Aerosol Generating Procedures (AGPs)

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This literature review will be updated in real time if any significant changes are found in the professional literature or from national guidance/policy.

Version	Date	Summary of changes	Changes marked
1.0	October 2019	Tracheotomy/tracheostomy procedures have been added to the list of AGPs, this includes the formation of a tracheotomy and associated procedure such as open suction. Cardiopulmonary resuscitation (CPR) is no longer specified as an AGP; however, procedures associated with CPR e.g. intubation, manual ventilation are included.	
1.1	March 2020	High flow nasal oxygen added to list of AGPs based on expert opinion (NERVTAG)	
1.2	May 2020	Addition of reference to updated AGP list and SBAR in consultation with NERVTAG.	

Approvals – this document requires the following approvals (in cases where signatures are required add an additional 'Signatures' column to this table)::

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		National Infection Prevention and Control (NIPC) steering and consensus groups		

Contents:

1. Objectives

The aim is to review the extant scientific literature regarding aerosol generating procedures (AGPs) in the healthcare environment to form evidence based recommendations for practice. The specific objectives of the review are to determine:

- What is an aerosol generating procedure (AGP)?
- Which procedures are considered to be aerosol generating?

2. Methodology

This targeted literature review was produced using a defined two-person methodology as described in the National Infection Prevention and Control Manual: development process.

3. Discussion

3.1 Implications for practice

What is an aerosol generating procedure (AGP)?

Aerosols are produced when an air current moves across the surface of a film of liquid; the greater the force of the air the smaller the particles that are produced.[1] Aerosol generating procedures (AGPs) are defined as any medical and patient care procedure that results in the production of airborne particles (aerosols).[1] AGPs can produce airborne particles <5 micrometres (µm) in size which can remain suspended in the air, travel over a distance and may cause infection if they are inhaled. Therefore AGPs create the potential for airborne transmission of infections that may otherwise only be transmissible by the droplet route.[1]

Which procedures are considered to be aerosol generating?

In 2007 a list of AGPs was agreed for use in NHS England, NHS Wales and NHSScotland; this was based on a 2007 systematic review by World Health Organization (WHO),[2] which ranked procedures according to the strength of available evidence. In addition to the procedures listed by WHO (2007) the UK list also included some dental procedures and induction of sputum.

The list of procedures was:

- Intubation and extubation
- Manual ventilation
- Open suctioning
- Cardiopulmonary resuscitation
- Bronchoscopy
- Surgery and post-mortem procedures involving high-speed devices
- Some dental procedures (e.g. drilling)
- Non-invasive ventilation (NIV) e.g. Bi-level Positive Airway Pressure (BiPAP) and Continuous Positive Airway Pressure ventilation (CPAP)

- High-Frequency Oscillating Ventilation (HFOV)
- Induction of sputum

In Republic of Ireland the list of AGPs differs, it only includes:

- Intubation
- Manual ventilation
- Non-invasive ventilation (e.g., BiPAP, BPAP)
- Tracheostomy insertion[3]

The most recent assessment by WHO (2014) states that there is only consistent evidence that there is an increased risk of transmission for the following procedures: tracheal intubation, tracheotomy procedure, non-invasive ventilation, and manual ventilation before intubation as AGPs.[1] This evaluation is based on a systematic review by Tran et al.[4] whose review included 10 studies (5 case-control; 5 cohort), all of which investigated transmission of SARS from patients to healthcare workers in intensive care or other healthcare settings during the 2002-2003 SARS outbreaks.[4] Tran et al presented their findings in descending order of risk,[4] and the list within the recommendations section of this document reflects this order; however, given the extremely limited volume and quality of studies available this hierarchy should be used for academic purposes only and not for clinical decision making.

Tracheal intubation[1, 5-7] and manual ventilation[1, 4, 5, 8] are consistently associated with risk of airborne transmission in the literature. However, there is mixed evidence, associated with transmission, for other procedures identified by Tran et al. Non-invasive ventilation (NIV) has been found to be associated with transmission of SARS;[4, 7] however, other studies have failed to find an association with either aerosol production or airborne contamination.[9-11] Similarly, neither bronchoscopy or open suctioning of bodily fluids were found by Tran et al to be associated with transmission of SARS;[4] but increased microbial contamination of air has been associated with both bronchoscopy [8, 9, 12] and open suctioning.[8, 13] Open suctioning was implicated in the transmission of MERS-CoV to a healthcare worker.[5]

Cardiopulmonary resuscitation (CPR) is not currently stated on WHO list of AGPs (2014).[1] Nevertheless, CPR can include a number of different procedures, namely intubation, manual ventilation, open suctioning, chest compression and defibrillation. Some of these procedures are identified AGPs. Therefore, CPR involving procedures listed as AGPs should be managed as such (i.e. a potential source of infectious aerosols).[5]

The use of high-speed devices such as those used for surgical, post-mortem and dental procedures have consistently been shown to generate aerosols which create widespread environmental contamination and therefore a risk of transmission of infection to healthcare workers.[14-19]

In the systematic review completed by Tran and colleagues in 2014, endotracheal aspiration, nebuliser treatment, administration of oxygen (including high flow oxygen), defibrillation, chest compressions, insertion of nasogastric tube, and collection of sputum were not found to be significantly associated with an increased risk of transmission of SARS.[4] That said, some of these procedures are considered to have a theoretical risk of aerosolisation, and therefore are listed as AGPs based on consensus of expert opinion, specifically, induction of sputum.

Induction of sputum typically involves the administration of nebulised saline to moisten and loosen respiratory secretions (this may be accompanied by chest physiotherapy (percussion and vibration)) to induce forceful coughing, this may create conditions for aerosol generation as described by WHO (2014).[1]

Nebulisation and chest physiotherapy performed independently are not considered to be AGPs. Nebulisation was previously included in WHO (2007) list of AGPs and reflected in the UK list at that time.[2] However, there is now published evidence that nebulisation and oxygen therapy (pressurised humidified O_2) do not result in an increased risk of aerosols.[4, 10] During nebulisation, the aerosols produced are derived from the fluid in the nebuliser chamber and not from the patient. Whilst chest physiotherapy was reported to be associated with airborne influenza RNA during the 2009 H1N1 pandemic,[8] it has been found that chest physiotherapy increases droplet production; these particles are predominantly >10µm in size and precipitate within 1m of the patient.[10]

Administration of high flow nasal oxygen should also currently be considered an aerosol generating procedure based on consultation with expert panel NERVTAG (New and Emerging Respiratory Virus Threats Advisory Group). Evidence for this recommendation is currently under review and will be included in an update.

Although there is an absence of strong evidence to support some of the procedures listed as AGPs in this document this does not mean that there is an absence of risk. A precautionary approach should be taken for all AGPs specified as potentially capable of generating infectious aerosols from patients suspected or known to have respiratory infections.

3.2 Implications for research

The scientific evidence necessary to establish which procedures are associated with transmission of respiratory pathogens is generally limited; most studies lack scientific rigor and the outcomes are contradictory for some procedures. The majority of available studies are case reports or observational studies undertaken during outbreaks of infection such as SARS or influenza and should be interpreted with caution.

The list of AGPs may be subject to change as new evidence emerges.

4. Recommendations

This review makes the following recommendations based on an assessment of the extant scientific literature on aerosol generating procedures (AGPs) in the healthcare setting.

What is an aerosol generating procedure (AGP)?

Aerosol generating procedures are described/defined as medical and patient care procedures that result in the production of airborne particles (aerosols) that create the potential for airborne transmission of infections that may otherwise only be transmissible by the droplet route.

(Category B recommendation)

Which procedures are considered to be aerosol generating?

The following procedures are currently considered to be AGPs:

- Intubation, extubation and related procedures e.g. manual ventilation and open suctioning.
- Tracheotomy/tracheostomy procedures (insertion/open suctioning/removal)
- Bronchoscopy.
- 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 (BiPAP) and Continuous Positive Airway Pressure ventilation (CPAP).
- High-Frequency Oscillating Ventilation (HFOV)
- Induction of sputum

(Category B recommendation)

- High flow nasal oxygen

(Category C recommendation)

N.B. Always refer to manufacturer's guidance for any new devices or equipment purchased which may have the potential to generate patient-derived aerosols.

(Category C recommendation)

Note: This list of AGPs was updated following a rapid review and consultation with NERVTAG in May 2020. A full review will be conducted as part of the next, formal, scheduled update.

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Appendix 1: Grading of recommendations

Grade	Descriptor	Levels of evidence
Mandatory	'Recommendations' that are directives from government policy, regulations or legislation	N/A
Category A	Based on high to moderate quality evidence	SIGN level 1++, 1+, 2++, 2+, AGREE strongly recommend
Category B	Based on low to moderate quality of evidence which suggest net clinical benefits over harm	SIGN level 2+, 3, 4, AGREE recommend
Category C	Expert opinion, these may be formed by the NIPC groups when there is no robust professional or scientific literature available to inform guidance.	SIGN level 4, or opinion of NIPC group
No recommendation	Insufficient evidence to recommend one way or another	N/A