Conducting spirometry in general practice

Infection control during the COVID-19 pandemic

KERRY HANCOCK BM BS, FRACGP
RICHARD PARSONS CRFS; **DAVID SCHEMBRI** CRFS

All healthcare guidelines endorse spirometry as best practice for measuring patients' lung function. However, with more than 500 health worker infections in Australia by July 2020, there is increasing concern about health worker protection. This article discusses the issues surrounding lung function testing in point-of-care settings such as general practice and summarises the current recommendations for infection control.

Spirometry is recommended as an indispensable tool for diagnosing, differentiating and monitoring chronic airways diseases. It has considerable impact on the accuracy of diagnosis and clinical management of patients with chronic obstructive pulmonary disease (COPD) and asthma at the point of patient care, especially in general practice.[1-10] All national and international healthcare guidelines endorse spirometry as best practice for measuring patients' lung function.[2-5]

COVID-19 (coronavirus disease), caused by the SARS-CoV-2 virus, emerged in December 2019 in Wuhan, China. This novel coronavirus initially caused a national outbreak of severe pneumonia in China, and rapidly spread around the world as a pandemic. The virus is expelled as droplets from the respiratory tract of an infected individual

RESPIRATORY MEDICINE TODAY 2020; 5(2): 28-33

Dr Hancock is a GP at Chandlers Hill Surgery, Adelaide. Mr Parsons and Mr Schembri are Senior Respiratory Scientists at the Department of Respiratory Medicine, Southern Adelaide Local Health Network, Adelaide, SA.

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Key points

- **Spirometry is recognised as the gold standard for diagnosing and managing chronic airways diseases.**
- **However, the virus responsible for COVID-19 can be transmitted via droplets and air.**
- **On 25 March 2020, the Thoracic Society of Australia & New Zealand and Australian & New Zealand Society of Respiratory Science recommended suspension of all lung function testing unless clinically essential.**
- **On 27 April 2020, they updated their advice to state that pulmonary function testing could be performed under certain circumstances.**
- **GPs and their staff who conduct spirometry understandably are concerned about how to proceed.**
- **This article discusses the issues surrounding lung function testing and summarises the current recommendations for infection control.**

(e.g. during coughing and sneezing) directly onto a mucosal surface or conjunctiva of a susceptible individual or an environmental surface. However, because of evaporation, even a single large droplet may reduce in diameter and become airborne during its trajectory. It is currently understood that transmission of the virus is highly likely to be by both droplet and airborne routes.[11]

With more than 500 health worker infections in Australia by July 2020, there is increasing concern about health worker protection and that current infection control guidelines are not aligned with the growing body of scientific evidence around transmission and prevention of SARS-CoV-2 infection.[12] Very few cases of infection transmission via spirometers have been documented before the COVID-19 pandemic, with the risk of serious infection to patients and spirometry operators reduced by usual standard infection control procedures (SICPs), including single-use consumables, vaccination (e.g. against influenza, pertussis and tuberculosis) or access to medication. Despite this, spirometry equipment has the potential to transmit pathogens by direct contact with surfaces and items such as mouthpieces, hand-held devices, valves and tubing or by indirect transmission during expiratory manoeuvres and through the patient's coughing or sneezing.[13]

Although SICPs have been advocated when conducting spirometry across all healthcare settings, microbiological contamination of spirometers has been documented, indicating the need for stricter attention to hygiene measures for spirometer maintenance and use in general practices.[14] Recommendations on lung function testing during the COVID-19 pandemic continue to evolve globally.

Should lung function testing be suspended during the COVID-19 pandemic?

International respiratory organisations have highlighted concerns about lung function testing being a vector for transmission in healthcare settings. For instance, the American Thoracic Society states: 'There remain many unknowns about the possibility of transmission … and the data are in evolution; however, the risks of transmission may be significant, and likely vary based on the prevalence of the virus in the community and the age [of the patient], severity of lung disease, and presence of immunosuppression.'[15]

Evolving advice

On 25 March 2020, the Thoracic Society of Australia & New Zealand (TSANZ) and the Australian & New Zealand Society of Respiratory Science (ANZSRS) recommended suspension of all lung function testing unless deemed clinically essential since it represented a potential avenue for COVID-19 transmission. Suspension of testing was also consistent with the recommended cancellation of all elective medical services as part of the Australian Federal Government's strategy to mitigate the spread of the virus, with the central aims of reducing the number of infected individuals (and potential mortalities) and preventing healthcare resources from being overwhelmed. Following the Federal Department of Health's later recommendation to restore some categories of elective surgery and endoscopy on 27 April 2020, TSANZ and ANZSRS updated their advice to state that pulmonary function testing could be performed in patients with the following conditions:

- All pulmonary function testing … can now be performed in patients who are afebrile, and who have no symptoms of a viral illness.
- In such patients, infection control measures (such as level of PPE [personal protective equipment] and cleaning of equipment between patients) in line with respective federal and state health departments, and physical distancing in public areas is still required.
- It is recommended that body temperature is measured in all patients prior to testing to ensure they are afebrile.
- Pulmonary function testing is NOT recommended in patients who are febrile, or who have an escalating acute respiratory condition.
- It is also recommended that testing only be performed using lung function equipment that utilise inline filters.

Although the TSANZ/ANZSRS recommendations were directed at secondary and tertiary healthcare settings, the National Asthma Council of Australia concurred with them and issued a statement in the *Australian Asthma Handbook*: 'Do not perform spirometry or peak expiratory flow on patients who have symptoms consistent with COVID-19, are febrile, or who have an escalating acute respiratory condition. Use only spirometers that use inline filters.' The handbook also provided more detailed information about mitigating risk with strict infection control measures, adding: 'The respiratory plume of exhaled particles contains virus for several hours and surfaces may retain viruses for several days.'[2]

Lung function testing in general practice

In healthcare settings, most patients are screened for symptoms of COVID-19 before entry, but it is difficult to screen and assess patients with pulmonary disease who are more likely to present with pre-existing respiratory symptoms consistent with their disease and unrelated to COVID-19. Clinicians who conduct spirometry in their practices, or are responsible for staff who do so, understandably are concerned about how to proceed. There has been confusion about who should be tested and what type of PPE should be used.

In this article, we discuss the issues surrounding lung function testing in point-of-care settings such as general practice where testing usually consists of spirometry before and after bronchodilator administration. This discussion is not relevant to lung function laboratories in secondary and tertiary centres that undertake more complicated testing such as cardiopulmonary exercise testing, bronchoprovocation testing and testing on more vulnerable patients.

Triple challenge

GPs have needed to be agile during this pandemic to manage the demands of providing both acute and ongoing chronic care to patients while continuing to safeguard the health and welfare of themselves and their staff. This is at a time when increasing financial

pressures present even further challenges to general practice. As many GPs are aware, the Medicare Benefits Schedule (MBS) rebates for spirometry (MBS item numbers 11505 and 11506) remain relatively low and the additional costs of providing a spirometry service within the infection control guidelines will be financially challenging.

The recommendations presented here are the authors' own and do not represent official positions of the TSANZ, ANZSRS or Royal Australian College of General Practice. They are intended as a baseline from which clinicians in a general practice can design their own plans, consistent with their unique circumstances. General practices should consider developing an operational strategy that addresses, as a minimum, patient prioritisation, screening and diagnostic testing, physical distancing, infection control and follow-up surveillance.

The recommendations presented here incorporate infection control measures that take into consideration lung function testing only when there are low levels of community transmission

Levels of transmission

Transmission of SARS-CoV-2 is a dynamic process and, therefore, it is likely that the prevalence of COVID-19 in the community will fluctuate over time. This will impact on the risk mitigation steps a practice should employ at any given timepoint during the pandemic. Operating procedures should be frequently reassessed and modified as needed.

The recommendations presented here incorporate infection control measures that take into consideration lung function testing only when there are low levels of community transmission. The community new case rate should be consistently low or have a downward trajectory for at least 14 days before considering resumption of any nonessential lung function testing. The recommendation for a downward trajectory of confirmed cases assumes that the volume of testing remains relatively constant; otherwise, variation in the daily case rate may reflect changes in testing volume rather than the infection rate.[16]

At other times, lung function testing should be limited to patients for whom it is essential for immediate treatment decisions. These are unlikely to be patients for whom lung function would be conducted in general practice anyway (e.g. evaluation of lung transplant and lung resection candidacy; assessment of the risk of bronchiolitis obliterans syndrome in lung or bone marrow transplant recipients; diagnostic evaluation of patients with significant unexplained or complex dyspnoea; and guidance of clinical decisions in patients with chronic lung diseases such as cystic fibrosis and interstitial lung disease).[16]

In general practice, confirmation of a diagnosis of COPD in a patient presenting with typical features of the disease can be safely delayed until after the COVID-19 pandemic, and the patient managed empirically with bronchodilators and the usual nonpharmacological strategies (e.g. smoking cessation, regular exercise, vaccination and attention to comorbidities). The patient with asthma can be regularly reviewed and asthma control assessed with validated questionnaires; the patient with a high probability of asthma based on history, symptoms and examination can be empirically managed with a monitored trial of inhaled corticosteroids.[17]

Easing restrictions, increasing cases

These recommendations are also guided by the realisation that easing of interstate and overseas border restrictions in Australia in communities that have low levels of transmission may lead to an increase in COVID-19 cases in those communities as well as the likelihood of increasing numbers of asymptomatic COVID-19-positive individuals. There is evidence that:[18]

- between 5 and 80% of people testing positive for SARS-CoV-2 may be asymptomatic
- symptom-based screening can miss cases, perhaps a significant number of them
- some asymptomatic cases can become symptomatic within a week (also known as 'presymptomatic cases')
- children and young adults can be asymptomatic
- there is no single reliable study to determine the number of asymptomatic people.

These recommendations also consider that there is no SARS-CoV-2 vaccine currently available. Therefore, general practice clinics should make significant efforts to mitigate the risk of viral exposure to patients and staff until the threat of COVID-19 has receded. The goals of any plan should be to:

- protect patients and staff from exposure to the virus
- account for limitations in staff, equipment and space
- provide access to care for patients with acute and chronic conditions.

The risk of spread of SARS-CoV-2 when conducting spirometry

There has been no published research evidence on the actual risks of generating aerosols and possible spread of COVID-19 to operators when performing manoeuvres that involve patients exhaling forcibly from full inspiration to full expiration. However, what is known is that exhalations, sneezes and coughs not only consist of mucosalivary droplets but, importantly, form a turbulent gas cloud that protects droplets from evaporation.

This may extend the lifespan of a droplet allowing it to travel up to 8 metres. Eventually, the cloud loses momentum and the remaining droplets evaporate forming droplet nuclei that remain suspended for hours with the ability to cause longer-range infectious transmission.[19,20]

Research conducted in five leading laboratories independently demonstrated that SARS-CoV-2 has more propensity for aerosolisation than SARS-CoV (severe acute respiratory syndrome

coronavirus) or MERS-CoV (Middle East respiratory syndrome coronavirus), both of which are accepted as having airborne potential, and that viable virus can be detected in the air 16 hours after aerosolisation.[21] A comprehensive overview of droplet and aerosol generation can also be found in a recently published paper by Australian and New Zealand authors.[22]

It is well recognised that the spirometry manoeuvre can regularly elicit a cough in many patients and that poor cough etiquette is often observed.

What about inline filters?

Many spirometers in Australia have single-use (disposable) sensors or mouthpieces and, until now, it was well accepted that the risk of cross-contamination from one patient to the next was eliminated by changing the sensor or mouthpieces between patients and additional antimicrobial filters were not necessary. However, these types of devices may allow exhaled breath to escape during the forced expiration manoeuvre with ambient contamination a risk in the current COVID-19 pandemic. This risk can be significantly reduced by adding a suitable filter (often referred to as an inline filter). Other spirometers use either disposable mouthpieces with a one-way valve to prevent inspiration through the equipment or a disposable, low-resistance micro-aerosol filter inserted between the patient and spirometer.

The manufacturer and/or company representative of individual spirometer devices should provide information about the efficiency, suitability and compatibility of inline filters for specific devices. *It is important to note the use of the wrong inline filter can result in significant errors in spirometry measurements*. It is the responsibility of individual health services to ensure that the correct inline antiviral filter is used with their spirometer device. Detailed information about spirometer devices commonly in use in Australia, including distributer contact details and infection control features, can be found in the *Spirometer Users and Buyers Guide*.[23] Considering that the number of asymptomatic COVID-19-positive patients in the community is likely to increase and spirometry operators are in close proximity to the patient, *the use of an inline filter alone will not entirely remove the risk of droplet contamination*.

Should we conduct spirometry in primary care settings during the COVID-19 pandemic?

During the COVID-19 pandemic, with scientific evidence accruing, daily rising healthcare worker infections and uncertainty, the precautionary principle should be followed.[24] This stipulates it is imperative to act in the face of imperfect evidence, because the potential benefits outweigh the harms. Health workers treating COVID-19 patients or suspected COVID-19 patients should be afforded optimal protection and unless every patient attending for spirometry is tested to determine that they do not have COVID-19 then one may need to consider every patient as a 'suspected COVID-19 patient'.[12]

Choice and level of PPE

After determining the clinical need for testing and accessibility (or not) to other services such as lung function laboratories where PPE is more readily available, the primary care-based health service should carefully consider the choice and level of PPE to be used by their spirometry operators.

PPE can include: gloves, gowns/aprons/suits, surgical masks, P2/N95 respirators, powered air-purifying respirators (PAPR), protective eyewear (safety glasses/goggles), full-face shields, headcovers and shoe covers. PAPR, head and shoe covers are not currently recommended for routine care of the patient with COVID-19 and therefore deemed as not required when performing spirometry. Gloves protect the hands, gowns or aprons protect the skin and/or clothing, masks and respirators protect the mouth and nose, goggles protect the eyes, and face shields protect the entire face. The respirator has been designed to also protect the respiratory tract from airborne transmission of infectious agents whereas surgical masks will not perform this function.

The careful use of PPE must comply with current Australian Guidelines for the Prevention and Control of Infection in Healthcare and current Department of Health COVID-19 advice.[25-27]

When performing spirometry in general practice … use a P2/N95 mask, preferably fitted, or surgical mask (if there is no access to P2/N95 masks), in combination with a face shield (or goggles if face shield not available).

CDC advice

The Centers for Disease Control and Prevention provides the following advice in relation to P2/N95 surgical respirators:[28]

Most healthcare workers/professionals caring for confirmed or suspected COVID-19 patients should not need to use surgical P2/N95 respirators and can use standard P2/N95 respirators/masks. (Surgical N95 respirators, sometimes called medical respirators, are recommended only for use by healthcare professionals who need protection from both airborne and fluid hazards, such as splashes or sprays.)

When performing spirometry in general practice, when testing is deemed to be clinically necessary and essential for an immediate treatment decision, in the presence of low community transmission, in an afebrile patient with no acute respiratory or other COVID-19 symptoms and low epidemiological risk, the pragmatic recommendation is to use a P2/N95 mask, preferably fitted, or surgical mask (if there is no access to P2/N95 masks), in combination with a face shield (or goggles if face shield not available). Further information on surgical masks, P2/N95 respirators and face shields for suspected, probable or confirmed COVID-19 cases is available from state-based public health units such SA Health.[29]

Full contact and droplet precautions

If the test is essential for clinical decision-making, use single-use, inline filters at all times to ensure low community transmission.

Perform hand hygiene

Use gloves (see body text for comment about gloves), surgical mask and eye protection (safety glasses or face shield), gown or apron:

- gloves must be removed and hand hygiene performed after each patient; new gloves are required for the next patient
- safety glasses and face shields can be worn during consecutive patient testing in the same location
- if labelled as reusable, the face shield can be cleaned with a detergent/disinfectant wipe in between uses
- if surgical masks are in short supply, they can be used for periods up to four hours during consecutive patient testing in the same location
- the mask should be discarded if it becomes wet or contaminated and on leaving the room, so care should be taken not to touch the mask while it is in place; if the front of the mask is touched it should be removed and discarded, hand hygiene should be performed and a new mask fitted.

Removal of PPE

At the end of the testing session:

- remove gloves, if used; perform hand hygiene
- remove gown or apron; perform hand hygiene
- remove face shield or safety glasses without touching the front; perform hand hygiene
- remove mask, without touching the front; perform hand hygiene.

Environmental hygiene

- In addition to routine cleaning, frequently touched surfaces should be wiped after every patient, with detergent/disinfectant wipes or a detergent product, using a disposable cloth.
- Any contaminated or visibly soiled surface should be cleaned/disinfected immediately.

Source: Coronavirus (COVID-19) environmental cleaning and disinfection principles for health and residential care facilities, Australian Government Department of Health (https://www.health.gov.au/resources/publications/coronavirus-covid-19-environmental-cleaning-and-disinfection-principles-for-health-and-residential-care-facilities).

Hand hygiene

Although gloves are an essential component of PPE and influence the risk of disease transmission by protecting against contact with infectious materials, the use of gloves when performing spirometry is controversial. Gloves can become contaminated during a spirometry procedure with the potential to spread infection across environmental surfaces while performing spirometry.

Based on substantial evidence, the 5 Moments for Hand Hygiene are designed to minimise the risk of transmission of microorganisms between the healthcare worker, patient and environment.[30] Therefore, adherence to this strategy of hand hygiene with alcohol-based handrub is considered appropriate as an alternative to wearing gloves when conducting spirometry.

Infection control measures

Since the risk of infection when performing spirometry is unknown, the following infection control measures are recommended for conducting spirometry in primary care settings:

- All patients presenting to the practice, clinic or health service should be administered a COVID-19 risk factor questionnaire that includes clinical and epidemiological enquiry of COVID-19 such as presence of acute respiratory symptoms, fever, loss of smell or taste, relevant travel or contact with a suspected/confirmed COVID-19 case. The regularly updated Communicable Diseases Network Australia (CDNA) guidelines for public health units include further details of clinical presentation.[31]
- All patients attending should have their temperature taken (via tympanic thermometer). Febrile patients and/or patients with new respiratory symptoms should be excluded from spirometry testing.
- Cough etiquette and respiratory hygiene must be observed at all times.
- Physical distancing remains in place and is to be observed as best as practicable.
- Staff and patients should observe physical distancing: at least 1.5 m is required between people except when physical distancing is impossible (e.g. during physical examination, clinical care or testing).
- Patient testing should occur in single rooms where practicable.
- Visitors accompanying patients should be discouraged; however, consideration needs to be made for essential patient support and/or appropriate chaperoning (e.g. heightened patient anxiety, disabilities, interpreter, carer, gender, children's parents or guardians).
- Strict adherence to hand hygiene for both the patient and the operator should be observed at all times.
- All surfaces, chairs, stadiometer, weigh scales, etc., in contact with the patient should be wiped with antimicrobial wipes.
- Administration of medication via nebulisation is regarded as an aerosol-generating procedure and should be avoided.

- *Point-of-care spirometry testing should only proceed with an inline, high-efficiency, single-patient use, antibacterial/antiviral filter in place.*
- *Full contact and droplet precautions should be applied when performing spirometry.*

See Box for the summary of full contact and droplet precautions.

Recommendations have not been made about precautions to take when using peak flow meters and microspirometers (such as PiKo6 and COPD-6 devices) in healthcare settings. However, precautions similar to those for conducting spirometry would be pragmatic.

General practice-based spirometry after the COVID-19 pandemic

The impact on COVID-19 on the population is likely to continue for a considerable period. The challenges for GPs and the healthcare system generally will be to manage effectively the physical, psychological and social implications of life after the COVID-19 pandemic. Many patients in tertiary centres will have had spirometry testing delayed during the pandemic, with many survivors of COVID-19 also requiring lung function testing as routine clinical follow up or as part of research studies.

There will be heightened demand on secondary and tertiary laboratory services. This may place more pressure on the primary care sector to provide spirometry for their own patients to achieve timely testing for confirmation of provisional diagnoses made during the pandemic or for ongoing monitoring of obstructive lung disorders such as asthma and COPD that was delayed because of the pandemic.

Establishing a recall system in the electronic medical record may assist in managing the prioritisation of patients when services are up and running again in general practice (e.g. 'spirometry-diagnostic- post-COVID-19'; 'spirometry-monitoring- post-COVID-19'). All health professionals conducting spirometry should be appropriately trained and practices could consider ensuring that staff undertake training in preparation for the post-COVID-19 demand on spirometry services.[2]

Conclusion

During the COVID-19 pandemic, the choice and level of PPE used as part of droplet precautions if conducting spirometry in primary care settings is at the discretion of individual general practices or health services and should be informed by the potential infection risk to healthcare workers and patients attending the workplace. With the mounting evidence for airborne potential of SARS-CoV-2 and the concerns about transmission from asymptomatic carriers, community-based services such as general practices need to realistically consider the practicalities of offering spirometry services to their patients. *The health and safety of healthcare workers and patients should be the priority at all times and infection risks mitigated*. The recommendations and advice specifically relevant to COVID-19 are subject to change and clinicians are advised to refer to the latest CDNA National guidelines for public health units and any state health public health unit alerts and local health network policies and procedures. **RMT**

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A list of references is included in the online version of this article www.respiratorymedicinetoday.com.au.

COMPETING INTERESTS: Dr Hancock, Mr Parsons and Mr Schembri receive fees for spirometry training courses for healthcare professionals.

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