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# **(ARCHIVED)** COVID-19 in Dental Care Settings

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## Highlights

- A major concern in medical and dental settings are procedures that result in significant production of respiratory aerosols, or liquid particles that take longer to settle out of the air and/or which may be small enough to potentially increase transmission risk. These are referred to as aerosol generating medical procedures (AGMP)
- In acute care settings, AGMPs are defined as those procedures that both potentially create aerosols and are epidemiologically demonstrated to increase the risk of viral transmission. Similar distinctions between aerosol generating procedures with and without evidence of disease transmission in dental settings are difficult to make due to limited reports of such occurrences.
- Certain dental procedures are associated with significant aerosol generation, including ultrasonic and sonic scalers, high-speed dental handpieces (tooth preparation with air abrasion, air turbine handpiece), air polishers, and air-water syringes. Although there are few reports of respiratory disease transmission, the potential exists due to the ubiquity of AGMPs in dental settings.
- The hierarchy of controls framework provides a systematic approach to identifying and mitigating the risk of COVID-19 in a dental setting.
- Following AGMPs, an administrative control of a waiting period, or fallow time, of 15-30 minutes prior to the next patient would allow for settling of aerosols that may pose an infection risk. This is based on epidemiologic evidence that the vast majority of COVID-19 transmissions occur during close contact with infected individuals, implicating mostly droplets that eventually settle out, and standards for air changes in dental operatories that would be expected to turnover between 90-99% of the air during this period.

- In our scan on available guidance, many Canadian and international jurisdictions do not recommend fallow periods following dental AGMPs and those that do use set periods ranging from 15-30 minutes and/or specify a percent air change to achieve.

# Background

COVID-19 is primarily spread person-to-person through close unprotected contact with someone who is infected, via droplet and contact transmission.[1,2] The cornerstones of prevention are self-isolation of infected individuals, physical distancing, hygiene measures (hand hygiene, cough and sneeze etiquette, source control where appropriate), and environmental cleaning and disinfection. Important risk factors for transmission include local prevalence of cases, whether an infected individual has symptoms, and the circumstances of the interaction. The evidence for transmission is summarized in PHO's What We Know So Far About….Routes of Transmission.[2]

Reducing the risk of COVID-19 transmission requires a comprehensive approach, and this document provides decision makers with considerations regarding dental settings through the framework of the hierarchy of controls. Dental care provision involves treatment of patients at close range, often with procedures that generate aerosols, necessitating use of personal protective equipment (PPE). A point of care risk assessment (PCRA) is completed by the healthcare worker before every patient interaction to determine the risk of being exposed to an infection.[3] A PCRA helps determine the appropriate PPE for protecting the healthcare worker in their interaction with the patient and patient environment.

PHO's PPE guidance advises the following during care of individuals with suspect or confirmed COVID-19:[3]

- Droplet and Contact precautions for direct care where no aerosol-generating medical procedures (AGMPs) are done.
- N95 respirators with Droplet and Contact Precautions during AGMPs.

Given the frequency of aerosol generation with procedures in dental practice, the determination of appropriate PPE will depend chiefly on the assessment of whether the patient is a suspect or confirmed case of COVID-19. In areas where community transmission is not low, patient screening prior to treatment is more likely to lead to false negative results, and it may be reasonable to consider all patients as possible COVID-19 cases, regardless of a negative screening result. In areas with a low level of transmission, PPE as worn pre-pandemic may be appropriate if the patient screens negative. Local epidemiology can be evaluated for this purpose but is beyond the scope of this document.

# Methods

- A library search was performed in Medline, Embase, CINAHL, Global Health, Scopus and Google Scholar on disease transmission through aerosol generating procedures in dental settings. In addition, targeted literature searches were performed on aerosol generating procedures and measures to reduce infection risks from aerosols in dental settings.
- A jurisdiction scan of COVID-19 guidance for dental settings was performed.

- A review of available evidence, current guidance for dental settings and relevant PHO reviews and advice regarding COVID-19 transmission risk and risk reduction measures in dental settings was completed.

# COVID-19 and Aerosols

COVID-19 transmission is generally not considered to occur by the airborne route but certain circumstances may increase the risk for this route of transmission. Particle droplet size of <5 µm is generally accepted as the size below which particles are more likely to hover in air currents for extended periods of time. Small droplets take longer to settle to the ground – spherical infectious particles 10 µm in diameter take about 17 minutes to fall 3 metres; smaller droplets take longer.[4] In general, the time aerosols remain in the air will depend not only on the size of the droplets, but also environmental conditions, including temperature, humidity and ventilation.

Currently, live virus in aerosols is not well-characterized for COVID-19, with respect to release from the respiratory tract, quantity, or survival in ambient air. It is reasonable to assume that there is viral presence in the mouth in an infected individual.[5,6] Under experimental conditions, aerosols <5 µm may contain viable virus for extended periods of time, but this does not confirm that airborne transmission occurs.[7,8]

## Aerosol Generating Medical Procedures (AGMPs) in Dental Settings

Of particular concern in medical and dental settings are procedures that result in significant production of respiratory aerosols, or liquid particles that take longer to settle out of the air and/or which may be small enough to potentially increase transmission risk. These are referred to as AGMPs, and are summarized in PHO's guidance on personal protective equipment (PPE) for care of suspect and confirmed COVID-19 patients. They include intubation, extubation and related procedures, and non-invasive ventilation.[3]

It is important to note that AGMPs in acute care settings are defined as those procedures that both potentially create aerosols *and* are epidemiologically demonstrated to increase the risk of viral transmission. For this reason, not all procedures that potentially aerosolize secretions (e.g., oral care, coughing, or sneezing) are included in the list of AGMPs.[9] This was derived from data in acute care settings (primarily SARS research), and generalizability to the dental care setting is limited.[8]

Similar distinctions between aerosol generating procedures with and without evidence of disease transmission in dental settings are difficult to make. One scoping review of bio-aerosols in healthcare and dental settings found little evidence (presence or absence) of staff or patient health risks from bio-aerosols in dental settings. There was one case study found describing Herpes Simplex Virus-1 infection in a dental worker, however it is unclear if transmission occurred from exposure to bio-aerosol from ultrasonic scaling or by direct contact (i.e., to conjunctiva) by rubbing eyes.[10] Ricci et al described a case of legionellosis in a patient attributed to a dental unit waterline.[11] A seroepidemiological study of respiratory virus infections among dentists found elevated prevalence of antibodies to influenza A, influenza B, and respiratory syncytial virus compared with the control group.[12]

With respect to aerosol generation without regard to disease transmission, ultrasonic and sonic scalers, high-speed dental handpieces (tooth preparation with air abrasion, air turbine handpiece), air polishers, and air-water syringes have been reported to produce more aerosols than other procedures.[13] These

instruments remove material from the operative site by rotating or vibrating, often in combination with an air-water spray and compressed air, releasing aerosols.

The United States (US) Centers for Disease Control and Prevention (CDC) Guidance for Dental Settings considers any procedure that manipulates the teeth or oral mucosa with the use of mechanized tools (e.g., use of dental handpieces, air-water syringe, ultrasonic scalers) as a potential AGMP.[14] As noted above, reports of disease transmission from aerosols generated during dental work are rare, however for the purposes of this document we consider dental aerosol generating procedures as AGMPs.

# Strategies to reduce transmission risk

The US National Institute for Occupational Safety and Heath's (NIOSH) hierarchy of controls for managing hazards in the workplace provides a systematic approach to mitigate the potential risk of COVID-19 transmission in the dental setting.[15] This framework applies whether or not the patient being treated has COVID-19. A summary and examples from the CDC's dental guidance and others are provided in Table 1 and the following sections.[14]

**Table 1. Hierarchy of controls for reducing COVID-19 transmission risk in dental settings**

| Control | Description | Examples |
|---|---|---|
| Elimination/Substitution | Strategies that remove the hazard completely | Avoiding performing AGMPs when possible, prioritize use of manual instruments |
| Engineering | Remove/block the hazard at the source before it can reach the worker | Designated/closed room, physical barriers, high volume evacuation, dental dams, ventilation optimization, portable HEPA filtration units |
| Administrative | Optimizing processes and workflows to minimize potential contact with the hazard | Patient and worker pre-visit screening or testing, physical distancing, AGMP earlier in visit if possible, delay visit or schedule visit at end of day for known COVID-19 patients, cleaning and disinfection, sick leave policy, no visitor policy, minimize number of assistants, use a "fallow period" after AGMPs |
| Personal Hygiene | Worker actions or behaviors that may potentially reduce hazard exposure | Cough/sneeze etiquette, hand hygiene |
| Personal Protective Equipment | The "last line of defense" when other controls are infeasible, inadequate or exhausted. | Droplet/contact precautions for general practice; plus use of N95 respirator instead of surgical mask when performing AGMP |

## Engineering Controls

Heating ventilation and air conditioning (HVAC) system optimization could be considered:

- Increase percentage of outdoor air supply to the system.

- Limit demand-controls on the ventilation to minimize decreases in air flow, e.g., when the office is not occupied.
- Ensuring that outflow of air is not impeded e.g., blocked vent or interference by a portable fan.
- Use of appropriately placed portable high efficiency particulate air (HEPA) filtration units in patient care areas.[16]

Patient placement considerations include the following examples:

- One room per patient, limit number of patients receiving care.
- For open floor plans, maintain at least 2 metres between patients.

Procedure considerations include the following examples:

- Provision of direct care for one patient at a time.
- Avoidance or minimization of certain procedures that may increase risk of aerosol generation where possible, such as ultrasonic instrumentation.[17,18]
- Prioritize use of techniques that decrease risk of aerosolization (e.g., manual instrumentation, low-speed hand pieces, instruments without water spray, etc.).[17,18]
- Use of high volume evacuation/suction and dental dams (see below) to minimize droplet, spatter, and aerosols.
- Use of pre-procedural mouth rinses for reducing the risk of COVID-19 transmission is not supported by evidence of transmission prevention, however they "may reduce the level of oral microorganisms in aerosols and spatter generated during dental procedures".[14] There have been studies in analogous viruses that have demonstrated susceptibility to povidone mouth rinse.[19]

## HIGH VOLUME SUCTION / EVACUATION

The effectiveness of high volume suction in reducing aerosol release has been mainly tested through in-vitro studies. Jacks showed that high volume evacuation during ultrasonic instrumentation resulted in reduction of particulates by 90%.[20] Graetz et al. concluded that high volume evacuation with an adequately calibrated cannula is capable of significantly reducing the amount of spatter contamination during ultrasonic and sonic scaling.[21] Harrel et al. also showed that high volume evacuator attachment along with ultrasonic scaler resulted in a 93% reduction in aerosol contamination.[22]

Klyn et al.'s in vivo study of bacteria-containing spray during treatment of 15 patients found that suction devices reduced bacterial levels during ultrasonic scaling compared to the control.[23]

## DENTAL/RUBBER DAMS

Harrel and Molinari state that the use of a rubber dam eliminates virtually all contamination arising from saliva or blood.[13] If a rubber dam is used, the only remaining source for airborne contamination is from the tooth that is undergoing treatment. This will be limited to airborne tooth material and any organisms contained within the tooth itself. Cochran et al. also state that rubber dam usage reduces microbial contamination at the primary source by 90%-98%.[24] A 2003 CDC guidance on infection control in dental care settings concurs that rubber dams minimize aerosol and blood spattering.[25]

However, rubber dam usage is not feasible with all dental procedures: periodontal and hygiene procedures such as routine scaling, polishing, root planing, and periodontal surgery; restorative procedures such as sub-gingival restorations and the final steps of crown preparation; and surgical extractions are not amenable to this control.

### PREPROCEDURAL RINSES

Kohn et al. state that although there is a lack of evidence that pre-procedural rinses prevent infections in dental care providers, they have been shown to reduce the level or oral microorganisms in aerosols and spatter from rotary handpieces, and suggest they may be more beneficial where rubber dams and high volume evacuation are not used.[25] A recent rapid review found no literature or guidelines on the effectiveness of mouth rinses for patients with severe acute respiratory syndrome or COVID-19.[26] We found one experimental study on COVID-19 inactivation by povidone-iodine at various concentrations and contact time. Bidra et al found about a 3 log reduction of virus after 15 seconds of contact with 1.5%, 0.75%, and 0.5% povidone-iodine.[27] Of note, the methods for this study were not fully described (e.g., regarding statistical analysis) and it was funded by the company that produced the povidone-iodine used in the study.

## Administrative Controls

- Minimize crowding in waiting areas, e.g., by instructing patients to arrive at a certain time.

Local prevalence of COVID-19 can be considered as part of an overall risk assessment. Local epidemiology may help inform what if any additional measures should be considered, and may affect the usefulness of measures such as pre-appointment/pre-shift screening for symptoms and risk factors for COVID-19.

### ENVIRONMENTAL CLEANING AND DISINFECTION

- Routine protocols for cleaning, disinfection and sterilization can continue as per standard guidelines for infection prevention and control in dental settings. PHO provides guidance on this.[28]

- Additional considerations may include measures intended to enhance environmental infection control, including applying a waiting time or “fallow period” after AGMPs to allow droplets to settle or be ventilated out of the room. This is discussed below.

## Personal Protective Equipment (PPE)

The current recommendation from PHO, WHO, and the Public Health Agency of Canada for health care settings where the patient is known or suspected to have COVID-19 is Contact and Droplet Precautions (gown, gloves, mask, and eye protection).[3,29,30] N95 respirators are recommended in addition to droplet and contact precautions during AGMPs.

## Additional Considerations During Care of Known COVID-19 Patients

Additional considerations may include: [14,31,17,18]

- Pre-visit telephone screening to confirm the patient is well enough for the appointment, and that the appointment is medically necessary and cannot be deferred.

- Schedule the visit at the end of day to decrease risk to other patients and also perform end of day/terminal cleaning post-visit.[32]

- Have the patient wear a mask at all times prior to direct care. During treatment they should be stored so that contamination of the inner surface is avoided.[33]

- Triage and coordinate entry to avoid or minimize use of common areas.

- Patients who previously tested positive for COVID-19 but have been cleared can be managed with standard precautions.[34]

# After AGMPs – "Fallow Time" Considerations

While droplet and contact transmission is the primary mode of transmission, AGMPs are noted as potential sources of exposure to respiratory aerosols.[35,3,36] For these procedures the use of an N95 respirator instead of a surgical mask is recommended in addition to Droplet and Contact Precautions.

Knowledge about COVID-19 continues to evolve, and practice considerations may need to change with the evidence. At present we lack empiric data on COVID-19 transmission in dental settings (either presence or absence), however in regions where community transmission is not low, there is concern that patients who screen negative may still be infectious. Given the duration of AGMPs that occur in dental offices and the fewer air changes compared to many acute care settings where AGMPs are performed, a fallow period after dental AGMPs may be a reasonable precaution. If re-entry is necessary prior to settling or removal by the ventilation system, N95 respirator/Droplet/Contact Precautions can be used to reduce exposure risk. A fallow period of 15-30 minutes after dental care is complete and the patient has left the room would likely allow most droplets to settle out of the air. This is based on several lines of evidence:

- This length of time would allow most settling droplets to fall to the ground. Droplets 10 µm in diameter take roughly 17 minutes to settle.[4] Martins-Filho et al. cites a study that found droplet nuclei generated from an air turbine drill can be suspended in air for up to 30 minutes; Bennett et al. found that aerosol concentration peaks during dental surgeries tended to decrease to background levels within 10-30 minutes. [31,38]

- The vast majority of COVID-19 transmissions occur during close contact with infected individuals, implicating mostly droplets that eventually settle out.

- During the fallow period, ventilation with fresh (outdoor) air by the air handling system will also move air out of the operatory, including aerosols generated during dental care.

    - A single air change in a closed room is estimated to remove about 63% of remaining airborne contaminants given perfect mixing of air and no stagnation.[39] After 3 air changes, about 95% of the original contaminant will be removed and after 5 air changes, more than 99% will be removed.

    - The Canadian Standards Association (CSA) air change standards for dental settings are 6 air changes per hour (ACH) for the office and waiting room areas and 9 ACH for dental operatories.[40] For an operatory with 9 ACH, 15 minutes will allow almost 90% turnover of the original air and 30 minutes will result in almost 99% turnover.[40]

- An assessment of the actual ventilation rate through the facility building management or a HVAC consultant may provide operationally useful information for individual dental offices.

The application of measures described in the previous section, e.g., high volume evacuation, should also reduce transmission risk. Their use, the duration of AGMPs and the operatory ventilation parameters, could help guide the time period most appropriate for the specific setting.

Environmental cleaning and disinfection could begin during this period, starting with the areas at lowest risk of contamination. Areas at highest risk of contamination should be cleaned at the end of the fallow period.

## Existing Guidance on Fallow Times

Existing recommendations on fallow times in dental settings vary (ranging from no specified period up to 2 hours). Where ACH is referenced, they appear to use the NIOSH airborne contaminant removal model as the basis, and use 99% or 99.9% removal prior to re-entry. See Table 2:

**Table 2: Fallow times recommendations by Canadian jurisdictions**

| Jurisdiction | Recommended fallow period or contaminant removal | Note |
|---|---|---|
| College of Dental Hygienists of British Columbia (BC), College of Dental Technicians of BC, College of Denturists of BC, College of Dental Surgeons of BC[41] | N/A | British Columbia's community care guidance recommends increasing air circulation (exchanges) and ventilation in patient areas and appropriate PPE for AGMPs, but does not mention fallow times post AGMPs.[42] The surgical guidance states that increased relative humidity and high ACH in operating suites will reduce the potential for bioaerosol spread by over 95% within 10-12 minutes following aerosol creation.[43] |
| Alberta Dental Association and College[44] | N/A | Guidance discusses clearing of aerosols but does not make recommendations on this. Alberta's healthcare guidance states: "No settle time is required after AGMP is complete."[45] |
| College of Dental Surgeons of Saskatchewan[46] | 15 minutes for medium risk procedures; 99% removal after high risk procedures | Fallow period of 120 minutes in a closed operatory for high risk procedures if air changes are unknown. Medium and high risk procedures are defined as those with and without use of a rubber dam, respectively. Manual procedures are considered low risk. The acute healthcare setting guidance recommends 99% contaminant removal after AGMPs.[47] |
| Manitoba Dental Association[48] | N/A | Emphasis on aerosol reduction at source. The provincial healthcare guidance on AGMPs recommends 99.9% contaminant removal.[49] |
| Royal College of Dental Surgeons of Ontario[50] | 99.9% removal | Recommends 99.9% airborne contaminant removal after AGMP. |

| Jurisdiction | Recommended fallow period or contaminant removal | Note |
|---|---|---|
| Ordre des dentists du Québec[51] | 90% removal | Use closed room for asymptomatic patients and suspected/confirmed COVID-19 patients; for the latter, treat in the last timeslot of the day. |
| Provincial Dental Board of Nova Scotia[52] | N/A | "… Not recommending observing 'settling times' based on air changes per hour".[52] |
| Newfoundland & Labrador Dental Association, Newfoundland & Labrador Dental Board[53] | N/A | Discusses aerosol clearance but does not provide specific guidance; advice to seek professional help. |
| Government of Northwest Territories[54] | 15 minutes for medium risk procedures; 99% removal after high risk procedures | Risk categorization is similar to Saskatchewan. After medium risk AGMP, fallow time is 15 minutes; after high risk AGMP, aim to remove 99.9% of contaminants. |

In addition, an international jurisdiction scan of recently published guidance and reports from 16 countries with recommendations for dental reopening found 9 out of 17 sources state the importance of ventilation.55 Where a waiting period after is specified among these countries, 4 recommend periods between 15-30 minutes after patient treatment or AGMPs. Saskatchewan was captured in this review and at the time, the province recommended 120 minutes of fallow period or 99% air contaminant removal, as higher ACH allows. Saskatchewan's guidance has since changed as shown in the Table 2.

# Conclusion

The risk of COVID-19 transmission in the dental care context is uncertain based on available literature. It is reasonable to expect that the community prevalence, type of care offered (e.g., frequency and duration of AGMPs), the manner in which care is delivered and use of PPE will affect the risk. A risk assessment of these factors and a hierarchy of controls approach should reduce the risk of COVID-19 transmission associated with dental care. Where AGMPs are performed, a fallow period of 15-30 minutes following the end of the AGMP would likely be adequate for aerosol settling or removal by the ventilation system for patients who screen negative but are still considered to be potential COVID-19 cases.

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Public Health Ontario provides expert scientific and technical support to government, local public health units and health care providers relating to the following:

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