Health Information and Quality Authority

An tÚdarás Um Fhaisnéis agus Cáilíocht Sláinte

Evidence summary for Aerosol Generating Procedures: risk of transmission of SARS-CoV-2 from patients without clinical symptoms

18 June 2020

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Key points

- Whether the risk of transmission of SARS-CoV-2 from an asymptomatic patient is augmented by the performance of an aerosol generating procedure (AGP) is unknown. HIQA systematically reviewed the published evidence for the association of performance of AGPs on individuals without clinical features of viral respiratory tract infection and airborne transmission to healthcare professionals (HCPs).
- In total, three studies were identified; two studies that examined the risk of transmission to healthcare professionals of undertaking an aerosol generating procedure (AGP) on a patient without clinical features of a viral respiratory disease, and one analytical study that examined the potential for the production of potentially infectious aerosols from an AGP.
- Of the three studies, one considered patients with SARS-CoV-1, one MERS-CoV and one Influenza A and B. No studies were identified that concerned SARS-CoV-2.
- At least one of six patients with unrecognised SARS-CoV-1 was a source of transmission to a HCP during a short time period (28 hours in total) which included the intubation procedure. A similar risk of transmission was observed in those cases that were recognised as SAR-CoV-1 patients at the time of intubation.
- MERS-CoV was not transmitted to any HCP who had contact with an unidentified case who underwent intubation during cardiac arrest. The cardiac arrest was assumed at the time to be related to the patient's underlying health condition.
- Influenza A and B were not aerosolised in viable, detectable quantities during bronchoscopy on patients from a general hospital setting where influenza was likely but not confirmed.
- The body of evidence identified in this review was of low quality.
- Generalisability of the findings to SARS-CoV-2 infections and AGPs not identified in this review, is unclear.
- In summary, there was no evidence identified to inform whether performance of AGPs on patients without clinical features of SARS-CoV-2 at the time of the procedure is associated with airborne transmission of the infection to healthcare professionals or production of potentially infectious aerosols.

Evidence summary for Aerosol Generating Procedures: risk of transmission of SARS-CoV-2 from patients without clinical symptoms

The Health Information and Quality Authority (HIQA) has developed a series of 'Evidence Summaries' to assist the Clinical Expert Advisory Group (EAG) in supporting the National Public Health Emergency Team (NPHET), as well as those developing infection prevention and control guidance in their response to COVID-19. These summaries are based on specific research questions (RQs). This evidence summary was developed to address the following research question:

> **Is performing aerosol generating procedures (AGPs) on patients without clinical features of viral respiratory tract infections associated with airborne transmission to healthcare professionals?**

This question was assessed as two sub-questions:

- What is the evidence that performance of AGPs on patients without clinical features of viral respiratory tract infection at the time of the procedure is associated with airborne transmission of respiratory viruses to healthcare professionals (HCPs)?
- What is the evidence that performance of AGPs on individuals without clinical features of viral respiratory tract infection at the time of the procedure, is associated with generation of potentially infectious aerosols?

The processes as outlined in HIQA's protocol, available on www.hiqa.ie, were followed. Below is the summary of all relevant studies until 5 May 2020.

Results

Three studies that examined viral respiratory infection were identified, none of which examined SARS-CoV-2. These included a descriptive case cohort study[1] of 45 patient cases retrospectively collected from the time frame of the 2013 SARS-CoV-1 outbreak in Toronto, Canada; a case report[2] of an, at the time unidentified, MERS patient in Saudi Arabia and; an analytical study[3] of the potential for bronchoscopy to aerosolise bacteria and viruses, undertaken in a general hospital setting. Data were available from the identified studies on intubation and bronchoscopy. Findings from individual studies are summarised below and detailed in Table 1.

Transmission to HCPs

A descriptive case cohort study reviewed risk of transmission to HCPs who cared for patients with laboratory-confirmed SARS-CoV-1 during a period spanning 24 hours prior to intubation and four hours post procedure. A total of 45 patients were intubated during the study period with six of these unrecognised as cases at the time of intubation. Twenty six of 624 HCPs that provided care were retrospectively confirmed as SARS-CoV-1 cases by laboratory IgG antibody tests.[1] One of six (17%) unrecognised patient cases at the time of intubation and six of 39 patients (15%) recognised as cases at the time of intubation were identified as sources of transmission to at least one HCP. While a large number of potential risk factors including those related to patient characteristics, HCP characteristics and their involvement in a range of wide range of care procedures including AGPs were investigated, no other disaggregated data by patient status were reported. Personal protection equipment (PPE) worn varied by type of equipment, with 74% always wearing goggles, 93% always wearing gloves, and 90% always wearing gowns in a patients room. For respiratory protection, 8% wore none, 5% wore a surgical mask, 82% wore an N95 mask or equivalent, with 4% wearing a higher level of protection (for example, N95 plus Stryker hood, powdered air-purifying respirators [PAPRs]). No details were provided on what was worn during different procedures. No details were reported on the symptoms or illness of patients not recognised as cases at the time of intubation, other than day of illness. However, the study period was at a point in the SARS-CoV-1 outbreak in Canada when clinical presentation was known and cases were actively being identified.

There were no reported cases of transmission to HCPs in a case report of an unsuspected MERS patient with underlying health conditions, presenting with abdominal distention, nausea, vomiting and a mild fever.[2] The patient was intubated during cardiac arrest in the emergency department. Sixty HCPs were exposed to the patient during her two visits to the emergency department and subsequent admission to the intensive care unit, including an unspecified number of HCPs who performed intubation and or CPR on the patient. HCP wore varying levels of PPE while treating the patient; however, the specifics of what was worn during different procedures were not reported. The patient did not have respiratory symptoms of MERS on initial presentation or during her care, although she was febrile throughout. She was confirmed as a MERS case towards the later part of her care, shortly prior to her death. Although there was no reported transmission to HCP, patient-to-patient transmission to one other patient who shared a room with the case patient, was reported.

Production of infectious aerosols

Influenza A and B were not aerosolised in viable, detectable quantities during bronchoscopy on patients from a general hospital setting where influenza was likely, but not confirmed.[3] Patients eligible for inclusion were any patient undergoing a bronchoscopy for any reason in either of two bronchoscopy rooms selected from across two hospitals. It was unclear whether any patients were influenza cases, no detail was given on symptoms, illness or reason for the bronchoscopy for the patient population as the focus of the study was to ascertain the potential infectious aerosols produced during bronchoscopy and characterise the bacterial and viral pathogens present. One bronchoscopy room was a negative pressure room, the second bronchoscopy room had three air outlets equipped with high-efficiency particulate air filters that expelled the air directly outdoors. Fifteen bronchoscopies were carried out across the two rooms during a one day sampling window. Air samples were collected at a fixed station located within a radius of 1.5 meter from the patient's mouth and the HCPs breathing zone, using a standard biological air sampler for culturable bio-aerosol analysis. Polymerase chain reaction (PCR) was used to detect the presence of influenza A and B. The authors note that pathogens present in the air are dependent on patient pathology, and the absence of any specific pathogens from the samples in the study does not mean they will always be absent.

Study quality and quality of the evidence

The descriptive cohort study was of good quality for its design although the outcomes of interest in this review were not the focus of the study with few details provided. As such, it was downgraded to low in terms of its contribution to this review. The case report was of low quality given its publication as a conference abstract providing limited data, and the questionable generalisability of the atypical case described.

The analytical study was of low quality. While it was well designed in terms of measuring and analysing potentially infectious aerosols, it lacked a detailed description of the population making it difficult to interpret the relevance of the findings in the context of this review.

Sample sizes were low in all studies and specific details on patient symptoms and use of PPE at the time of intubation were lacking.

Discussion and conclusion

AGPs may expose healthcare workers to pathogens and cause infection,[4] but the risk of transmission from AGPs is not fully known. Even less is known about the risk of transmission from patients without symptoms or those without a laboratory case confirmation at the time of the procedure. In terms of SARS-CoV-2, there is

increasing evidence that patients may be infectious when pre-symptomatic or asymptomatic.[5] Whether this risk of transmission extends to or is augmented by the performance of an AGP is unknown. In light of the SARS-CoV-2 public health emergency, HIQA systematically reviewed the published evidence for the association of performance of AGPs on individuals without clinical features of viral respiratory tract infection and airborne transmission to HCPs.

The total body of evidence included in this review was of low quality due to the study types identified. The quality of the individual studies were of low quality for their study type. The main sources of bias across the three studies were small sample size, indirect analysis of the outcome of interest in this review and poor description of patient symptoms at the time of AGP. More reporting on the clinical features of the patient at the time of AGP in studies assessing the risk of transmission is needed.

In summary, there was no evidence identified to inform whether performance of AGPs on patients without clinical features of SARS-CoV-2 at the time of the procedure is associated with airborne transmission of the infection to healthcare professionals or production of potentially infectious aerosols. There was extremely limited evidence that transmission to a HCP occurred from SARS-CoV-1 from at least one unrecognised case; however, this transmission cannot be directly attributed to the AGP procedure itself as the study included a 28-hour window which included the intubation procedure. For MERS-CoV, one case report on a patient during intubation showed no transmission to HCPs. There was extremely limited, low-quality evidence from one study that Influenza A and B were not aerosolised in viable, detectable quantities during bronchoscopy on patients from a general hospital setting where influenza was likely, but not confirmed. The generalisability of these findings to SARS-CoV-2 is unclear and should be undertaken with caution.

Table 1 Summary of identified studies

Transmission to healthcare professionals (HCPs)			
Author **Country** **Study design**	Population details Setting PPE details	Patient details Included AGPs	Outcome results
Author: Raboud J **Country:** Canada **Study design:** Descriptive cohort **url:** https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0010717	**Population details:** 624 HCPs who provided care to 45 intubated SARS-CoV-1 patients during treatment or transportation and who entered a patient room or had direct patient contact from 24 hours before to 4 hours after intubation. Staff physician 16 (3%), medical resident 283 (45%), nurse 89 (14%), respiratory therapist 67 (11%), radiology technologist 38 (6%), housekeeper 26 (4%), personal service assistant 14 (2%), laboratory technician 3 (0.5%), pharmacist 2 (0.3%), ward clerk 2 (0.3%), porter 1 (0.2%), physiotherapist/occupational therapist 4 (0.6%). 26 HCP-cases were identified and confirmed by IgG antibody tests. SARS-CoV-1 was transmitted to 26 HCPs from 7 patient cases; 21 of whom were infected by 3 patient cases. **Setting:** Intubation in patient rooms. **PPE details:** While in the patient room HCPs always wore: goggles 74%; gloves 93%; gown 90%; respiratory protection none 8%, surgical masks 5%, N95 or equivalent 82%, higher protection than N95 (e.g., N95 + Stryker hood, PAPRs) or equivalent 4%.	**Patient details:** Retrospective case ascertainment of laboratory-confirmed SARS-CoV-1, includes those identified (n=39) and those not identified (n=6) as having SARS-CoV-1 at the time of intubation. **Included AGPs:** Intubation. Other AGPs evaluated in the study, but no breakdown by recognition of SARS-CoV-1 or by patient symptoms, at the time of procedure.	**Infection rate in HCPs:** 1/6 (17%) unrecognised cases at the time of intubation and 6/39 (15%) recognised cases at the time of intubation were identified as sources of transmission to at least one HCP. **Risk of transmission from patients to HCPs:** No results reported specific to risk of transmission to HCP from patients without clinical features of SARS at the time of intubation. **Other:** Lack of adherence to IPC measures was identified as a risk factor for transmission for the total cohort, OR not reported.
Author: Fagbo S **Country:** Saudi Arabia **Study design:** Case report	**Population details:** 60 HCP exposed to an unsuspected MERS patient, including an unspecified number of HCP who performed intubation and or CPR on the patient. **Setting:** 2 ED visits and subsequent admission to ICU.	**Patient details:** 77 year old female with diabetes mellitus, hypertension, chronic kidney disease and chronic myelocytic leukemia, presenting with	**Infection rate in HCPs:** Zero HCPs infected. **Risk of transmission from patients to HCPs:** Zero transmission. **Other:** One patient to patient transmission reported.

url: https://www.ijidonline.com/action/showPdf?pii=S1201-9712%2816%2930456-8	**PPE details:** Varying levels of protection, not reported specific to procedures.	abdominal distention, nausea, vomiting and fever. **Included AGPs:** Intubation.	
Production of infectious aerosols			
Author **Study design**	**Population details** **Setting**	**Included AGPs** **Viral detection method**	**Outcome results**
Author: Marchand G **Study design:** Analytical **url:** **https://www.ncbi.nlm.nih.gov/pubmed/27388266**	**Population details:** Any patient from a general hospital setting, undergoing a bronchoscopy for any reason in either of the 2 rooms described below. 15 bronchoscopies (Room A: n=5; Room B: n=10) were carried out during a 1 day sampling window. Unclear as to whether any patients were influenza cases, no detail given on symptoms, illness or reason for the bronchoscopy for the patient population. **Setting:** Two bronchoscopy rooms in 2 different hospitals. Room A had a volume of 79 m^3 and had negative pressure in relation to its anteroom, with 12 air changes per hour. Room B had a volume of 59.8 m^3 with three air outlets equipped with high-efficiency particulate air filters that expelled the air directly outdoors.	**Included AGPs:** Bronchoscopy. **Viral detection method:** Air samples were collected at a fixed station located within a radius of 1.5 m from the patient's mouth and the HCPs breathing zone using a standard biological air sampler for culturable bio-aerosol analysis. PCR was used to detect the presence of influenza A and B.	**Detection of viable virus in generated aerosols:** No influenza A or B were detected. **Molecular detection of viral material in generated aerosols:** None reported.

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Published by the Health Information and Quality Authority (HIQA).

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