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POSITION STATEMENT

Spirometry training courses: Content, delivery and assessment - a position statement from the Australian and New Zealand Society of Respiratory Science*

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ABSTRACT

Spirometry training courses are provided by health services and training organizations to enable widespread use of spirometry testing for patient care or for monitoring health. The primary outcome of spirometry training courses should be to enable participants to perform spirometry to international best practice, including testing of subjects, quality assurance and interpretation of results. Where valid results are not achieved or quality assurance programmes identify errors in devices, participants need to be able to adequately manage these issues in accordance with best practice. It is important that potential participants are confident in the integrity of the course they attend and that the course meets their expectations in terms of training. This position statement lists the content that the Australian and New Zealand Society of Respiratory Science (ANZSRS) has identified as required in a spirometry training course to adequately meet the primary outcomes mentioned above. The content requirements outlined in this position statement are based on the current international spirometry standards set out by the American Thoracic Society and European Respiratory Society. Furthermore, recommendations around course delivery for theoretical and practical elements of spirometry testing and post-course assessment are outlined in this statement.

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Abbreviations: ANZSRS, Australian and New Zealand Society of Respiratory Science; ATS/ERS, American Thoracic Society/European Respiratory Society; BTPS, body temperature pressure saturated; FEV_1, forced expiratory volume in 1 s; FVC, forced vital capacity; GP, general practitioner; QC, quality control.

BACKGROUND

In 2004, the Australian and New Zealand Society of Respiratory Science (ANZSRS) in conjunction with the Thoracic Society of Australia and New Zealand (TSANZ) released a position statement on the minimum requirements for spirometry training courses. This was to ensure that accurate and quality spirometry meeting recognized international standards was taught to course participants.[1]

This position paper is an update of the 2004 document incorporating the latest evidence available on performance of spirometry.[2–5] This document should be read in consultation with the recent ANZSRS spirometry competency document.[6] The aim of this updated position statement is to ensure that the content of spirometry training courses reflects the knowledge expected in the ANZSRS competency document.

INTRODUCTION

Spirometry is the most commonly performed test for assessing respiratory function. Spirometry is recognized as a valuable tool for identifying and managing chronic obstructive pulmonary disease (COPD), asthma and other disorders that may affect the respiratory system.[7–12] Advances in technology over the last 20 years have resulted in the manufacture of portable low-cost spirometers that meet the requirements of the 2005 American Thoracic Society/European Respiratory Society (ATS/ERS) standards for spirometry.[3]

Consequently, performance of spirometry is now encouraged and commonplace in primary care, occupational health and sports medicine settings.

Although spirometry appears to be a relatively easy test to perform, it is often not appreciated that the clinical utility of spirometry is dependent on the accuracy of the spirometer and the competence and knowledge of both the operator performing the test and the practitioner interpreting the results. Quality spirometry is achieved when the operator has the skills to instruct and motivate the patient to perform the correct breathing manoeuvre and can also identify and overcome equipment and/or patient-related problems. These skills ensure acceptable and repeatable results are achieved that are clinically useful. Although many spirometers have software with inbuilt algorithms to provide feedback on test quality, sole reliance on this can be inadequate. Müller-Brandes *et al.* found that utilization of inbuilt algorithms could not replace visual inspection by the operator for assessment of quality of forced expiratory manoeuvres in children.[13] Spirometry tests, whether performed in or outside of dedicated respiratory function laboratories, should be performed to international best practice.[3] Poorly performed spirometry tests, use of unmaintained spirometers or incorrect interpretation of results may result in serious medical consequences, such as misdiagnosis and mismanagement.

REVIEW OF SPIROMETRY KNOWLEDGE AND PERFORMANCE IN PRIMARY CARE SETTINGS

Multiple studies of spirometry in primary care settings[14–18] have shown poor achievement of adherence to quality criteria as described in the international standards.[3] Reasons for this include a lack of knowledge and skill in spirometry performance, access to spirometry training and ongoing support, an inability to maintain competency due to infrequent testing, and insufficient maintenance and quality control (QC) of spirometers.

A survey from the USA[19] investigating spirometry practice in primary care found that only 42% of respondents with a spirometer in their practice had received any spirometry training. In a similar survey in Australia, all respondents had undertaken some form of training, although 64% had half-a-day of training or less, with 40% having less than 2 h.[20] The length and type of training have been shown to be important in achieving valid spirometry results in primary care. Eaton *et al.*[14] showed that 2 h of training is better than no training (13.5% vs 3.5% meeting acceptability and repeatability criteria, respectively).[14] Borg *et al.*[15] showed that 5 months after 14 h of training, healthcare professionals met acceptability and repeatability criteria 40% of time, with improvement to 58% with follow-up training. Similarly, Burton *et al.*[16] showed 57% adherence to spirometry quality criteria following 3–4 h of training and eight weekly feedback sessions. In the USA, a study[21] investigating spirometry use and its impact on clinical management decisions in COPD and asthma demonstrated that 71% of spirometry results performed in the study were deemed acceptable. Prior to the commencement of this study, an intensive 2-day spirometry training programme had been undertaken by study participants. These results suggest that the length of a spirometry training course, follow-up training and quality feedback are important inclusions of a training programme to improve the quality of spirometry results.

The frequency of spirometry testing may also impact the quality of spirometry results. Schermer *et al.*[17] found that only 39% of tests performed in general practices in the Netherlands met acceptability and repeatability criteria. They suggested that 'apart from limited training and quality assurance activities, lack of experience and routine are likely to be important factors in the high rate of low-quality spirometry tests observed in general practice'. Borg *et al.* showed that of those participants not able to meet acceptability and repeatability criteria at follow-up assessments at 5 and 7 months after training, the majority consisted of participants who had not tested patients between assessments.[15] A mixed-methods study comparing models of spirometry delivery in primary care for patients at risk of COPD[18] found that spirometry performed by visiting trained nurses was of a higher quality than spirometry performed by nurses or general practitioners (GP) from the practice (76% vs 44% met acceptability and repeatability criteria, respectively). Polish researchers[22] demonstrated that primary care nurses who dedicated their time to spirometry after 8 h of training achieved spirometry quality goals 92% of the time. This study focused on the prevalence, severity and burden of COPD in primary care. This study also included oversight and feedback to the tester on their spirometry quality by one of the investigators. These results suggest that adherence to international spirometry standards improves with frequency of testing and hence experience.

REVIEW OF EQUIPMENT QUALITY ASSURANCE

While improved technologies mean that many spirometers designed for use in primary care may not require daily calibration, equipment maintenance, and accuracy and precision checks are still an essential component of quality spirometry. International standards state that spirometer calibration should be verified on the day of use.[3] Worn/damaged components, dropped devices and ageing equipment can all result in changes in accuracy and precision of spirometers. Poor application of equipment QC was demonstrated in 67% of primary care facilities with spirometers surveyed in Australia and 47% surveyed in the USA.[19,20] In the Australian study, only 22% of respondents used a 3-L calibration syringe for equipment QC/calibration checks and the regularity of equipment checks varied widely (from daily, yearly or never).

REVIEW OF INTERPRETATION OF SPIROMETRY RESULTS

Another important aspect of any spirometry service is the correct interpretation of results. Personnel reporting spirometry results are required to be skilled and competent when assessing test quality and identifying patterns of normality and abnormality, rather than relying on automatic interpretative software. In addition, the ability to recognize spirometry patterns, such as obstructive, restrictive and normal, in context with the clinical question being asked assists the operator to have confidence in the spirometry results. A Welsh study investigating spirometry use in general practice found that 66% of GP had limited or no confidence in interpreting results.[23] Similarly, a survey of 137 GP who had participated in a spirometry evaluation programme in the Netherlands found that 94 (69%) felt that they required ongoing support with interpretation of spirometry.[24] A US study demonstrated a 76% concordance between GP and a respiratory expert in interpretation of spirometry results.[19] This result suggests that training the operator and the reporter/interpreter is important for providing a quality spirometry service.

SUMMARY

In order to provide a quality spirometry service, several key factors are to be met by the health professional conducting the test. The minimal requirements include

- An understanding of the measurement,
- Knowledge and understanding of the importance of checking the spirometer's accuracy,
- Developing appropriate coaching skills to get the best manoeuvre from the patient,
- Ability to identify good quality manoeuvres and provide feedback to the patient so as to achieve a quality test result,
- Identify normal and abnormal spirometry patterns and
- Access to ongoing support after training.

The quality of results increases when operators are regularly performing spirometry and are able to identify normal and abnormal spirometry patterns. Completing a spirometry training course that encompasses all of the above will (in part) ensure that some of these elements are met. Thereafter, ongoing support including feedback on the quality of tests and refresher training will assist the development of expertise.

CORE COMPONENTS OF A SPIROMETRY TRAINING COURSE

The Spirometry Training Course Working Group considers the following core components be included in a spirometry training course as a minimum. These components are based on the 2005 ATS/ERS pulmonary function standards,[2–4] the General Practitioners in Asthma Group (GPIAG) recommendations for performance of spirometry in the primary care setting[25] and the Australian Government's training paper.[26]

The following outline is a summary of the core components of a spirometry training course.

1. Introduction
   - Explanation of what spirometry is
   - Volume–time and flow–volume curves
   - Definitions of spirometric indices (e.g. forced expiratory volume in 1 s (FEV_1), forced vital capacity (FVC), FEV_1/FVC)
   - Use of forced expiratory time (FET) and peak expiratory flow (PEF) for assessing quality of manoeuvres
   - International standards for spirometry testing and interpretation[3,4]
   - Refer to ANZSRS position papers pertaining to spirometry[5,6]
   - Explanation of Body Temperature Pressure Saturated (BTPS) conditions for reported values
2. Purpose of spirometry
   - To identify spirometry patterns
     - Normal
     - Obstructive
     - Restrictive
   - Identify indications for testing
   - Highlight contraindications/precautions for testing
3. Test performance requirements
   - Pre-appointment instructions
   - Correct method for measuring height (or surrogate height)
   - Instructions to patient
     - Importance of coaching and motivation to elicit maximal results
   - Demonstration of spirometry manoeuvre
   - Performance of manoeuvres
     - FVC—expiratory manoeuvre only
     - Flow–volume loop—expiratory and inspiratory manoeuvre
   - Acceptability criteria
     - Identifying trials that meet the acceptability criteria
     - Identifying and removing/disabling unacceptable trials, which include, but not limited to:
       - Sub-maximal inhalation
       - Sub-maximal start
       - Interruption in flow
       - Early termination of the trial
       - Slow vital capacity (VC)
   - Impact of unacceptable test manoeuvres
   - Repeatability criteria
   - End of test criteria
   - Reversibility assessment
     - Bronchodilator withholding times
     - Method of administering bronchodilator
     - Time to peak efficacy
   - Troubleshooting instrument errors
   - Troubleshooting patient manoeuvres to achieve acceptability
   - Technical comments to describe test quality
4. Selection of best test data for the report
   - Spirometry values
   - Volume–time and flow–volume graphs
5. Reference values
   - Definition
   - Selection of reference values[5]

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- Use of lower limit of normal (LLN), z-score and percent predicted
- Limitations of reference equations including ethnicity implications

6. Interpretation
   - Quality of test statement
   - Pattern recognition: normal, obstructive or restrictive pattern
   - Assessing severity of obstruction
   - Identification of bronchodilator response
   - Serial trend in data
   - Limitations of spirometry—when other tests may be required; for example, follow-up of a restrictive pattern and bronchial challenge for suspected asthma
7. Spirometers
   - Minimum spirometer standards required to achieve a quality test
   - Minimum performance requirements including verifying the calibration
   - Size of graphics in real time for quality review during the test
   - Minimum requirements for report including reference values
   - Spirometry values are expressed in BTPS conditions
8. Quality control
   - Calibration versus calibration check/instrument verification
   - Definition for verifying spirometer volume accuracy
   - Flow linearity and volume accuracy using a calibrated, certified 3-L syringe at different flow ranges; slow, medium and fast
   - Frequency of verification procedures
   - Checking logic for new versions of software, for example choice of best test data
   - Record keeping of calibration, linearity and accuracy checks
9. Quality assurance
   - Ongoing training
   - Development of standard operating procedures
   - Adherence to local workplace guidelines for infection prevention
   - Adherence to local workplace guidelines for medical emergencies/complications arising from performing spirometry
   - Record keeping
     - Patient data
     - Equipment troubleshooting and maintenance logs
     - Equipment documents

Other considerations for spirometry training

- Spirometry training course content must adhere to the current international ATS/ERS pulmonary function standards for spirometry testing and interpretation.
- Spirometry training courses should be coordinated and run by a suitably qualified person with substantial experience in the theoretical and practical aspects of spirometry measurement and interpretation. For example, a respiratory scientist who has passed the Certified Respiratory Function Scientist examination (CRFS) and has at least 5 years of experience in a respiratory laboratory would meet these criteria.
- Spirometry training courses may be designed as a fully attended course or a mixture of e-learning spirometry knowledge modules plus attended practical modules. Distance (online) learning without an attended practical component is neither acceptable nor applicable for practical spirometry training and assessment.[25]
- Execution of attended sessions is at the discretion of course coordinator. However, as a guide, it is recommended that a minimum of 10 h attended course training would be required and at least 6 h will be practical training.
- Resource material provided to course participants should contain the required content on spirometry as well as a recommended reference list.
- For e-learning with an online spirometry course, there is no recommended number of hours, it can be at the participant's own pace. Following the completion of e-learning modules, the participant will be required to complete an attended practical session to provide additional learning for test performance, quality assurance and interpretation of results. As a guide, 6 h of attended practical training will be required.
- An ideal ratio of participants to demonstrators for the practical training component is 4:1 or less but no more than 5:1.

Assessment on completion of a training course for spirometry core competencies

- Participants are required to demonstrate the required skills and knowledge at the end of the spirometry training course.
- Assessment should include a combination of direct observation, verbal questions and written questions.
- Assessment and competency are addressed in ANZSRS spirometry competency paper.[6]

Assessment tool following completion of a spirometry training course (compulsory)

Courses must develop a post-training course assessment tool to assess evidence of test performance and application of learned skills. The tool may take the form of a workbook or other assessment package. Participants are required to submit their assessments within 3 months of completing a spirometry training course.

The workbook or assessment tool will require the participant to provide answers to a set of learning tasks. The learning tasks are designed to assist the knowledge and an understanding of:

- Responses
  - How to recognize quality tests and adding relevant technical comments
  - Demonstrating an understanding of the flow profile for verifying the calibration, that is simulating the air flow encountered during a spirometry manoeuvre (fast, medium and slow)
  - Showing knowledge of the reference values being used in the workplace including limitations

- Troubleshooting poor manoeuvres and how to encourage a correct manoeuvre
- Ten tests that have been performed in the workplace (patient identification removed) which will include
  - A technical comment on test acceptability
  - A technical comment on test repeatability
  - Comment on spirometric pattern; that is, normal, obstructive or restrictive
  - All flow–volume and volume–time graph curves
- Evidence of spirometer calibration check associated with each of the 10 tests.

These assessment tools will direct clear and focused feedback for the required improvement in particular assessment objectives.

The ANZSRS can provide an exemplar workbook upon request or course coordinators can design their own assessment tool with the criteria outlined above.

Evaluation

Course coordinators should have participants complete an evaluation at the end of each course and use the feedback to update and improve their course when appropriate.

Training records

Each course provider should maintain an up-to-date database of the dates of courses and the success rates of participants from each course.

Suggested further training

To enhance and maintain spirometry skills, the following activities should be considered:

- If viable, there are considerable benefits in achieving practical experience within an accredited respiratory function laboratory
- A refresher course should be attended 12 months after the successful completion of the initial training course
- To keep skills and knowledge up-to-date and maintain competency, the group recommends a refresher course with a minimum duration of 6 h every 3 years thereafter

Providing an effective spirometry training course for health practitioners based on the current international spirometry standards should result in the participant gaining relevant knowledge of spirometry theory and to some extent practical skills. Because the training course *per se* cannot teach 'experience', this advisory group recommends that all health practitioners should undertake the spirometry competency assessment as set out by the ANZSRS.[6]

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