



Aerosol Generating Medical Procedures (AGMPs) and COVID-19

Disclaimer:

This *Quick Response Report* was published on May 14, 2020. Given the rapidly changing nature of the coronavirus pandemic, some of the references included in this report may quickly become out-of-date. We further caution readers that researchers at the Newfoundland & Labrador Centre for Applied Health Research are not experts on infectious diseases and are relaying work produced by others. This report has been produced quickly and it is not exhaustive, nor have the included studies been critically appraised.

Readers will note that some text below has been highlighted for emphasis.

Defining Aerosol Generating Medical Procedures

Original inquiry: What is the generally agreed upon definition for an AGMP? What procedures meet the definition of AGMP?

There does not appear to be a single official list of individual procedures that meet the definition of AGMP. Individual studies and reviews will define AGMP for their own purposes. Health authorities seem to provide non-exclusive lists of examples.

Centres for Disease Control (CDC). **Healthcare Infection Prevention and Control FAQs for COVID-19.** May 6, 2020 ([LINK](#))

- “Which procedures are considered aerosol generating procedures in healthcare settings?”
 - “Development of a comprehensive list of AGPs for healthcare settings has not been possible, due to limitations in available data on which procedures may generate potentially infectious aerosols and the challenges in determining if reported transmissions during AGPs are due to aerosols or other exposures. There is neither expert consensus, nor sufficient supporting data, to create a definitive and comprehensive list of AGPs for healthcare settings.”
 - References Tran et al. (2012) as source.

World Health Organization (WHO). **Infection prevention and control during health care for probable or confirmed cases of novel coronavirus (nCoV) infection.** May 6, 2013 ([LINK](#))

- Appears to be “official” definition of AGP / AGMP
- “An aerosol-generating procedure is defined as any medical procedure that can induce the production of aerosols of various sizes, including small (< 5 mkm) particles.”

Health Canada. **Infection Prevention and Control for COVID-19: Second Interim Guidance for Acute Healthcare Settings.** April 30, 2020 ([LINK](#))

- Aerosol-generating medical procedures (AGMPs): “An AGMP is any procedure conducted on a patient that can induce production of aerosols of various sizes, including droplet nuclei. Examples include: Intubation and related procedures (e.g., manual ventilation, open endotracheal suctioning); Bronchoscopy; Sputum induction; Non-invasive positive pressure ventilation (CPAP, BiPAP).”

Royal College of Surgeons. **Good Practice for Surgeons and Surgical Teams.** April 3, 2020 ([LINK](#))

- “Aerosol Generating Procedures (AGPs). The following procedures are currently considered to be potentially infectious AGPs for COVID-19:
 - Intubation, extubation and related procedures, e.g., manual ventilation and open suctioning of the respiratory tract (including the upper respiratory tract)
 - Tracheotomy/tracheostomy procedures (insertion/open suctioning/removal)
 - Bronchoscopy and upper ENT airway procedures that involve suctioning
 - Upper Gastrointestinal Endoscopy where there is open suctioning of the upper respiratory tract
 - Surgery and post mortem procedures involving high-speed devices
 - Some dental procedures (e.g., high speed drilling)
 - Non-invasive ventilation (NIV) e.g., Bi-level Positive Airway Pressure Ventilation (BiPAP) and Continuous Positive Airway Pressure Ventilation (CPAP)
 - High Frequency Oscillatory Ventilation (HFOV)
 - Induction of sputum
 - High flow nasal oxygen (HFNO)

Additional Sources

Norwegian Institute of Public Health. **Aerosol generating procedures in health care, and COVID-19.** March 2020 ([LINK](#))

BC Provincial Infection Control Network (PICNet). **Orientation Program for Infection Control Professionals.** 2020 ([LINK](#))

Straube ([Review Protocol](#)). **Categorizing aerosol-generating procedures (AGP).** Expected date of completion: April 30, 2020 ([LINK](#))

- “Which procedures are categorized as AGP in documents by different authors/agencies?”

Specific Procedures and their Risks for Viral Transmission

Original inquiry: Are “High Flow Nasal Cannula” or “High Flow Oxygen” considered an AGMP? Are there any procedures that societies have listed as AGMP (for example, colonoscopies, labour and delivery, hyperventilation for electroencephalograms) that can be said to have no increased risk of viral transmission for healthcare workers?

CDC. **Clinical Questions about COVID-19: Questions and Answers.** May 6, 2020 ([LINK](#))

- Labour and delivery:
 - “When available, respirators (or facemasks if a respirator is not available), eye protection, gloves, and gowns should be used for the care of patients with known or suspected COVID-19 infection, including women who are pregnant.”
 - “Based on limited data, **forceful exhalation during the second stage of labor would not be expected to generate aerosols to the same extent as procedures more commonly considered to be aerosol generating**... Forceful exhalation during the second stage of labor is not considered an aerosol-generating procedure for respirator prioritization during shortages over procedures more likely to generate higher concentrations of infectious respiratory aerosols.”
- High-flow oxygen: “Based on limited data, **high-flow oxygen use is not considered an aerosol-generating procedure** for respirator prioritization during shortages over procedures more likely to generate higher concentrations of infectious respiratory aerosols... Patients with known or suspected COVID-19 should receive any interventions they would normally receive as standard of care.”

Protection for Healthcare Workers

Original inquiry: At this point, is there any evidence that neck protection for a person performing an intubation reduces the risk of viral transmission? Are there AGMPs that can be converted to a non-AGMP by altering the set-up of the procedure (for example, non-invasive ventilation, bi-level positive airway pressure, continuous positive airway pressure)?

The following resources address protective measures for health service providers in the context of AGMPs and COVID-19. No sources were found that address neck protection for intubation specifically, but several do include mention of neck protection as a part of Power Air-Purifying Respirators (PAPRs).

Guidance

Alberta Health Services. **IPC Recommendations for Suspected or Confirmed COVID-19 Patients requiring Urgent or Emergent Surgery.** April 21, 2020 ([LINK](#))

- Includes recommendations about: operating rooms, PPE, pre-operative protocols, induction and intubation, post-operative protocols, and references.

Alberta Health Services. **PPE for endoscopy procedures during COVID-19 pandemic.** April 25, 2020 ([LINK](#))

- “Where possible, avoid endoscopy procedures for patients with confirmed or suspected COVID-19”
- “AHS IPC does not consider gastroscopy to be an AGMP based on current scientific evidence.”

- “AHS IPC does not consider colonoscopy to be an AGMP based on current scientific evidence.”

Alberta Health Services. **Respiratory Illness: Assessing the Need for Additional Precautions.** March 13, 2020 ([LINK](#))

- List of Aerosol-Generating Medical Procedures: intubation and related procedures (e.g., manual ventilation, open endotracheal suctioning, extubation); cardiopulmonary resuscitation (CPR); Bi-level Positive Airway Pressure (e.g. BiPAP, CPAP); humidified high flow oxygen systems (e.g., ARVO, Optiflow); tracheostomy care; bronchoscopy; sputum induction; nebulized therapy/aerosolized medication administration; open respiratory/airway suctioning; high frequency oscillatory ventilation.
- The following procedures have not been shown to generate aerosols that increase transmission risk (includes but not limited to): Nasopharyngeal (NP) swabs; NP aspirates; oral suctioning; chest physiotherapy. Use the PCRA to determine appropriate PPE when performing these non-AGMP.
- Similar documents, though the lists of AGMPs differ:
 - Winnipeg Regional Health Authority. **Aerosol Generating Medical Procedures.** July, 2017 ([LINK](#))
 - Vancouver Coastal Health. **IPAC BEST PRACTICES GUIDELINE Aerosol Generating Medical Procedures.** March 23, 2020 ([LINK](#))
 - Australian and New Zealand Intensive Care Society (ANZICS). **COVID-19 Guidelines.** March 16, 2020 ([LINK](#))

Additional Sources

- Canadian Anesthesiologists’ Society. **COVID-19 Recommendations during Airway Manipulation.** March 21, 2020 ([LINK](#))
- CSO-NHS Taskforce. **Recommendations from the CSO-HNS taskforce on performance of tracheotomy during the COVID-19 pandemic.** April 27, 2020 ([LINK](#))
- ICM Anaesthesia COVID-19 (UK). **COVID-19 airway management principles.** March 19, 2020 ([LINK](#))

Multiple National Partners (UK). **Consensus guidelines for managing the airway in children with COVID-19.** April 1, 2020 ([LINK](#))

- Highlighting differences in practice from adult guidelines

Systematic Reviews

Chiesa-Estomba et al. medRxiv. **Systematic review of international guidelines for tracheostomy in COVID-19 patients.** April 29, 2020 ([LINK](#))

- “This review of international guidelines for tracheostomy in COVID-19 infected patients, aiming to summarize in a systematic way the available recommendations from 18 guidelines from all over the world.”

Cochrane Systematic Review. Behavioural interventions to promote workers' use of respiratory protective equipment. December 7, 2016 ([LINK](#))

- “Objectives: To assess the effects of any behavioural intervention either directed at organisations or at individual workers on observed or self-reported RPE use in workers when compared to no intervention or an alternative intervention.”
- “There is very low quality evidence that behavioural interventions, namely education and training, do not have a considerable effect on the frequency or correctness of RPE use in workers.”

Cochrane Special Collection. Coronavirus (COVID-19): regional anaesthesia to reduce drug use in anaesthesia and avoid aerosol generation. March 23, 2020 ([LINK](#))

- A collection of Cochrane reviews and overviews related to anaesthetic strategies to reduce exposure to aerosol generation.
- Sub-sections include:
 - Regional anaesthesia compared with conventional analgesic techniques
 - How best to perform regional anaesthesia and which local anaesthetics and adjuncts to use
 - Orthopaedic surgery
 - General surgery and vascular surgery
 - Cardiothoracic surgery

Cochrane Systematic Review. Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff. April 15, 2020 ([LINK](#))

- “Objectives: To evaluate which type of full-body PPE and which method of donning or doffing PPE have the least risk of contamination or infection for HCW, and which training methods increase compliance with PPE protocols.”
- “We found low- to very low-certainty evidence that covering more parts of the body leads to better protection but usually comes at the cost of more difficult donning or doffing and less user comfort, and may therefore even lead to more contamination... Face-to-face training in PPE use may reduce errors more than folder-based training.”

Other Reviews

Archer & Ungern-Sternberg. Pediatric anesthetic implications of COVID-19—A review of current literature. Pediatric Anesthesia, April 19, 2020 ([LINK](#))

CADTH. Masks During Aerosol-Generating ENT Procedures: Clinical Effectiveness and Guidelines. March, 2020 ([LINK](#))

- “No relevant studies were identified regarding the clinical effectiveness of masks for clinicians and healthcare workers exposed to bioaerosols or infectious agents during ENT procedures. In addition, no relevant evidence-based guidelines were identified regarding the selection of respiratory protection during ENT procedures for clinicians and health care workers.”

Cook . **Personal protective equipment during the coronavirus disease (COVID) 2019 pandemic – a narrative review.** Anaesthesia, April 4, 2020 ([LINK](#))

- “Recommendations from international organisations are broadly consistent, but equipment use is not. Only airborne precautions include a fitted high-filtration mask, and this should be reserved for aerosol generating procedures.”

First 10 EM. **Aerosol Generating Procedures.** May 7, 2020 ([LINK](#))

- Review of multiple procedures for evidence of increased risk of transmission to healthcare workers and evidence that they can be done safely with a reduced level of PPE.

Mick & Murphy. **Aerosol-generating otolaryngology procedures and the need for enhanced PPE during the COVID-19 pandemic: a literature review.** Journal of Otolaryngology - Head & Neck Surgery, May 11, 2020 ([LINK](#))

NSW Health (Australia). **Continuous Positive Airway Pressure (CPAP) machines.** April 10, 2020 ([LINK](#))

- “There is limited evidence on the topic of CPAP and/or BiPAP as aerosol generating procedures. Some publications describe CPAP and BiPAP as potential aerosol-generating procedures involved in nosocomial virus transmission. A systematic review found non-significant results for transmission for CPAP.”

NSW Health (Australia). **Laparoscopy during COVID-19.** March 25, 2020 ([LINK](#))

- “Advice from governing and academic bodies regarding laparoscopy was found in the grey literature... The Royal College of Surgeons of Edinburgh outline in relation to COVID-19, laparoscopy should generally not be used as it risks aerosol formation and infection.”

NSW Health (Australia). **Spirometry and transmission risk.** April 6, 2020 ([LINK](#))

- “There is very little and low level evidence. One non-human experimental article suggests that a significant transfer of aerosolised organisms does not occur during routine pulmonary function testing; as long as an interval of 5 minutes or more is allowed between tests.”

Ontario Health Quality. **Powered Air Purifying Respirators (PAPRs) as an Alternative to N95 Respirators in a HealthCare Setting: Supplemental Information.** April 7, 2020 ([LINK](#))

- Review of national and international guidelines, as well as published research literature.

Whittle et al. **Respiratory support for adult patients with COVID-19.** JACEP, April 2, 2020 ([LINK](#))

- “Summary recommendations include: (1) Avoid nebulized therapies. Consider metered dose inhaler alternatives. (2) Provide supplemental oxygen following usual treatment principles for hypoxic respiratory failure. Maintain awareness of the aerosol-generating potential of all devices, including nasal cannulas, simple face masks, and venturi masks. Use non-rebreather masks when possible. Be attentive to aerosol generation and the use

of personal protective equipment. (3) High flow nasal oxygen is preferred for patients with higher oxygen support requirements. Non-invasive positive pressure ventilation may be associated with higher risk of nosocomial transmission. If used, measures special precautions should be used reduce aerosol formation. (4) Early intubation/mechanical ventilation may be prudent for patients deemed likely to progress to critical illness, multi-organ failure, or acute respiratory distress syndrome (ARDS).”

Thamboo et al . **Clinical evidence based review and recommendations of aerosol generating medical procedures in otolaryngology – head and neck surgery during the COVID-19 pandemic.** Journal of Otolaryngology - Head & Neck Surgery, May 6, 2020 ([LINK](#))

- “Direct evidence indicates that CO2 laser ablation, the use of high-speed rotating devices, electrocautery and endotracheal suctioning are AGMPs. Indirect evidence indicates that tracheostomy should be considered as potential AGMPs. Nasal endoscopy and nasal packing/epistaxis management can result in droplet transmission, but it is unknown if these procedures also carry the risk of airborne transmission.”

The following article is a preprint and has not been peer-reviewed. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice.

Birgand et al. **Analysis of national and international guidelines on respiratory protection equipment for COVID-19 in healthcare settings.** medRxiv, April 29, 2020 ([LINK](#))

- “The recommendation of respirators was universally recommended for aerosol generating procedures (AGP) across countries, although the type of respirators and what constituted an AGP was variable.”

Expert Opinion

Medical Journal of Australia. **Consensus statement: Safe Airway Society principles of airway management and tracheal intubation specific to the COVID-19 adult patient group.** March 16, 2020 ([LINK](#))

- Extensive list of recommendations, beyond the scope of our understanding to reliably summarize or quote.

Primary Research

Cordier et al . **Health workers' safety during tracheostomy in COVID-19 patients: Homemade protective screen.** Head & Neck, April 29, 2020 ([LINK](#))

- “This installation is simple, easy, and fast to achieve and can be carried out with inexpensive material available in every hospital. This physical interface is an additional safety measure that prevents the direct projection of secretions or droplets.”

Cubillos et al. **A multipurpose portable negative air flow isolation chamber for aerosol-generating procedures during the COVID-19 pandemic.** British Journal of Anaesthesia, April 27, 2020 ([LINK](#))

- “We created a rigid cubic frame chamber that relies almost exclusively on materials available at hardware stores, which is then draped with a clear plastic bag.”

- “Even though our results are preliminary and qualitative in nature, we demonstrate proof of concept for an additional physical barrier during aerosol-generating procedures.”

Malik et al. Maximising application of the Aerosol Box in protecting healthcare workers during the covid-19 pandemic. *Anaesthesia*, April 29, 2020 ([LINK](#))

- “The Aerosol Box was intended to protect healthcare workers performing aerosol generating procedures (AGPs), specifically tracheal intubation, by providing a physical barrier to droplet and/or aerosol exposure. An increased infection rate has been reported in healthcare workers internationally, particularly when the level of personal protective equipment (PPE) has been inadequate... The Aerosol Box... is re-usable after careful decontamination with an appropriate cleansing agent.”

Soma et al. Operative team checklist for aerosol generating procedures to minimise exposure of healthcare workers to SARS-CoV-2. *International Journal of Pediatric Otorhinolaryngology*, July 2020 ([LINK](#))

- “An 8 step operative team checklist is provided describing details for the immediate pre-operative, intra-operative and post-operative journey of the patient to encourage healthcare workers to reflect upon and modify usual practice during AGP to mitigate exposure to SARS-CoV-2.”

Thompson et al. Influenza Aerosols in UK Hospitals during the H1N1 (2009) Pandemic – The Risk of Aerosol Generation during Medical Procedures. *PLoS One*, February 13, 2013 ([LINK](#))

- Frequently referenced, seems to be a benchmark paper.
- “With our small sample size we found that AGPs do not significantly increase the probability of sampling an H1N1 (2009) positive aerosol (OR (95% CI) = 4.31 (0.83–22.5)). Although the probability of detecting positive H1N1 (2009) positive aerosols when performing various AGPs on intensive care patients above the baseline rate (i.e. in the absence of AGPs) did not reach significance, there was a trend towards hierarchy of AGPs, placing bronchoscopy and respiratory and airway suctioning above baseline (background) values.”

van Doremalen et al. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. *NEJM*, April 16, 2020 ([LINK](#))

- “We found that the stability of SARS-CoV-2 was similar to that of SARS-CoV-1 under the experimental circumstances tested... Our results indicate that aerosol and fomite transmission of SARS-CoV-2 is plausible, since the virus can remain viable and infectious in aerosols for hours and on surfaces up to days (depending on the inoculum shed).”

Workman et al. Endonasal instrumentation and aerosolization risk in the era of COVID-19: simulation, literature review, and proposed mitigation strategies. *International Forum of Allergy & Rhinology*, April 3, 2020 ([LINK](#))

- “We confirm that aerosolization presents a risk to the endonasal skull base surgeon. In the outpatient setting, use of a barrier significantly reduces aerosol spread. Cold surgical

instrumentation and microdebrider use pose significantly less aerosolization risk than a high-speed drill. Procedures requiring drill use should carry a special designation as an “Aerosol Generating Surgery” to convey this unique risk, and support the need for protective PPE.”

The following articles are preprints and have not been peer-reviewed. They report new medical research that has yet to be evaluated and so should not be used to guide clinical practice.

- Brar et al. medRxiv. **St George's COVID shield for use by ENT surgeons performing tracheostomies.** May 11, 2020 ([LINK](#))
- Chahal et al. medRxiv. **A Rapidly Deployable Negative Pressure Enclosure for Aerosol-Generating Medical Procedures.** April 21, 2020 ([LINK](#))
- Fears et al. medRxiv. **Comparative dynamic aerosol efficiencies of three emergent coronaviruses and the unusual persistence of SARS-CoV-2 in aerosol suspensions.** April 28, 2020 ([LINK](#))
- Iwashyna et al. medRxiv. **Variation in Aerosol Production Across Oxygen Delivery Devices in Spontaneously Breathing Human Subjects.** April 20, 2020 ([LINK](#))
- Matava et al. medRxiv. **Clear plastic drapes may be effective at limiting aerosolization and droplet spray during extubation: implications for COVID-19.** March 30, 2020 ([LINK](#))

Transmission and Infection

Original Inquiry: In SARS-CoV-1 and H1N1, what were the rates of healthcare worker infection after performing specific AGMPs? What are the rates of healthcare worker infection with COVID-19 after performing AGMPs in the current pandemic? What is the current state of research regarding whether COVID-19 is a droplet vs. airborne spread illness?

Systematic Reviews

Health Technology Assessment Unit, University of Calgary. **Transmission of Acute Respiratory Infections During Aerosol Generating Medical Procedures.** April 8, 2020 ([LINK](#))

- Update of 2011 CADTH Systematic Review (see below)
- “Both additional studies concluded that the performance of AGMPs significantly increased risk of ARI transmission to HCWs. Analysis by Kuster et al. (2013) suggests that the provision of assistance for AGMPs also carries risk of transmission.”
- “The 2011 CADTH report appears to find no pattern to the procedures that are significantly associated with risk of transmission to healthcare workers”
- “Like the 2011 CADTH report, this update finds the presence of a significant research gap. Moreover, the generalizability of these findings to the current COVID-19 outbreak is unclear.”

- Related document: CADTH. **Aerosol-Generating Procedures and Risk of Transmission of Acute Respiratory Infections: A Systematic Review**. November, 2011 ([LINK](#))
 - “Procedures that are believed to generate aerosols and droplets as a source of respiratory pathogens include positive pressure ventilation (bi-level positive airway pressure [BiPAP] and continuous positive airway pressure [CPAP]), endotracheal intubation, airway suction, high-frequency oscillatory ventilation, tracheostomy, chest physiotherapy, nebulizer treatment, sputum induction, and bronchoscopy.”
 - See Table 1 for odds ratios for different procedures (pp 7-8), figures 1-2 for meta-analysis results (pp 9-10)
 - “Our findings suggest that some procedures potentially capable of generating aerosols have been associated with increased risk of SARS transmission to HCWs or were a risk factor for transmission, with the most consistent association across multiple studies identified with tracheal intubation.”
 - “These findings must be interpreted in the context of the very low quality of the studies”

Methodology

Newfoundland and Labrador Centre for Applied Health Research (NLCAHR) COVID-19 Quick Response reports are initiated by, and shared with, our partners in the provincial health system, including the four Regional Health Authorities, the Departments of Health and Community Services and Children, Seniors and Social Development, and public health officials.

NLCAHR staff work with topic submitters to clarify the research question. We then search for related systematic reviews, meta-analyses, other reviews, interim and other guidance statements, primary research, expert opinion and health and science reporting.

We use several search strategies, with a focus on the following databases:

- [Alberta Health Services](#)
- [CADTH](#)
- [Canadian Pharmacists Association](#)
- [Campbell Collaboration](#)
- [Cochrane Collaboration](#)
- [Centre for Disease Control](#)
- [Centre for Evidence Based Medicine](#)
- [Evidence for Policy and Practice Information and Co-ordinating Centre](#)
- [European Centre for Disease Prevention and Control](#)
- [Health Canada](#)
- [HIQA \(Ireland\)](#)
- [Joanna Briggs Institute](#)
- [MedRxiv](#)
- [National Collaborating Centres on Methods and Tools \(NCCMT\)](#)
- [National Institutes of Health](#)
- [National Institute of Allergy and Infectious Diseases](#)
- [National Library of Medicine](#)
- [Public Health Agency of Canada](#)
- [Trip Database](#)
- [World Health Organization](#)

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