A physiotherapist led inpatient spirometry service in rural Victoria: a service review

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Abstract

Introduction: Spirometry is an essential tool in the diagnosis and management of respiratory disease. An inpatient spirometry service was developed in 2013 by the Physiotherapy Department at Northeast Health Wangaratta (NHW), a 228 bed acute sub-regional hospital located in North East Victoria. The service aimed to i) enhance patient care, ii) aid accurate diagnosis and enhance management of respiratory patients and iii) optimise hospital revenue with improved accuracy in patient coding.

Method: Investigations into the feasibility of a spirometry service commenced in February 2013. Due to the limited resources and support rurally, The Alfred's Lung Function Laboratory agreed to act as NHW's 'resource laboratory' and provided expert advice regarding implementation of the service, including guidance on equipment, testing procedures and quality assurance measures.

The EasyOne-Line World™ spirometer (NicheMedical) was selected, as it is portable, permitting bedside testing; uses disposable mouthpieces; can be cleaned with alcohol wipes; and does not require routine calibration.

Two Physiotherapists completed a two-day spirometry course endorsed by the Australian and New Zealand Society of Respiratory Science.

A protocol based on the American Thoracic Society and European Respiratory Society guidelines was developed by senior NHW physiotherapists and reviewed by the Director of Medical Services and the Head Scientist from The Alfred's Lung Function Laboratory.

Results/discussion: The spirometry service commenced operation in July 2013. During the first 12-months, 30 patients were referred, resulting in a total of 48 tests being performed. This represented a 300% increase in the use of spirometry by Medical Officers compared with the previous 12-months where testing occurred offsite.

The top three reasons for referral included review of known COPD (n=10), assessment for new diagnosis of COPD (n=9) and monitoring respiratory function in patients with Guillain-Barre′ Syndrome (n=4). Patient care was enhanced by aiding the diagnosis of COPD (n=3), pulmonary fibrosis (n=2) and fixed upper airway obstruction (n=1).

Prior to July 2013, spirometry testing was contracted out to an offsite facility. With testing now onsite, this represented a saving of $5,718.72. Furthermore, spirometry results were used to more accurately code patient presentations resulting in an additional $10,154.28 in WIES funding. Minus start-up costs of $4832.00, the net financial gain to NHW over 12-months was $11,041.00.

Key insights

- Patient care was improved and enhanced as patients did not need to travel offsite, diagnosis and follow up was relatively easy, and results were quickly available to treating clinicians.
- Partnering with a metropolitan teaching hospital with an international reputation in treating lung conditions was key to developing a successful spirometry service.
- Spirometry in the acute setting was useful to diagnose and quantify the severity of COPD.
- Spirometry increased hospital revenue by allowing for more accurate coding of patient presentations.

Introduction

Spirometry is the objective measurement of air moving in and out of the lungs[1]. Spirometry testing is safe, relatively quick to perform and generates immediate results. The following indices can be measured by a spirometer: Forced Vital Capacity (FVC), Forced Expiratory Volume in 1.0 second (FEV_1), FEV_1/FVC ratio, and Peak Expiratory Flow (PEF) among others. Spirometry results are compared to predicted "normal" values obtained from healthy population studies, allowing the detection and quantification of a respiratory disorder. The American Thoracic Society (ATS) and the European Respiratory Society (ERS) have published standards for spirometry testing to ensure valid and reliable results are obtained[1].

Spirometry may be used to:

- aid diagnosis of a respiratory condition (often in combination with other clinical indicators)
- assess disease severity and progression
- optimise clinical management e.g. titrating medication
- monitor for early signs of respiratory muscle paralysis or fatigue and predict the need for mechanical ventilation in certain conditions (e.g. Guillain-Barre′ Syndrome, Myasthenia Gravis, and quadriplegia)
- provide surveillance for high risk populations e.g. mining industry.

Health professionals working with respiratory patients are able to receive training to be accredited in spirometry testing including nurses, physiotherapists, respiratory scientists and medical staff. Physiotherapists are introduced to spirometry testing and interpretation at an undergraduate level, however attending a post-graduate training course endorsed by the Australia and New Zealand Society of Respiratory Science (ANZSRS) and The Thoracic Society of Australia and New Zealand (TSANZ) is required to ensure spirometry is performed to internationally recognised standards.

National clinical guidelines state that spirometry is essential for the diagnosis of COPD[2] and asthma[3]. Spirometry can also be used to help determine whether patients require domiciliary oxygen[4]. COPD is defined as airflow limitation that is not fully reversible, or more specifically, a post bronchodilator FEV1/FVC ratio <0.7 in combination with a history of smoking, or exposure to other noxious agents[2]. Alternatively, asthma is a disease of variable airway limitation that is reversible following bronchodilator administration[3].

The COPD-X guidelines state that spirometry can be performed to diagnose COPD in the community or prior to discharge from hospital[2]. It is estimated that only 30% of patients with demonstrable airflow limitation have had their lung function formally assessed with spirometry[5]. Therefore, a large proportion of patients presenting to hospital with COPD symptoms may never have had a diagnosis confirmed with spirometry. Minus spirometry, the severity of COPD is difficult to quantify and thus, a patient's medical management may not be consistent with COPD-X guidelines. Formally diagnosing COPD also has important implications for effective patient education including self-management and smoking cessation advice, and early referral to pulmonary rehabilitation.

Indications of spirometry testing for COPD (but not necessarily other conditions, e.g. idiopathic pulmonary fibrosis) include[2]:

- inappropriate level of breathlessness
- chronic (daily for two months) or intermittent, unusual cough
- frequent or unusual sputum production
- relapsing acute infective bronchitis
- risk factors including exposure to tobacco smoke, occupational dusts and chemicals, and a strong family history of COPD.

Aim

To develop a Physiotherapist-led inpatient spirometry service at Northeast Health Wangaratta (NHW) that would:

- optimise health and well-being of patients
- optimise medical management of patients with respiratory dysfunction
- allow medical staff to diagnose COPD in patients during their inpatient stay
- optimise hospital revenue with improved accuracy in patient coding.

Method

Investigations into the feasibility of developing a Physiotherapist-led inpatient spirometry service at NHW commenced in February 2013. The National Asthma Council's *Spirometer Users' and Buyers' Guide*[5] was the principal resource used to investigate the requirements of the service. This document provided detailed information regarding factors that needed to be considered when purchasing a spirometer, including tables comparing the key features of 32 spirometers available for purchase in Australia. The document also provided the contact details of respiratory function laboratories in each state that consented to act as 'resource laboratories' to help health professionals with spirometry.

Due to the limited resources and support available in a regional setting, obtaining expert advice from a metropolitan 'resource laboratory' was considered an essential step in developing the NHW spirometry service. Therefore, The Alfred's Lung Function Laboratory was approached for support. Respiratory scientists at The Alfred assisted with equipment selection, testing procedure and quality assurance measures.

The EasyOne-Line World™ spirometer (NicheMedical) was selected. Desirable features included:

- portability, permitting bedside testing without a computer
- disposable mouth pieces, enabling simple and effective infection control
- routine calibration not required – only calibration checking
- ultrasonic technology, providing greater stability over time compared with turbine technology as there are no moving parts.

A protocol based on the ATS and ERS standards for spirometry[1] was developed by senior NHW physiotherapists and reviewed by the NHW Director of Medical Services and the Head Scientist from The Alfred's Lung Function Laboratory. The protocol outlined the process for referral, testing and quality assurance.

Prior to commencing the service, two Physiotherapists completed a two-day ANZSRS and TSANZ endorsed spirometry course at The Alfred.

Results

The Physiotherapy Spirometry Service commenced operation in July 2013, following 5 months of planning and preparation. Start-up costs came to **$4832.00.**

During a 12 month period from July 2013 to June 2014, a total of 30 individual patients were referred for spirometry, resulting in a total of 48 spirometry tests being performed. Over a similar 12 month period between 2012-2013, 14 spirometry tests were carried out externally. Thus, the introduction of an onsite service resulted in a 300% increase in spirometry testing for inpatients compared to the previous year. The Physiotherapy department was able to conduct the tests without any changes to their staffing profile. Table 1 outlines the rationale for spirometry referral.

Table 1 Reason for Referral to the Physiotherapy Spirometry Service

Reason for Referral	Number of referrals (%)
? New diagnosis of COPD	9 (30)
Review of known diagnosis - COPD	10 (33)
Neurological pathology – monitoring respiratory function	5 (17)
Review of known diagnosis - asthma	2 (7)
? New diagnosis of pulmonary fibrosis	1 (3)
? New diagnosis of obesity hypoventilation syndrome	1 (3)
Review of known diagnosis - pulmonary fibrosis	1 (3)
Differential diagnosis progression COPD vs CCF	1 (3)
Total	30

Sixty-three per cent of patients were referred for inpatient spirometry to test for or review diagnosis of COPD. Thirteen per cent of patients referred for spirometry presented with known diagnosis of Guillain-Barre′ Syndrome to monitor respiratory function. Patients referred for spirometry were predominantly located on the medical ward (n=19), followed by surgical (n=3), critical care (n=5), emergency (n=2), and rehabilitation (n=1) wards.

Clinical service impact

From the nine referrals for possible diagnosis of COPD, COPD was confirmed for three patients (30%). This enabled appropriate patient management and education to commence and initiated referrals to pulmonary rehabilitation. From the 10 referrals to review known COPD, medical management was amended and optimised for eight patients (80%), with copies of spirometry results sent to the patients' GP and pulmonary rehabilitation providers to assist with ongoing patient care.

New diagnosis of pulmonary fibrosis was confirmed for two patients. Treatment was optimised and home oxygen was put in place for both patients. Given the poor prognosis of pulmonary fibrosis, management of one patient resulted in discharge to residential care. One patient with known pulmonary fibrosis was found to have had a significant deterioration in lung function on spirometry. This information assisted medical staff to inform the patient of prognosis and determine possible suitability for a lung transplant.

Four patients diagnosed with Guillain-Barre′ Syndrome were closely monitored for respiratory muscle paralysis, receiving spirometry testing 4-6 hourly initially as per best practice guidelines[6-8]. This involved out-of-hours testing on five occasions and weekend testing on four occasions. Testing also commenced in the Emergency Department (ED) for one patient, assisting medical staff to determine that patient transfer to a tertiary facility was not required. No deterioration in respiratory function was detected in all four patients. This information also permitted two patients to be managed exclusively on the ward for monitoring, preventing two avoidable admissions to the Critical Care Unit.

An acute neurological patient was promptly transferred to a tertiary metropolitan hospital after spirometry testing demonstrated a significant deterioration in respiratory function over a 4 hour period in ED.

An unexpected finding of fixed upper airway obstruction was identified by spirometry in a patient presenting with hypoxia, prompting medical staff to refer the patient to an ENT specialist. Vocal cord paralysis was subsequently diagnosed and the patient subsequently received a tracheostomy.

No reliable results were obtained for two patients, reasons included pain (n=1), and unable to follow instructions (n=1).

Financial impact

Prior to the commencement of inpatient spirometry, patients requiring spirometry testing at NHW were transferred via hospital transport to an off-site private facility at a cost of $119.14 per test (inclusive of travel). With 48 spirometry tests performed between July 2013 – June 2014, use of the Physiotherapy Inpatient Spirometry Service represented savings of $119.14 x 48 = **$5718.72.**

As previously described, a diagnosis of COPD was confirmed with spirometry for three patients. Without a confirmed COPD diagnosis, these patients could only be coded for 'bronchitis' (DRG E69B [WIES 0.4578]), which attracts $2061.93 in funding. Diagnosis of COPD allowed for coding of 'infective exacerbation of COPD' (DRG E65B [WIES 1.2093]), which attracts $5446.69, a difference of $3384.76 compared to bronchitis. Hence, confirming COPD in three patients, resulted in **$10,154.28** ($3384.76 x 3) in revenue generation to NHW.

The net financial benefit to NHW (Total savings/revenue – Start-up spirometry costs) in the first 12 months of operation was **$11,041.00.**

Discussion

The implementation of an inpatient Physiotherapy Spirometry Service at NHW achieved its aims in the first year of operation.

- Medical management and patient care was optimised for patients presenting with COPD, asthma, pulmonary fibrosis, hypoxia of unknown aetiology, and Guillain-Barre′ Syndrome.
- Spirometry assisted medical staff to diagnose COPD in three patients during their inpatient stay.
- Hospital revenue was optimised due to accurate patient coding

Additional outcomes of interest following the introduction of onsite spirometry included the increased utilisation of spirometry by medical staff compared to when testing was offsite. The onsite service meant that patients requiring supplemental oxygen, continuous monitoring or assistance with mobility did not need to be transported offsite and could be tested safely at their bedside. Conducting spirometry at bedside was a significant advantage of the portable spirometer. The ability to perform bedside testing was especially important for patients presenting with Guillain-Barre′ Syndrome.

As Guillain-Barre′ Syndrome involves progressive muscle weakness that can include the respiratory muscles, 4-6 hourly spirometry testing is recommended to (i) help triage patients to either a ward bed or critical care for monitoring, (ii) identify patients at high risk of mechanical ventilation and (iii) monitor disease progression and stabilisation[6-8]. Performing spirometry at the recommended intervals was extremely difficult prior to the introduction of onsite spirometry. As all four patients had impaired mobility, performing spirometry at the bedside was advantageous in terms of safety and convenience. Furthermore, as testing occurred overnight, patients were able to complete the test with minimal sleep disturbance. Close monitoring of respiratory function meant two patients did not require admission to critical care for monitoring and were managed appropriately on the ward, freeing up critical care beds.

Having spirometry readily available in the acute setting was integral in permitting medical staff to formally diagnose COPD in three patients. Some clinicians may have reservations about conducting spirometry during a patient's inpatient stay due to the possibility of generating 'false positives'. However, evidence suggests that there is no significant change in spirometry results between day of discharge and 30 days post discharge in patients admitted with an acute exacerbation of COPD[9]. Hence, diagnosing COPD upon discharge is permitted by the COPD-X guidelines[2]. Given the potential for patients in regional areas to become lost to follow-up secondary to large travel distances for appointments, confirming a diagnosis of COPD in the inpatient setting is worthwhile. Once a diagnosis is confirmed, the appropriate patient education can be provided and a referral to pulmonary rehabilitation can be initiated prior to discharge. Furthermore, medical management can be optimised including the prescription of medication in accordance with disease severity and the provision of a more detailed discharge summary to the patient's general practitioner.

Benefits to the patient included not having to be transferred to an offsite facility for spirometry testing during their inpatient stay, receiving spirometry results within hours of testing, minimal sleep disruption and improved medical care. For some patients, spirometry testing on the day of discharge meant that follow-up testing as an out-patient was no longer required.

In addition to optimising medical management, confirming a diagnosis of COPD in three patients also had the benefit of increasing hospital revenue via more accurate coding. Increasing revenue through the optimisation of coding is a goal shared by most health services especially given that random audits of discharge summaries conducted at Victorian hospitals have found between 16-48% of patient presentations are under-coded, mainly due to incomplete and poor documentation[10,11].

As previously mentioned, the introduction of the service did not require an increase in Physiotherapy staffing. Setting up the service (i.e. selecting a spirometer, protocol development) did require a significant amount of time but was achieved without significantly impacting upon clinicians' clinical workload. Once operational, nothing significant was foregone by the Physiotherapy Department due to the time allocated to the spirometry service (approximately 1hr per week). Physiotherapists were required on occasion to attend NHW to perform testing out-of-hours (e.g. between 6pm-11pm), which represented a change to normal work practices.

Conclusion

The implementation of an inpatient spirometry at NHW enhanced care and management of patients admitted to NHW with acute respiratory conditions. The availability of an internal service led to a significant uptake in testing by medical officers compared to previous practice, resulting in financial gains to NHW by reducing the need for outsourced investigations and by optimising revenue through accurate coding of patient presentations. The service paid for itself within the first year of operation.

Recommendations

- Rural and regional health services should consider investing in onsite spirometry testing to service the acute wards (if a service is not currently in place). We found onsite testing significantly improved patient care through the increased utilisation of spirometry by medical staff compared with offsite testing.
- Spirometry testing would be an excellent addition to a Rural Physiotherapist's generalist skill set. Physiotherapists working in rural and regional health services should therefore aim to complete an accredited spirometry training course.
- Partnering with a metropolitan hospital was key to developing a successful spirometry service within a short timeframe with minimal resources.
- Spirometry in the acute setting should be utilised to diagnose and assess the severity of COPD to enhance patient care, with additional benefits in optimising hospital revenue via accurate patient coding.

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Presenter

Dr Brooke Winzer is a Grade 2 Physiotherapist at Northeast Health Wangaratta, a 228-bed acute hospital in the Hume region of Victoria. Brooke's role includes treating respiratory patients on the general wards and in the Critical Care Unit. She is a clinical supervisor for Physiotherapy undergraduate students and a mentor for junior Physiotherapy staff. Brooke also educates Allied Health, Nursing and Medical Staff on topics including Physical Activity and Cancer; Oxygen Therapy; Non-Invasive Ventilation; Chest Physiotherapy and Spirometry. In addition to her role at Northeast Health Wangaratta, Brooke is a Senior Research Assistant at The University of Melbourne. She is currently an Interventionist on a NHMRC funded RCT investigating the effect of a rehabilitation program on lung cancer patients. Previously, Brooke has been a casual Lecturer at The University of Queensland (Brisbane) and Charles Sturt University (Albury). Brooke completed a full time PhD at The University of Queensland (School of Medicine) in 2012. Her thesis, titled "The Effect of Exercise on Cancer Risk Factors in Males with Barrett's Oesophagus" included three publications in international journals (Cancer, Causes & Control, BMC Cancer and PLOS ONE). She was also successful in obtaining $85,436 in competitive grant funding for the project.