms, asymptomatic individuals may primarily transmit through simply breathing or speaking.

Viral particles can be encapsulated in globules of mucus, saliva, and water, with the behaviour of the droplet depending on the size. Larger droplets fall more quickly and can land on surfaces while small droplets are able to evaporate quickly and linger in the air in the form of aerosols. These small globules can drift further away from the point of origin than the larger droplets, which is a concern when considering what the optimal social distancing distance is.

\(^{25}\) [https://www.medrxiv.org/content/10.1101/2020.05.10.20097543v2](https://www.medrxiv.org/content/10.1101/2020.05.10.20097543v2)

Aerosol transmission may have also played a role in various super-spreading events, which is plausible given the settings and activities. For example, there have been incidents where increased vocalisation led to an outbreak such as during choir practice in Washington DC\textsuperscript{27}, as well as in karaoke bars in South Korea\textsuperscript{28}. Severity of aerosol transmission can vary based on the setting, with airplanes, cars and public transport being potentially high risk settings. Offices, hotels and apartments lacking windows that can be opened may also be high-risk. These settings may not receive much natural ventilation and require individuals to remain in a confined space for an extended period.

Among researchers, the mechanisms of how SARS-CoV-2 may spread in aerosol form are not yet fully understood although there is a consensus that this form of transmission must be recognised by international health authorities such as the WHO, as failure to recognise this route of transmission would lead to not addressing all necessary airborne interventions. Interventions to prevent aerosol spread are highly relevant to preventing transmission in critical healthcare areas such as hospitals and aged care. In late March, the WHO stated there was insufficient evidence for airborne spread of SARS-CoV-2 outside of a handful of medical contexts\textsuperscript{29}.

One study in the US was able to demonstrate viable SARS-CoV-2 in aerosols for up to 3 hours, although this was in a highly artificial environment which may not reflect the natural settings for COVID-19\textsuperscript{30}. The co-author of the study, Professor Jamie Lloyd-Smith stated that a “non-zero risk of longer-range spread through the air” is worth taking precautionary measures for.

In early July, an open letter linked to 239 scientists titled “It is Time to Address Airborne Transmission of COVID-19” was written to address the WHO’s absent stance on airborne transmission. An infectious disease epidemiologist at the University of Minnesota stated that we should not “let perfect be the enemy of convincing” when it comes to aerosol spread, as clearer evidence for airborne transmission could take years and can cost lives in the meantime\textsuperscript{31}. On 9 July, a new scientific brief by the WHO was released which included scientific evidence on airborne transmission\textsuperscript{32}.

The severity of airborne transmission is heavily dependent on environmental factors including but not limited to temperature, relative humidity and radiation from sunlight. These factors can alter the viability and infectivity of the virus. Preventive measures can include\textsuperscript{33}:

- Increased ventilation rate
- Use of natural ventilation
- Avoiding re-circulation of air
- Avoiding direct air flow from another person
- Minimising the number of people sharing the same environment

\textsuperscript{27} https://www.cdc.gov/mmwr/volumes/69/wr/mm6919e6.htm
\textsuperscript{28} https://www.thejakartapost.com/life/2020/05/16/from-itaewon-to-hongdae-coronavirus-spread-through-karaoke-rooms.html
\textsuperscript{29} https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations
\textsuperscript{30} https://www.nejm.org/doi/full/10.1056/nejmc2004973
\textsuperscript{31} https://www.nature.com/articles/d41586-020-00974-w
\textsuperscript{32} https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions
\textsuperscript{33} https://pubmed.ncbi.nlm.nih.gov/30116608/
In addition to these measures, widespread face mask use can offer a level of protection from aerosols, however the type of mask can influence the level of protection. A recent study looked at the effectiveness of masks to prevent droplets spreading during conversation and found that scarf-like masks (including neck fleece and bandanas) conferred the least protection and prevention of droplet spread\(^{34}\). The study also found that use of these types of masks displayed a dispersion of larger droplets into multiple smaller droplets, which is counterproductive as a preventative measure.

Further research on aerosol spread requires an inter-disciplinary approach not only to understand the biological underpinnings, but the physics and aerodynamics of air flow. The WHO urges that high-quality research is necessary to elucidate the role of airborne transmission in the absence of aerosol generating procedures. This research can provide valuable insights into how it is transmitted and can provide information on how we can best prepare against it.

\(^{34}\) https://advances.sciencemag.org/content/early/2020/08/07/sciadv.abd3083
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