

Spirometry Testing: A Useful and Effective Tool

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Disclosure of Conflict of Interest Information

I have no existing conflict of information to disclose

Disclosure information stated above is current as of 10/18/2010

Objectives

Upon completion of the presentation each participant will be able to

List indications and contraindications for performing Spirometry

Discuss the patient preparation techniques that are recommended when performing Spirometry

Determine when Spirometry is acceptable or repeatable

Determine whether there is a significant response to bronchodilators

Did you know?

FACT OR FICTION

- Red automobiles cost more to insure
- Ceiling Fans help cool a room
- Rinsing dishes before placing them in dish water helps them get cleaner
- More mattress coils means a better mattress
- Storing alkaline batteries in the refrigerator will prolong their life

Did you know?

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THEY ARE ALL FICTION

Really they are

Spirometry has it's myths too



The announcement of life itself at birth by a loud cry has brought joy to millions from time immemorial. The tragedy of leaving this world with the "last breath" has also dramatized the lungs more than any other organ in the body.

Then why has it taken so long for this organ to get its fair shake in modern times?

The heart has earned its place as the "heart of the ...," "at the heart of it all," "he has no heart," and "comes from the heart" in today's popular usage.

*What about the lungs that supply oxygen to the heart?
When the New York Times published public education
material on different organs in the body (May 13, 2008),
lungs were conspicuously missing!*

*The Forum of International Respiratory Societies (FIRS) has come together to declare **"2010: The Year of the Lung" (YOL)**. FIRS comprises the American College of Chest Physicians (ACCP), American Thoracic Society (ATS), European Respiratory Society (ERS), Asociación Latinoamericana de Tórax (ALAT), Asia Pacific Society of Respirology (APSR), and International Union Against Tuberculosis and Lung Diseases (IUATLD).*

As a group of respiratory and public health experts from around the globe, we want to engage our partners to raise the awareness of the deep impact of lung diseases worldwide. We eventually want policymakers to increase funding for lung disease research, enact smoking cessation legislation, support preventive measures, and support air quality legislation.

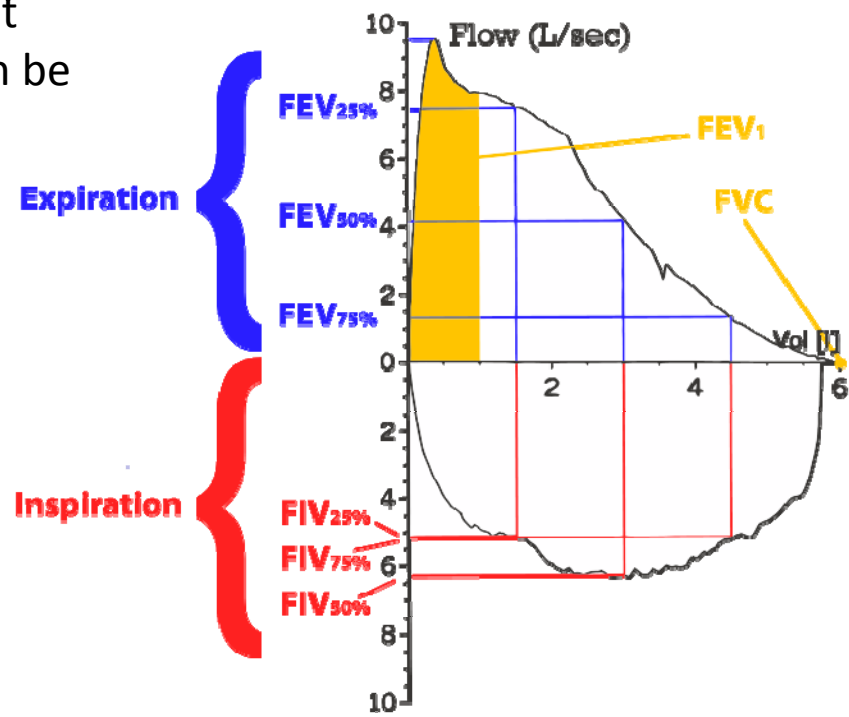
Brief History

- 1679 lung measurements were measured for the first time (BARELLI)
- 1846 Vital Capacity was Defined and shown to be related to a subjects height (Hutchinson)
 - Demonstrated that obesity age and resp disease reduced VC
- 1800 – 1900s
 - man and machine evolved the concepts of dynamic lung volumes

Spirometry

Spirometry (meaning *the measuring of breath*) is the most common of the Pulmonary Function Tests (PFTs), measuring [lung](#) function, specifically the measurement of the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled.

wikipedia



Indication for Spirometry

A. Diagnose the presence or absence of disease

1. Hx of Pulmonary symptoms

- a. dyspnea , wheezing
- b. cough, phlegm production
- c. chest discomfort, orthopnea

2. Physical indicators

- a. decreased breath sounds
- b. chest wall abnormalities

3. Abnormal lab findings

- a. CXR or CT scan
- b. ABG or Pulse Oximetry

Indications for Spirometry

B. Quantify the extent of known disease

1. Pulmonary Disease

- a. COPD, Asthma, CF, ILD

2. Cardiac Disease

- a. CHF

3. NMD

- a. GBS, MG,

Indications for Spirometry

C..Measure the effects of occupational exposure

1. smoking
2. hazardous working situations

D. Determine the beneficial/negative effects of Therapy

1. Bronchodilators Steroids
2. Cardiac Drugs (diuretics, anti- arrhythmic)
3. Lung resection, transplantation, lung reduction
4. Pulmonary Rehabilitation

Indications for Spirometry

E. Assess Risk of Surgery

1. Lung resection (lobectomy, pneumonectomy)
2. Thoracic procedures (Sternotomy)
3. Upper Abdominal Procedures

F. Evaluate disability or impairment

1. Social Security or other compensation programs
2. Legal or insurance evaluation
3. C-P rehabilitation assessment

G. Epidemiologic or clinical research involving lung or health disease

Don't perform Spirometry if

1. Recent MI within a month
2. Recent Stroke, eye surgery, thoracic/abdominal surgery
3. Uncontrolled hypertension
4. Known, thoracic, aortic, cerebral aneurysm
5. Recent pneumothorax

Maybe perform, after consulting with the MD

Chest, abdominal, facial pain; headaches, stress incontinence, dementia; confusion

Preliminaries to patient testing

- Patient preparation
- Physical measurements and assessment
- Brief pulmonary history
- Pre Test instructions

Patient preparation

If the patient is taking:		Withhold medication
Short acting B agonist		4 hours
Short acting anti- cholinergics		4 hours
Long acting B agonist		12 hours
Long – acting anti- cholinergics		24 hours
Methylxanthines		12 hours
Slow release Methylxanthines		24 hours
Cromolyn Sodium		8 – 12 hours
Leukotriene modifiers		24 hours
Inhaled steroids		Maintain dosage

Patient preparation

Smoking cessation

Recommended to stop for
24 hours before the test day

DLCO and ABG



Patient Preparation

Meals

Refrain from eating large meals

Fast for 2 to 4 hours prior to test

Caffeine or cola (theobromines) drinks

Light not heavy exercise

Comfortable clothing

Mouth appliances

Permanent tracheostomies

Physical measurement & Assessment

Age & Height

- Age
 - Use last birthday
- Height
 - measure while standing (inch or cm)
 - no shoes
 - erect posture
 - use alternate height measurements for patients who are unable to stand



stadiometer

Physical measurement & Assessments

1. Use ruler or tape measure
2. Extend both arms horizontally on both sides
3. Measure the distance from the tips of the middle finger



Arm-Span Method

Estimated height = measure
arm span/1.06

Physical measurement & Assessments

Weight

- Lbs or kgs
- Scale must be accurate
- BMI is used in certain situations (obesity)
- Use IBW
 - Obesity may overestimate values



Physical measurement & Assessments

Physical Assessment

Breathing pattern

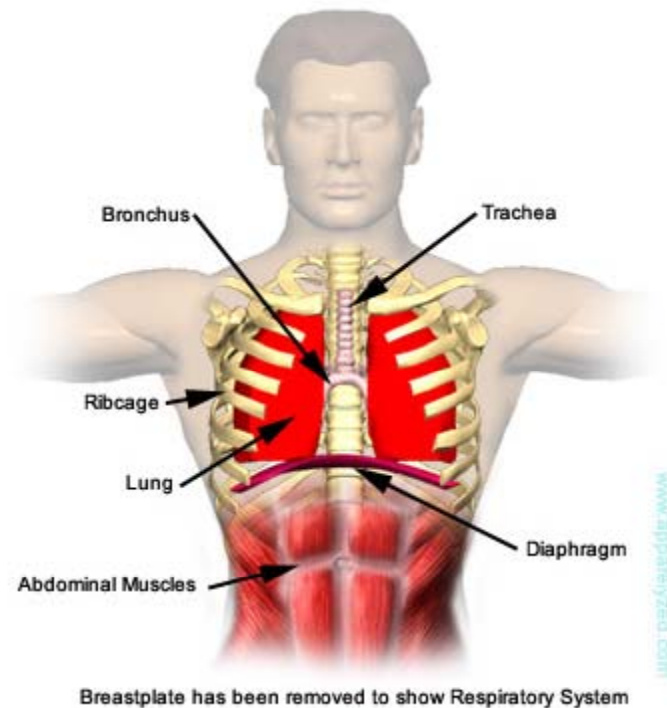
RR, Angina, Ass Musc.,
pursed lips

Breath Sounds

distant, absent, wheezing ,
stridor

Resp Symptoms

c/o SOB, notable cyanosis,
SpO2 reading, O2 use



Brief Pulmonary History

Pulmonary History

- Age, gender, height, weight
ethnicity
- Current diagnosis
- Reason for the test
- Family History
- Personal History
- Occupational History
- Smoking habits
- Cough
- Dyspnea
- Current medications

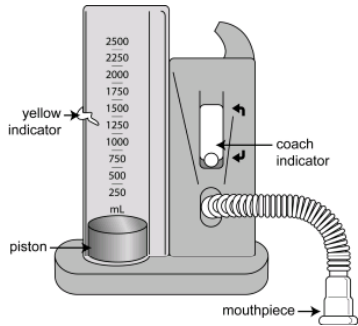
Patient Pre Test Instructions

Aim for the best and valid results

- Be the COACH
- Assure patient understanding
- Demonstrate the procedure
- Correct poor technique before continuing to next phase

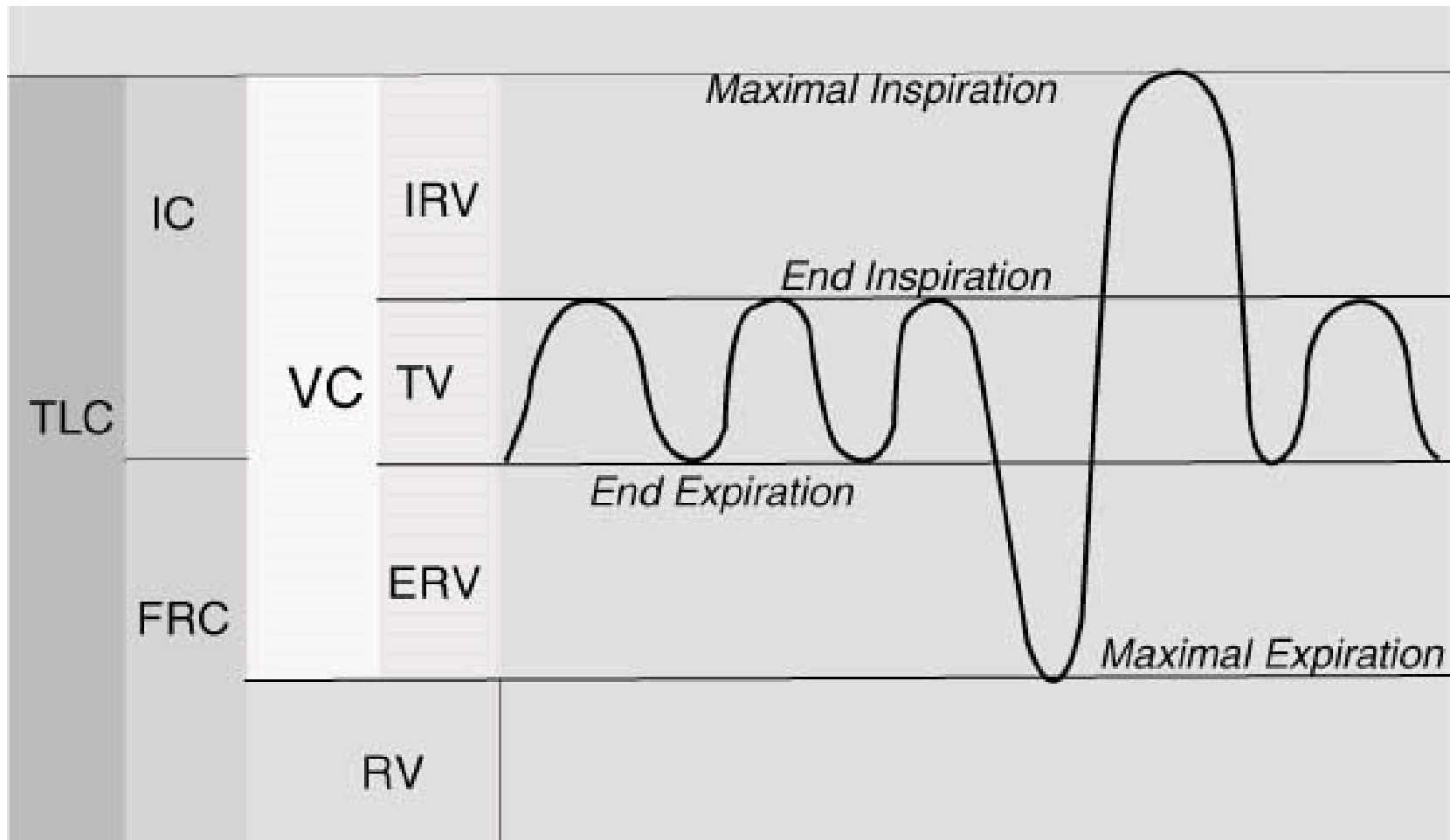


How do we measure all this?



Bedside Devices
Experienced Practitioner Observation

PFT Lab Equipment



<http://www.rcjournal.com/cpgs/slvcpjg-update.html>

Spirometry instruction

Proper position of the patient. Sitting up straight, feet on the floor, NC on ,mouthpiece in- secure without leaks

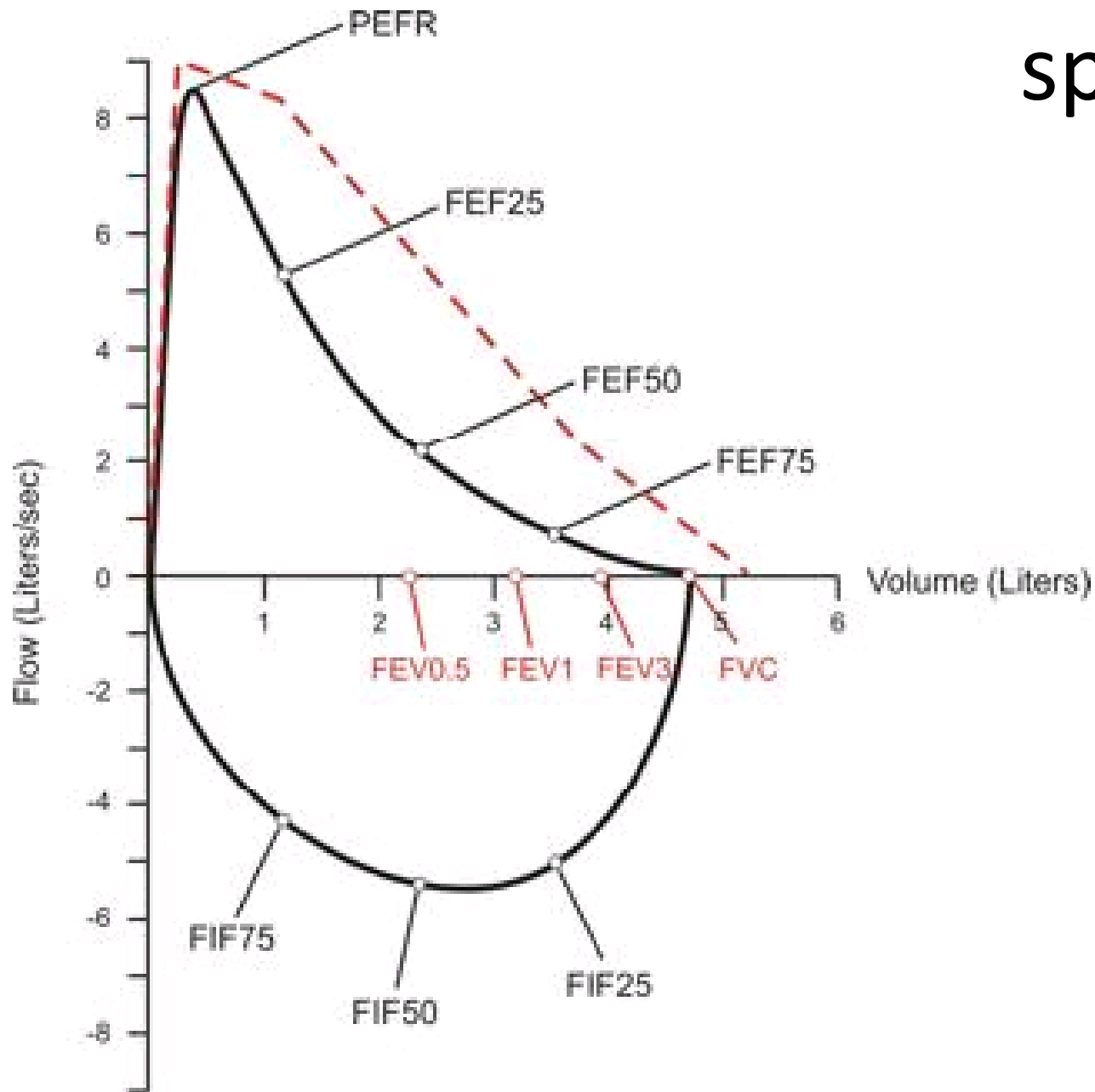
Collect tidal breathing. Get patient familiar with the equipment

“Big breath in” Must get patient to their true TLC

“Blast it out. BLOW BLOW BLOW” Have patient push hard but relax their throat while he exhales to a true RV

“Big Breath in again. All the way to the top” to get patient to a true TLC

spirometry



What's what?

⊙ How MUCH

⊙ Liters or Milliliters

⊙ VC (SVC, FVC)

⊙ FEV₁

⊙ FRC

⊙ IC

⊙ TLC

⊙ RV

Capacity/**V**olume

• How FAST

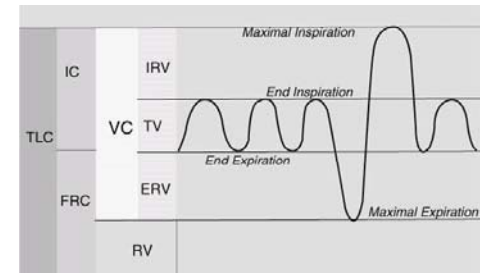
• Liters per Minute

• FEF₂₅₋₇₅

• PEFR

Flows

Vital Capacity



Define: largest amount of air that can be exhaled after a maximal inhalation. May be forced or slow.

Nonspecific finding; that is, if it is low, then you need to check other things.

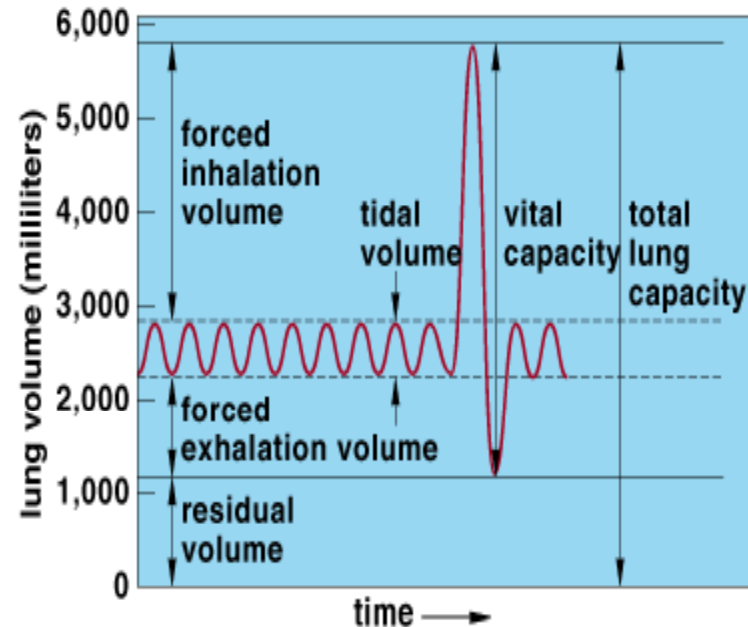
Important to note: changes in other capacities may affect vital capacity

Decreased: loss of distensible lung tissue, obstructive lung disease, reduced chest wall excursion



Vital Capacity

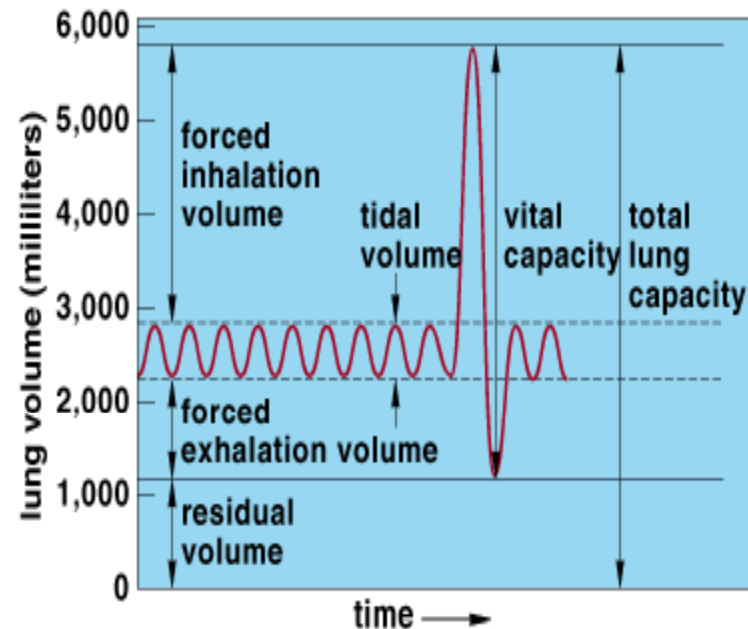
- FVC vs SVC
- ATPS to BTPS
- Graphic Display vs Numerical value
 - Reliability
 - Reimbursement



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Vital Capacity

- Is the VC test valid?
- Maximal effort, no cough or glottic closure
- Volume plateau (1 – 2 sec) is observed
- 3 attempts performed; 2 acceptable VC maneuvers should be obtained; volumes within 150ml
- 6 seconds of exhalation



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Vital Capacity

Test		Trial 1		Trial 2		Trial 3		Best test	
FVC Liters		5.20		5.30		5.35		5.35	

Fev1: Forced expiratory Volume

Amount of air that can be forcefully exhaled in one second

Effort Dependent

Reduced in obstructive ventilatory defect

Mucous secretion, bronchospasm, inflammation, loss of elastic support, intra-airway tumor.

May not be reduced in early stages of disease

FEV1/FVC ratio is gold standard for diagnosing obstructive lung disease (Asthma)

FEV1/FVC

Mild		$\geq 70\%$ pred
Moderate		= 60% - 69% predicted
Moderately Severe		= 50% - 59% predicted
Severe		= 35% - 49% predicted
Very Severe		$\leq 35\%$ predicted

ATS/ERS Task Force

FEVt

FEV t		Healthy Adults
FEV 0.5%		50% - 60%
FEV1%		75%- 85%
FEV2%		90% - 95%
FEV3		= 35% - 49% predicted
Very Severe		=≤ 35 % predicted

ATS/ERS Task Force

Peak Flow Rate

- Fastest flow that can be exhaled or inhaled
- Effort dependent
- Useful in monitoring large airway function
- Reduced with high airway resistance
- In the PFT lab used to monitor quality of test and presence of special obstructions



Peak Flow

- Personal Best
 - Measured consistently
 - Morning vs evenings
 - Before or after bronchodilator



Zone System

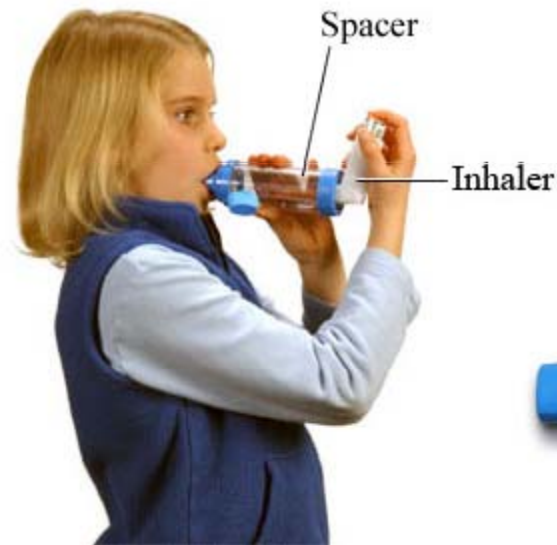
Green – 80% – 100% of personal best

Yellow – 50% - 80% of personal best

Red - \leq 50% of personal best

Before & After – Bronchodilator Studies

Used to determine the reversibility of airway obstruction



Inhaler



Spacer

Before & After – Bronchodilator Studies

Set up equipment to administer the medication

Coach patient in proper breathing technique

Administer therapy

Monitor response
-HR, RR, LOC, Arrhythmias

Allow 15 mins for SABA

Allow 30 mins for Anti cholinergics

Repeat Spirometry

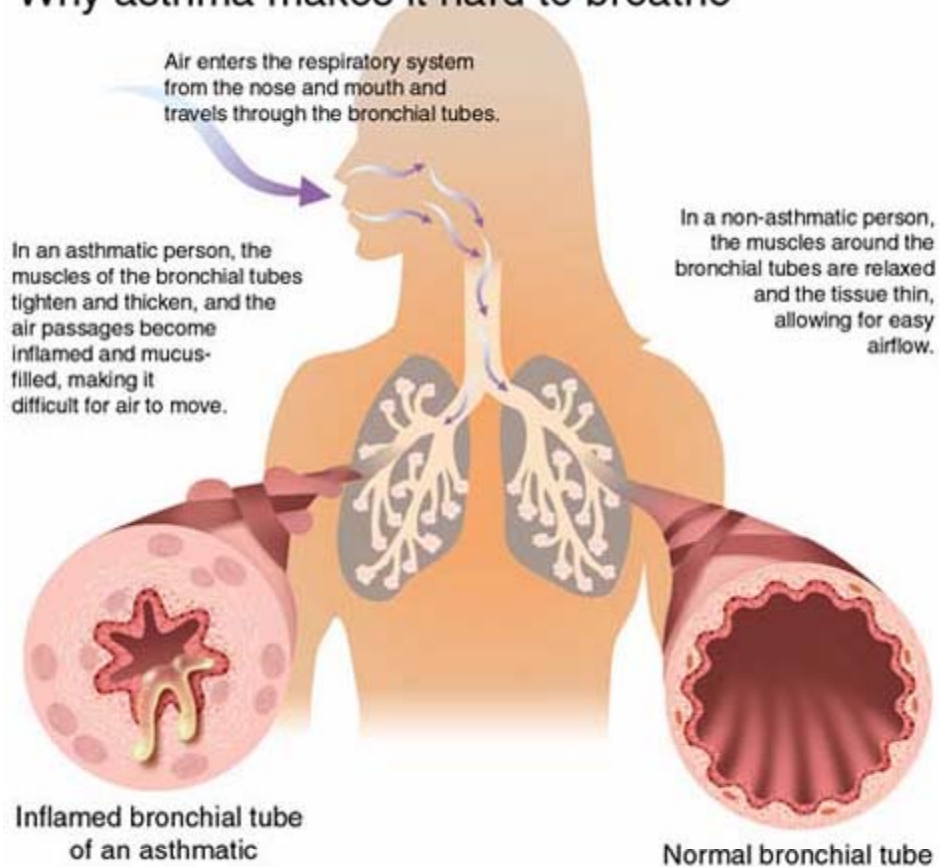
Before & After – Bronchodilator Studies

$$\% \text{ Change} = \frac{\text{Post drug} - \text{Pre Drug}}{\text{Pre Drug}} \times 100$$

A post drug response of 12% or greater is considered significant

This applies to Peak flows, FEV or FVC

Why asthma makes it hard to breathe



Best Test

- You decide

You are smarter than the software

- Best test is defined as greatest sum of FVC and FEV1
- The computer recognize all data unless the technician deletes the values
- Print the FVL with the largest PEFr which is acceptable and reproduces
- Different insp and exp limbs can be combined in final loop for report

Technician Notes

- Be specific

Just the facts

There should always be tech notes with every test

The first sentence should be a simple statement. The patient did/did not meet ATS standards for this testing

Just the facts

If not, must say why. Start with name of test, list number of attempts and then acceptability errors you encountered. End with any repeatability criteria not met.

For example, The patient did not meet ATS standards. FVC attempted x 8 with all testing demonstrating unacceptable volumes of back extrapolation. Best graphic pri

Summary

Fact

Disease
identification

Symptom Free
Days

Spirometry “is” a useful and effective
tool in the management of Asthma

Early detection

Medication
monitoring

Reduced
hospital visits

Thank you for your attention