

Aerosol-Generating Medical Interventions on Suspected and Confirmed Cases of COVID-19

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Scope of Recommendations

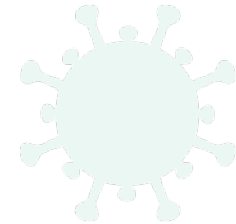
These recommendations apply to aerosol-generating medical procedures (AGMPs) carried out on patients who are suspected or confirmed cases of COVID-19. In contexts of sustained community transmission, risk assessments must be carried out to determine whether these recommendations shall also apply during AGMPs on individuals who are asymptomatic or have unknown COVID-19 status. Also, a negative result from PCR testing done in the 24-48 hours prior to an AGMP on a patient who does not present COVID-19 symptoms and has had no significant contact with the virus, may result in the AGMP being carried out according to standard precautions, unless the presence of another contagious infectious disease (e.g., tuberculosis) is suspected or suspected COVID-19 remains possible. A table summarizing the recommendations is available in the appendix.

Analysis

In the context of the SARS-CoV-2 pandemic, a number of interventions and procedures are now considered AGMPs by medical societies while they previously were not. Many of these procedures have not been classified as such by conclusive studies, but are often associated with coughing produced during the procedure and by implication, the presumed production of small aerosols.

For a better understanding of the concept of an AGMP as it relates to the risk of COVID-19 transmission, it is important to highlight the following premises:

- ▶ SARS-CoV-2 is mainly transmitted through droplets or contact (WHO, 2020). With over seven million cases declared worldwide, all public health organizations have clearly established that transmission occurs largely by droplets and contact, usually in contexts of close proximity and extended periods (e.g., family contacts). Airborne transmission is only presumed during aerosol-generating procedures, which is referred to as opportunistic airborne transmission. This suggests that SARS-CoV-2 is not transmitted by air under usual healthcare circumstances, as opposed to tuberculosis, for example, but rather during procedures that can generate infectious aerosols (Romano-Bertrand S. et al., 2020)
- ▶ In contrast with transmission via droplets, aerosols < 5 µm can remain suspended in the air, travel long distances, and may cause infection when inhaled.
- ▶ The presence of small aerosols, even during breathing, has often been cited as evidence of potential airborne transmission. However, a lack of transmission through the established aerosol transmission models (like those of measles and tuberculosis) does not substantiate the mere presence of aerosols as proof of airborne transmission. The role of these aerosols in transmission over short distances remains to be proven.

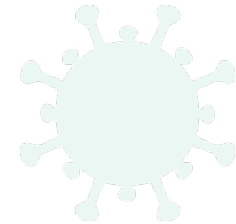


- ▶ Coughing, sneezing and procedures that cause these actions do not by themselves justify a procedure being considered an AGMP. Instead, it is the type of procedures that artificially manipulate the airway and secretions therein that can agitate and dramatically increase the infectious aerosols generated when microorganisms are present.
- ▶ In the case of SARS-CoV-2, the role AGMPs play in transmission to healthcare workers exposed during these procedures remains to be documented. For the time being, the hypotheses are extrapolated from studies on SARS-CoV-1 and other viruses. Moreover, a widely cited systematic review on SARS-CoV-1 transmission to healthcare workers at hospital centres or in intensive care units has shown consistent airborne transmission for one AGMP only: tracheal intubation. The other AGMPs cited in this meta-analysis, non-invasive ventilation (NIV), tracheotomy, and manual ventilation before intubation, are only associated with transmission by aerosols in a few small studies deemed to be of poor quality (Tran et al., 2012). Other procedures cited, being endotracheal aspiration, manual ventilation before intubation, bronchoscopy, administering medication by nebulization, use of high-flow O₂, BiPAP, handling of a Ventimask, defibrillation, chest compressions, insertion of a nasogastric tube, and sputum collection, have not been associated with transmission of infection. At present, there have been no rigorous studies or reviews of cases that demonstrate a clear association between AGMPs and transmission of SARS-CoV-2. Case reports sometimes imply transmission while other times calling it into question (Ng et al., 2020; Zhu, 2020) but the quality of these reports is insufficient to draw any conclusion. It has also not been proven that these workers were infected during the AGMP, from contamination when removing personal protective equipment (PPE) afterwards, or simply through the community.
- ▶ The presence of viral DNA detected by PCR testing does not in itself prove that the virus is viable and transmissible. The presence of a viable virus is a prerequisite for transmission. We therefore feel that it is unlikely that the mere presence of viral SARS-CoV-2 DNA in the stool or blood indicate that a procedure carried out at this level (e.g., colonoscopy, thrombectomy via a blood vessel) render the procedure an AGMP, especially since no aerosols are generated during these procedures.
- ▶ In its recent review of mask use in the COVID-19 context, WHO (2020) has reaffirmed its position on the use of N95 masks and only recommends their use in circumstances where COVID-19 patients are undergoing an AGMP. These experts specifically name AGMPs as being limited to tracheal intubation, non-invasive ventilation (NIV), tracheotomy, cardiopulmonary resuscitation, manual ventilation before intubation, bronchoscopy, sputum induction using nebulized hypertonic saline, and autopsies.

Classification

The following classification is largely based on evidence collected by the Unité d'évaluation des technologies et des méthodes d'intervention en santé (UETMIS) at CHU de Québec-Université Laval, whose reports can be consulted on the INSPQ website at <https://www.inspq.qc.ca/covid-19>.

More recent reviews of the literature on AGMPs also propose this hierarchy of measures in a context that lacks more rigorous scientific data (Harding et al., 2020). Other experts are more categorical in their definition, which is simply a binary one: "It is either an AGMP or not an AGMP," and yet others add another category: uncertain AGMP.



The following procedures are associated with a known risk of infectious aerosol transmission (known AGMP) for suspected and confirmed cases of COVID-19. “Known” refers to procedures that have been listed for years as carrying an increased risk of infection by airborne transmission and recognized as such by the medical community long before the COVID-19 pandemic.

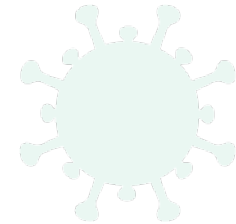
- ▶ Tracheal intubation and extubation
- ▶ Bronchoscopy
- ▶ Cardiopulmonary resuscitation¹
- ▶ Manual ventilation before intubation
- ▶ Aspiration of tracheal secretions with open-circuit suctioning on an intubated patient or patient with a tracheotomy
- ▶ Sputum induction (saline instillation technique and other similar techniques)
- ▶ Nasopharyngeal aspirate (NPA) in children
- ▶ Autopsy

The following procedures are associated with a possible risk of infectious aerosol transmission (possible AGMP) for suspected and confirmed cases of COVID-19.

- ▶ Non-invasive positive-pressure ventilation via face mask (e.g., BiPAP, CPAP,² and other similar techniques that actively deliver air into the airway using a device that operates with positive pressure or nebulization, such as with breath stacking and cough assist devices).
- ▶ Tracheotomy and tracheostomy care
- ▶ In the context of the COVID-19 pandemic, it is appropriate to add any surgical intervention via the nasopharynx or oropharynx, as well as thoracic surgery on any patient who is a confirmed or suspected COVID-19 case, since SARS-CoV-2 is prevalent in the nasopharynx, oropharynx, and lungs and a surgical intervention performed at these sites, especially when done using a motorized tool, has a high likelihood of generating infectious aerosols containing COVID-19 (Mick et al., Thamboo A. et al).

¹ According to an analysis by UETMIS, chest compression done as part of CPR has been classified as an AGMP with uncertain and little documented risk. Other organizations are in agreement with UETMIS; as quoted in a report from the INESSS (https://www.inesss.qc.ca/fileadmin/doc/INESSS/COVID-19/COVID-19_INESSS_RCR.pdf): “Seven of them (Ontario Health, Heart and Stroke Foundation, Canadian Red Cross, Public Health England, Resuscitation Council, the European Resuscitation Council, and the American Heart Association) distinguish the risk of transmission according to the components of CPR and consider that chest compressions and defibrillation do not constitute AGMPs.” [translated from the original French]

² The Association des Pneumologues de la province de Québec recommends ceasing positive-pressure treatment for long-term patients who do not have severe nocturnal hypoxemia, regardless of their COVID-19 status. However, this decision must be made by an individual with the expertise to make such a decision.



The following procedures are associated with an undocumented risk of infectious aerosol transmission (undocumented AGMP) for suspected and confirmed cases of COVID-19.

- ▶ High-flow nasal cannula (e.g., Optiflow)
- ▶ Digestive endoscopy procedures
- ▶ Transesophageal echocardiogram (TEE)
- ▶ Insertion and removal of a chest tube
- ▶ Ophthalmology procedures not involving the tear ducts, sinuses, or canaliculi
- ▶ Laryngoscopy
- ▶ Nebulization therapy

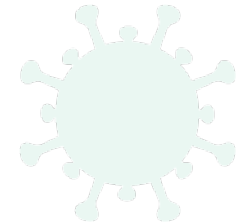
The following procedures are not considered AGMPs:

- ▶ Conventional oxygen therapy with face mask (e.g., Ventimask)
- ▶ Nasopharyngeal swab for adults and children
- ▶ Insertion of a nasogastric tube
- ▶ Jejunostomy, gastrostomy
- ▶ It appears unlikely that surgical procedures or interventions for which the site of entry does not contain the virus (for example, thrombectomy via the groin, laparoscopy without intestinal entry) generate infectious aerosols containing COVID-19, in contrast to sites recognized as containing high concentrations of the virus (for example, the nasopharynx and oropharynx). However, for laparoscopies, there are specific recommendations for the insufflation and CO₂ exsufflation pressure, smoke evacuation, etc., which can be consulted on the INPSQ website.

Recommendations

In light of the aforementioned premises and in consideration of the work done by UETMIS and the review of the most recent literature on the subject, CINQ suggests a risk grading for AGMPs:

- ▶ We recommend that for AGMPs with known or possible risk of infectious aerosol transmission, airborne/contact precautions with eye protection be applied. This recommendation is based on a high degree of scientific evidence and a favourable analysis of the benefits and risks (level of certainty: high).
- ▶ For undocumented AGMPs, we suggest droplet/contact precautions with eye protection be put in place instead of airborne/contact precautions with eye protection. This recommendation is based on limited scientific evidence (for example, lack of specific studies on the issue, or the studies being methodologically weak) and a balanced analysis of the benefits and risks (expert opinions, level of certainty: low).



Comments and Context for Recommendations: These recommendations are intended to optimize healthcare quality. Their aim is to assist healthcare environments in implementing measures to prevent AGMP-related infections. They are supported by a review of the evidence conducted by UETMIS as well as a review of the most recent literature.³

It is important to emphasize that there is a high level of agreement between these recommendations and those of other international learned societies, although they are not identical. This reflects the uncertainty that results from the lack of scientific evidence around certain procedures with “undocumented” risk. Due to this lack of evidence, learned societies have issued recommendations based on expert opinions, which can result in some variation in their recommendations. If airborne transmission remains possible, it is certainly not predominant and is possibly even exceptional. Transmission during the majority of the above-mentioned procedures is itself not scientifically well documented. However, a certain risk cannot be completely ruled out and this risk perception may lead to differing recommendations. Due to the lack of data, some advocate for a more cautious attitude and the application of airborne precautions to minimize risk.

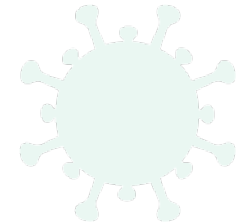
In cases of unknown or relatively low risk, the choice whether or not to apply certain preventative measures is, to a certain extent, related to risk perception. Other factors to consider include equipment availability, allocation of resources to the detriment of other needs, ethical decisions, the implications associated with preventing airborne transmission (e.g., negative pressure room, air exchange), and the implications of individual transmission. All of these variables are largely outside the scientific framework on which our recommendations are based.

Given the low level of certainty regarding the recommendation for undocumented procedures at risk of producing aerosols, it is possible that various environments will adjust and apply this recommendation differently (for example, between different facilities in the province or even different departments in the same facility) according to local epidemiology and impact. However, the limit for modulation remains to be determined. This adjustment could reflect variation in different stakeholders’ values and risk perception. It may be necessary to involve a number of stakeholders to arrive at a local consensus.

Considering the possible increase in transmission during these procedures:

- ▶ Limit these procedures to those that are absolutely necessary.
- ▶ Try to postpone an AGMP until a time when the patient will no longer be contagious with COVID-19, or replace the procedure with an alternative in the interim (e.g., transthoracic echocardiogram [TTE] in place of a transesophageal echocardiogram [TEE]).
- ▶ Insofar as possible, try to schedule AGMPs in advance to avoid having to perform them in emergency.
- ▶ Limit the number of people in the room to the experienced healthcare workers who are needed to carry out the procedure.
- ▶ In addition to the recommended personal protective equipment, wear a long-sleeved, single-use, disposable gown.
- ▶ A visor is recommended as the first choice over safety goggles for AGMPs with a known or possible risk (except for children’s NPA).

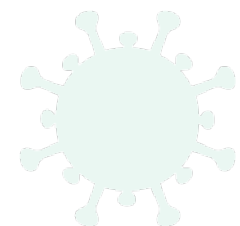
³ For each recommendation, an assessment was also carried out on the magnitude of the alternative options’ risks and benefits. A “favourable” analysis of the benefits and risks suggests that the benefits are clearly greater than the risks associated with the recommendation. A “balanced” analysis of the benefits and risks suggest that the risks and benefits are of a similar magnitude.



- ▶ Respect the required waiting time according to the ventilation characteristics of the room used (number of air exchanges per hour for a 99.9% elimination rate) before entering the room without personal protective equipment.
- ▶ In emergency situations where the patient’s COVID status is unknown, airborne/contact precautions with eye protection should be applied.

Appendix: AGMP Summary Table

Risk level of infectious aerosol transmission	Medical procedures	Additional precautions required for suspected or confirmed cases of COVID-19
Known risk	Known AGMP <ul style="list-style-type: none"> ▶ Endotracheal intubation and extubation ▶ Bronchoscopy ▶ Cardiopulmonary resuscitation (excluding chest compressions) ▶ Manual ventilation before intubation ▶ Aspiration of tracheal secretions with open-circuit suctioning on an intubated patient or patient with a tracheotomy ▶ Sputum induction (saline instillation technique) 	<ul style="list-style-type: none"> ▶ Airborne/contact with eye protection
Possible risk	Possible AGMP <ul style="list-style-type: none"> ▶ Non-invasive positive-pressure ventilation via face mask (e.g., BiPAP, CPAP, and other similar techniques that actively deliver air into the airway using a device that operates with positive pressure or nebulization such as with breath stacking and cough assist devices). ▶ Tracheotomy and tracheostomy care ▶ Surgical intervention via the nasopharynx or oropharynx ▶ Thoracic surgeries 	<ul style="list-style-type: none"> ▶ Airborne/contact with eye protection
Undocumented risk	Undocumented AGMP <ul style="list-style-type: none"> ▶ High-flow nasal cannula (e.g., Optiflow) ▶ Digestive endoscopy procedures ▶ Transesophageal echocardiogram (TEE) ▶ Insertion and removal of a chest tube ▶ Ophthalmology procedures not involving the tear ducts, sinuses, or canaliculi ▶ Laryngoscopy ▶ Nebulization therapy 	<ul style="list-style-type: none"> ▶ Droplet/contact with eye protection



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The French version is entitled *Interventions médicales générant des aérosols chez les cas suspects ou confirmés COVID-19* is also available on the website of the Institut national de santé publique du Québec at: www.inspq.qc.ca/publications/2960-interventions-aerosols-covid19

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