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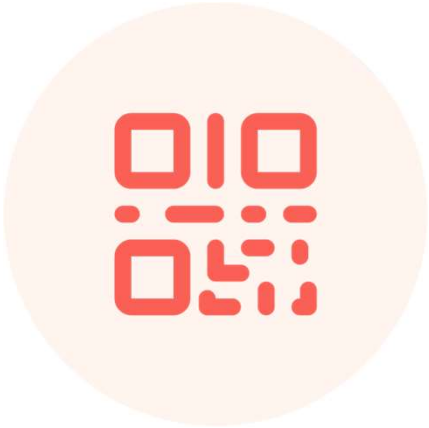

Join at slido.com
#6420547

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SPIROMETRY : MEASURING LUNG FUNCTION IN CHILDREN

Brian R Wingrove, MHS, PA-C, DFAAPA
Children's Physician Group – Pulmonology, Scottish Rite
Children's Healthcare of Atlanta at Scottish Rite

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Two Lies and a Truth

ⓘ Start presenting to display the poll results on this slide.

Non-Declaration Statement: I have no relevant relationships with ineligible companies to disclose within the past 24 months. (Note: Ineligible companies are defined as those whose primary business is producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients.)

Learning Objectives

- Identify indications for the use of spirometry
- Recognize obstruction, restriction, and bronchoreactivity
- Explain the procedure for obtaining spirometry in children
- Know the difference between peak flow monitoring and spirometry
- Integrate spirometry into asthma management

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For children under the age of 14 years, a normal value for FEV1 is :

ⓘ Start presenting to display the poll results on this slide.

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Peak flow meter monitoring :

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Normal spirometry :

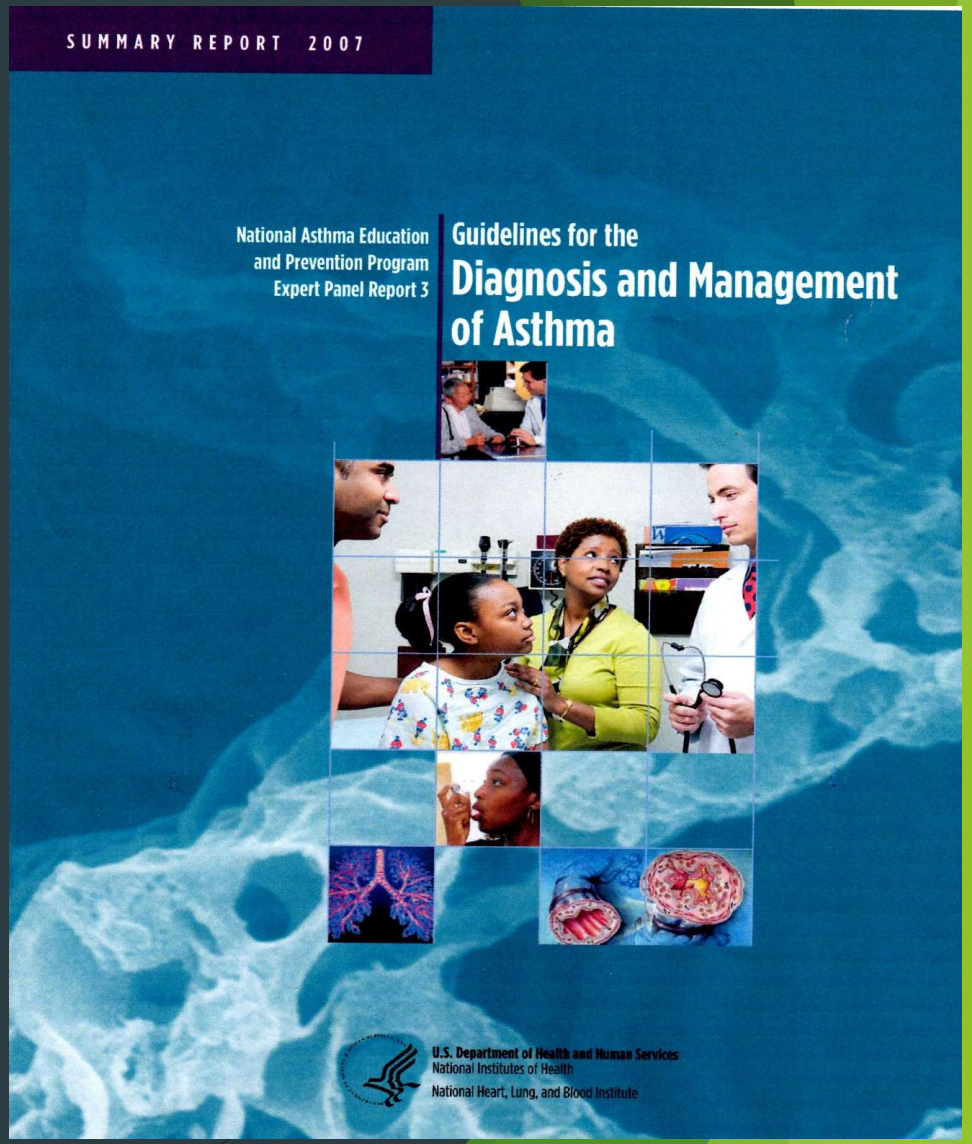
ⓘ Start presenting to display the poll results on this slide.

What is Asthma?

- Asthma is a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role: in particular, mast cells, eosinophils, T lymphocytes, macrophages, neutrophils, and epithelial cells. In susceptible individuals, this inflammation causes recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning. **These episodes are associated with widespread but variable airflow obstruction that is often reversible either spontaneously or with treatment.** The inflammation also causes an associated increase in the existing bronchial hyperresponsiveness to a variety of stimuli. **Reversibility of airflow limitation may be incomplete in some patients with asthma.**

National Asthma Education and Prevention Program Expert Panel Recommendations (NAEPP – EPR)

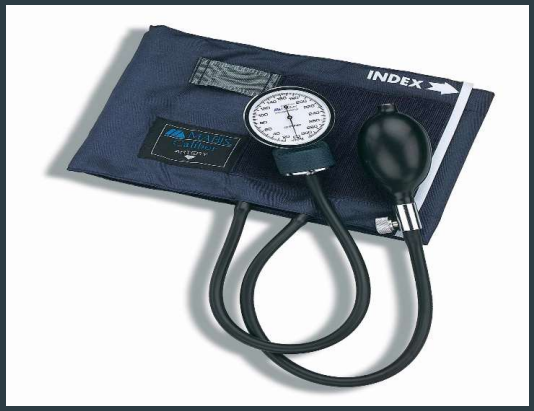
Spirometry should be utilized by all providers who treat asthma patients



IS TO


Allergy & Asthma Network
Mothers of Asthmatics
Asthma Inhalers
Inhaled Bronchodilators
Inhaled Anti-Inflammatories
Combination Medications
AstraZeneca
ExxonMobil

AS


INDEX

IS TO


BETA-
BLOCKER


NDC 0781-5085-92
Fosinopril
Sodium Tablets
40 mg
90 Tablets
Rx only
SANDOZ
NDC 0143-1172-01
Captopril Tablets, USP
25 mg
Rx Only
100 TABLETS

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What is your level of expertise with spirometry?

ⓘ Start presenting to display the poll results on this slide.

What is the Value of Spirometry ?

- Diagnosis
  - Detection of early airway obstruction
  - Explore and rule out differential diagnoses

What is the Value of Spirometry ?

- Long-term management
  - Objective assessment of severity
  - Identify obstruction in patients with low symptom awareness
  - Track disease progression over time
  - Measure response to therapy
  - Supporting therapeutic decisions

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What is your area of practice?

ⓘ Start presenting to display the poll results on this slide.

Spirometry is Under-utilized

- Family Practice — 35%
- Internal Medicine — 30%
- Pediatrics — 25%

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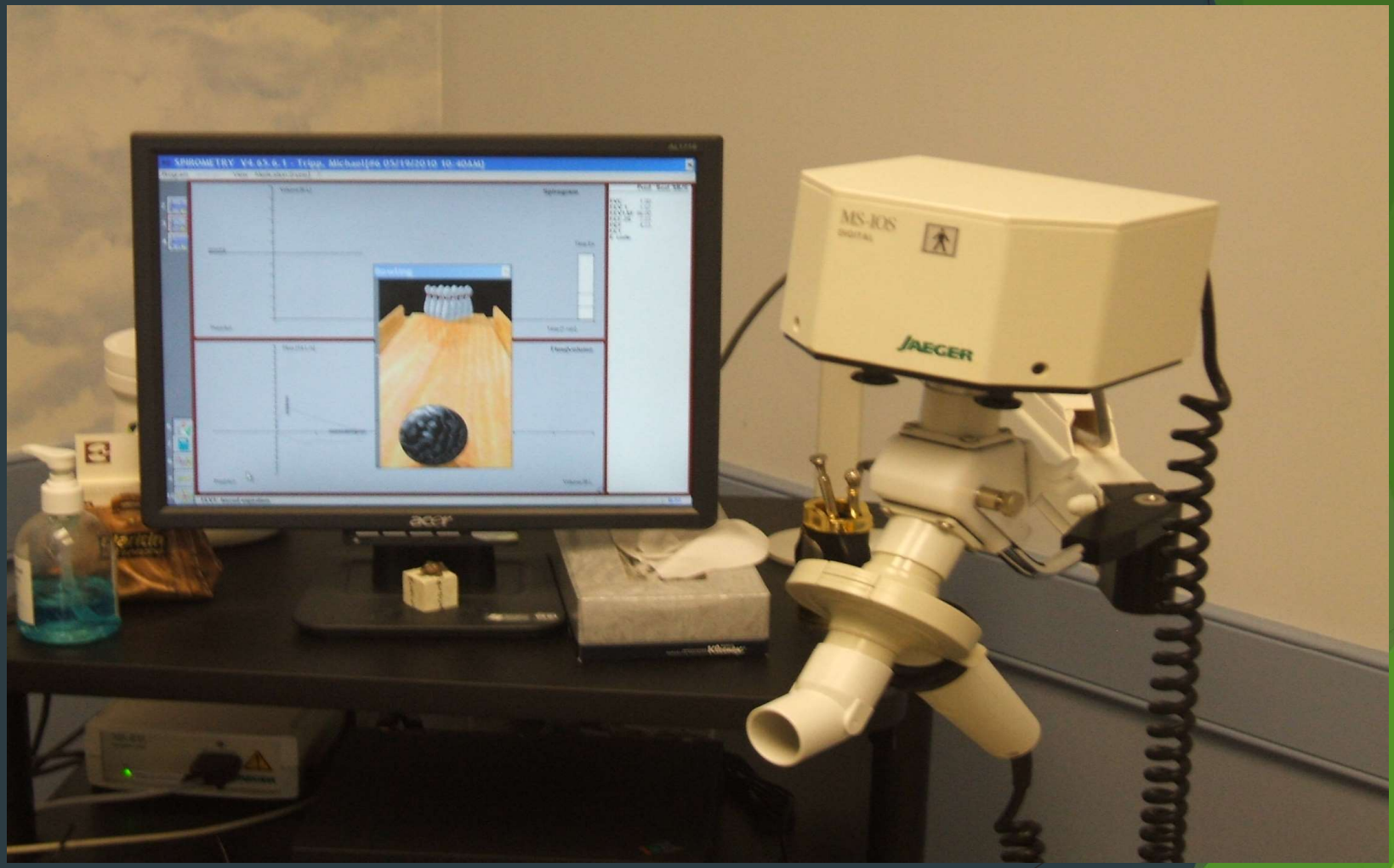
What are barriers to doing spirometry in your practice?

ⓘ Start presenting to display the poll results on this slide.

When is it done?

- Starting at age 5 years
- At the time of initial assessment to determine severity
- After treatment is initiated to document attainment of “normal” airway function
- During a period of progressive or prolonged loss of asthma control
- At least every 1 to 2 years to assess the maintenance of airway function

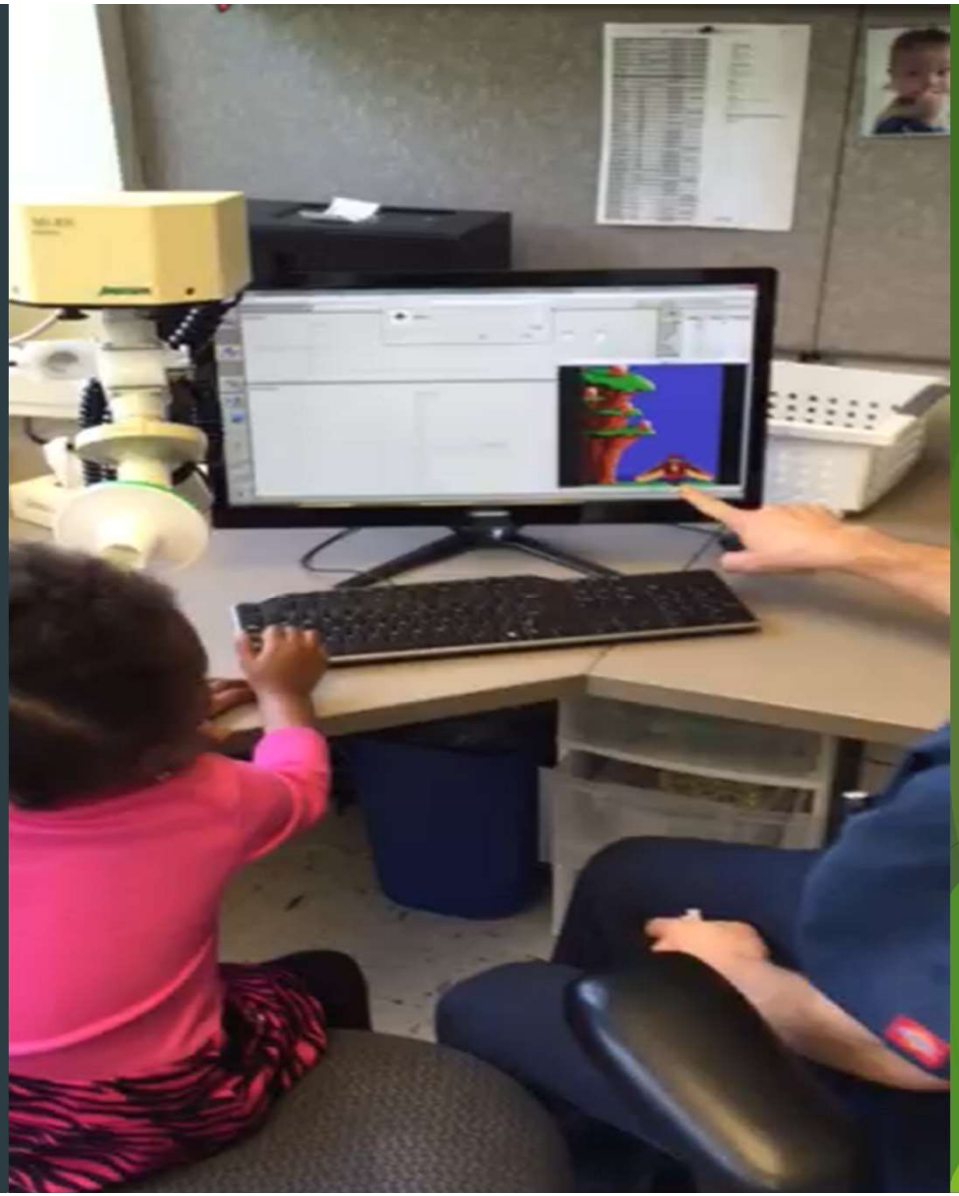

SPIROMETRY V4.65.6.1 - Tripp, Michael[66 05/19/2010 10:40AM]
acer
MS-IOS
JAEGER

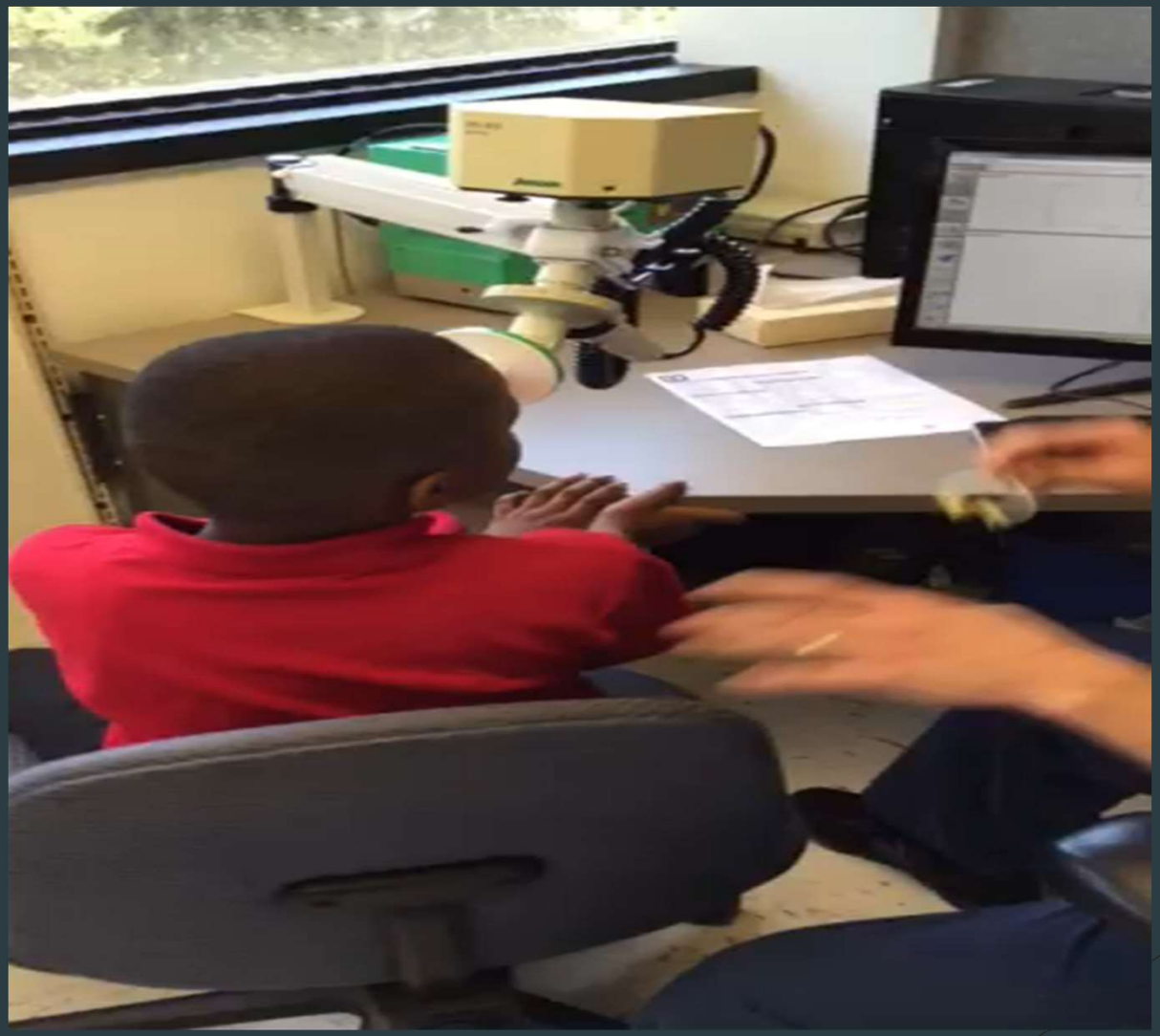
Spirometry Procedures

- Measure standing height
- Record age, gender, and ethnicity
- Explain and demonstrate the correct maneuver
- Coach and watch patient perform each maneuver
- Repeat until 3 acceptable maneuvers
- The two largest FVCs and FEV_1s from the two best tests should be less 5% of each other
- Establish baseline and repeat after inhalation of bronchodilator

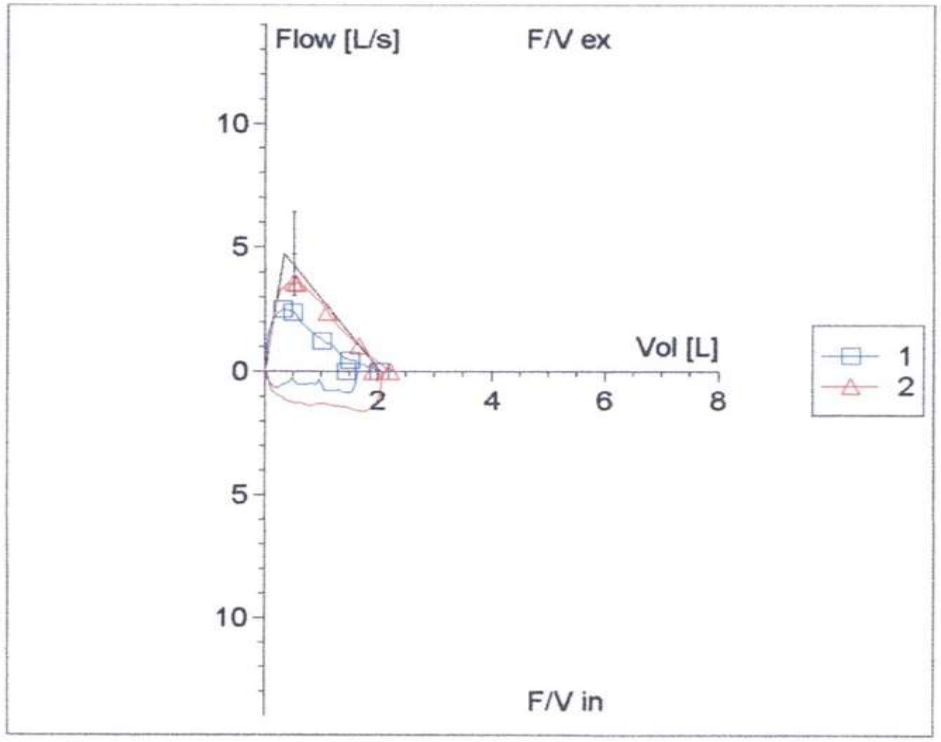
American Thoracic Society. *Standardization of Spirometry 1994 Update*..Am J Respir Crit Care Med 1995; 152;1107-1136.

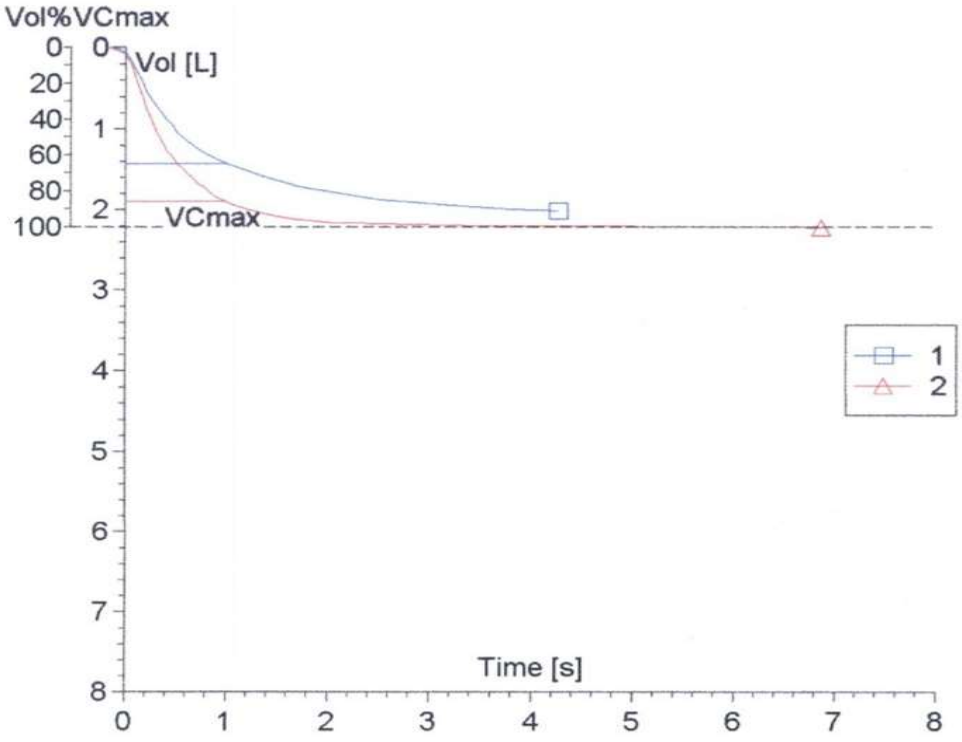
How is it done?





		Pred	Pre	%Pred	Post	%Pred	%Chg
Date			01/28/08		01/28/08		
Time			09:45:12A		09:55:42A		
FVC	[L]	2.04	2.02	99.0	2.22	108.8	10.0
FEV 1	[L]	1.83	1.44	78.7	1.91	104.3	32.5
FEV 1 % FVC	[%]		71.29		85.91		20.5
PEF	[L/s]	4.72	2.48	52.5	3.54	74.9	42.7
FEF 25-75	[L/s]	2.24	1.01	45.3	2.01	89.8	98.4
FET	[s]		4.30		6.91		60.7
ATS error code			13		3		-76.9





Contraindications to Spirometry

- Known pneumothorax
- Splinting/pain
- Hemoptysis
- Cardiovascular instability
- Recent ocular, thoracic or abdominal surgery
- Known cerebral, abdominal or thoracic aneurysm

Spirometry — Common Problems

- Inadequate or incomplete blow
- Lack of blast effort during exhalation
- Slow start to maximal effort
- Lips not sealed around mouthpiece
- Coughing during the blow
- Extra breath during the blow
- Glottic closure or obstruction of mouthpiece by tongue or teeth
- Poor posture — leaning forwards

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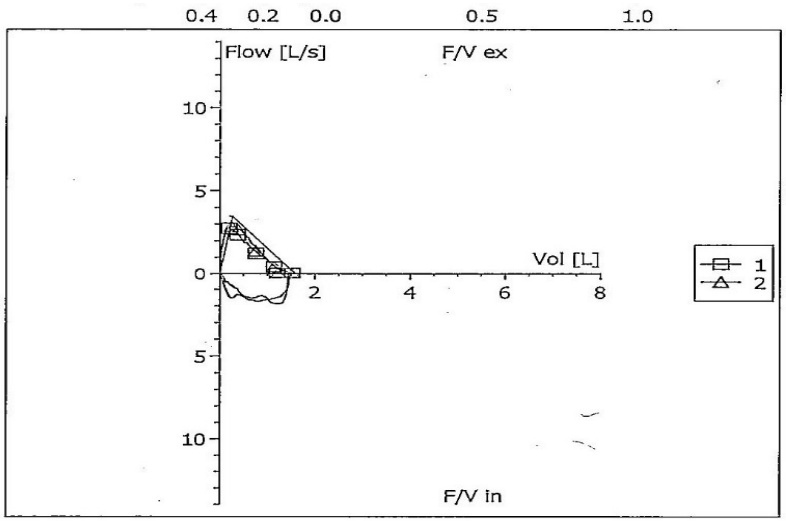
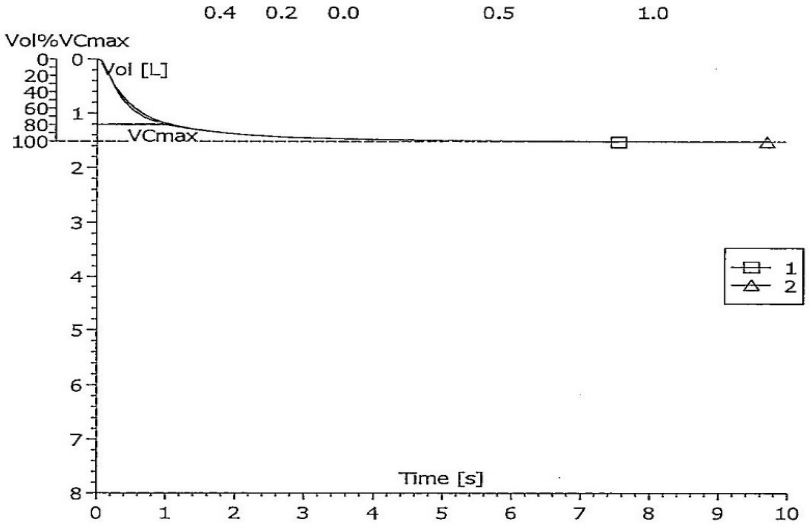
Atlanta Georgia

Last Name:	[redacted]	First Name:	[redacted]	Identification:	[redacted]
Date of Birth:	[redacted]	Age:	6 Years	Sex:	male
Height:	120.7 cm	Weight:	24.5 kg	Race:	African American
Physician:	Wingrove,Brian	Operator:	[redacted]	Pred. Module:	GPPA NHANES

		Pred	Pre	%Pred	Post	%Pred	%Chg
Date			06/23/14		06/23/14		
Time			09:31:41A		09:35:41A		
FVC	[L]	1.59	1.52	95.7	1.52	95.8	0.1
FEV 1	[L]	1.42	1.20	84.9	1.22	86.4	1.8
FEV 1 % FVC	[%]	86.00	78.93	91.8	80.26	93.3	1.7
PEF	[L/s]	3.45	2.74	79.4	2.84	82.2	3.5
MMEF 75/25	[L/s]	1.85	1.06	57.2	1.14	61.5	7.5
FET	[s]		7.52		9.64		28.2
ATS error code			0		0		



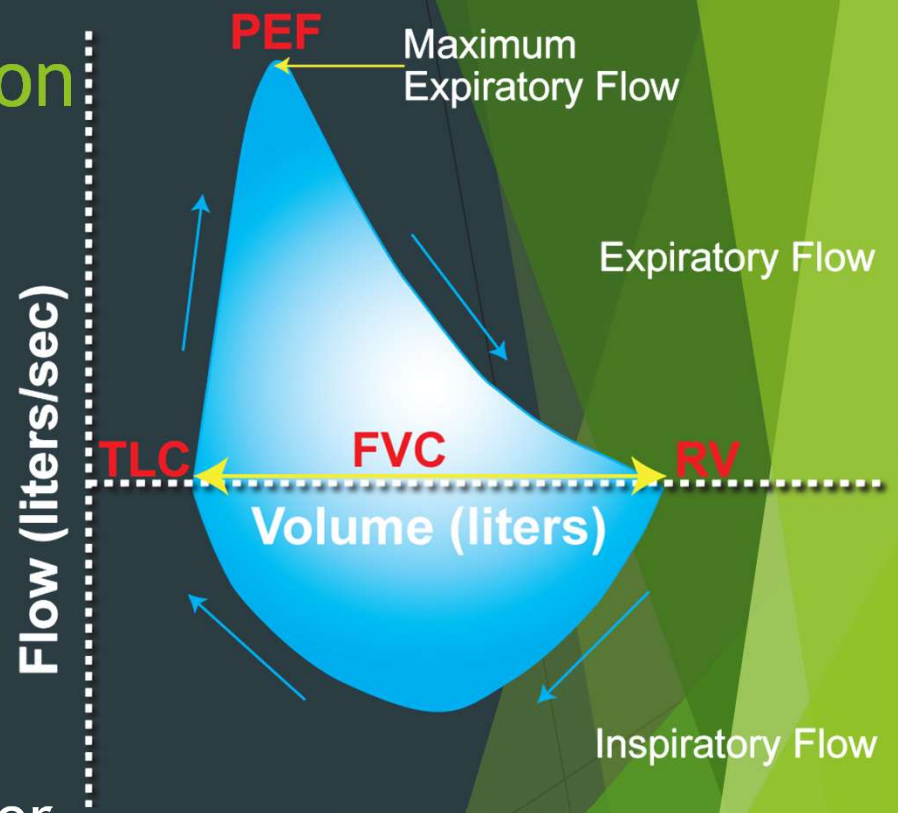


Peak Expiratory Flow Rate

- Information gathered from Peak Flow Meters
- Measures the rate at which air exhaled
- Highly manipulative
- Does NOT give information about volumes or obstruction
- Not superior to the 5 question Asthma Control Test

Interpreting Pulmonary Function Tests in Asthma

1. Examine the flow/volume curve
2. Determine the FVC
3. Determine the FEV_1
4. Determine the FEV_1/FVC ratio
5. Determine the $FEF_{25-75\%}$
6. Assess the response to bronchodilator
7. Consider pertinent clinical information



FVC: Forced Vital Capacity

- Measures volume of air patient can blow out very rapidly
- Indicates degree of lung and chest expansion
- Good indicator of patient effort
- Normal FVC > 80% predicted for age, sex, and height

FEV_1: Forced Expiratory Volume In 1 Second

- Measures volume of air blown out forcefully in first second of FVC maneuver
- Best measure of severity of airflow obstruction
- Normal FEV_1 >80% predicted for age, sex and height
- 3-fold increase in probability of an exacerbation for an FEV_1 <60%
- Significant change post bronchodilator >10-15%

FEV_1/FVC Ratio

- Distinguishes airway obstruction from restriction
- FEV_1/FVC ratio
  - > 80% ages 5-13
  - > 85% ages 14-19
- Age dependent loss of elasticity leads to lower ratios in adults

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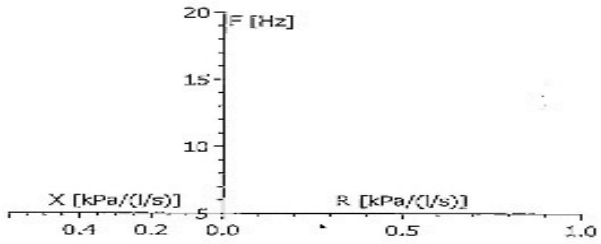
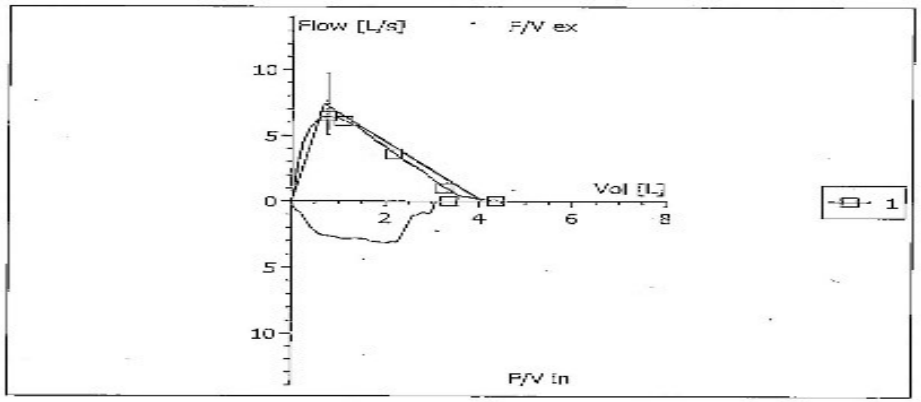
Atlanta Georgia

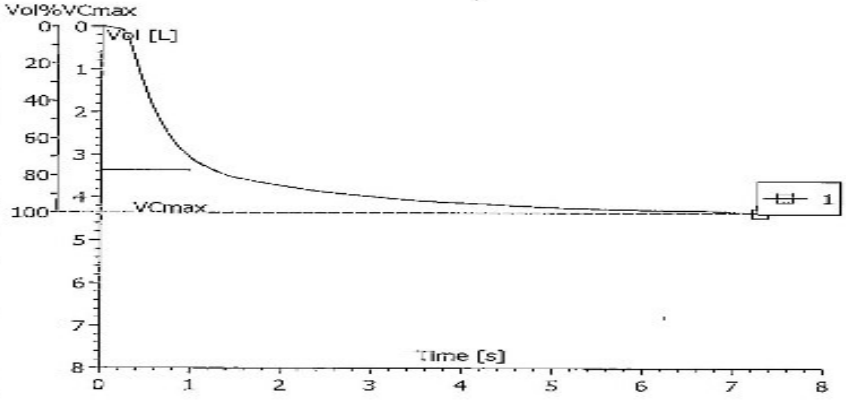
Last Name:	[redacted]	First Name:	[redacted]	Identification:	[redacted]
Date of Birth:	[redacted]	Age:	13 Years	Gender:	male
Height:	167 cm	Weight:	79.5 kg	Race:	US-Hispanic
Physician:	Wingrove,Brian	Technician:	[redacted]	Pred. Module:	GPPA NHANES

		Pred	Act1	%(A/P)
Date			08/18/	
Time			01:43:	
FVC	[L]	4.09	4.36	106.5
FEV 1	[L]	3.56	3.37	94.6
FEV 1 % FVC	[%]	87.18	77.32	88.7
PEF	[L/s]	7.38	6.44	87.3
MMEF 75/25	[L/s]	4.05	2.39	73.8
FET	[s]		7.08	
ATS error code			22	



CO at 5 Hz		
CO at 10 Hz		
CO at 20 Hz		
R at 5 Hz	[cmH2O/(L/s)]	2.53
R at 20 Hz	[cmH2O/(L/s)]	2.12
X at 5 Hz	[cmH2O/(L/s)]	0.41
AX	[cmH2O/L]	
Z at 5 Hz	[cmH2O/(L/s)]	2.56





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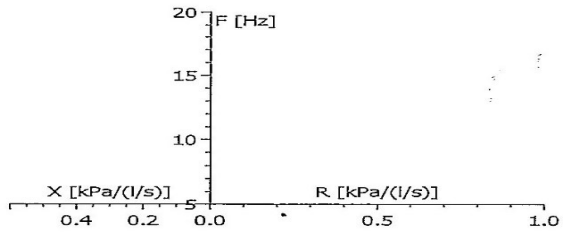
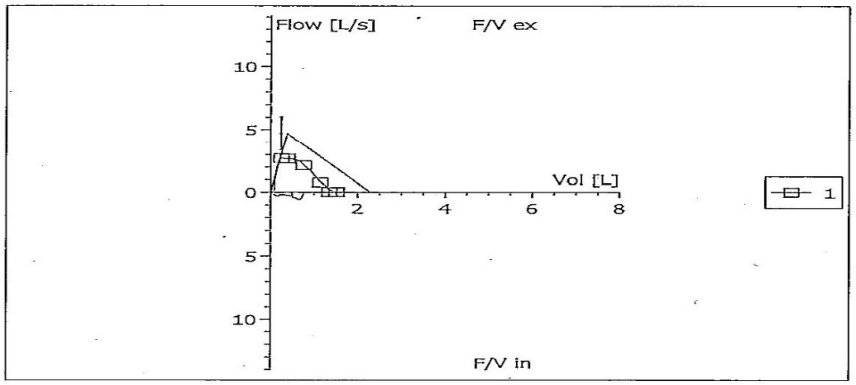
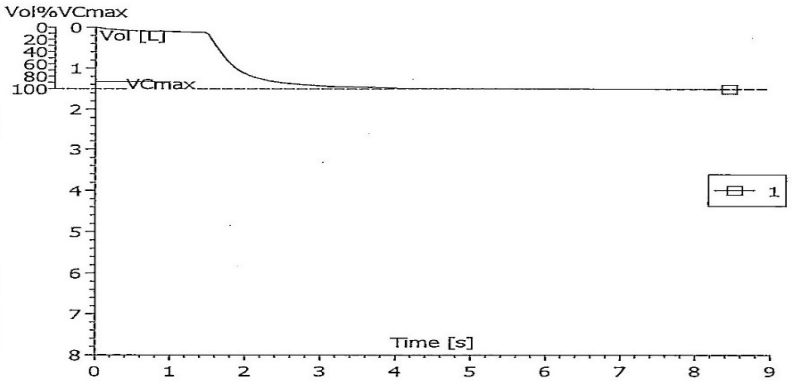
Atlanta Georgia

Last Name:	[redacted]	First Name:	[redacted]	Identification:	[redacted]
Date of Birth:	[redacted]	Age:	14 Years	Sex:	female
Height:	132 cm	Weight:	24.2 kg	Race:	US-Hispanic
Physician:	Wingrove,Brian	Operator:	[redacted]	Pred. Module:	GPPA NHANES

		Pred	Act1	% (A/P)
Date			07/28/	
Time			01:18:	
FVC	[L]	2.28	1.51	66.0
FEV 1	[L]	2.06	1.34	64.9
FEV 1 % FVC	[%]	89.21	88.77	99.5
PEF	[L/s]	4.68	2.70	57.7
MMEF 75/25	[L/s]	3.00	1.71	57.1
FET	[s]		7.02	
ATS error code			0	
CO at 5 Hz				
CO at 10 Hz				
CO at 20 Hz				
R at 5 Hz	[cmH2O/(L/s)]		3.24	
R at 20 Hz	[cmH2O/(L/s)]		2.62	
X at 5 Hz	[cmH2O/(L/s)]		0.28	
AX	[cmH2O/L]			
Z at 5 Hz	[cmH2O/(L/s)]		3.25	







Comments

$FEF_{(25-75)}$

- Measures flow generated in the middle third of an FVC maneuver
- Indicates patency of small airways
- Less reliable in children with short exhalation times
- Significant change post bronchodilator >25%

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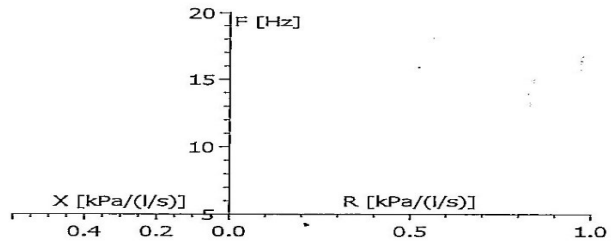
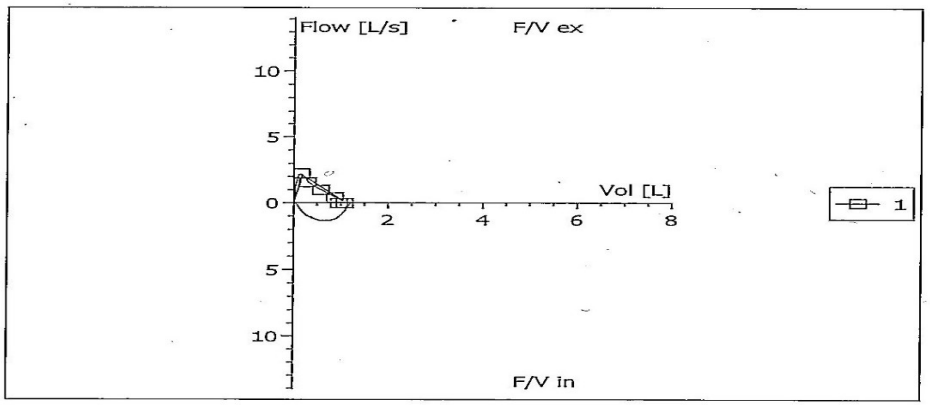
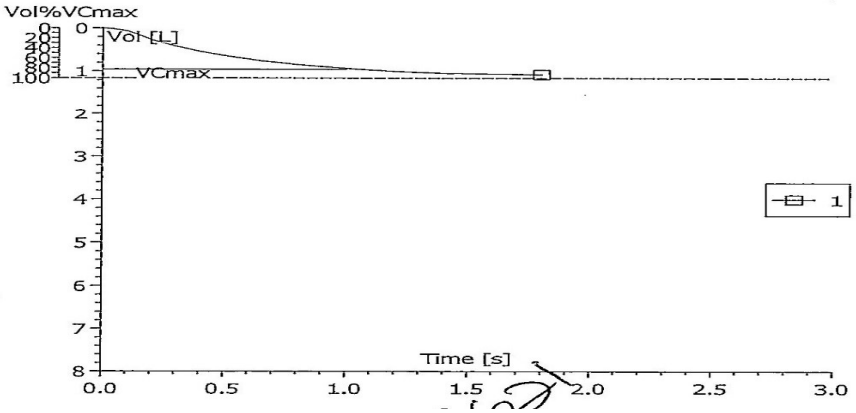
Last Name:	[redacted]	First Name:	[redacted]	Identification:	[redacted]
Date of Birth:	[redacted]	Age:	4 Years	Sex:	male
Height:	105.4 cm	Weight:	17.8 kg	Race:	Caucasian
Physician:	Wingrove,Brian	Operator:	[redacted]	Pred. Module:	GPPA NHANES

		Pred	Act1	%(A/P)
Date			07/22/	
Time			03:36:	
FVC	[L]	1.11	1.08	97.2
FEV 1	[L]	0.97	0.96	99.3
FEV 1 % FVC	[%]	86.00	89.38	103.9
PEF	[L/s]	2.12	2.24	105.6
MMEF 75/25	[L/s]	1.18	0.91	77.3
FET	[s]		1.74	
ATS error code			10	
CO at 5 Hz				
CO at 10 Hz				
CO at 20 Hz				
R at 5 Hz	[cmH2O/(L/s)]	2.43		
R at 20 Hz	[cmH2O/(L/s)]	2.02		
X at 5 Hz	[cmH2O/(L/s)]	0.51		
AX	[cmH2O/L]			
Z at 5 Hz	[cmH2O/(L/s)]	2.48		







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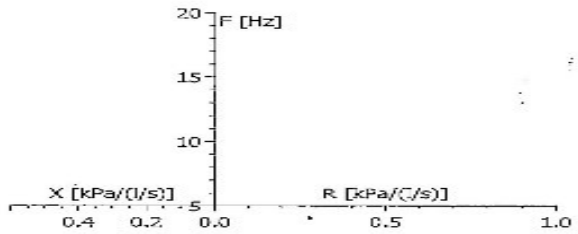
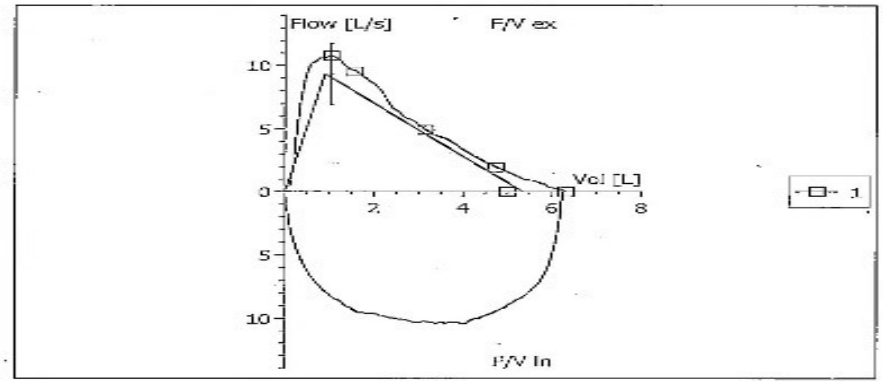
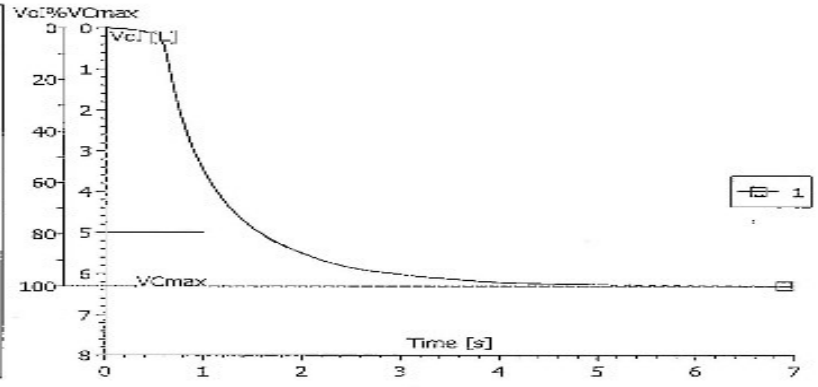
Last Name:	[redacted]	First Name:	[redacted]	Identification:	[redacted]
Date of Birth:	[redacted]	Age:	17 Years	Gender:	male
Height:	181.6 cm	Weight:	87.5 kg	Race:	Caucasian
Physician:	Wingrove,Brian	Technician:	[redacted]	Pred. Module:	GPPA NHANES

		Pred	Actl	%(A/P)
Date			09/16/	
Time			01:42:	
FVC	[L]	5.35	6.31	117.9
FEV 1	[L]	4.50	5.00	111.2
FEV 1 % FVC	[%]	84.55	79.35	93.8
PEF	[L/s]	9.33	10.75	115.2
MMEF 75/25	[L/s]	4.69	4.38	93.3
FET	[s]		6.39	
ATS error code			0	
CO at 5 Hz				
CO at 10 Hz				
CO at 20 Hz				
R at 5 Hz	[cmH2O/(L/s)]		2.57	
R at 20 Hz	[cmH2O/(L/s)]		2.16	
X at 5 Hz	[cmH2O/(L/s)]		0.36	
AX	[cmH2O/L]			
Z at 5 Hz	[cmH2O/(L/s)]		2.60	







Comments

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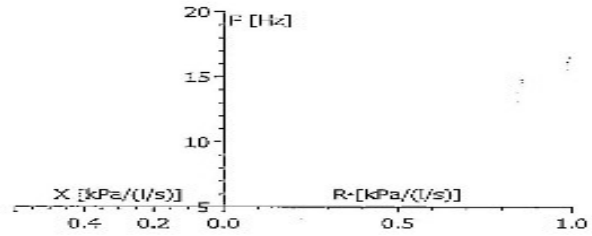
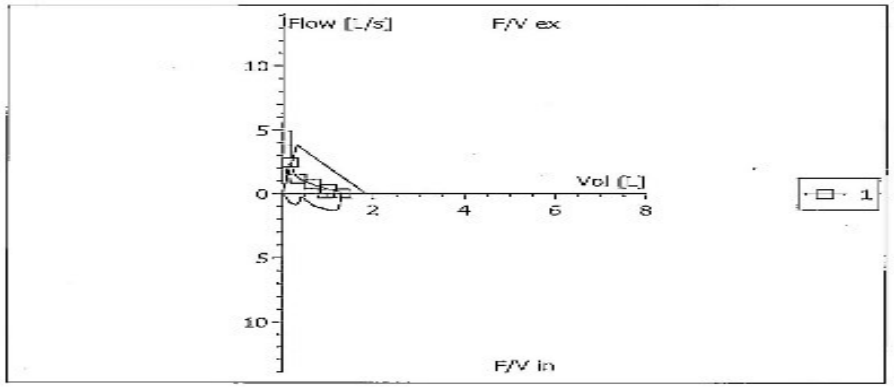
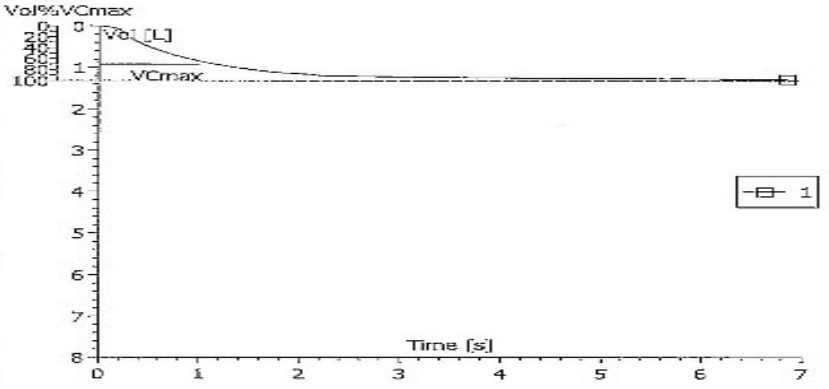
Atlanta Georgia

Last Name:	[redacted]	First Name:	[redacted]	Identification:	[redacted]
Date of Birth:	[redacted]	Age:	10 Years	Sex:	female
Height:	128.3 cm	Weight:	24 kg	Race:	Caucasian
Physician:	Wingrove,Brian	Operator:	[redacted]	Pred. Module:	GPPA NHANES

		Pred	Act1	%(A/P)
Date			01/16/	
Time			08:32:	
FVC	[L]	1.82	1.33	72.8
FEV 1	[L]	1.68	0.93	55.5
FEV 1 % FVC	[%]	98.68	70.13	79.1
PEF	[L/s]	3.83	2.46	64.3
MMEF 75/25	[L/s]	2.34	0.66	28.3
FET	[s]		6.68	
ATS error code			0	
CO at 5 Hz				
CO at 10 Hz				
CO at 20 Hz				
R at 5 Hz	[cmH2O/(L/s)]		3.17	
R at 20 Hz	[cmH2O/(L/s)]		2.56	
X at 5 Hz	[cmH2O/(L/s)]		0.38	
AX	[cmH2O/L]			
Z at 5 Hz	[cmH2O/(L/s)]		3.19	







Comments

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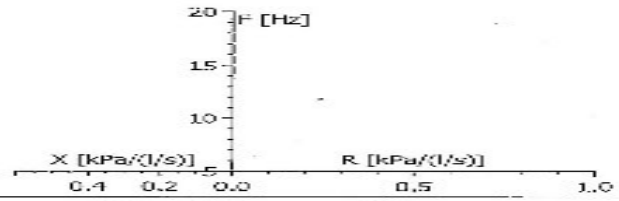
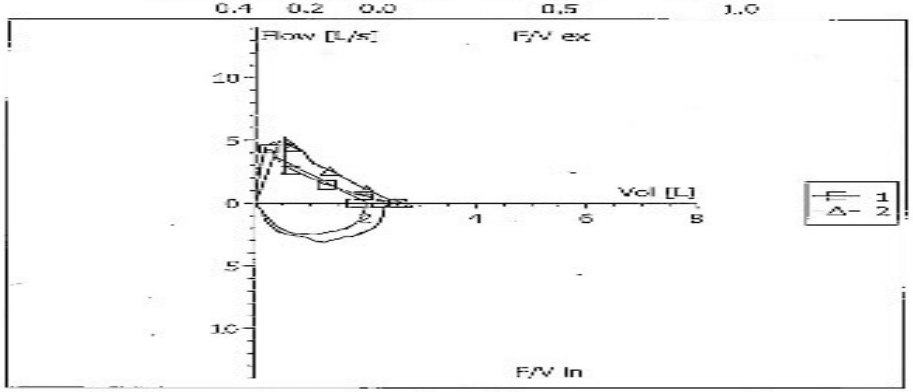
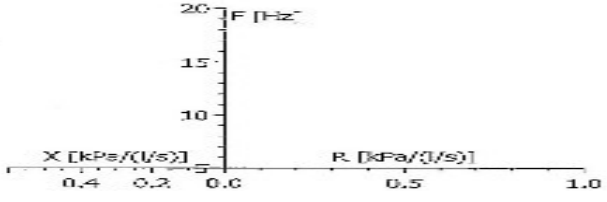
Atlanta Georgia

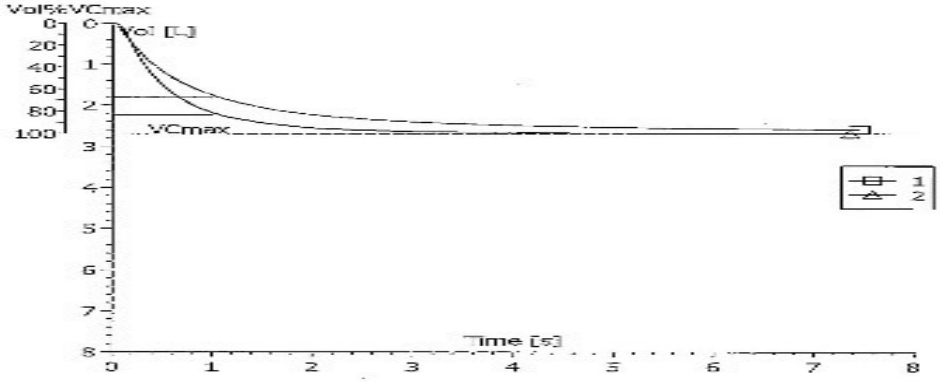
Last Name:	[redacted]	First Name:	[redacted]	Identification:	[redacted]
Date of Birth:	[redacted]	Age:	9 Years	Sex:	male
Height:	132.1 cm	Weight:	43.5 kg	Race:	US-Hispanic
Physician:	Wingrove,Brian	Operator:	[redacted]	Pred. Module:	GPPA NHANES

		Pred	Pre	%Pred	Post	%Pred	%Chg
Date			08/20/14		08/20/14		
Time			03:57:20P		04:02:08P		
FVC	[L]	2.03	2.59	127.2	2.69	132.4	4.1
FEV 1	[L]	1.78	1.82	102.3	2.25	126.4	23.6
FEV 1 % FVC	[%]	88.06	70.38	79.9	83.58	94.9	18.8
PEF	[L/s]	5.73	4.29	114.8	4.92	131.8	14.8
MMEF 75/25	[L/s]	2.11	1.24	58.8	2.20	104.3	77.4
FET	[s]		7.43		7.51		-2.6
ATS error code			0		0		
CO at 5 Hz							
CO at 10 Hz							
CO at 15 Hz							
R at 5 Hz	[cmH2O/(L/s)]	2.48					
R at 15 Hz	[cmH2O/(L/s)]	2.22					
R at 20 Hz	[cmH2O/(L/s)]	2.07					
AX	[cmH2O/L]						



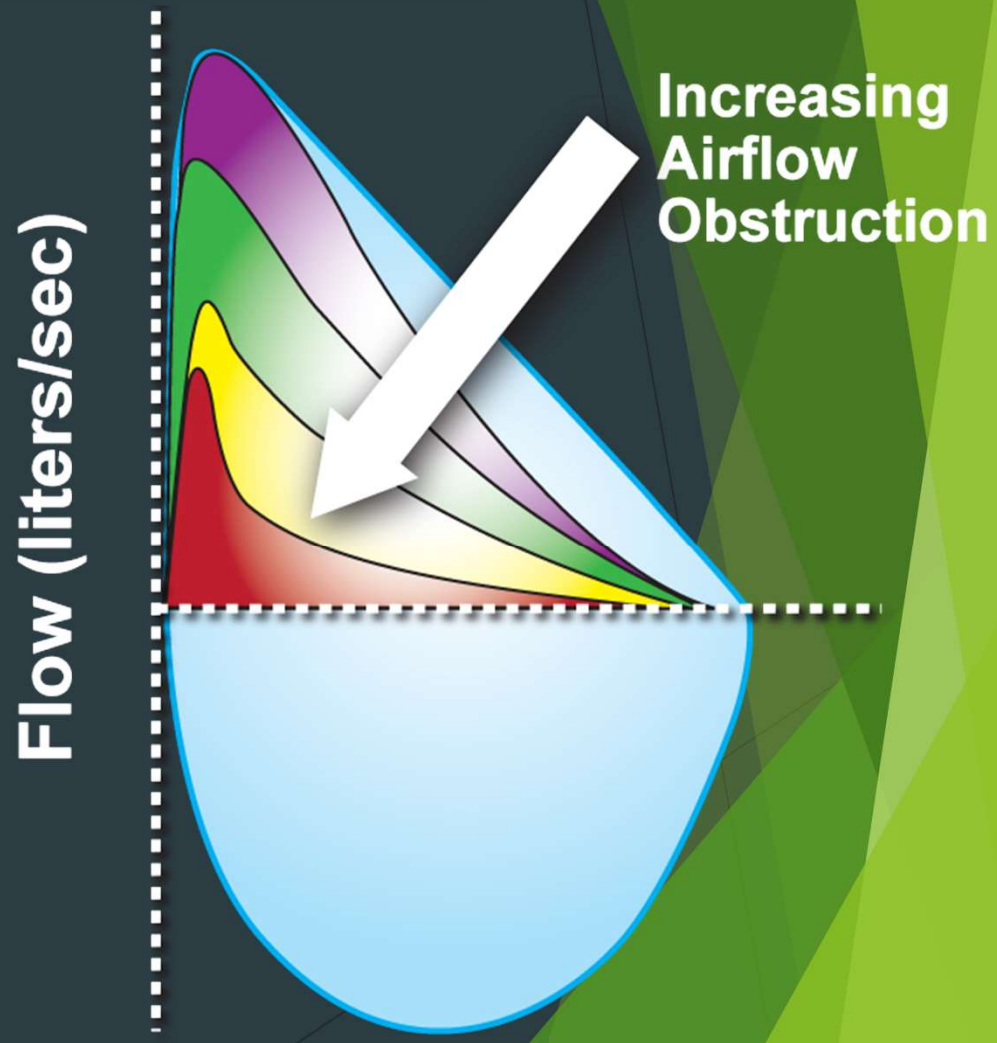






Good effort and understanding.
Good technique with blue aerochamber.

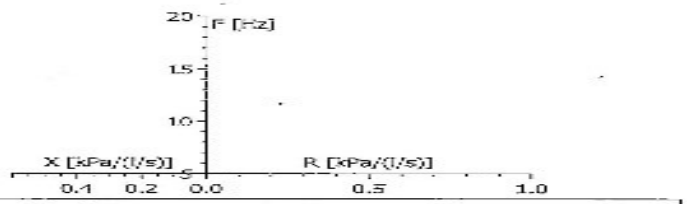
Characteristic Flow-Volume Loops due to Increasing Airflow Obstruction

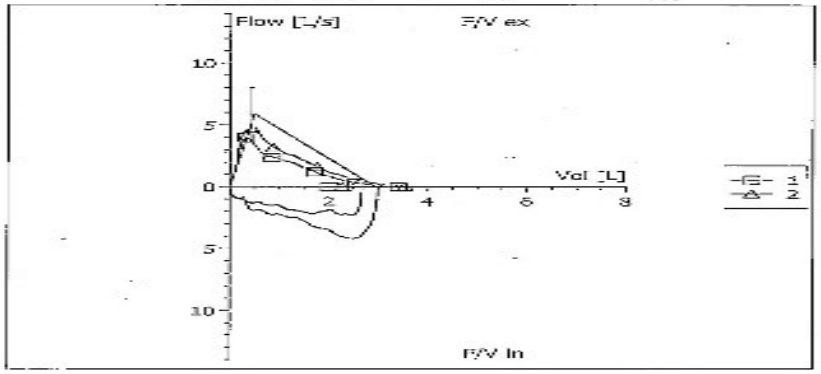


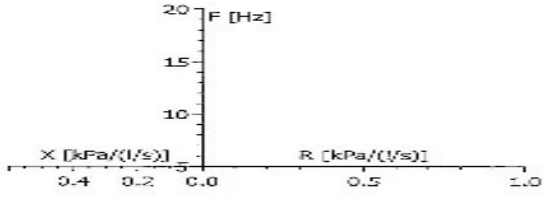
Georgia Pediatric Pulmonology Associates
Atlanta Georgia

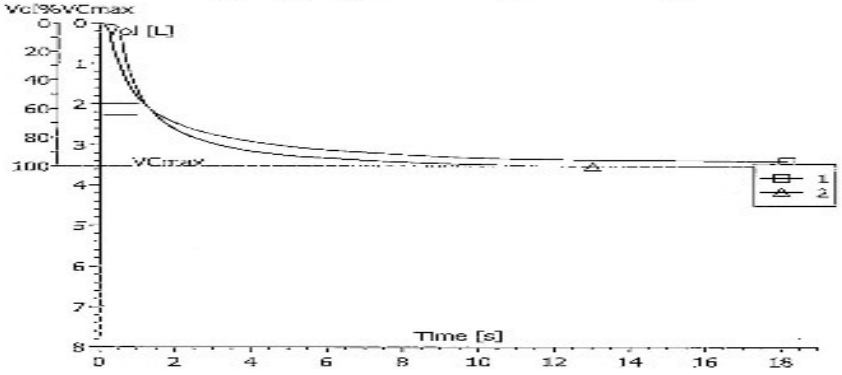
Last Name:	[redacted]	First Name:	[redacted]	Identification:	[redacted]
Date of Birth:	[redacted]	Age:	12 Years	Gender:	male
Height:	158.8 cm	Weight:	107.5 kg	Race:	African American
Physician:	Wingrove, Brian	Technician:	[redacted]	Pred. Module:	GPPA NHANES

		Pred	Pre	%Pred	Post	%Pred	%Chg
Date			01/16/15		01/16/15		
Time			08:31:21A		08:41:15A		
FVC	[L]	2.98	3.40	115.2	3.33	119.8	4.0
FEV 1	[L]	2.56	1.99	77.8	2.27	88.6	13.8
FEV 1 % FVC	[%]	87.05	58.63	67.4	64.18	73.7	9.5
PEF	[L/s]	5.88	3.97	67.5	4.73	80.4	19.2
MMEF 75/25	[L/s]	2.95	0.91	30.9	1.22	41.2	33.4
FET	[s]		18.01		12.57		-30.2
ATS error code			0		0		
CO at 5 Hz							
CO at 10 Hz							
CO at 15 Hz							
R at 5 Hz	[cmH2O/(L/s)]	2.52					
R at 15 Hz	[cmH2O/(L/s)]	2.24					
R at 20 Hz	[cmH2O/(L/s)]	2.11					
AX	[cmH2O/L]						





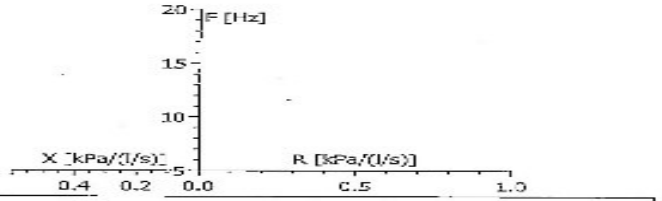


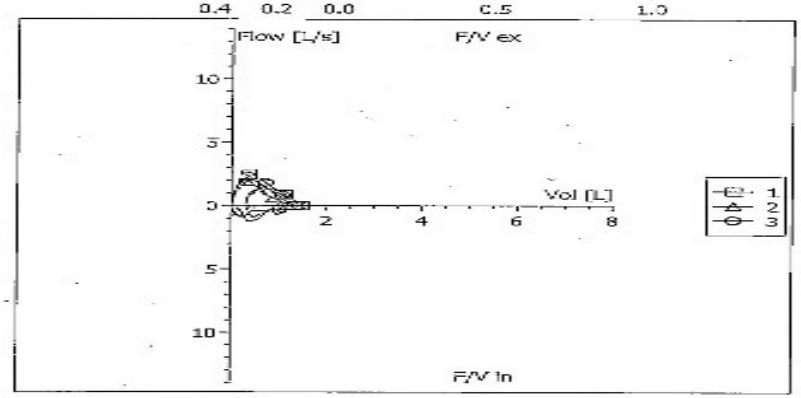


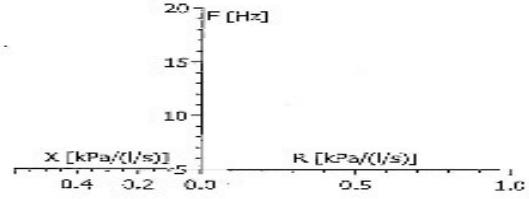
Georgia Pediatric Pulmonology Associates
Atlanta Georgia

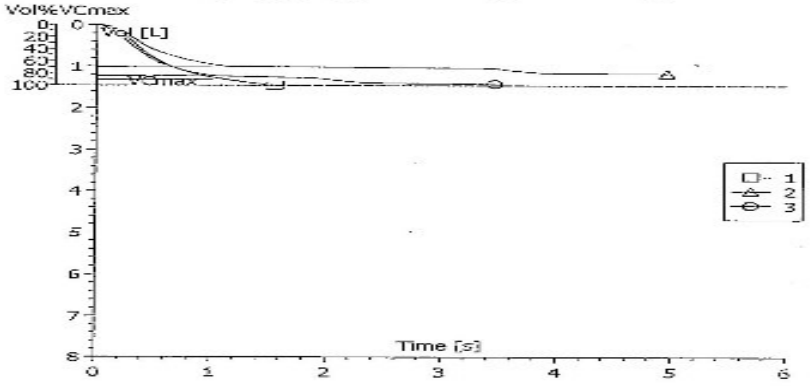
Last Name:	[redacted]	First Name:	[redacted]	Identification:	[redacted]
Date of Birth:	[redacted]	Age:	5 Years	Sex:	male
Height:	113 cm	Weight:	18.3 kg	Race:	Caucasian
Physician:	Wingrove,Brian	Operator:	[redacted]	Pred. Module:	GPPA NHANES

		Pred	Pre	%Pred	Post	%Pred	%Chg
Date			07/24/14		07/24/14		
Time			02:53:08P		03:00:54P		
FVC	[L]	1.30	1.17	90.4	1.43	110.2	21.9
FEV 1	[L]	1.14	1.03	89.8	1.24	108.7	21.1
FEV 1 % FVC	[%]	86.00	87.54	101.8	86.95	101.1	-0.7
PEF	[L/s]	2.68	1.93	72.0	2.28	85.2	18.3
MMEF 75/25	[L/s]	1.46	1.06	72.6	1.52	104.1	43.4
FET	[s]		4.81		3.41		-29.1
ATS error code			10		10		0.0
CO at 5 Hz							
CO at 10 Hz							
CO at 15 Hz							
R at 5 Hz	[cmH2O/(L/s)]	2.44					
R at 15 Hz	[cmH2O/(L/s)]	2.17					
R at 20 Hz	[cmH2O/(L/s)]	2.03					
AX	[cmH2O/L]						





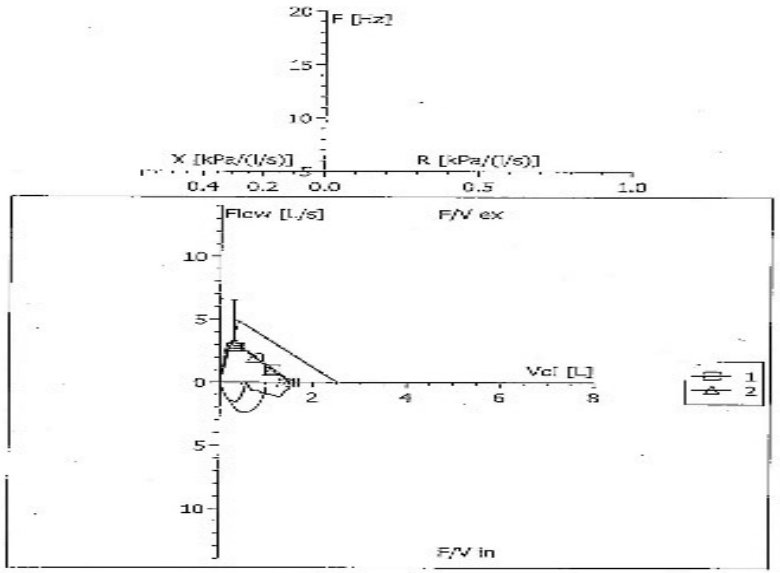


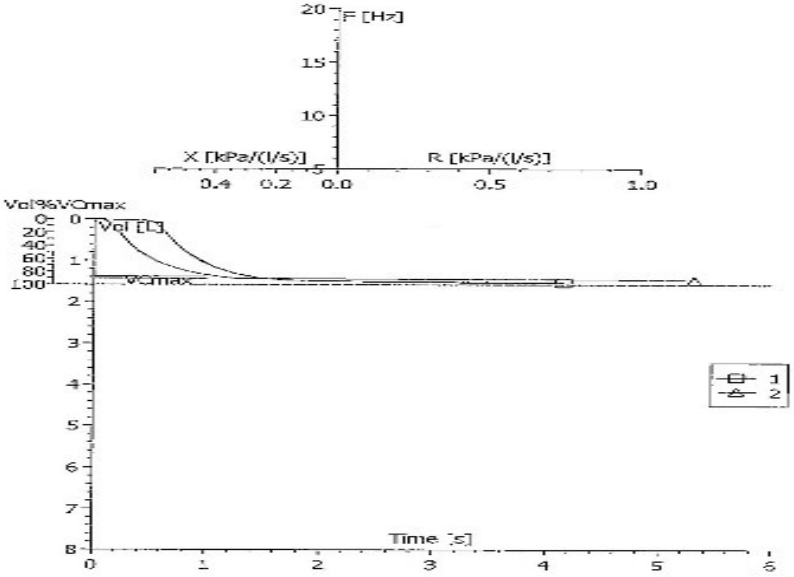


Georgia Pediatric Pulmonology Associates
Atlanta Georgia

Last Name:	[redacted]	First Name:	[redacted]	Identification:	[redacted]
Date of Birth:		Age:	10 Years	Gender:	female
Height:	145.4 cm	Weight:	41 kg	Race:	US-Hispanic
Physician:	Wingrove,Brian	Technician:	[redacted]	Pred. Module:	GPPA NHANES

		Pred	Pre	%Pred	Post	%Pred	%Chg
Date			08/04/14		08/04/14		
Time			03:51:55P		04:01:25P		
FVC	[L]	2.51	2.54	101.4	1.51	60.3	-1.8
FEV 1	[L]	2.25	1.44	64.1	1.40	62.2	-2.9
FEV 1 % FVC	[%]	90.11	93.64	103.9	92.62	102.8	-1.1
PEF	[L/s]	4.87	2.82	57.9	3.21	65.9	13.8
MMEF 75/25	[L/s]	2.85	1.88	66.0	1.70	59.8	-9.4
FET	[s]		3.64		5.21		43.0
ATS error code			10		10		0.0
CO at 5 Hz							
CO at 10 Hz							
CO at 15 Hz							
R at 5 Hz	[cmH2O/(L/s)]	3.17					
R at 15 Hz	[cmH2O/(L/s)]	2.76					
R at 20 Hz	[cmH2O/(L/s)]	2.56					
AX	[cmH2O/L]						





Lessons for Practice

- Spirometry is a necessary tool for diagnosing, managing, and evaluating asthma in children.
- National asthma guidelines recommend spirometry at initial evaluation, at least annually, and whenever there is a change in control.
- Asthma is primarily a disease of obstruction, frequently with reactive changes after a bronchodilator, though this change can be incomplete.

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For children under the age of 14 years, a normal value for FEV1 is :

ⓘ Start presenting to display the poll results on this slide.

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Peak flow meter monitoring :

ⓘ Start presenting to display the poll results on this slide.

slido

Normal spirometry :

ⓘ Start presenting to display the poll results on this slide.