It’s “Just” Spirometry
Objectives

• Overview of spirometry
• American Thoracic Society guidelines for acceptable spirometry
• Recognizing a valid test
• Coaching and feedback to achieve valid test
• Selecting efforts and documentation
• The impact on care plans
Indications for Spirometry

- Evaluate symptoms
- Initial screening and monitoring of lung disease
- Assess therapeutic interventions
- Effects of environmental or occupational exposure
- Monitor for adverse reactions to drugs
- Preoperative or disability determination
- Evaluate prior to pulmonary rehab or strenuous physical activity
- Encourage smoking cessation
Spirometry Preparation

• Calibration of equipment
• Enter correct patient demographics:
  • age, height, gender and race
• Patient posture
• Dentures, if loose, should be removed
• Tight clothing should be loosened
Spirometry Instructions

1. Nose clips and mouthpiece
2. Normal breathing
3. Deep breath in
4. Exhale forcefully
5. Continue to exhale
6. Deep fast breath in
Spirometry Values

**FVC:** Volume of air exhaled as rapidly and forcefully as possible from a maximal inspiration

**FEV1:** Volume of air exhaled within the 1\textsuperscript{st} second of a FVC maneuver
American Thoracic Society Standards

• Extrapolated volume ≤ 5% of the FVC or 150ml
  • No hesitation or false start
• No cough in first second of exhalation
• No early termination of exhalation – minimum of 6 seconds in adults and 3 seconds in children < 10 years of age
• No evidence of glottic closure
• No obstruction of mouthpiece by tongue or dentures
• Efforts should be free from leaks
ATS Reproducibility Criteria

• A minimum of 3 acceptable efforts should be obtained
• Of the 3 acceptable efforts:
  Two largest FVC values are required to be within 150ml
  Two largest FEV1 values are required to be within 150ml

* If FVC ≤ 1.0 liter repeatability should be within 100ml
Volume Time Curve & Flow Volume Loop
Back Extrapolation

Hesitation, Slow Start, No Sharp Peak, Large Extrapolated Volume
Coach: No Hesitation, Blast Harder, Blast Faster

Niosh
Cough

Cough in First Second
Correction: Clear Throat, Drink of Water

Niosh
No Plateau

No Plateau, Early Termination
Correction: Keep Blowing, Check for Leaks, Check Equipment
Obstruction of Mouthpiece

Partially Blocked Mouthpiece
Correction: Reposition Mouthpiece, Secure Dentures
Technologist Comments

- Patient effort
- ATS standards met
- Bronchodilator
- Pertinent information that will impact interpretation
Spirometry Results Matter!

- Additional testing
- Medications
- Diagnosis
- Disability determination
- Surgery determination
- Travel time
- Healthcare cost
Encourage

Very good

more

Blow

www.sibelmed.com
Spirometry per ATS Standard

<table>
<thead>
<tr>
<th>Effort</th>
<th>FVC</th>
<th>FEV1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effort 1</td>
<td>3.26</td>
<td>2.64</td>
</tr>
<tr>
<td>Effort 2</td>
<td>3.35</td>
<td>2.70</td>
</tr>
<tr>
<td>Effort 3</td>
<td>3.37</td>
<td>2.75</td>
</tr>
</tbody>
</table>
Patient 1

<table>
<thead>
<tr>
<th></th>
<th>Pre-BD</th>
<th>Post-BD</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>2.40</td>
<td>2.46</td>
</tr>
<tr>
<td>FEV1</td>
<td>1.67</td>
<td>1.68</td>
</tr>
</tbody>
</table>

Comments:
- Good efforts

Correction:
- Blast hard & fast
- Exhale to plateau, check for leaks
- Comment to reflect efforts
Patient 2
Visit 1

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>% Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>4.83</td>
<td>101</td>
</tr>
<tr>
<td>FEV1</td>
<td>3.59</td>
<td>98</td>
</tr>
</tbody>
</table>

Comments: Pt. displayed good efforts during the exam

Know your Equipment, Correlate FVL and FVC/FEV1 values
Patient 2
Visit 2

<table>
<thead>
<tr>
<th></th>
<th>Pre-actual</th>
<th>% Predicted</th>
<th>Post-actual</th>
<th>% Predicted</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>3.81</td>
<td>79</td>
<td>3.99</td>
<td>83</td>
<td>+4</td>
</tr>
<tr>
<td>FEV1</td>
<td>2.65</td>
<td>72</td>
<td>2.87</td>
<td>78</td>
<td>+8</td>
</tr>
</tbody>
</table>

Comments:
- Good efforts
- Multiple attempts
- Best reported
- Albuterol administered

Impact:
- Additional testing
- Increased healthcare cost
- Travel time
Patient 3
Visit 1

<table>
<thead>
<tr>
<th></th>
<th>Pre-Actual</th>
<th>% Predicted</th>
<th>Post-actual</th>
<th>% Predicted</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>1.10</td>
<td>92</td>
<td>1.13</td>
<td>95</td>
<td>+2</td>
</tr>
<tr>
<td>FEV1</td>
<td>0.68</td>
<td>63</td>
<td>0.84</td>
<td>77</td>
<td>+22</td>
</tr>
</tbody>
</table>

**MD interpretation:**
- Moderate airflow limitation
- Significant improvement post BD

**Impact:**
- Documentation affects therapy, steroids increased
- Choose FVL, FVC and FEV1 values which correlate

**Comments:**
- Good efforts
- Albuterol administered
Patient 3
Visit 2

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>% Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>0.98</td>
<td>82</td>
</tr>
<tr>
<td>FEV1</td>
<td>0.57</td>
<td>51</td>
</tr>
</tbody>
</table>

Comments:
- No BD given secondary to multiple variable attempts
- Good efforts
- Unable to perform per ATS standard

Interpretation:
- Moderate airflow limitation
- Accurate interpretation limited by suboptimal technique

Impact:
- Documentation affects therapy, steroids decreased
- MD values our knowledge of acceptable tests
Patient 4
Visit 1

Pre bronchodilator:

Post bronchodilator:
Patient 4
Visit 1

<table>
<thead>
<tr>
<th></th>
<th>Pre-actual</th>
<th>% Predicted</th>
<th>Post-actual</th>
<th>% Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>2.03</td>
<td>101</td>
<td>1.97</td>
<td>98</td>
</tr>
<tr>
<td>FEV1</td>
<td>1.72</td>
<td>112</td>
<td>1.69</td>
<td>110</td>
</tr>
</tbody>
</table>

**Comments:**
- Good efforts

**Correction:**
- Encourage pt. to blast hard & fast
- Perform more efforts
- Choose FVL, FVC & FEV1 values which correlate
## Patient 5

<table>
<thead>
<tr>
<th>Effort</th>
<th>FVC</th>
<th>FVC%</th>
<th>FEV1</th>
<th>FEV1%</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.97</td>
<td>42</td>
<td>0.54</td>
<td>30</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>1.80</td>
<td>78</td>
<td>0.76</td>
<td>42</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>1.73</td>
<td>75</td>
<td>1.30</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1.93</td>
<td>84</td>
<td>1.48</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1.80</td>
<td>78</td>
<td>1.40</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1.62</td>
<td>70</td>
<td>1.08</td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

### Comments:
- Great efforts

### Correction:
- Re-explain how to perform test
- Perform more efforts
- Documentation

### Impact:
- FVL can lead to a misdiagnosis by MD
Patient 6

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>% Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>3.51</td>
<td>78</td>
</tr>
<tr>
<td>FEV1</td>
<td>1.14</td>
<td>32</td>
</tr>
</tbody>
</table>

**Comments:**
- Multiple good efforts

**Interpretation:**
- Fixed airway obstruction
Do These FVL Look the Same?

<table>
<thead>
<tr>
<th></th>
<th>FVC</th>
<th>FVC%</th>
<th>FEV1</th>
<th>FEV1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effort 1</td>
<td>3.65</td>
<td>76</td>
<td>2.95</td>
<td>79</td>
</tr>
<tr>
<td>Effort 2</td>
<td>3.41</td>
<td>71</td>
<td>2.77</td>
<td>74</td>
</tr>
</tbody>
</table>

**Correction:**
- Blast fast & hard
- Perform more efforts

**Impact:**
- FVL w/back extrapolation values falsely higher
One More Patient...

<table>
<thead>
<tr>
<th></th>
<th>FVC</th>
<th>FVC%</th>
<th>FEV1</th>
<th>FEV1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effort 1</td>
<td>2.86</td>
<td>90</td>
<td>2.84</td>
<td>110</td>
</tr>
<tr>
<td>Effort 2</td>
<td>2.87</td>
<td>90</td>
<td>2.87</td>
<td>111</td>
</tr>
<tr>
<td>Effort 3</td>
<td>2.79</td>
<td>88</td>
<td>2.79</td>
<td>108</td>
</tr>
</tbody>
</table>
It’s “NOT” just Spirometry!

- Know your equipment
- FVL, FVC and FEV1 values correlate
- Comments impact interpretation
- Quality testing affects:
  - Diagnosis
  - Appropriate tests ordered
  - Treatment plans
  - Travel time
  - Health care costs
QUESTIONS?

ONE DOES NOT SIMPLY

UNDERSTAND PULMONARY FUNCTION TESTING
References

• Wanger, Jack, MSc, RRT, RPFT, FAARC: ATS Pulmonary Function Laboratory Management and Procedure Manual 3rd edition

• Mottram, Carl, BA, RRT, RPFT: Ruppel’s Manual of Pulmonary Function Testing 10th edition

• U.S. Department of Health and Human Services: DHHS (NIOSH) Publication No. 2011-135