Evidence check

6 April 2020

Rapid evidence checks are based on a simplified review method and may not be entirely exhaustive, but aim to provide a balanced assessment of what is already known about a specific problem or issue. This brief has not been peer-reviewed and should not be a substitute for individual clinical judgement, nor is it an endorsed position of NSW Health.

Spirometry and transmission risk

Rapid review question

Is there evidence that spirometry is an aerosol generating procedure and what risk does it carry?

In brief

- Peak organisations such as the World Health Organisation (WHO) and the National Health Service (NHS) do not list spirometry as an aerosol generating procedure.
- 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.
- A systematic review included spirometry in its search terms for aerosol generating procedures but did not generate any studies.
- Two case reports have presented circumstantial evidence of the transmission of infection by respiratory function testing equipment. Recent Chinese expert consensus outline risks of pulmonary function testing and suggest prevention and control strategies to prevent nosocomial infection during COVID-19.

Limitations

Very limited and low level evidence is available.

Background

Spirometry is the most frequently performed lung function test in primary care and specialist settings. Spirometry has not been categorised as one of aerosol generating procedures (AGPs) in clinical guidelines from WHO, (1) or the Scotland and UK NHS. (2, 3) However, the Thoracic Society of Australia and New Zealand (TSANZ) and the Australian and New Zealand Society of Respiratory Science (ANZSRS) recently recommended the suspension of spirometry testing during COVID-19 due to its potential risk of transmission (4)

Methods (Appendix 1)

PubMed and google searches were performed between the 3rd and 6th of April 2020.

Results (Table 1)

Table 1: Spirometry as an aerosol generating procedure and risk

Study	Findings
Peer reviewed studies	
Hiebert, 1999 (5)	In this study Escherichia coli (E. coli) introduced as an aerosol into spirometry tubing could be recovered from air drawn from the proximal end of the spirometry tube within 1-2 minutes after inoculation. No *E. coli* was recovered after 5 minutes. These observations supported the hypothesis that a significant transfer of aerosolized organisms does not occur during routine pulmonary function testing as long as an interval of 5 minutes or more is allowed between tests. This supports the hypothesis that there was no transfer of aerosolized organisms from the pulmonary function tubing as long as there was at least a 5 minute delay between injection of the aerosolized organisms into the tubing and forcible withdrawal of the air from the tubing.
Kendrick, 2003 (6)	This study describes the below two studies (Gough and Hazaleus) which have presented circumstantial evidence of the transmission of infection by respiratory function testing equipment, although in neither case was the aetiological agent recovered from the implicated instrument.
Gough et al,1990 (7)	In this study 18 patients were infected with an ampicillin-resistant β-lactamase-producing strain of Haemophilus influenza. The organism was not isolated from repeated environmental samples; but there was strong circumstantial evidence that a spirometer was a common iatrogenic source of the cross-infection.
Hazaleus et al,1981 (8)	In this study 22 patients used the test device after use on a patient with pulmonary tuberculosis. There was one patient converter; 21 other patients who had also used the contaminated apparatus in the same time period did not convert. Infection of the patient who did convert is attributed to the pulmonary function testing apparatus.
Tran et al, 2012 et al. (9)	Spirometry was a search term in this systematic review but did not generate any studies that included spirometry.
Grey literature	
World Health Organisation (1)	• Spirometry has not been categorised as one of the aerosol generating procedures (AGPs) • Some aerosol generating procedures have been associated with increased risk of transmission of coronavirus (SARSCoV) such as tracheal intubation, non-invasive ventilation, tracheotomy, cardiopulmonary resuscitation, manual ventilation before intubation and bronchoscopy

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	• Increased risk of SARS-CoV transmission was also reported when performing non-invasive ventilation, tracheotomy and manual ventilation before intubation; however, these findings were identified from a limited number of very low quality studies
National Health Services (NHS) (2)	In 2007 a list of AGPs were agreed for use in NHS England, NHS Wales and NHS Scotland: • Intubation and extubation • Manual ventilation • Open suctioning • Cardiopulmonary resuscitation • Bronchoscopy • Surgery and post-mortem procedures involving high-speed device • Some dental procedures (e.g. drilling) • Non-invasive ventilation (e.g. bi-level positive airway pressure or continuous positive airway pressure ventilation • High-frequency oscillating ventilation • Induction of sputum In Northern Ireland the list of AGPs differs and only includes: • Intubation • Manual ventilation • Non-invasive veneration • Tracheostomy insertion
National Health Services (NHS) (3)	The following procedures are considered likely to generate aerosols capable of transmitting respiratory pathogens when undertaken on patients with an RTI: • Intubation, extubation and related procedures; for example, manual ventilation and open suctioning • Cardiopulmonary resuscitation • Bronchoscopy (unless carried out through a closed circuit ventilation system) • Surgery and post-mortem procedures in which high-speed devices are used • Dental procedures • Non-invasive ventilation (e.g. bi level positive airway pressure ventilation) • Continuous positive airway pressure ventilation • High frequency oscillatory ventilation • Induction of sputum

Task Force of Pulmonary Function Testing and Clinical Respiratory Physiology, Chinese Association of Chest Physicians, & Pulmonary Function Testing Group, Respiratory Therapeutics Group, Chinese Thoracic Society (10)	Expert consensus on lung function tests during the prevention and control of new coronavirus pneumonia: • COVID-19 is mainly transmitted by respiratory droplets and close contact • Pulmonary function testing procedures have been associated with an increasing risk of COVID-19 transmission among patients and medical staffs (Note – this was not referenced) • Spirometry testing technique requires the patient to repeatedly perform forced breathing, which often causes the person to cough and spit. When the person exhales hard or coughs or spits, a large amount of respiratory droplets can be generated, forming a high concentration of aerosol, which can pollute the inspection environment, instruments and surrounding objects, or even spray or splash to the cornea of the operator, skin or clothing. When the subject inhales hard, they may inhale the aerosol suspended in the respiratory circuit or air in the lung function device. • Pulmonary function tests can increase the risk of COVID-19 droplet transmission and contact transmission among medical staff and patients. Effective prevention and control strategies must be compulsorily implemented to prevent nosocomial infection. This recommendation is intended to be followed by staff of pulmonary function testing laboratory when COVID-19 is in epidemic. Based on the features of pulmonary function testing, precaution principles and strategies are developed in three aspects of management: operating procedure, environment and equipment.

References

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Appendix

Search 1 (PubMed) – “Spirometry”[MeSH] AND aerosol – 518 hits
Search 2 (PubMed) – “Spirometry”[MeSH] AND aerosol AND (“bacteria”[MeSH]) – 8 hits
Search 3 (PubMed) – “Spirometry/adverse effects”[MAJR] – 21 hits
Search 4 (PubMed) – ((("Spirometry"[Mesh]) OR (spirometry[Title/Abstract])) AND ("aerosol generat*"[Title/Abstract] OR "airborne infection*"[Title/Abstract] OR "air dispersion"[title/abstract] OR transmission[title/abstract]) AND (1990:2020[pdat])) NOT ("data transmission"[Title/Abstract])
Search 5 (Google) – spirometry infection aerosol – 191,000 hits (first 100 hits reviewed)

Inclusion/exclusion criteria:

Retrieved studies were performed in humans and were published in English. Exclusion criteria were non-healthcare occupational hazard study (e.g. silica dust exposure in construction workers), drug and pharmacotherapy studies (e.g. bronchodilators), studies with no abstract, and any study with a lung disease emphasis (rather than a device or procedure emphasis).