

International Horizon Scanning and Learning to Inform Wales' COVID-19 Public Health Response and Recovery

Report 11, 09/07/2020



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Collaborating Centre on
Investment for Health and Well-being



Overview





The International Horizon Scanning and Learning work stream was initiated following and informing the evolving coronavirus (COVID-19) public health response and recovery plans in Wales. It focuses on COVID-19 international evidence, experience, measures, transition and recovery approaches, to understand and explore solutions for addressing the on-going and emerging health, wellbeing, social and economic impacts (potential harms and benefits).

The learning and intelligence is summarised in weekly reports to inform decision-making. These may vary in focus and scope, depending on the evolving COVID-19 situation and public health/policy needs. The reports provide high-level summary of emerging evidence from country experience and epidemiology, research papers and key organisations' guidance or reports, including sources of information to allow further exploration. The reports do not provide detailed or in-depth data/evidence analysis and need to be considered with caution.

This work is aligned with and feeding into the Welsh Government Office for Science and into Public Health Wales Gold Command. It is part of a wider Public Health Wales' systematic approach to intelligence gathering to inform comprehensive, coherent, inclusive and evidence-informed policy action, which supports the Wellbeing of Future Generations (Wales) Act and the Prosperity for All national strategy towards a healthier, more equal, resilient, prosperous and globally responsible Wales.

Disclaimer: The reports collate views / conclusions of different organisations and from different countries, which do not necessarily reflect the position of Public Health Wales. Due to the novelty of COVID-19 virus/disease, and dynamic change in situation, studies and evidence can be conflicting, inconclusive or depending on country / other context.

In focus this week

-  **Outbreak hot-spots and transmission routes**
-  **Human behaviour during pandemics**
-  **Seasonal variation and transmission**
-  **Country epidemiology update**

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At a glance: summary of international learning on COVID-19

“We have a shared responsibility to ensure that all people have access to the tools to protect themselves, especially those who are most at risk.”

Dr Tedros Adhanom Ghebreyesus, WHO Director-General

Outbreak hot-spots and transmission routes

- ✚ COVID-19 pandemic shows high local (regional/district/city) variation and is a significantly **regionalized phenomenon with clusters / local outbreaks** in many countries
- ✚ **Disparities in COVID-19 morbidity and mortality** have a geographical footprint, showing residential clustering of social class and ethnicity, compounded by the living environment
- ✚ **Lower-income neighbourhoods** with high population density, less access to green spaces and greater air pollution, **suffer disproportionately** and need targeted support
- ✚ **Meat packing/processing settings** ([highlighted in report 10](#)), **residential nursing/care homes and indoor markets** have been significantly affected by the COVID-19 outbreak
- ✚ **High proportion of Long Term Care Facilities** globally reported COVID-19 outbreaks, with high rates of **morbidity, case fatality in residents and staff absenteeism**
- ✚ **Indoor markets’** outbreaks have **wider impacts**, disrupting food supply chains and food production; loss of income and labour shortages, creating tensions and **food insecurity**
- ✚ Transmission of COVID-19 commonly occurs in **closed indoor spaces with poor ventilation**
- ✚ **Heating, ventilation and air conditioning** systems may have a role in **decreasing, or sometimes increasing, transmission in indoor spaces**
- ✚ The **faecal-oral transmission cannot be excluded** as COVID-19 transmission route
- ✚ **Water, sanitation and hygiene measures** are key for providing adequate care and protecting patients, staff and caregivers
- ✚ COVID-19 **transmission route via food and its packaging** is considered **highly unlikely and generally low risk**
- ✚ **Stability of COVID-19 virus on surfaces and in the air vary**, depending on temperature, humidity, etc. and research on different routes and risks for transmission continue

More information is summarised [on pp.5-12](#)

Human behaviour during pandemics

- ✚ **Three types of behaviour** identified: preventive, avoidant and management of disease
- ✚ Every mass public health intervention raises **ethical and human rights concerns**
- ✚ Being **older, female, more educated, or non-white**, is associated with a higher chance of **adopting protective behaviours**
- ✚ **Inequalities in access to resources** can affect the ability to comply with recommended behaviours
- ✚ **Key predictors of** adherence to / compliance with measures, include: levels of perceived susceptibility to, severity of and risk from the disease; belief in the effectiveness of the recommended behaviours; levels of anxiety, fear and trust in authorities
- ✚ **‘Optimism bias’** is the belief that bad things are less likely to happen to oneself, useful for avoiding negative emotions, but also underestimating risk and reducing compliance
- ✚ **Communication strategies** must strike a **balance** between breaking through optimism bias without inducing excessive feelings of anxiety and fear

- ✚ **Messages are most influential** when accurate, clear, uncomplicated, not sensationalistic or alarmist, as reassuring as possible, and targeted to specific communities / groups
- ✚ **Weather has an effect on population behaviour**, such as, people spend most of their time indoors in cold/cooler weather; and physical activity increases in spring / summer
- ✚ Most **secondary cases of COVID-19 virus transmission occur in public/community settings** where social distancing should be maintained after easing lockdown

More information is summarised **on pp. 13-15**

Seasonal variation and transmission

- ✚ **Meteorological parameters can play substantial role** in the transmission of infectious diseases and the variation of incidence rates
- ✚ Many **infectious diseases spread more in cold weather** when people stay mostly indoors; and **transmission decreases in warmer weather** when people go outdoors more and ventilate their homes more often
- ✚ **Meteorological conditions can influence the viability and concentration of COVID-19 virus**, which decrease at higher temperatures (e.g. 38°C) and relative humidity more than 95%
- ✚ COVID-19 pandemic can **amplify the health risks from heat due to synergetic risk factors**, such as, older age, underlying chronic heart, lung and kidney conditions, etc.
- ✚ **Coronaviruses are more stable at low temperatures and low humidity**, which may facilitate community transmission in subtropical areas in spring and in air-conditioned environments
- ✚ The weather effect can be minimal and estimates are subject to significant biases, reinforcing the **need for robust public health measures**
- ✚ Particulate matter, including **droplets, tend to last longer in an environment with cold winds and less humidity**
- ✚ There is evidence that **vitamin D deficiency may contribute to increased risk of influenza and other respiratory tract infections**

More information is summarised **on pp. 16-18**

Outbreak hot-spots and transmission routes

Spatial patterns of the COVID-19 pandemic outbreak¹

- In many countries COVID-19 outbreak shows high regional/district/city variation and is a significantly regionalized phenomenon (*Figure 1*)
- Outbreak cluster patterns can be distorted by differences in testing and reporting in countries
- Countries with lower overall number of COVID-19 cases have generally been found to have contained the virus more successfully in one or two concentrated areas; while the worst affected countries have less localised concentration and multiple hot-spots. This could be connected with the timing and effectiveness of lockdown measures
- Comparing the number of confirmed COVID-19 cases in a region with the number that would be expected if all cases in a country were distributed in proportion to the population is a helpful measure (*Figure 2*)
- Disparities in COVID-19 morbidity and mortality between social cohorts have a geographical footprint, showing residential clustering of social class and ethnicity
- Unequal COVID-19 impact may be compounded by the living environment - lower-income neighbourhoods tend to have higher population density, less access to green spaces, and greater air pollution, all potentially aggravating factors
- Communities that suffer disproportionately high mortality rates from COVID-19 would be weakened economically and socially
- Local-level data collection and targeted support are necessary to rebuild local economies and social infrastructure and to overcome emotional trauma

Country example: Australia^{2,3,4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14} (*Figure 3*)

Localised outbreak post easing lockdown

- Victoria has recorded a significant spike in COVID-19 cases since lockdown eased: 127 new cases on 6th July and 191 on the 7th July
- Localities with a lower socioeconomic profile and higher number of ethnic minorities are reporting an increased number of infections
- On 2nd July, authorities locked down 12 areas of Melbourne, including strict lockdown for nine social housing towers with 3,000 residents, banned from leaving their homes for at least five days. Many residents have underlying health conditions and are living in overcrowded, cramped spaces
- Smaller localised outbreaks also recorded in neighbouring New South Wales (NSW)

¹ <http://imagine-project.eu/2020/05/13/covid-19-territorial-inequalities-and-spatial-justice-part-one/>

² <https://app.powerbi.com/view?r=eyJrIjoia0DBmMmE3NWQzZWNIINC00OWRkLTk1NjYtMjYTYTY1MjI2ZjliiwidCl6ImMwZTA2MDFmLTBmYWwtNDQ5Yy05Yzq4LWExMDRjNGViOWYyOCJ9>

³ <https://www.theguardian.com/world/2020/jun/29/victorias-coronavirus-spike-whats-causing-it-and-is-anyone-to-blame>

⁴ <https://theconversation.com/nine-melbourne-tower-blocks-put-into-hard-lockdown-what-does-it-mean-and-will-it-work-142033>

⁵ <https://www.bloomberg.com/news/articles/2020-07-06/melbourne-second-wave-signals-setback-to-tourism-education-hub>

⁶ <https://www.bloomberg.com/news/articles/2020-07-06/australia-s-most-populous-states-to-close-shared-border>

⁷ Department of Health and Human Services, Victoria

⁸ <https://www.covid19data.com.au/>

⁹ <https://www.theguardian.com/australia-news/2020/jun/28/coronavirus-victoria-experts-warn-against-blaming-migrant-communities-for-spreading-misinformation>

¹⁰ <https://www.news.com.au/world/coronavirus/australia/coronavirus-australia-live-all-residents-in-melbourne-banned-from-nsw/live-coverage/284785987152496de2b907a4420e90df>

¹¹ <https://www.theguardian.com/australia-news/2020/jul/07/coronavirus-victoria-update-191-new-covid-19-cases-as-community-transmission-soars>

¹² <https://theconversation.com/metropolitan-melbourne-and-mitchell-shire-return-to-lockdown-this-is-just-how-vigilant-we-have-to-be-until-a-covid-19-vaccine-is-found-142165>

¹³ <https://www.sbs.com.au/news/what-is-the-dangerous-misinformation-that-is-stopping-melburnians-getting-tested-for-covid-19>

¹⁴ <https://www.sbs.com.au/news/government-rubbishes-reports-migrant-communities-weren-t-included-in-coronavirus-response>

- One third of the new cases are amongst people in their 20s and 30s

New lockdown measures, stopping the spread

- The border between NSW and Victoria, Australia's most populous territories, is closing at midnight 8th July for six weeks, enforced by police and military personnel, with fines and potential incarceration for attempting to cross without a permit
- Limited number of people granted boarder passes to allow crossing, such as key workers and people receiving essential medical treatment
- Residents are receiving hardship payments from the government and have had their rents waived for the next fortnight

Contributing factors

- Prohibitive lockdown measures and low case numbers early in the pandemic meant that people started relaxing and questioning the need for social distancing
- High risk categories identified as family clusters, quarantine hotel staff and health providers
- Safety breaches at Melbourne's quarantine hotels investigated, such as a lack of training in infection prevention and control
- Gatherings of extended families, encompassing multiple households and suburbs
- Most infections emerging from community transmission and not from returning overseas travellers (1,079 infections from contact with a confirmed case; 979 from travel overseas)
- 'Silent' transmission and cold, winter weather also highlighted as a potential factor
- Lack of targeted messaging for communities with English as a second language and the spread of misinformation online

Increased testing, confirming more cases

Figure 1. Relative regional concentration of COVID-19 cases for selected countries (%): in April, 69% of confirmed cases in Finland were reported in the Helsinki region; 60% in the Norte region in Portugal; 58% in the Oslo region in Norway; 57% in the Attica region in Greece; 56% in the Hovedstaden region of Denmark; and 55% in the Yugozapaden region in Bulgaria

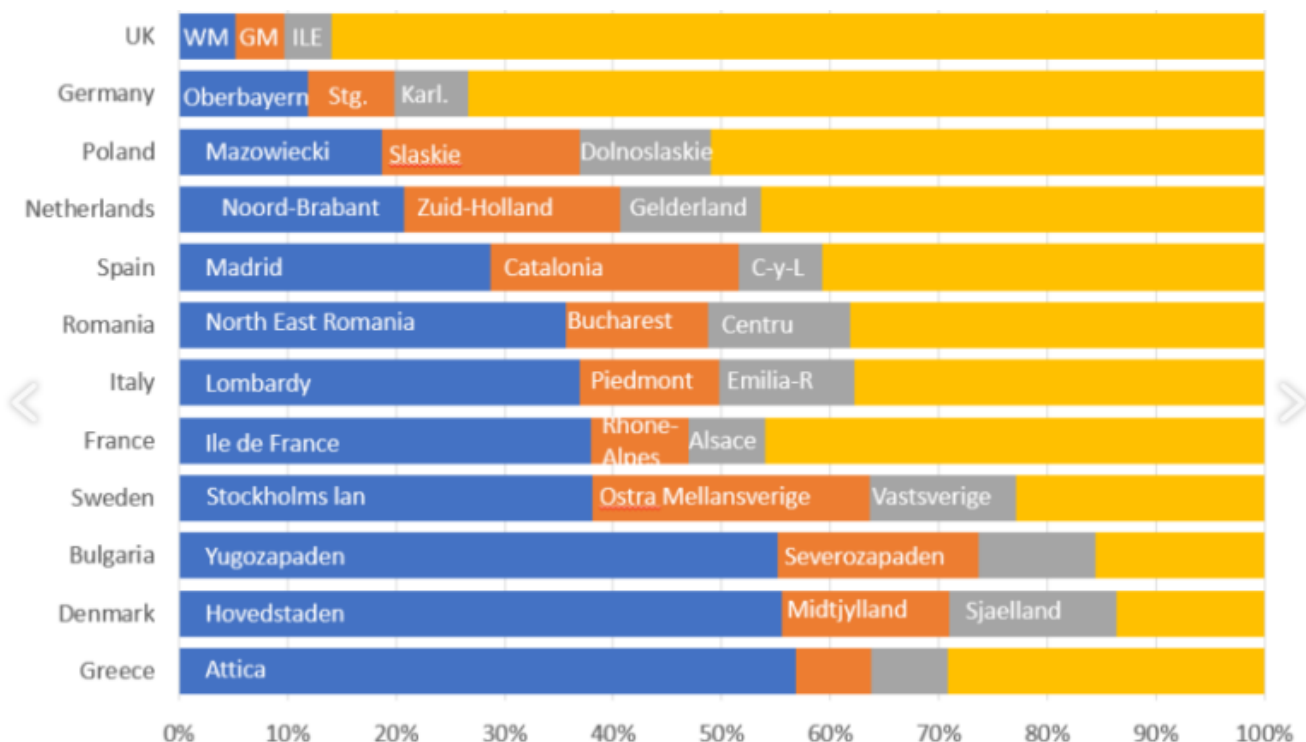


Figure 2. Regional proportionate distribution of COVID-19 cases in different countries

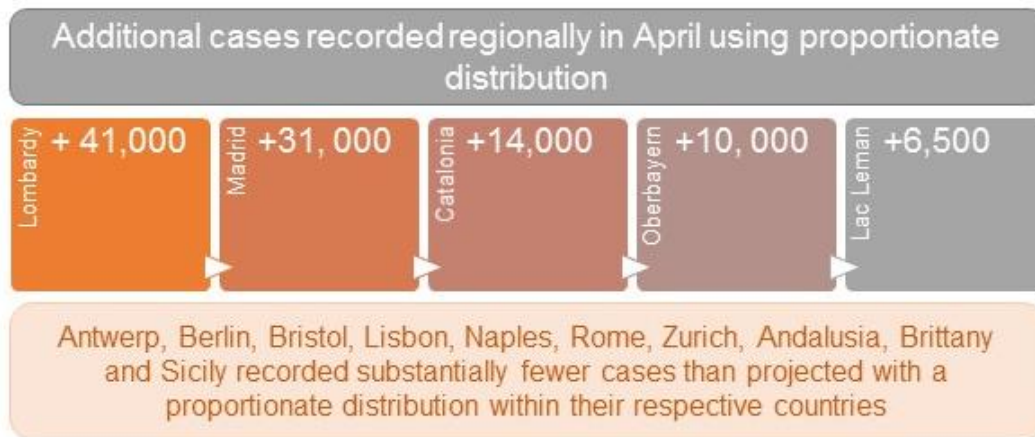
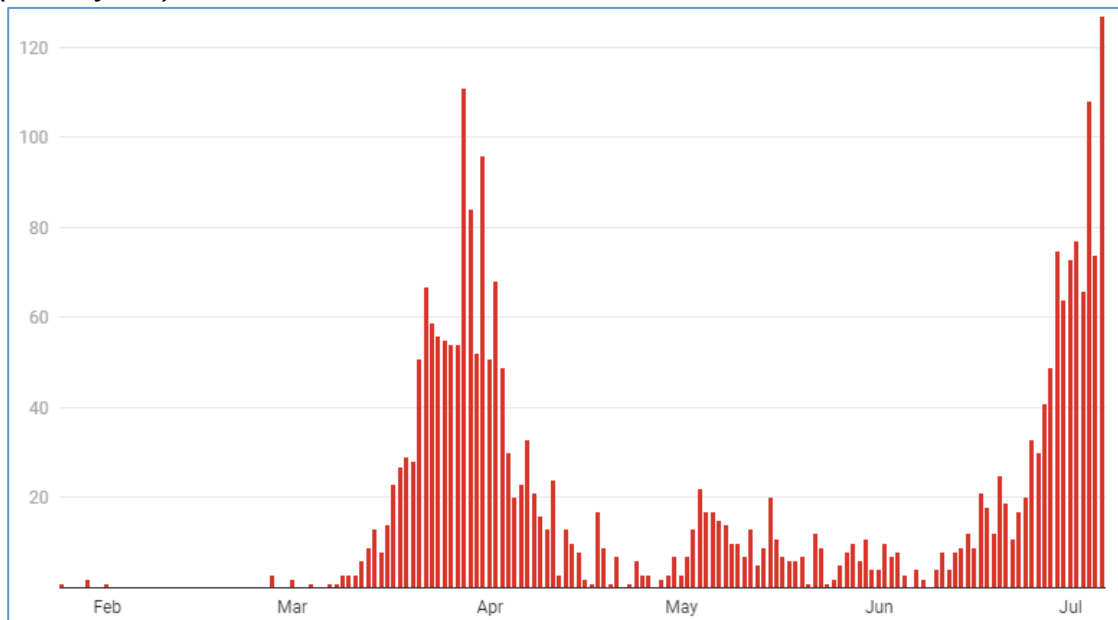


Figure 3. COVID-19 case curve in Victoria, Australia: new cases by day since first reported case (January 25th)



Setting specific hot-spots

Residential (nursing / care) homes

- Residential care/nursing homes have been significantly affected by COVID-19
- Early in the pandemic, a high proportion of Long Term Care Facilities globally reported COVID-19 outbreaks, with high rates of morbidity and case fatality in residents; and high rates of staff absenteeism
- Up to 50% of all COVID-19 deaths to date have occurred among care home residents in Europe (WHO estimates)
- Approximately 80,000 care home residents have now died of COVID-19; hundreds of care workers have died and tens of thousands have been infected¹⁵

¹⁵ <https://www.wsws.org/en/articles/2020/06/01/caeu-j01.html>

- 19,394 people died with COVID-19 in care homes across England and Wales between 2nd March and 12th June¹⁶
- 20% of people living in care homes in England became infected with COVID-19 in the 56% of care homes that had at least one confirmed case¹⁷

1 in 5 people living in care homes in England became infected with COVID-19 between March and June 2020

Country examples

- A nursing facility in **Washington State, US**, recorded 64% of their residents tested positive for COVID-19, 23 days after the first case was confirmed
- In **Belgium**, 51% of the 9,052 COVID-19 related fatal cases reported from Long Term Care Facilities, with only 23% of cases laboratory-confirmed (as of 17th May)
- Between 1st March and 11th May, 7,469 facilities reported COVID-19 cases in **France**, of which 66% were in nursing homes for the elderly and 34% were at other Long Term Care Facilities, such as facilities for disabled persons or children and young adults
- In **Norway**, 61% of all 224 fatal cases reported by 11th May were in 'home care' or 'other health institutions'
- In **Spain**, 17,730 fatalities reported from 5,400 affected care-home residents, representing 66% of all fatal cases linked to COVID-19 (as of 11th May)
- In **Sweden**, 212 of 400 Long Term Care Facilities in the Stockholm region reported 1,711 COVID-19 cases, representing 45% of 1,406 deaths in Stockholm
- **Germany** reported 22,071 infections related to institutions caring for the elderly (long-term care, nursing homes), people with disabilities, homeless, migrants, or those in prisons (as of 17th May). Of these, 8,536 cases were staff (42 died) and 14,740 cases were residents. Of the residents, 20% died, representing 37% of all 7,914 deaths related to COVID-19 in Germany¹⁸. COVID-19 outbreaks continue to be reported sporadically in nursing homes¹⁹
- Residential care also accounts for a high proportion of COVID-19 fatalities in **Ireland** (62% of 1,500 deaths); **Portugal** (40% of 1,125 deaths); and **Austria** (41% of 510 deaths)²⁰

Indoor markets

- Market settings may increase the risk and challenge of containing the COVID-19 spread through less physical distancing and hygiene; crowded space and transport conditions²¹
- Disruption in food supply chains and shocks, affecting food production, loss of income and remittances, are creating strong tensions and food security risks in many countries
- Outbreaks in markets have a wider impact, such as labour shortages (due to morbidity, movement restrictions, social distancing rules), and are in turn having a knock on effect for producers, processors, traders and truck/logistics companies in food supply chains, particularly for food products that require workers to be in close proximity
- The United Nations World Food Programme has warned that an estimated 265 million people could face acute food insecurity by the end of 2020²²
- Food producers also face large losses on perishable and nutritious food as buyers have become limited and traders stop engaging with farmers

¹⁶ <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/deathsinvolvedwithcovid19inthecaresectorenglandandwales/deathsoccurringupto12june2020andregisteredupto20june2020provisional>

¹⁷ <https://www.newscientist.com/article/2237475-covid-19-news-almost-20000-care-home-deaths-in-england-and-wales/>

¹⁸ <https://www.ecdc.europa.eu/sites/default/files/documents/covid-19-long-term-care-facilities-surveillance-guidance.pdf>

¹⁹ https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Situationsberichte/2020-07-05-en.pdf?__blob=publicationFile

²⁰ <https://www.wsws.org/en/articles/2020/06/01/caeu-j01.html>

²¹ <https://news.cgtn.com/news/2020-06-14/Global-COVID-19-Roundup-Fears-food-markets-are-new-hotbed--RjASf1utRS/index.html>

²² <https://insight.wfp.org/covid-19-will-almost-double-people-in-acute-hunger-by-end-of-2020-59df0c4a8072>

Country examples

- The Central de Abasto in **Mexico**, one of the world's biggest fruit and vegetable markets, has become a hot-spot for COVID-19 infections and has been closed. There are 90,000 workers within the market and produce is distributed throughout the country²³
- One of five stallholders (20%) tested positive for COVID-19 at a popular street market in **Lima, Peru**. The authorities launched spot tests in the Caquéta food market, which showed how rapidly the coronavirus was spreading in spite of Peru's stringent lockdown²⁴
- **Seattle American** Seafoods confirmed that 92 fishermen from its American Dynasty ship, nearly 3/4 of the 124 members on board, tested positive for COVID-19²⁵
- **Beijing's** Xinfadi largest wholesale food market and 11 surrounding neighbourhoods were locked down after more than 50 people in the capital tested positive in early June (first confirmed cases in 50 days)²⁶

Transmission routes and factors perpetuating hot-spots

Heating, ventilation and air-conditioning systems²⁷

- Poor ventilation in confined indoor spaces is associated with increased transmission of respiratory infections, such as the COVID-19 virus (SARS-CoV-2)
- Numerous COVID-19 transmission events have occurred in closed indoor spaces, including some from pre-symptomatic cases
- The role of ventilation in preventing COVID-19 transmission is not well-defined, i.e. by preventing dispersal of infectious particles to minimise the risk of transmission, or preventing transfer of an infectious dose to susceptible individuals
- COVID-19 is thought to be primarily transmitted via large respiratory droplets
- An increasing number of outbreak reports implicate the role of aerosols, consisting of small droplets and droplet nuclei, which remain in the air for longer than large droplets
- Well-maintained ventilation systems, including air-conditioning units, securely filter large droplets containing SARS-CoV-2
- It is possible for COVID-19 aerosols to spread through ventilation / air-conditioning systems in a building or vehicle, if air is recirculated; and generated air flow may facilitate the spread of infectious droplets longer distances within indoor spaces
- There is currently no evidence of human infection caused by infectious aerosols distributed through ventilation systems and the risk is rated as very low
- Heating, ventilation and air conditioning systems may have a complementary role in decreasing transmission in indoor spaces by increasing the rate of air change, decreasing recirculation of air and increasing the use of outdoor air
- Inadequate and poorly designed ventilation in crowded public places and urban transit systems may increase exposure to air-borne pathogens
- Higher relative humidity may also affect the stability of air-borne droplets in which pathogens transmit from person to person

²³ <https://www.aljazeera.com/news/2020/06/mexico-citys-biggest-food-market-covid-19-hotspot-200607104309125.html>

²⁴ <https://newsus.cgtn.com/news/2020-05-01/Peru-food-markets-are-hotspots-for-COVID-19-Q7YjRFvcdO/index.html>

²⁵ <https://news.cgtn.com/news/2020-06-14/Global-COVID-19-Roundup-Fears-food-markets-are-new-hotbed--RjASf1utRS/index.html>

²⁶ <https://news.sky.com/story/coronavirus-china-reports-surge-in-covid-19-cases-after-beijing-shuts-food-market-12006390>

²⁷ <https://www.ecdc.europa.eu/sites/default/files/documents/Ventilation-in-the-context-of-COVID-19.pdf>

Drinking water and faecal-oral transmission route^{28,29,30}

- Detection of viable SARS-CoV-2 in stools of COVID-19 positive patients has been reported and virus RNA has been found in sewage increasing the risk of faecal-oral transmission
- It is known that flushing toilets can create plumes containing droplets and droplet residue when toilets are flushed with open lids
- As viral fragments have been found in excretions and because of other potential infectious disease risks, wastewater should be treated in well-designed and well-managed centralized wastewater treatment works
- While the presence of the COVID-19 virus in untreated drinking-water is possible, it has not been detected in drinking-water supplies
- There is no evidence to date that the COVID-19 virus is transmitted via sewage systems, with or without wastewater treatment
- Existing recommendations for water, sanitation and hygiene measures in health care settings are important for providing adequate care and protecting patients, staff and caregivers from infections
- **WASH-related actions are particularly important**, including:
 - ✓ engaging in frequent hand hygiene using appropriate techniques
 - ✓ implementing regular environmental cleaning and disinfection practices
 - ✓ managing excreta (faeces and urine) safely
 - ✓ safely managing health care waste produced by COVID-19 cases

Surface transmission

Analysis and evaluation of the stability of SARS-CoV-2 (COVID-19) and SARS-CoV-1 (SARS coronavirus) in aerosols and on various surfaces and an estimation of their decay rates was undertaken. Data consisted of 10 experimental conditions involving the two viruses in five environmental settings (aerosols, plastic, stainless steel, copper, and cardboard) (*Figure 4*)³¹:

- Both viruses had an exponential decay in virus titre across all experimental conditions
- SARS-CoV-2 remain viable in aerosols throughout the duration of the experiment (3 hours) with a small reduction in the infectious titre³², similar to that observed with SARS-CoV-1
- SARS-CoV-2 is more stable on plastic and stainless steel than on copper and cardboard. Viable virus was detected up to 72 hours after application to these surfaces with the virus titre greatly reduced
- The dried virus SARS-CoV-1 on smooth surfaces retain its viability for over 5 days at temperatures of 22–25°C and relative humidity of 40–50%, that is, typical air-conditioned environments. Virus viability was rapidly lost at higher temperatures and higher relative humidity³³
- Stability of SARS-CoV-2 is similar to that of SARS-CoV-1 under experimental conditions, which indicates that differences in their epidemiologic characteristics probably arise from other factors, including high viral load in the upper respiratory tract and the potential for persons infected with SARS-CoV-2 to shed and transmit the virus while asymptomatic

²⁸ <https://www.sciencedirect.com/science/article/pii/S0048969720324360>

²⁹ https://www.rehva.eu/fileadmin/user_upload/REHVA_COVID-19_guidance_document_ver2_20200403_1.pdf

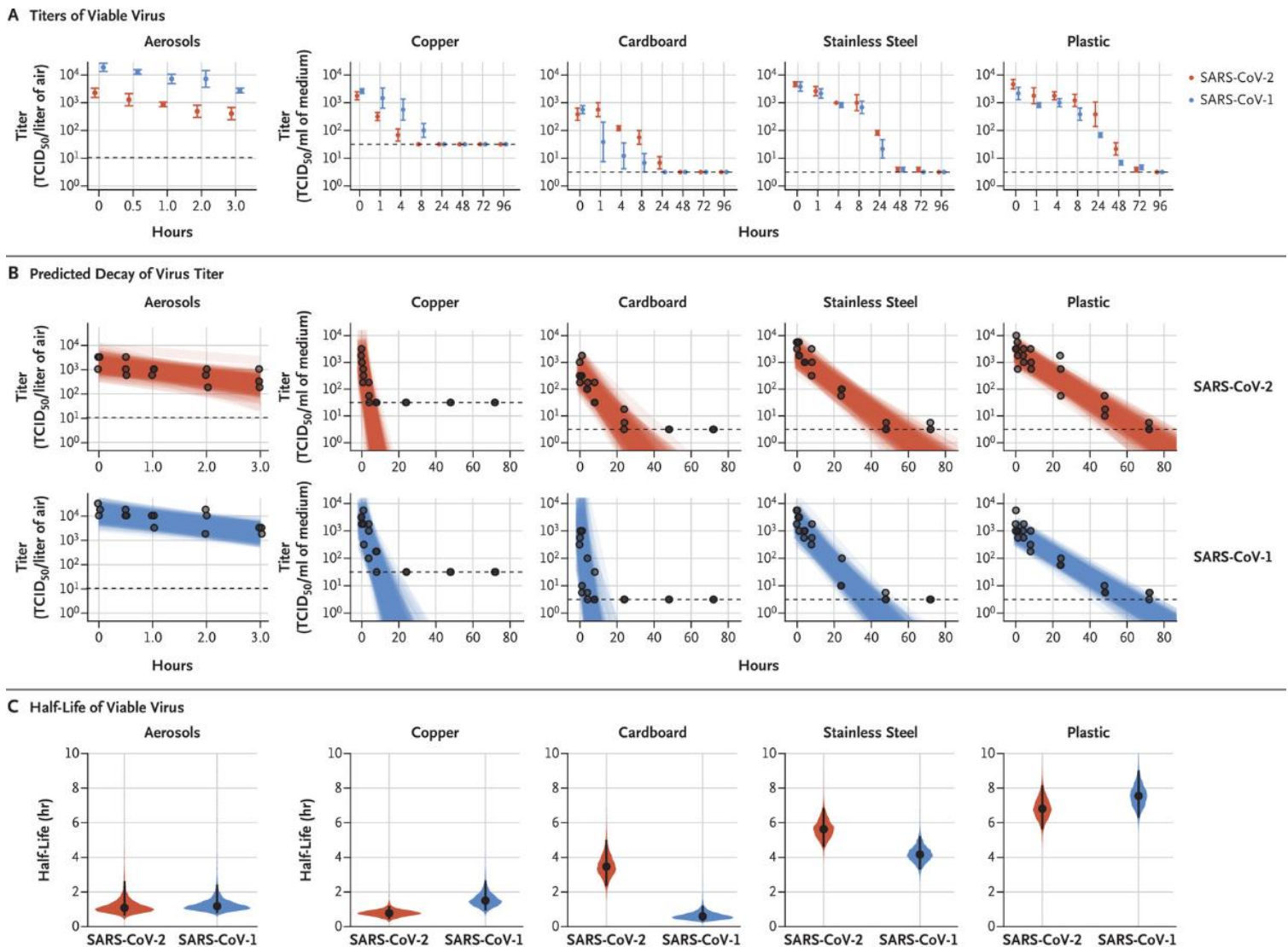
³⁰ <https://www.who.int/publications/i/item/water-sanitation-hygiene-and-waste-management-for-covid-19>

³¹ <https://www.nejm.org/doi/full/10.1056/nejmc2004973>

³² Titre is a way of expressing concentration

³³ <https://www.hindawi.com/journals/av/2011/734690/>

Figure 4: Viability³⁴ of SARS-CoV-1 and SARS-CoV-2 in aerosols and on various surfaces



While transmission via surfaces (including food and packaging) is theoretically possible³⁵:

- Currently, there is no evidence that food is associated with COVID-19 virus spread
- The risk of getting COVID-19 from food products, food packaging, or shopping bags; from food cooked at home or from handling / consuming food from restaurants, take-out or drive-through; and from fruit and vegetables grocery stores, is considered very low³⁶
- There is no evidence of virus transmission from staff to consumers through the food or packaging in stores or food processing/handling settings
- COVID-19 transmission route via food and its packaging is considered highly unlikely by the WHO, but cannot be completely ruled out³⁷

³⁴ Virus viability is the ability of a microbe/virus to survive under given conditions

³⁵ <https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/food-and-COVID-19.html>

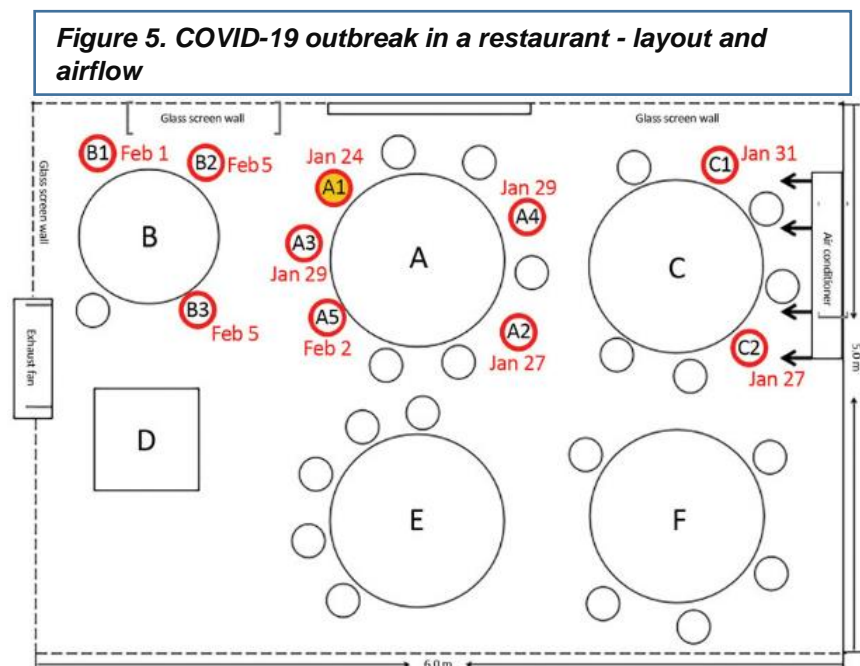
³⁶ <https://www.mayoclinic.org/diseases-conditions/coronavirus/expert-answers/can-coronavirus-spread-food-water/faq-20485479>

³⁷ file:///C:/Users/AN168472/Downloads/WHO-2019-nCoV-Food_Safety-2020.1-eng.pdf

- One study³⁸ showed capability of the COVID-19 virus to remain viable on differing surfaces for extended time periods (including cardboard for up to 24 hours). However, the study took place under experimental conditions with controlled levels of humidity and temperature³⁹, which limits its validity and generalisability

Country example: China outbreak associated with air conditioning in a restaurant⁴⁰

- On 24th January, a total of 91 persons (83 customers, 8 staff) were in a restaurant with 15 tables for lunch (*Figure 5*)
- Among the 83 customers, 10 became ill with COVID-19; the other 73 were identified as close contacts and quarantined for 14 days
- During that period, no symptoms developed, and throat swab samples from the contacts and 6 smear samples from the air conditioner (3 from the air outlet and 3 from the air inlet) were negative
- The index patient (patient A1) was asymptomatic during the lunch
- Given the incubation periods for family B, the most likely scenario is that all 3 family B members were directly infected by patient A1. It is not conceivable to exclude the possibility that patients B2 and B3 were infected by patient B1, the first family B member to become ill.
- For family C, a possible scenario is that both patients C1 and C2 were infected by patient A1; another scenario is that the patient C1 acquired the infection while caring for patient C2, beginning on 27th January
- In this outbreak, droplet transmission was prompted by air-conditioned ventilation
- The key factor for infection was the direction of the airflow
- Patient B3 was afebrile and 1% of the patients in this outbreak were asymptomatic, providing a potential source of outbreaks among the public
- **Recommendations** to prevent spread of COVID-19 in restaurants include increasing the distance between tables and improving ventilation



³⁸ <https://www.nejm.org/doi/pdf/10.1056/NEJMc2004973?articleTools=true>

³⁹ https://ec.europa.eu/food/sites/food/files/safety/docs/biosafety_crisis_covid19_gandas_en.pdf

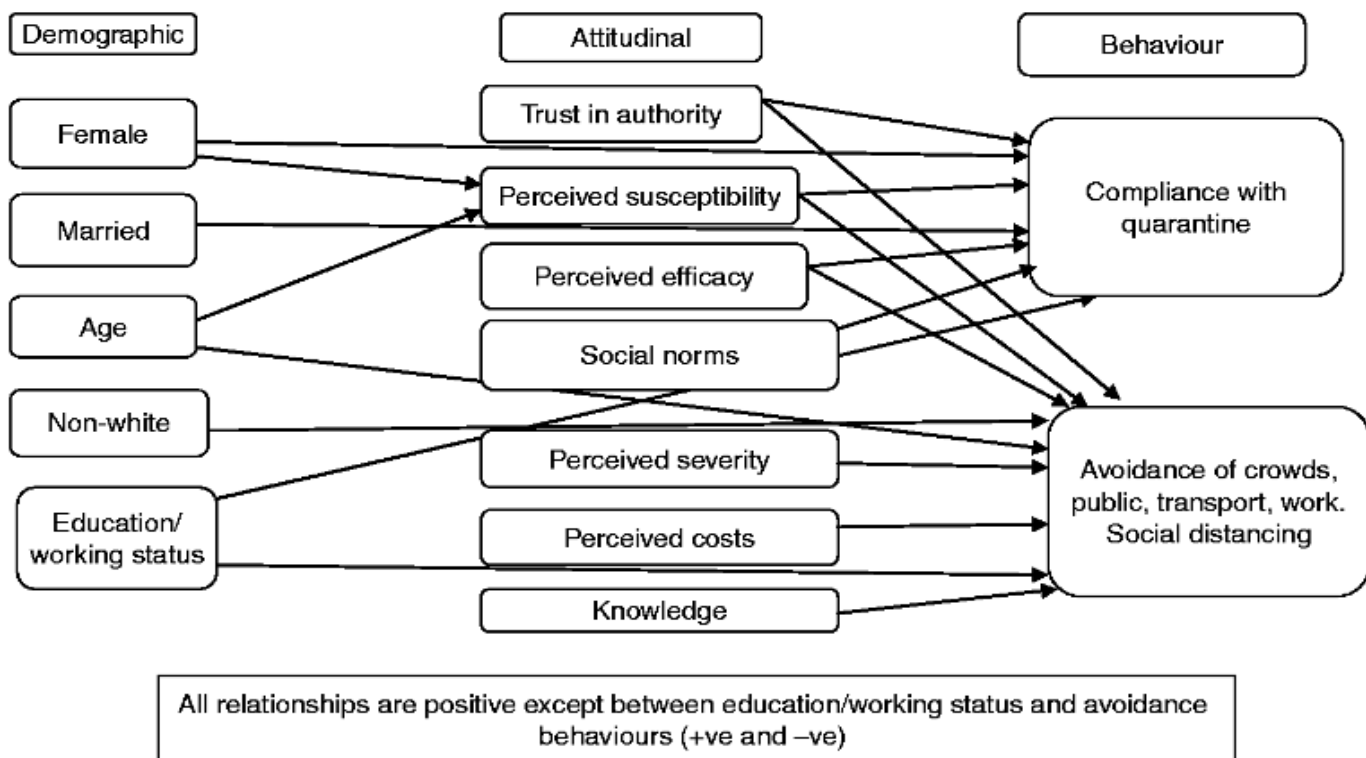
⁴⁰ Lu J, Gu J, Li K, et al., 2020. Emerging Infectious Diseases. 2020;26(7):1628-1631. doi:10.3201/eid2607.200764.

Human behaviour during pandemics

Understanding and influencing human behaviour during a pandemic^{41,42,43,44}

- Changes in human behaviour have the potential to rapidly alter the course of a pandemic
- **Three types of human behaviour during a pandemic** have been identified (*Figure 6*):
 - 1) **Preventive**, such as hand washing, coughing or sneezing into a hand or tissue, cleaning surfaces; mask wearing and uptake of vaccinations.
 - 2) **Avoidant**, such as avoiding crowds, public transport, and work and compliance with quarantine restrictions
 - 3) **Management of disease**, such as taking antiviral medication, seeking help from a professional and use of telephone or internet help lines
- Some of these behaviours are responsibility of the **individual**, while others are **government or legally enforced**

Figure 6: Factors associated with avoidant behaviours



- Every mass public health intervention raises **ethical and human rights concerns**, and errant social-distancing actions can have distributive or justice implications. **For example**, screening or testing can pose serious threat to a person's privacy and bodily integrity; restrictive policies have worst implications for those with the fewest resources, etc.

⁴¹ <https://www.nature.com/articles/s41562-020-0884-z>

⁴² <https://www.ncbi.nlm.nih.gov/books/NBK54163/>

⁴³ <https://onlinelibrary.wiley.com/doi/full/10.1348/135910710X485826>

⁴⁴ https://academic.oup.com/jid/article/214/suppl_4/S404/2527912

- **Demographic differences** exist - being older, female, more educated, or non-white, is associated with a higher chance of adopting protective behaviours
- Members of **racial and ethnic minorities communities** may be more likely to be distrustful in the public health information they receive, less willing to adopt recommended safety measures and potentially more susceptible to 'fake news'
- **Inequalities in access to resources** can affect the ability to comply with recommended behaviours. For example, the homeless vulnerable cannot shelter in place; families in housing without running water cannot wash their hands frequently; people detained in prison, immigrant or refugee camps, may not be able to implement physical distancing
- **Predictors** of behavioural change and adherence to / compliance with measures, include: levels of perceived susceptibility to, severity of and risk from the disease; belief in the effectiveness of the recommended behaviours; levels of anxiety and trust in authorities
- People often exhibit '**optimism bias**', the belief that bad things are less likely to happen to them. While this may be useful for avoiding negative emotions, it can lead to underestimating likelihood of contracting a disease and ignoring public health warnings
- **Fear** helps behavioural change only when people feel a sense of efficacy, whereas fear combined with low-efficacy messages produce the greatest level of defensive response
- **Targeting fears can be useful in some situations, but not others:** appealing to fear leads people to change their behaviour, if they feel capable of dealing with the threat; but leads to defensive reactions when they feel helpless to act
- **Negative emotions**, resulting from threat can be contagious, and fear can make threats appear more imminent
- **Communication strategies must strike a balance** between breaking through optimism bias without inducing excessive feelings of anxiety and fear
- **Messages are most influential** when specific to communities and groups with shared identity, providing in-group models for norms or health behaviours
- **Public education campaigns** should be grounded in the science of risk communication, as the acceptability of health measures is vital to community adherence
- **Information disseminated** should be accurate, clear, uncomplicated, not sensationalistic or alarmist, and as reassuring as possible
- **Weather has an effect on population behaviour**, such as, people spend most of their time indoors in cold/cooler weather; and physical activity increases in spring / summer
- Virus **spread increases with more indoor social gatherings and holiday travel**^{45,46}
- Influenza-like illness incidence in schools decreases during winter/summer breaks
- Most **secondary cases of COVID-19 virus transmission occur in community settings**, rather than healthcare settings

⁴⁵ <https://www.mdpi.com/1660-4601/17/5/1633/htm?luicode=10000011&lfid=231522type%3D1%26t%3D10%26g%3D%23%E4%B8%96%E5%8D%AB%E7%BB%84%E7%BB%87%E5%B7%A5%E4%BD%9C%E4%BA%BA%E5%91%98%E5%9C%A8%E4%BC%8A%E6%9C%97%E6%84%9F%E6%9F%93%E6%96%B0%E5%86%A0%E7%97%85%E6%AF%92%23&featurecode=newtitle%E7%9C%8B%E8%B5%B7&u=https%3A%2F%2Fwww.mdpi.com%2F1660-4601%2F17%2F5%2F1633%2Fhtm>

⁴⁶ <https://www.clima.com/noticias/como-afectara-el-invierno-en-argentina-al-coronavirus>

Social contact-based transmission⁴⁷

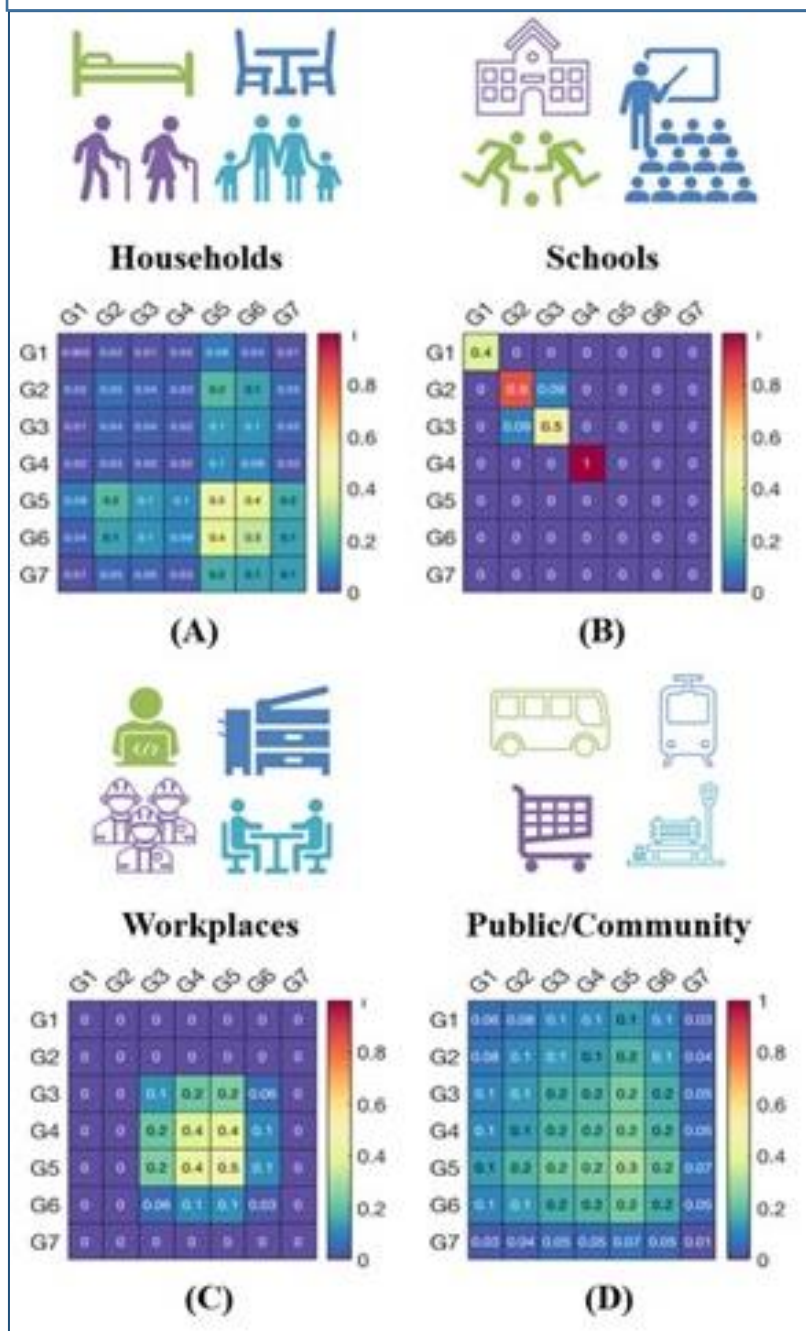
- Understanding the **underlying transmission patterns** among different populations provides insights into what may have happened retrospectively and what can be anticipated prospectively during a disease outbreak
- This enables understanding of **how effective different intervention strategies are** in controlling an outbreak and what may happen as people gradually return to schools and workplaces

Social contact-based risk analysis, demonstrated in the case of COVID-19 outbreak in

China, can help other countries or regions in conducting similar studies and designing intervention policies (*Figure 7*)

- The intensity of social contact among **seven age groups in four major settings** in Wuhan, is measured: (A) households; (B) schools; (C) workplaces; and (D) public/community
- The contact patterns in these four settings are consistent with common social behaviours observed in a typical society
- In households (A), the majority of the social contacts occur across different generations
- In schools (B) the main social contact is among children in the same age-group
- In workplaces (C), social contacts occur among young and middle-aged adults
- In public / community setting (D), social contacts are more diverse when people are in public places
- Key implication of this study is to **maintain social distancing in public / community settings**, even when school and business activities are resumed

Figure 7. Distribution of age-groups involving relatively intensive contacts in households and public/communities



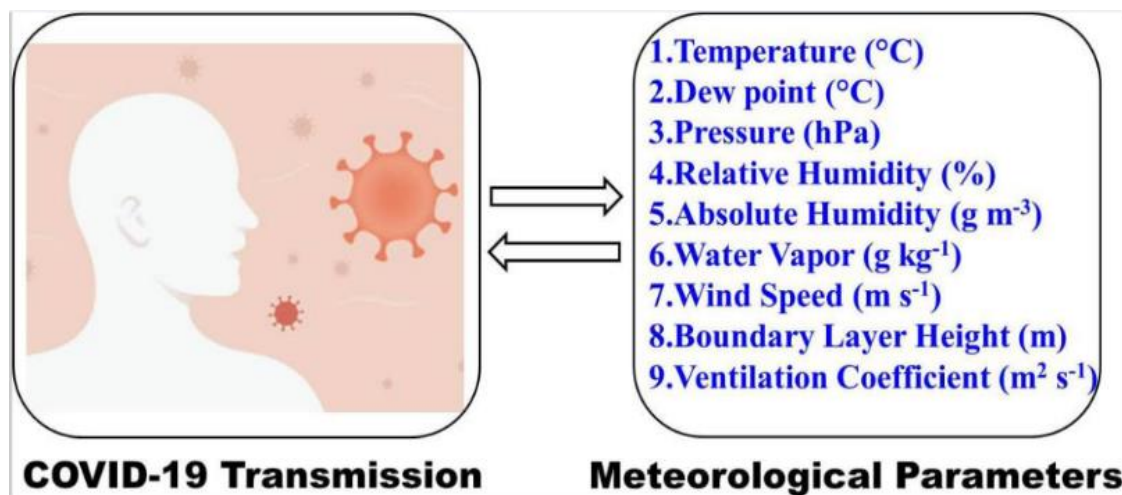
⁴⁷ <https://www.thelancet.com/action/showPdf?pii=S2589-5370%2820%2930098-5>

Seasonal variation and transmission

Overview^{48,49}

- Meteorological parameters can play substantial role in the transmission of infectious diseases, such as Middle East Respiratory Syndrome (MERS), Severe Acute Respiratory Syndrome (SARS), and Influenza (Flu) (*Figure 8*)
- Infectious disease incidence rates are likely to be influenced by weather changes
- Many infectious diseases spread more in cold weather when people stay mostly indoors; and transmission decreases in warmer weather when people go outdoors more and ventilate their homes more often

Figure 8: Meteorological parameters influencing COVID-19 transmission



- Meteorological conditions can influence the viability and concentration of COVID-19 virus, including temperature, humidity and the environmental circumstances the virus lives in, such as in aerosols or on various surfaces
- Viability of COVID-19 virus decreases at higher temperatures (e.g. 38°C) and relative humidity more than 95%
- COVID-19 pandemic can amplify the health risks from heat, as several risk factors for severe COVID-19 disease overlap with key heat risk factors, including: older age; having underlying conditions, such as chronic heart, lung and kidney problems; and also both are associated with systemic inflammation⁵⁰
- Coronaviruses are more stable at low temperatures and low humidity, which may facilitate community transmission in subtropical areas (such as Hong Kong) during spring and in air-conditioned environments⁵¹
- Emerging evidence suggests that weather conditions may influence the transmission of SARS-CoV-2, with cold and dry conditions appearing to increase the spread. This can be attributed to the stability of the virus and the effect of the weather on the host

⁴⁸ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7289735/>

⁴⁹ <https://www.hindawi.com/journals/av/2011/734690/>

⁵⁰ <https://publichealthmatters.blog.gov.uk/2020/06/24/covid-19-and-summer-temperatures/>

⁵¹ <https://www.hindawi.com/journals/av/2011/734690/>

- The weather effect is minimal and all estimates are subject to significant biases reinforcing the need for robust public health measures⁵²
- Particulate matter, including droplets, tend to last longer in an environment with cold winds and less humidity⁵³
- Studies suggest that the immune system is weakened during the winter

Seasonal impact on common coronaviruses⁵⁴

- Over a period of 10 years, 890 to 1,441 individuals from several hundred households participated in a Household Influenza Vaccine Evaluation study, an ongoing longitudinal investigation of respiratory illnesses in households with children
- In 2010, the study began tracking the occurrence of four typically mild human coronaviruses: OC43, 229E, HKU1 and NL63.
- The researchers looked at frequency, seasonality and household transmission characteristics of the 993 coronavirus infections. They found:
 - ✓ Overall, 9% of adult cases and 20% of cases in children were associated with doctor visits
 - ✓ On average, 30% of influenza cases required a doctor visit
 - ✓ Year-round surveillance showed that most coronavirus cases were detected between December and April/May, peaking in January/February
 - ✓ Only 2.5% of the cases occurred between June and September
 - ✓ The highest infection frequency was in children under the age of 5
 - ✓ Of the 993 infections, 260 were acquired from infected household contact
 - ✓ The serial interval between index and household-acquired cases ranged from 3.2 to 3.6 days; secondary infection risk ranged from 7.2% to 12.6% by type
 - ✓ Cases in children under the age of 5 and adults over the age of 50 were more likely to be classified as severe
- The study concludes that coronaviruses' incidence rates have seasonal variation and similar transmission to that of the influenza A (H3N2) virus in the study population. The results are not indicative of how SARS-CoV-2 will behave

Temperature-dependant immune responses⁵⁵

- At warmer temperatures, animals (mice) infected with a rhinovirus produce a burst of antiviral immune signals, which activate natural defences that fight off the virus
- At cooler temperatures, mice produce fewer antiviral signals and the infection can persist
- Research on human airway cells in laboratory conditions show that warm infected cells are more likely to undergo programmed cell death, cell suicide brought on by immune responses aimed at limiting the spread of infections
- Temperature-dependent immune reactions help to explain the successful spread of rhinoviruses at lower temperatures, i.e. humans breathe in colder air that chills their upper airways just enough to allow rhinoviruses to flourish

⁵² <https://www.cebm.net/covid-19/do-weather-conditions-influence-the-transmission-of-the-coronavirus-sars-cov-2/>

⁵³ <https://www.bbc.com/mundo/noticias-51705064>

⁵⁴ <https://www.sciencedaily.com/releases/2020/04/200407164949.htm>

⁵⁵ <https://www.nature.com/news/cold-viruses-thrive-in-frosty-conditions-1.13025>

Vitamin D and transmission of infectious diseases⁵⁶⁵⁷

- There is evidence that vitamin D deficiency may contribute to increased risk of influenza and other respiratory tract infections
- Vitamin D deficiency more often occurs in winter months, due to a decreased exposure to sunlight
- Experimental evidence supports the hypothesis that vitamin D has direct anti-viral effects, particularly against enveloped viruses
- Existing evidence do not completely model the complex effects of vitamin D and may not accurately represent its systemic influence
- Further experiments are necessary to fully reveal the mechanisms of vitamin D effects, especially in case of COVID-19

Country example: Singapore⁵⁸

- The role of Singapore's hot tropical weather in COVID-19 transmission was studied by exploring the association between meteorological parameters and COVID-19 cases
- The first case of local SARS-CoV-2 transmission was reported on 4th February and daily data available (both meteorological parameters and COVID-19 cases) until 31st May
- Daily records of basic meteorological parameters, such as min/max/ average temperature, humidity, wind speed and dew point were obtained
- Temperature, dew point, relative humidity, absolute humidity, and water vapour showed positive significant correlation with COVID-19 transmission
- Maximum, average and minimum temperatures; as well as maximum, average and minimum dew point, showed significant positive correlations with new as well as total COVID-19 cases. However:
 - ✓ Maximum, average and minimum temperature showed relatively strong association with COVID-19 cases during early phase of the transmission (4th February – 30th April)
 - ✓ Maximum, average and minimum dew point showed higher association for the whole period and dataset (4th February - 31st May 31)

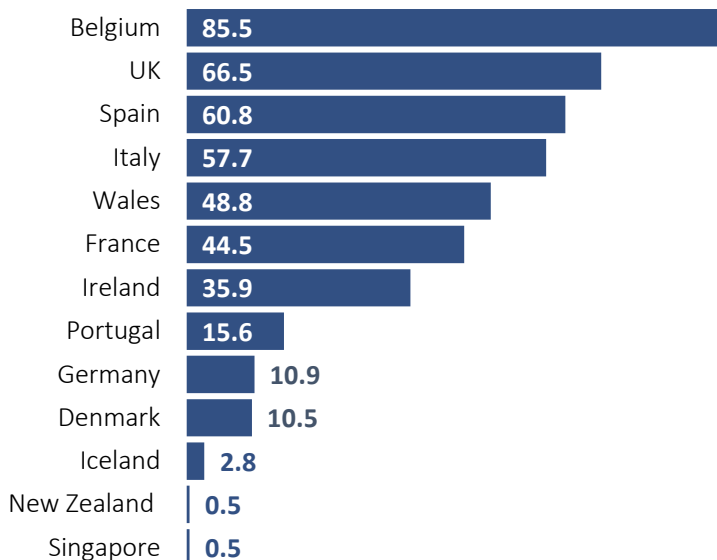
⁵⁶ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3308600/>

⁵⁷ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6121423/>

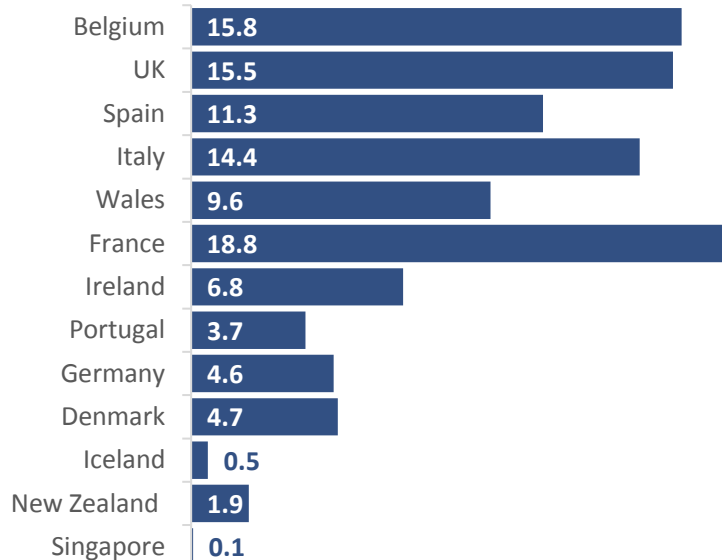
⁵⁸ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7289735/>

Country epidemiology update

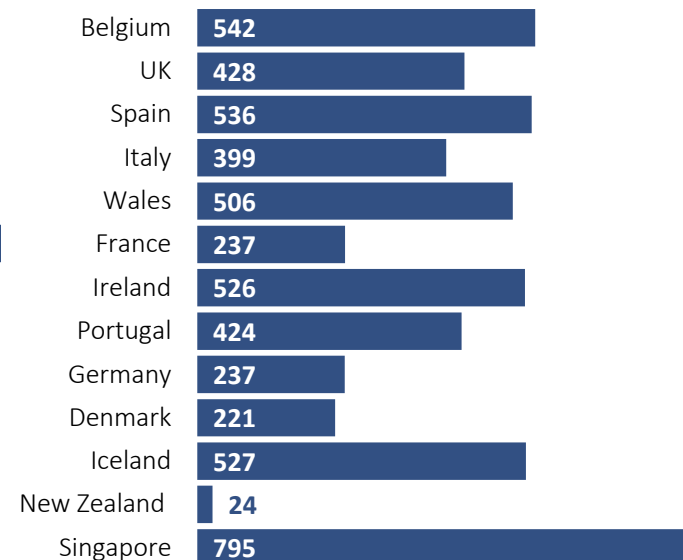
Cumulative death rate per 100,000



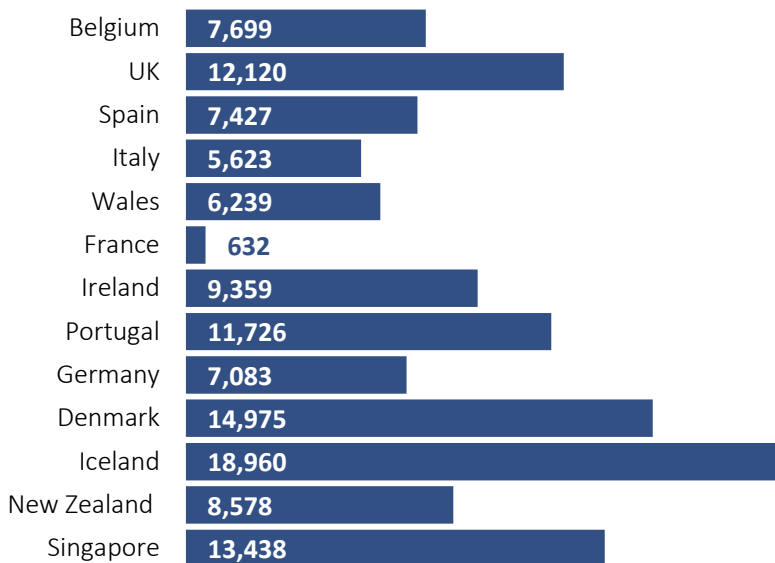
% COVID-19 cases died



Cases, rate per 100,000



COVID-19 tests, rate per 100,000



Sources

All data extracted 06 July 2020

Cases/deaths:

WHO Coronavirus Disease (COVID-19) Dashboard. Available at: <https://covid19.who.int/>

Public Health Wales Rapid COVID-19 surveillance. Available at:

<https://public.tableau.com/profile/public.health.wales.health.protection#!/vizhome/RapidCOVID-19virology-Public/Headlinessummary>

Population data:

Population, Total, The World Bank. Available at: <https://datacatalog.worldbank.org/population-total>

Population estimates for the UK, England and Wales, Scotland and Northern Ireland, provisional Statistical bulletins, Office for National Statistics. Available at:

<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/previousReleases>

Testing

Testing data extracted from the Ministry of Health website for the respective country.

Testing data for France is that of 26/05/2020.

Data for Iceland and Portugal is based on the number of samples, rather than the number of tests carried out.

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