Teaching the NIOSH-Approved Spirometry Course

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Spriometry is a pulmonary function test (PFT) that may be used as a screening and diagnostic tool to detect lung abnormalities such as obstructive and restrictive diseases. In the occupational health setting, spirometry plays a central role in primary, secondary and tertiary prevention of workplace–related lung disease (Townsend, 2010). In the non-occupational health setting, spirometry may be used for early diagnosis and treatment of chronic obstructive lung disease (COPD) and asthma. A justified case can be made for spirometric testing by trained staff in a primary care practice of patients with chronic obstructive lung disease. Clinical Nurse Specialists (CNS) in Primary Care Clinics may be effective in identifying undiagnosed individuals with COPD and promoting behavior change (Dijong and Veltman, 2004).

Nurses specialized in caring for COPD patients may improve the quality of care as evidenced by lowered COPD exacerbations (Lofdah, Tilling, Ekstorm, Jorgenson, 2009). Nurses trained in the NIOSH-approved spirometer courses to perform spirometry screening and teaching may enhance positive patient outcomes, improve quality of life for patients with COPD and help reduce healthcare costs.

NIOSH-Approved Spirometry Course

The National Institute for Occupational Safety and Health (NIOSH) approved Spirometry Course is designed to train health professionals to perform pulmonary function testing in health care settings. The goal of the course is to provide the health professional adequate knowledge and practical experience in spirometry testing. NIOSH-Approved Spirometry Course training includes analyzing normal and abnormal spirometry tracings, use of volume and flow spirometers, performing quality control testing as outlined by the American Thoracic Society

Standards (ATS) and the American College of Environmental Medicine (ACOEM)

recommendations. In addition, students will be able to describe back extrapolation, and

analyze pulmonary tracings for obstructive and restrictive lung conditions. Back extrapolation

may be defined as excessive hesitation when blowing out air in the first second and can be

interpreted as a pulmonary condition (NIOSH, 2005).

NIOSH is responsible for ensuring quality control and standardized Spirometry Programs

for equipment performance, conducting tests, comparing results with reference values and

evaluation of results over time. Spirometric reference values encompassed a wide range for

three ethnic groups and were useful for diagnostic and research purposes **(**Miller, Hankinson,

Brusasco, Burgos, 2005).

Obstructive Lung Disease

Obstructive lung disease is characterized by reduced airflow into and out of the lungs

from bronchospasm, inflammation, mucus secretion and loss of airway support. Common

obstructive diseases are bronchitis, asthma and emphysema (Townsend, 2010). Chronic

obstructive lung disease is a major public health problem and is the fourth leading cause of

chronic morbidity and mortality in the United States. It is projected to rank 5th as the most

prevalent disease worldwide by the year 2020. COPD is relatively ignored by the public and by

government officials, especially considering COPD's magnitude and scope. To bring more

awareness to the problem, a group of researchers encouraged the United States National

Heart, Lung, and Blood Institute and the World Health Organization (WHO) to form the Global

Initiative for Chronic Obstructive Lung Disease (GOLD). Among the initiatives of GOLD is to

increase public awareness of COPD and to help millions of people who suffer and die

prematurely from complications of the disease. GOLD published a report on *Global Strategy for the Diagnosis, Management, and Prevention of COPD, in 2001* to promote world health awareness of COPD. GOLD national leaders and a network of international experts have developed innovative strategies for dissemination and implementation of COPD management. Consequently, GOLD continues to promote national and world attention on the major public health problem of COPD (Klaus, Hurd, Anzuetoa, Barnes, et al 2007).

Chronic Obstructive Pulmonary Disease Case Study

A 55 year old female admitted to the ED for c/o wheezing, dyspnea, tachycardia who was later diagnosed with emphysema. Patient stated "I just moved to Washington State and yes I smoke a pack of cigarettes to relieve my stress at work. When it gets too cold I can't breathe." Lungs sound wheezy with a respiratory rate of 28-30 a minute. Pulmonary function test were FVC=2.93, FEV1=1.67 and a ratio of 57%. Patient was treated with albuterol and discharged with normal breath sounds, respiratory rate of 22, and clear bilateral breath sounds. FVC, FEV1 and ratio were significantly improved and oxygen saturation was 98% on room air. The patient was discharged to home after improved outcomes.

Pathophysiology

COPD is caused by airway obstruction, air trapping, loss of surface area for gas exchange causing frequent exacerbations such as infections and bronchospasm. Clinical manifestations of airway obstruction are dyspnea, cough, hypoxemia, hypercapnea and corpulmonale (McCance & Huether, 2010).

Obstructive Lung Spirometric Pattern
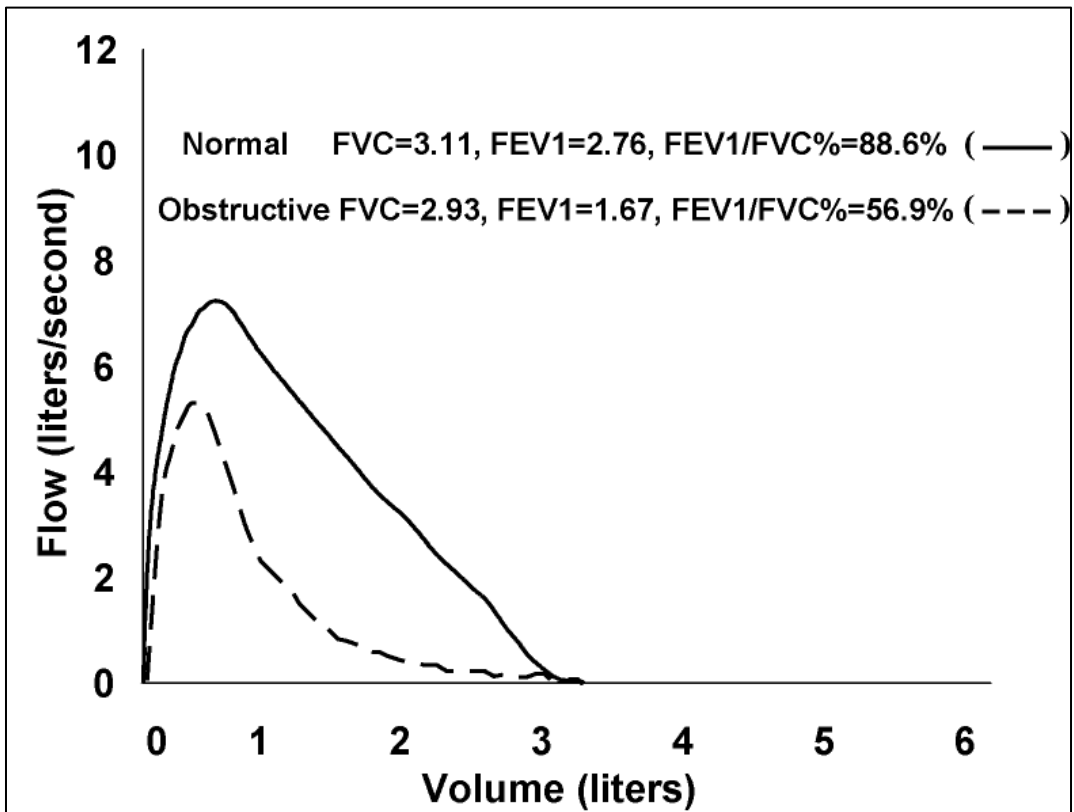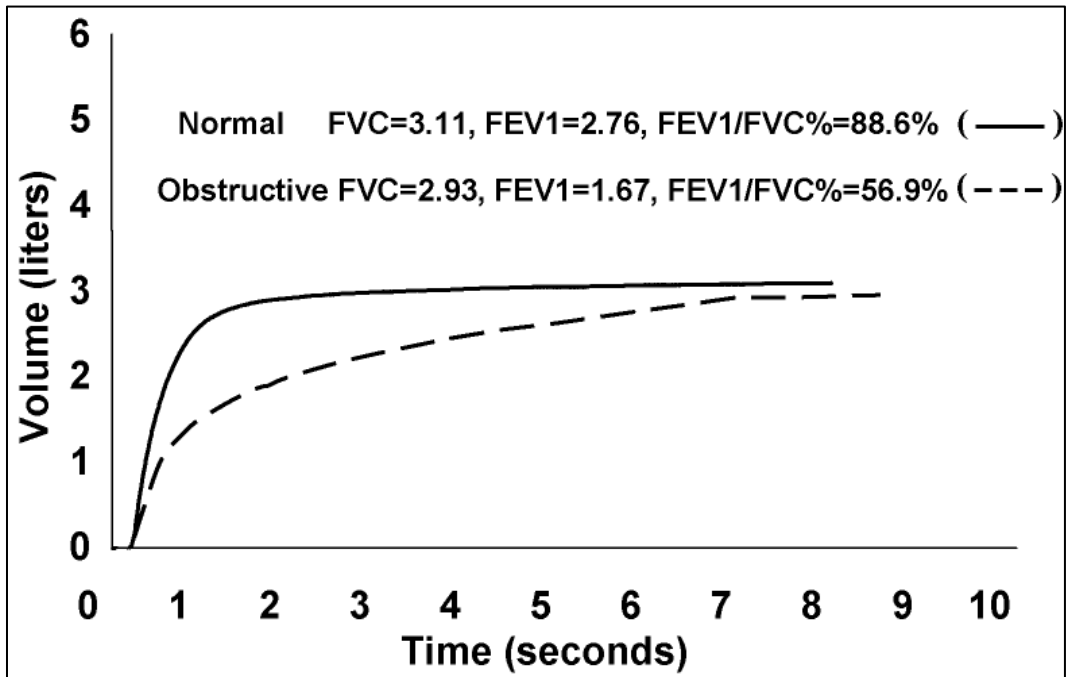
(National Institute for Occupational Safety and Health, 2005)

Restrictive Lung Disease

Restrictive lung disease is characterized by the inability of the lung to expand caused by chronic inflammation and neuromuscular diseases. The effects may be a reduced lung volume, decreased oxygen and dyspnea (NIOSH, 2005).

Restrictive Lung Disease Case Study

A 60 year old retired government worker was admitted to Critical Care with c/o dyspnea, fatigue, chest pain, and coughing pink tinged secretions with clots. Work history revealed 20 years oversight of asbestos removal. Baseline spirometer testing results were: Low FVC, FEV1, and Ratio. CXR showed nodules and congestive heart failure. Cardiac enzyme confirmed negative for myocardial infarct. CT scan confirmed metastatic cancer due to asbestos exposure.

Pathophysiology

Asbestos exposure begins with inhalation of asbestos fibers in the range of microns which are deposited within the lungs. These fibers may cause inflammation and may cause an influx of alveolar macrophages. Asbestos–activated macrophages discharge growth factors that produce fibrous connective tissue. Oxygen-free radicals injure tissues and sustain the inflammatory process. Scar tissue develops and diffusion of oxygen and carbon dioxide are impaired. Hypoxemia from decreased ability of the lungs to inflate causes vasoconstriction of the pulmonary vessels and pulmonary hypertension (Bruyere, 2009).

Restrictive Spirometric Lung Pattern
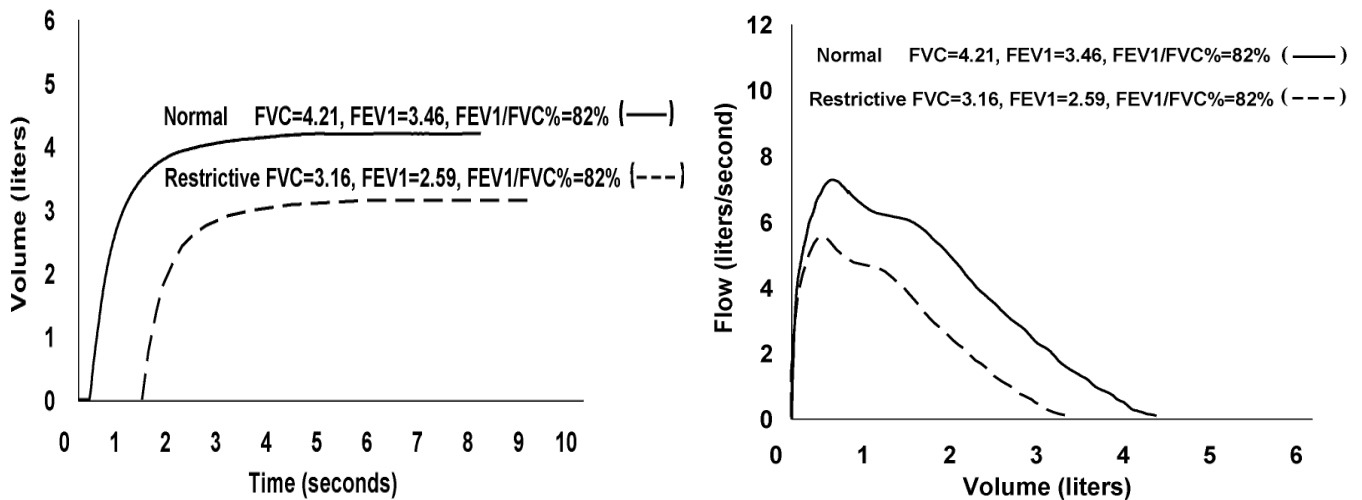
(National Institute for Occupational Safety and Health, 2005)

Teaching Strategies

According to NIOSH (2005), upon completion of the course the learner will:

- Identify valid and invalid spirometry tracings

- Analyze and synthesize obstructive and restrictive lungs patterns

- Correctly perform calculations for basic spriometry parameters

- Implement quality assurance procedures for spirometry equipment

- Recognize the applications, strengths, and limitations for spirometry

The National League for Nursing (NLN), 2007 proposed that nurse educators facilitate

learning by implementing a variety of teaching strategies to promote positive learner

outcomes, content and context. Teaching strategies include lecture and discussion, role-play,

case studies, video technology and simulation using the eaglet flow spirometer, group

discussion and analysis of normal and abnormal tracings for obstructive, restrictive, mixed

obstructive and restrictive lung conditions. Students are taught to perform pulmonary function

testing and calibration. The Hankinson Computer Module may be used to simulate coaching

and pulmonary function testing. Bloom's Taxonomy of Learning Domains supports these

teaching strategies. Lectures and visual strategies support Bloom's cognitive domain. Class

simulation and group work underline the psychomotor domain. Students are encouraged to do

hands-on experience with the spirometers and the Hankinson Computer Module simulation

program. Group work and interpersonal engagement between instructors and students

facilitate the learning process of identifying normal and abnormal spriometry tracings.

Discussion and analysis of spirometry data allow students to synthesize the practical application

with the theoretical approach to spirometry.

Evaluation Methods

According to the National League for Nursing (NLN) 2007**,** Nurse Educators may use a

variety of assessment and evaluation strategies to enhance the teaching-learning process.

Nurse Educators may evaluate learning in the cognitive, psychomotor, and affective domains.

 NIOSH-Approved Spirometry Course evaluation and assessment methods are:

- Written examination with a passing grade of 70% or greater

- Practical examination with a passing grade of 70% or greater

- Course evaluations by the students upon course completion

Problems

Chronic obstructive pulmonary disease (COPD) is a major public health problem. COPD

is the fourth leading cause of chronic morbidity and mortality in the United States. A study

published by World Bank/World Health Organization has projected that COPD may rank fifth in

2020 in the burden of disease worldwide (Klaus et al, 2007).

In addition, the National League of Nursing (NLN) advocates transforming research in nursing education and transforming nursing curriculum (NLN, 2012). According to the NLN, evidenced-based nursing education is essential for improving quality patient outcomes. *Educating Nurses: A Call for Radical Transformation* recommends the development of new teaching models that promote effective nursing practice and critical thinking. NLN recommends that academics partner with health care communities to enhance nursing education skills (Benner, Sutphen, Leonard, &Day, 2010). Nursing students may observe nurses who provide spirometry screening and teaching in primary care clinics for patients with obstructive and restrictive pulmonary diseases.

Spirometry training is evidence-based and may improve patient outcomes through screening, early detection and treatment of COPD. NIOSH-Approved Spirometry Courses are based on American Thoracic Standards (ATS), European Respiratory Society (ERS), and International Organization for Standardization (IOS) and American College of Occupational and Environmental Medicine (ACOEM) recommendations that were incorporated for the pulmonary function testing changes (Townsend, 2011).

Intervention

Teaching the NIOSH-Approved Spirometer Course may be an excellent training for nurses in emergency, primary care and family practice clinics. The nurse educator may apply Benner's teaching model from novice to expert and Bloom's Taxonomy of Learning Domains.

Literature Review

- NIOSH-Approved Spirometry Course with standardized methods in accordance to American Thoracic Standards and ACOEM recommendations (Townsend, 2011).

- National League of Nursing (NLN) recommended transformation in Nursing Education

- Global Strategy for the Diagnosis, Management and Prevention of Chronic Obstructive

  (GOLD) proposed early diagnosis and treatment for COPD to reduce morbidly, mortality

  and healthcare costs (Klaus et al, 2007).

Analysis

Teaching spirometry may improve patient outcomes though early detection and

treatment of COPD and restrictive lung condition. Challenges for teaching a NIOSH-approved

spirometry are leadership support for resources, finance, logistics, equipment and technology.

Particular attention should be paid to the unique challenges each teaching institution faces.

Also, accredited NIOSH sponsored institutions are limited in their capacity to provide training

for nurse educators and measures should be taken to address this issue.

Healthcare institutions may request a cost benefit analysis to ensure a return of

investment. Based on studies, institutions may have long term benefits from reduction of

emergency room visits, hospitalizations and readmissions. In addition, spirometry instruction

may be effective in primary prevention for smoking cessation programs and patient care

management of COPD.

Recommendations for Nursing Education and Practice

The first recommendation is to implement a pilot study for 6 months to a year and

promote professional development training for nurses who would like to be NIOSH-trained in

spirometry. This program may promote a cadre of case managers who can provide pulmonary

function testing to screen patients with obstructive and restrictive lung conditions. Incentives

may be personal recognition, professional development and monetary rewards. The nurse's

role includes spirometry screening, teaching and case management for patients with COPD and restrictive pulmonary conditions. Global Strategy for the Diagnosis, Management and Prevention of Chronic Obstructive (GOLD) proposes early diagnosis and treatment for COPD to reduce morbidly, mortality and healthcare costs (Klaus et al, 2007).

The second recommendation is for nursing schools to partner with members of a community such as Primary Care Clinics with specialized nurses caring for obstructive and restrictive pulmonary conditions. For the nursing student, this presents an opportunity to learn and care for patients with chronic pulmonary conditions and apply concepts for primary prevention. Health Promotion and Family Practice Clinics nurses may function in roles for smoking cessation where spirometry is used. Nurses may have a proactive role promoting positive patient outcomes through early diagnosis and treatment of COPD patients (Klaus et al 2007).

CONCLUSION

Nurses may be instrumental in promoting positive health care outcomes and reducing healthcare costs in the occupational and non-occupational health care setting. Evidenced-based data has shown the value of nursing in the prevention, early diagnosis and treatment of pulmonary conditions such as chronic obstructive pulmonary disease and restrictive lung diseases.

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