EFFECTIVE SPIROMETRY
Workshop For
Asthma Educators
June 8, 2019
Amanda Clark, RRT
Sponsored by Vitalograph

Disclosures
Carolina Diagnostic Solutions
Vitalograph, Ltd.
Morgan Scientific
Pritchett and Hull
Encore Healthcare
I have no perceived conflicts in presenting this content

Today’s Objectives
1. Give 3 Points for reportable spirometry
2. ATS Quality Standards: Understanding data vs junk
3. Importance of serial studies
4. Hands on learning/how to perform spirometry

Trivia Question:
• What is the number of spirometry??
In the beginning...

- Fundamentals established
  - **WHAT?**
    - A basic test used to assess static and/or dynamic airflow in the upper and distal airway
  - **WHY?**
    - To further assess symptoms such as cough, wheezes, or shortness of breath
    - Early detection and diagnosis of lung disease
    - Objective assessment of airflow obstruction and restriction
    - Quantitative classification of diagnosed diseases
    - Measurement of the response to therapy
    - Assessment of change over time

Problematic Barriers

- Underutilized
- Misdiagnosis
- Delayed care
- How much of the US adult asthma population is confirmed with spirometry?
  - 48%
- Quality Control Issues
  - Device maintenance
  - Ignorant of Guidelines
  - Lack of training/skill
  - Further avoidance due to low comfort!

Even when providers are aware of spirometry, learning to use it is commonly complicated by mismatches.

Brian Carlin, MD, FCCP, FAARC
Critical Care Staff Physician, Altoona Regional Health System


Know the Lingo... becomes second language

- **Vital Capacity (VC)** - Maximal volume of gas that can be expired from the lungs during a relaxed and complete expiration from a position of full inspiration. It is a measure of lung size.
- **Forced Vital Capacity (FVC)** - Maximal volume of gas that can be expired from the lungs during a forced and complete expiration from a position of full inspiration. It is a measure of lung size.
- **Forced Expiratory Volume in 1 second (FEV1)** - Maximal volume of gas which can be expired from the lungs in the first second of a forced expiration from a position of full inspiration. It is an indicator of large airway disease.
- **FEV1/FVC Ratio** - The ratio of the flows listed above. It is a measure of the severity of airflow obstruction.
- **Forced Expiratory Flow (FEF)** - The expiratory flow during the middle portion of the FVC maneuver. It is measured at percentage intervals of the FVC. Particularly, FEF25/75 may be used to gauge small airway disease.
- **Peak Expiratory Flow (PEF)** - Maximal flow achievable from a forced expiration with an open glottis starting from a position of full inspiration. It is a measure of airway function.
- **Forced Expiratory Time (FET)** - Length of expiration Good indicator for end of test criteria.*
US Guidelines from:
American Thoracic Society (ATS)
2015 Standardization Statement

Keep handy for quick reference
*See also Interpreting strategies ATS document

**Know Your Device**

**How**

**Pros/Cons**

**Limitations**

Before you test, *always* validate your device

- Why validation is important
  - It ensures that the device is functioning correctly and is not producing inaccurate results.
  - Before starting tests, the device must be calibrated to ensure accurate readings.
- Calibration should be done annually. This is when the device is checked thoroughly and gain adjusted as needed. You should not need to adjust your calibration more than this. If so, there is a deeper issue to address.
- In addition to calibration, the device will pass a leak test annually.
- The NEW term here is Daily Validation Check.
  - You will need to verify the device daily to ensure it is accurate.
  - Two daily checks are required:
    - One with a simple volumetric assessment at three flows (typically at 3, 6, and 1 l/s).
    - This must be within 3%: (2.91 l/s - 3.09 l/s)

*Not All Created Equal!*
Infection Control

- Every patient
  - New disposable filter/ mouthpiece & nose clip
  - Allow settling of aerosolised particles
  - Time between sessions – sometimes difficult due to time but recommended 5 mins (BTS).
- Every day
  - Clean potentially contaminated parts
  - Every day/test – wipe anything that patient has touched or coughed on with cidex or disinfectant wipe. NOT inside spirometer, just outside.
- Every month (or 100 patients depending on volume of testing)
  - Manufacturers should give instructions on how to do this.
- Every year
  - Service recommended. (previous slide: Routine annual service: hygiene, safety, function, security & calibration certification)

3 Things to Keep an Eye on
1. Flow Volume Loop
2. Volume-Time Curve
3. The Numbers

Graphs, Loops, and More...

1. Flow Volume Loop

- Forced Vital Capacity
- Inspiratory flow rate
- Expiratory flow rate
- PEF
- FEF25
- FEF50
- FEF75
- FEV1

Hint: think Upper airway
Hint: think Distal airway
Hint: think Total airway

6/7/19
2. Volume-Time Curve

Forced Expiratory Ratio
FER = \frac{FEV}{FVC}

Hint: look for plateau of flow at end of test

The highest volume from the session should be used.

At a Glance

1. Look for fast start
2. End expiratory plateau
3. Artifact-free smooth curve

Reproducibility & Quality of Test

Minimum of 3 technically acceptable blows:

- Biggest breath in
- No slow start or hesitation
- No cough during 1st sec
- Blow for 6 sec reached plateau ≥ 3 secs (if < 8 years old)
- Maximal effort.

The first and second highest FEV₁ and FVC within 150mL.
Before Performing Spirometry

Preparation

1. Explain the purpose of the test and demonstrate the procedure (time-tested approach for kids coming up)
2. Record the patient’s age, height, weight, gender, and ancestry
3. Note when the patient was last used
4. Note the patient’s living habits, dietary confidentiality, or smoking (less than 2 days)
5. Examine any tight clothing
6. Empty the bladder beforehand if needed
7. Look for any contraindications

Predicted Value Equations

• Calculations based
  - age, sex, height, race
• Established values for most ages
• Sets
  - percent predicted value (%)
• Lower limit of normal (LLN)

• GLI (Global Lung Initiative)
  - All races
  - Ages 3-99
• New standard
• NHANES III (National Health and Nutrition Examination Survey revision 3)
  - African American, Caucasian, Mexican American
  - Ages 16-80
• Limited

Hint: Set the default! If these are not set right, results will be questionable at best!!

Let’s have fun with this!

Explain and demonstrate
It is best received from kids if you do this in 3 steps
1. First, I ask them to show me their "swimming pool breath" meaning a deep breath much like the one prior to jumping in
2. Second, I ask them to show me how to blow hard and fast (usually very short, almost like spitting)
3. Third, I ask them to show me how to blow long (not hard just long exhalation)

Lastly, I ask them to put it all together into ONE breath if they are successful / then move onto exploring the mouthpiece, nose clip, and computer

OR you can use boring flat traditional instructions...
Did I pass?

ATS Requirements

1. Minimum 3 satisfactory maneuvers
   - Two largest FVC's within 0.25 L
   - Two largest FEV1's within 0.15 L

2. Did the effort meet end of test?
   - ≥ 3 secs (if < 8 years old)
   - ≥ 6 sec (if > 8 years)

3. Flow volume loops overlap (signifies reproducibility)

   Hint: 1. NO more than 8 attempts
   2. Look at BOTH graphs!

   • Most software programs are equipped with quality indicators.
   • Mainstream workflow for end user and physician interpreting data
   • Offers Peace of mind for all clinicians

Quality noted reports

1. An unsatisfactory start of expiration characterized by excessive hesitation of false start extrapolated volume of >150 ml or 5%
2. Coughing during the first second of the maneuver, thereby affecting the measured FEV1 value, or any cough that interferes with the accurate measurement of FVC
3. Valsalva Maneuver glottic closure
4. A leak in the system or around the mouthpiece keep those corners tight
5. An obstructed mouthpiece tongue in front of the mouthpiece or mouthpiece not behind front teeth
Free Resources
NIOSH Poster
Download your copy @

Spirometry Patterns: Obstructive

Spirometry Patterns: Restrictive
Application to Pediatric Disease

The importance of trending – Trends and Early Detection

- Demonstrates a complete clinical picture
- See how your patients are trending from season to season
- Assess medication compliance

References

4. Office Spirometry in Primary Care for the Diagnosis and Management of COPD. Gregg L Ruppel, Brian W Carlin, Mary Hart and Dennis E Doherty. Respiratory Care February 2018, 63(2) 242-252; DOI: https://doi.org/10.4187/respcare.05710
8. Vitalograph 2-Hour Spirometry Workshop PowerPoint
6/7/19

Any Questions?

- Send email questions to: Amanda@carolinadxsol.com
- Call 803-545-0273

1. Select to enter new patient
2. Enter info - verify height, age, race

Population = predicted equation - select GLI
3. Select FVC to perform spirometry

Everything is ready, no further keystrokes.

1. Assess effort quality
2. Redirect as needed
3. Proceed to next effort