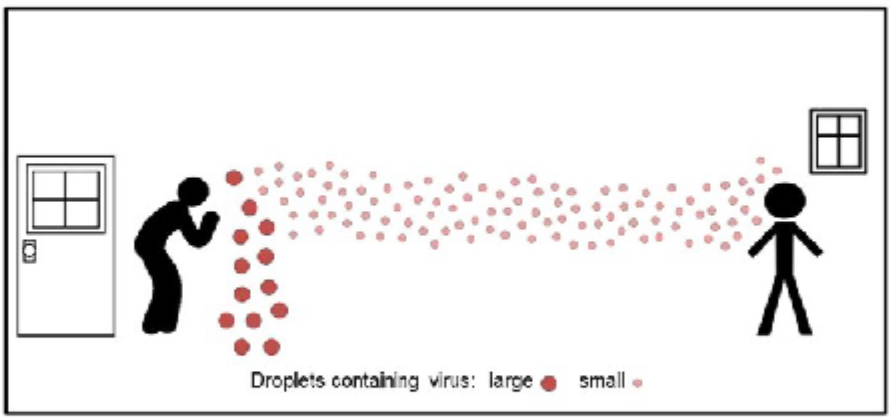
Report of Dr. Dan Seekins to the Building Re-Opening Task Force
June 7, 2020

What kind of precautions are needed?

It is no surprise the church has struggled to understand the route of transmission and the impact of building ventilation (or lack thereof) on risk of members attending services in the building. Air handling is different for healthcare than public settings since the goal in a hospital is negative pressure (keep the virus in the patient's room to prevent spread). The typical number to prevent transmission is 6-12 air exchanges per hour (see CDC section). The flow of the air also matters since those directly in the path of the virus are more susceptible than others. The science is quite new and even experts are divided, mainly because it all depends on the size of the droplets.



I think this summary from the *Journal of Infectious Diseases* summarizes consensus well:

Journal of Infectious Diseases (Note this is a very reputable journal)

Airborne or Droplet Precautions for Health Workers Treating COVID-19?

"Cases of COVID-19 have been reported in over 200 countries. Thousands of health workers have been infected and outbreaks have occurred in hospitals, aged care facilities and prisons. World Health Organization (WHO) has issued guidelines for contact and droplet precautions for Healthcare Workers (HCWs) caring for suspected COVID-19 patients, whilst the US Centre for Disease Control (CDC) has recommended airborne precautions. The 1 - 2 m (≈3 - 6 ft) rule of spatial separation is central to droplet precautions and assumes large droplets do not travel further than 2 m (≈6 ft). We aimed to review the evidence for horizontal distance travelled by droplets and the guidelines issued by the World Health Organization (WHO), US Center for Diseases Control (CDC) and European Centre for Disease Prevention and Control (ECDC) on respiratory protection for COVID-19. We found that the evidence base for current guidelines is sparse, and the available data do not support the 1 - 2 m (≈3 - 6 ft) rule of spatial separation. Of ten studies on horizontal droplet distance, eight showed droplets travel more than 2 m (≈6 ft), in some cases more than 8 meters (≈26 ft). Several studies of SARS-CoV-2 support aerosol transmission and one study documented virus at a distance of 4 meters (≈13 ft) from the patient. Moreover, evidence suggests infections cannot neatly be separated into the dichotomy of droplet versus airborne transmission routes. Available studies also show that SARS-CoV-2 can be detected in the air, 3 hours after aeroslisation. The weight of combined evidence supports airborne precautions for the occupational health and safety of health workers treating patients with COVID-19."

Joint Commission on the Accreditation of Healthcare Organizations (JACHO)

As of March 24, 2020, CDC recommends:

- Contact Plus Droplet plus Eye Protection when providing routine care to known or suspected COVID-19 patients.
- Airborne Plus Droplet plus Eye Protection when performing aerosol generating procedures on known or suspected COVID-19 patients.

CDC guidance

https://www.cdc.gov/infectioncontrol/guidelines/environmental/background/air.html#c1

Contact precautions

Contact precautions poster

Contact precautions are intended to prevent transmission of infectious agents, including epidemiologically important microorganisms, which are spread by direct or indirect contact with the patient or the patient's environment. The specific agents and circumstance for which contact precautions are indicated are found in Appendix A of the 2007 CDC Guidance.[1] The application of contact precautions for patients infected or colonized with Multidrug-Resistant Organisms MDROs is described in the 2006 HICPAC/CDC MDRO guideline.[14] Contact precautions also apply where the presence of excessive wound drainage, fecal incontinence, or other discharges from the body suggest an increased potential for extensive environmental contamination and risk of transmission. A single-patient room is preferred for patients who require contact precautions. When a single-patient room is not available, consultation with infection control personnel is recommended to assess the various risks associated with other patient placement options (e.g., cohorting, keeping the patient with an existing roommate). In multi-patient rooms, >3 feet spatial separation between beds is advised to reduce the opportunities for inadvertent sharing of items between the infected/colonized patient and other patients. Healthcare personnel caring for patients on contact precautions wear a gown and gloves for all interactions that may involve contact with the patient or potentially contaminated areas in the patient's environment. Donning PPE upon room entry and discarding before exiting the patient room is done to contain pathogens, especially those that have been implicated in transmission through environmental contamination (e.g., VRE, C. difficile, noroviruses and other intestinal tract pathogens; RSV)[15][16][17][18][19][20][21]

Droplet precautions

Droplet precautions poster

As of 2020, the classification systems of routes of respiratory disease transmission are based on a conceptual division of large versus small droplets, as defined in the 1930´s.[22]

Droplet precautions are intended to prevent transmission of certain pathogens spread through close respiratory or mucous membrane contact with respiratory secretions, namely respiratory droplets. Because certain pathogens do not remain infectious over long distances in a healthcare facility, special air handling and ventilation are not required to prevent droplet transmission. Infectious agents for which mere droplet precautions are indicated include *B. pertussis*, influenza virus, adenovirus, rhinovirus, *N. meningitidis*, and group A streptococcus (for the first 24 hours of antimicrobial therapy). A single patient room is preferred for patients who require droplet precautions. When a single-patient room is not available, consultation with infection control personnel is recommended to assess the various risks associated with other patient placement options (e.g., cohorting, keeping the patient with an existing roommate). Spatial separation of > 3 feet and drawing the curtain between patient beds is especially important for patients in multi-bed rooms with infections transmitted by the droplet route. Healthcare personnel wear a simple mask (a respirator is not necessary) for close contact with an infectious patient, which is generally donned upon room entry. Patients on droplet precautions who must be transported outside of the room should wear a mask if tolerated and follow Respiratory Hygiene/Cough Etiquette.

c. Airborne Viral Diseases

Some human viruses are transmitted from person to person via droplet aerosols, but very few viruses are consistently airborne in transmission (i.e., are routinely suspended in an infective state in air and capable of spreading great distances), and health-care associated outbreaks of airborne viral disease are limited to a few agents. Consequently, infection-control measures used to prevent spread of these viral diseases in health-care facilities primarily involve patient isolation, vaccination of susceptible persons, and antiviral therapy as appropriate rather than measures to control air flow or quality.[6] Infections caused by VZV frequently are described in health-care facilities. Health-care associated airborne outbreaks of VZV infections from patients with primary infection and disseminated zoster have been documented; patients with localized zoster have, on rare occasions, also served as source patients for outbreaks in health-care facilities.[162–166] VZV infection can be prevented by vaccination, although patients who develop a rash within 6 weeks of receiving varicella vaccine or who develop breakthrough varicella following exposure should be considered contagious.[167]

Viruses whose major mode of transmission is via droplet contact rarely have caused clusters of infections in group settings through airborne routes. The factors facilitating airborne distribution of these viruses in an infective state are unknown, but a presumed requirement is a source patient in the early stage of infection who is shedding large numbers of viral particles into the air. Airborne transmission of measles has been documented in health-care facilities.[168–171] In addition, institutional outbreaks of influenza virus infections have occurred predominantly in nursing homes,[172–176] and less frequently in medical and neonatal intensive care units, chronic-care areas, HSCT units, and pediatric wards.[177–180] Some evidence supports airborne transmission of influenza viruses by droplet nuclei,[181, 182] and case clusters in pediatric wards suggest that droplet nuclei may play a role in transmitting certain respiratory pathogens (e.g., adenoviruses and respiratory syncytial virus [RSV]).[177, 183, 184] Some evidence also supports airborne transmission of enteric viruses. An outbreak of a Norwalk-like virus infection involving more than 600 staff personnel over a 3-week period was investigated in a Toronto, Ontario hospital in 1985; common sources (e.g., food and water) were ruled out during the investigation, leaving airborne spread as the most likely mode of transmission.[185]

Smallpox virus, a potential agent of bioterrorism, is spread predominantly via direct contact with infectious droplets, but it also can be associated with airborne transmission.[186, 187] A German hospital study from 1970 documented the ability of this virus to spread over considerable distances and cause infection at low doses in a well-vaccinated population; factors potentially facilitating transmission in this situation included a patient with cough and an extensive rash, indoor air with low relative humidity, and faulty ventilation patterns resulting from hospital design (e.g., open windows).[188] Smallpox patients with extensive rash are more likely to have lesions present on mucous membranes and therefore have greater potential to disseminate virus into the air.[188] In addition to the smallpox transmission in Germany, two cases of laboratory-acquired smallpox virus infection in the United Kingdom in 1978 also were thought to be caused by airborne transmission.[189]

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Table 4. Microorganisms associated with airborne transmission*

Problems that may indicate airborne transmission of pathogen.			
Evidence for airborne transmission	**Fungi**	**Bacteria**	**Viruses**
Numerous reports in health-care facilities	*Aspergillus* spp.+ *Mucorales* (*Rhizopus* spp.)[97, 115]	*Mycobacterium tuberculosis*+	Measles (rubeola) virus[168-170] Varicella-zoster virus[162-166]
Occasional reports in health-care facilities (atypical)	*Acremonium spp.*[105, 206] *Fusarium spp.*[102] *Pseudoallescheria boydii*[100] *Scedosporium spp.*[116] *Sporothrix cyanescens*¶[118]	*Acinetobacter spp.*[161] *Bacillus spp.*¶[160, 207] *Brucella spp.***[208-211] *Staphylococcus aureus*[148, 156] Group A *Streptococcus*[151]	Smallpox virus (variola)§[188, 189] Influenza viruses[181, 182] Respiratory syncytial virus[183] Adenoviruses[184] Norwalk-like virus[185]
No reports in health-care facilities; known to be airborne outside.	*Coccidioides immitis*[125] *Cryptococcus* spp.[121] *Histoplasma capsulatum*[124]	*Coxiella burnetii* (Q fever)[212]	Hantaviruses[193, 195] Lassa virus[205] Marburg virus[205] Ebola virus†[205] Crimean-Congo virus[205]
Under investigation	*Pneumocystis carinii*[131]	n/a	n/a

* This list excludes microorganisms transmitted from aerosols derived from water.

+ Refer to the text for references for these disease agents.

§ Airborne transmission of smallpox is infrequent. Potential for airborne transmission increases with patients who are effective disseminators present in facilities with low relative humidity in the air and faulty ventilation.

¶ Documentation of pseudoepidemic during construction.

** Airborne transmission documented in the laboratory but not in patient-care areas.

† The recommendations in this guideline for Ebola Virus Disease has been superseded on August 1, 2014.

Table 10. Summary of ventilation specifications in selected areas of health-care facilities*

Ventilation characteristics and specifications for various healthcare areas.					
Specifications	**AII room (includes bronchoscopy suites)**	**PE room**	**Critical care room§**	**Isolation anteroom**	**Operating room**
Air pressure¶	Negative	Positive	Positive, negative, or neutral	Positive or negative	Positive
Room air changes	≥6 ACH (for existing rooms); ≥12 ACH (for renovation or new construction)	≥12 ACH	≥6 ACH	≥10 ACH	≥15 ACH
Sealed**	Yes	Yes	No	Yes	Yes
Filtration supply	90% (dust-spot ASHRAE 52.1 1992)	99.97% (Fungal spore filter at point of use (HEPA at 99.97% of 0.3 µm particles))	>90%	>90%	90%
Recirculation	No (Recirculated air may be used if the exhaust air is first processed through a HEPA filter.)				

Occupational Safety and Health Administration (OSHA)

The primary routes of infectious disease transmission in U.S. healthcare settings are contact, droplet, and airborne. Contact transmission can be sub-divided into direct and indirect contact. Direct contact transmission involves the transfer of infectious agents to a susceptible individual through physical contact with an infected individual (e.g., direct skin-to-skin contact). Indirect contact transmission occurs when infectious agents are transferred to a susceptible individual when the individual makes physical contact with contaminated items and surfaces (e.g., door knobs, patient-care instruments or equipment, bed rails, examination table). Two examples of contact transmissible infectious agents include Methicillin-resistant *Staphylococcus aureus* (MRSA) and Vancomycin-resistant enterococcus (VRE).

Droplets containing infectious agents are generated when an infected person coughs, sneezes, or talks, or during certain medical procedures, such as suctioning or endotracheal intubation. Transmission occurs when droplets generated in this way come into direct contact with the mucosal surfaces of the eyes, nose, or mouth of a susceptible individual. Droplets are too large to be airborne for long periods of time, and droplet transmission does not occur through the air over long distances. Two examples of droplet transmissible infectious agents are the influenza virus which causes the seasonal flu and *Bordetella pertussis* which causes pertussis (i.e., whooping cough).

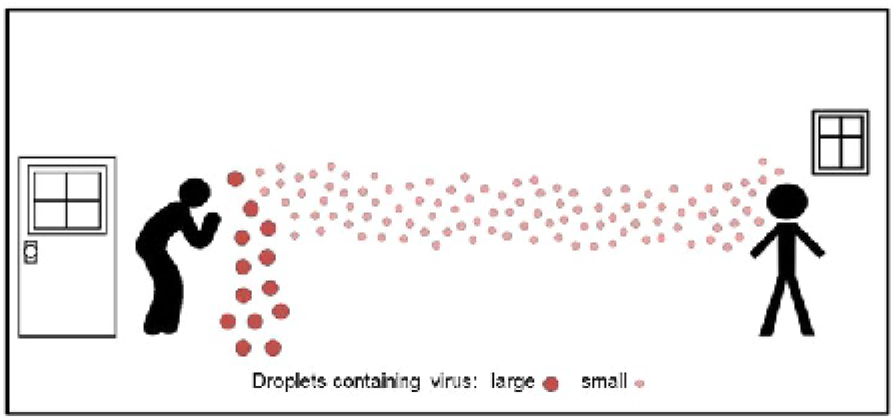
Airborne transmission occurs through very small particles or droplet nuclei that contain infectious agents and can remain suspended in air for extended periods of time. When they are inhaled by a susceptible individual, they enter the respiratory tract and can cause infection. Since air currents can disperse these particles or droplet nuclei over long distances, airborne transmission does not require face-to-face contact with an infected individual. Airborne transmission only occurs with infectious agents that are capable of surviving and retaining infectivity for relatively long periods of time in airborne particles or droplet nuclei. Only a limited number of diseases are transmissible via the airborne route. Two examples of agents that can be spread through the airborne route include *Mycobacterium tuberculosis* which causes tuberculosis (TB) and the measles virus (*Measles morbillivirus*), which causes measles (sometimes called "rubeola," among other names).

Several OSHA standards and directives are directly applicable to protecting workers against transmission of infectious agents. These include OSHA's Bloodborne Pathogens standard (29 CFR 1910.1030) which provides protection of workers from exposures to blood and body fluids that may contain bloodborne infectious agents; OSHA's Personal Protective Equipment standard (29 CFR 1910.132) and Respiratory Protection standard (29 CFR 1910.134) which provide protection for workers when exposed to contact, droplet and airborne transmissible infectious agents; and OSHA's *TB compliance directive* which protects workers against exposure to TB through enforcement of existing applicable OSHA standards and the General Duty Clause of the OSH Act.

Recent Publications

Lidia Morawska and Junji Cao "Airborne transmission of SARS-CoV-2: The world should face the reality", Environment International 139 (2020) 105730

“A World Health Organization review of the evidence stated that viral infectious diseases can be transmitted across distances relevant to indoor environments by aerosols (e.g. airborne infections), and can result in large clusters of infection in a short period. Considering the many similarities between the two SARS viruses and the evidence on virus transport in general, it is highly likely that the SARS-CoV-2 virus also spreads by air (Fineberg 2020). Experts in droplet dynamics and airflow in buildings agree on this (Lewis2020). Therefore, all possible precautions against airborne transmission in indoor scenarios should be taken. Precautions include increased ventilation rate, using natural ventilation, avoiding air recirculation, avoiding staying in another person’s direct air flow, and minimizing the number of people sharing the same environment (Qian et al. 2018). Of significance is maximizing natural ventilation in buildings that are, or can be naturally ventilation and ensuring that the ventilation rate is sufficiently high. These precautions focus on indoor environment of public places, where the risk of infection is greatest, due to the possible buildup of the airborne virus-carrying droplets, the virus likely higher stability in indoor air, and a larger density of people”



Harvey V. Fineberg, M.D., Ph.D., Chair Standing Committee on Emerging Infectious Diseases and 21st Century Health Threats

Rapid Expert Consultation on the Possibility of Bioaerosol Spread of SARS-CoV-2 for the COVID-19 Pandemic (April 1, 2020)

"While the current SARS-CoV-2 specific research is limited, the results of available studies are consistent with aerosolization of virus from normal breathing."

American Society of Heating, Refrigerating and Air-Conditioning Engineers

"Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of heating, ventilating, and air-conditioning systems, can reduce airborne exposures.

Ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air. Unconditioned spaces can cause thermal stress to people that may be directly life threatening and that may also lower resistance to infection. In general, disabling of heating, ventilating, and air-conditioning systems is not a recommended measure to reduce the transmission of the virus."

Journal of Infectious Diseases (Note this is a very reputable journal)

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