Study Guide for Spirometry
2020

1. **Overview**
   a. Spirometry is a measurement of the forced vital capacity (FVC) and forced expiratory volume measured over 1 second (FEV1). Airways obstruction is characterized by a decrease in the FEV1/FVC ratio. A ratio of less than 70% in adults and 80% in children indicates an airway obstruction.
   b. Spirometry is used as part of the diagnosis and for ongoing treatment in asthma, chronic obstructive pulmonary disease (COPD), and congestive heart failure (CHF). It is an inexpensive diagnostic tool that can be effective in managing pulmonary diseases.

2. **Goal of the procedure**
   a. To effectively administer a spirometry diagnostic test.
   b. Evaluate results of spirometry

3. **References**
   a. Global Initiative for Chronic Obstructive Lung Disease (GOLD). (2017). Spirometry for health care providers. Retrieved from http://goldcopd.org/wp-content/uploads/2016/04/GOLD_Spirometry_2010.pdf
   b. Moore, V. C. (2012). Spirometry: Step by step. Breathe, 8(3), 232-40. Retrieved from http://breathe.ersjournals.com/content/8/3/232
   c. Primary Care Res. Academy (2016) Spirometry https://respiratoryacademy.co.uk/clinical/cpd-modules/spirometry/

4. **Required Reading and Video**
   a. Spirometry with animated flow volume loops
   b. Normal Spirometry, Obstructive and Restrictive

5. **Required Procedure Competencies**
   a. This document printed and an ink pen
   b. Gather equipment: spirometer, disposable mouth piece, nose clips
   c. Check spirometer accuracy (daily calibration check): Will discuss as a group
   d. Measure the patient's height
   e. Wash your hands
   f. Ask the patient to sit for the test
   g. Loosen restrictive clothing
   h. Place loose dentures in a cup
   i. Optionally, use nose clips

6. **During CSI Skills Lab**
   a. Prior to arriving, you are expected to have read and watched the above. The skills lab is intended to build upon the above information and allow you to engage in a more patient-centered way.
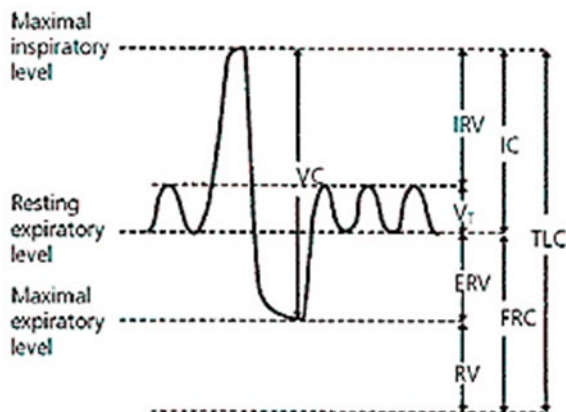
What is the likely diagnosis based on the spirometry results? (work on at CSI)

a) 65 y.o. male FEV1 84% FEV1/FVC 95% TLC 85%

b) 65 y.o. male FEV1 74% FEV1/FVC 93% TLC 81%

c) 65 y.o. male FEV1 74% FEV1/FVC 78% TLC 42%

What can be identified by Spirometry?

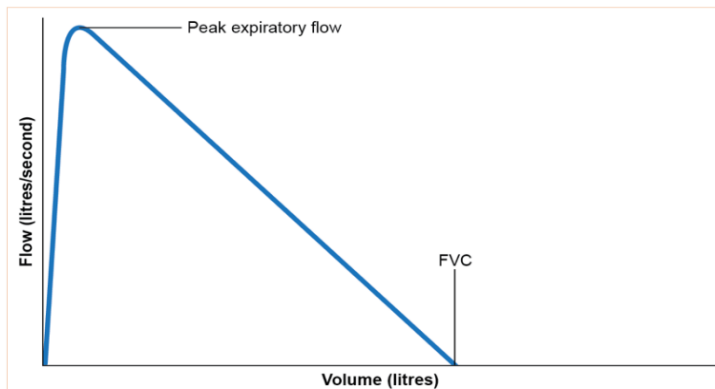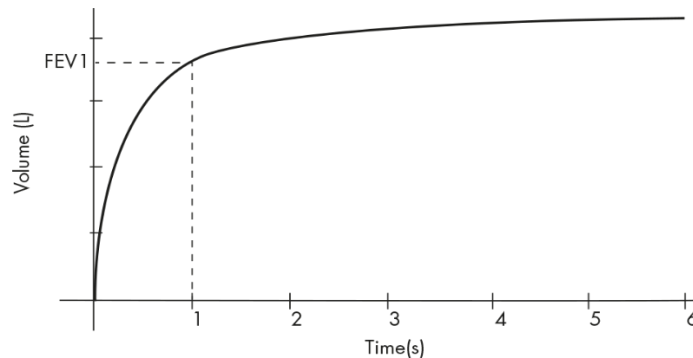| Obstructive disease	Restrictive disease
Asthma	Sarcoidosis
COPD	Fibrosing alveolitis
Bronchiectasis	Interstitial lung disease
Cystic fibrosis	Pneumoconiosis
Localised obstruction	Asbestosis
Tumour Foreign Body	Pleural effusions
Post-tracheotomy stenosis	Ascites (restrictive pattern)
	Obesity (restrictive pattern)
	Muscle weakness e.g. diaphragm paralysis
	Kyphoscoliosis

Example Results:

Key points to check when reporting a set of spirometry results:

1. Demographics
    - Make sure the report contains the correct age, identification, sex, height and ethnicity.
    - Although weight and BMI are not required to interpret the spirometry they are useful when reviewing the clinical picture that is emerging.
2. Technically acceptable blows
    - The flow volume (FV) and volume/time (VT) graphs should be printed.
    - The volume/time trace should show a rapid rise as 3/4 of the air is expired in the first second. The trace plateau should reach a minimum of 6 seconds (Figure 1).
    - The flow/volume trace should rise almost vertically to the peak expiratory flow and then as the air is expired from the airways the flow rate will decrease steadily (Figure 2).
    - The trace should then merge smoothly with the horizontal axis of the graph.
    - The graphs should be free from abrupt stops, slow starts, cough or air leaks.

3. Minimums
    - There should be a minimum of three relaxed vital capacity blows and three forced blows.
4. Reproducibility (repeatability)
    - The criteria state that ideally there should be no more than 100ml (or 5%, whichever is the larger) between each blow (grade A) but up to 150ml (grade B) is acceptable in highly variable patients[2].
    - The highest FEV_1, FVC and VC from 3 efforts meet reproducibility criteria if they are within 5%.

- The highest FEV$_1$, FVC and VC can come from any of the three blows as long as they meet the reproducibility criteria.
- These figures are not always possible to achieve – indeed, even experts can find it problematic in people having their first-ever test.

Interpretation

1. Percentage of predicted FEV1 Value

Percentage of predicted FEV1 value	Result
>80%	Normal
70-79%	Mildly abnormal
60-69%	Moderately abnormal
50-59%	Moderate to severely abnormal
35-49%	Severely abnormal
<35%	Very severely abnormal

2. Age

Age	Low FEV1/FVC ratio
5-18 y.o.	<85%
Adults	<70%

3. TLC

	TLC
Elevated	Above 120%
Normal	80-120%
Mildly reduced	60-79%
Moderately reduced	40-59%
Severely reduced	<40%

4. Obstructive vs. Restrictive
   - *Obstructive* airways disease causes a reduction in the rate of air expired but does not affect the maximum volume of air expired. Hence the FEV$_1$ is usually reduced to less than 80% but the FVC and VC will usually be >80%. In severe obstruction you may get a reduction in the FVC.
   - *Restrictive* airways disease causes lung volumes to be reduced but the rate of airflow is unaffected. Hence the FEV$_1$, FVC and VC are reduced in proportion to each other but the ratio will be >70%.

Obstructive (of expected)	Restrictive (of expected)
<FEV1	<FEV1
<FEV1/FVC	>FEV1/FVC
=>TLC	<TLC

5. Diurnal Variation
   - There needs to be diurnal variation of 20% for 3 days in a week over several weeks.
   - On a day take the higher reading – lower/higher x100 = diurnal variation.

GOLD Guidelines for COPD

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) Guidelines (www.goldcopd.com), launched in 1997 in collaboration with the World Health Organization and the National Institutes of Health's National Heart, Lung, and Blood Institute, provide a diagnostic screening tool for adult patients who may have COPD.

1. *Grade I, mild COPD:* FEV_1/FVC < 0.70 ± chronic symptoms. $FEV_1 \geq 80\%$ predicted. Chronic cough and sputum production may be present.
2. *Grade II, moderate COPD:* FEV_1/FVC < 0.70 ± chronic symptoms. $50\% \leq FEV_1 < 80\%$ predicted. Shortness of breath, typically developing on exertion. This typically is the stage at which patients seek medical attention.
3. *Grade III, severe COPD:* FEV_1/FVC < 0.70 ± chronic symptoms. $30\% \leq FEV_1 < 50\%$ predicted. Greater shortness of breath, reduced exercise capacity, and repeated exacerbations that have an impact on patient's quality of life.
4. *Grade IV, very severe COPD:* FEV_1/FVC < 0.70 ± chronic symptoms. $FEV_1 < 30\%$ predicted or < 50% predicted with chronic respiratory failure or cor pulmonale. Patients may have grade IV COPD even if the FEV_1 is > 30% whenever this complication is present.