SPIROMETRY IN SOUTH AFRICA

SOURCES OF VARIABILITY AND ETHNIC ISSUES IN SPIROMETRY TESTING OF A WIDELY CULTURALLY DIVERSE SOUTH AFRICAN POPULATION
Aim

- Improve the **standardisation**, **quality** and **usefulness** of spirometry in all settings
Spirometry

- fulfills a pivotal role in respiratory medicine
- used to diagnose:
  - airways obstruction
  - assess severity and prognosis
  - Assess risk factors (e.g. preoperative assessment)
  - detect early lung disease
  - monitor for normal lung growth and lung function decline.
Introduction

- Final spirometric measurements rely on methods and controls to reduce variability of data so that interpretation of the end result is accurate. Data errors persist. In South Africa the additional challenge of a diverse ethnic population is magnified by the current use of foreign studies of ECSC which form the basic reference values against which our subject’s blows are evaluated.
How are Spirometry results are currently measured

- Predicted values are values derived from studies of healthy population groups
- based on equations that take into account age, height and gender primarily but also ethnicity
- Measured values are then compared to the predicted normal values. This will determine whether the spirometry result is within the normal range for that individual
- Most fall into a range between 80% and 120% of the reference value
- Spirometry results are then reported as an actual measurement as well as a percentage of the predicted value
<table>
<thead>
<tr>
<th>Result</th>
<th>Pred</th>
<th>Pre</th>
<th>%Prd</th>
<th>Post</th>
<th>%Prd</th>
<th>%Chg</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (L)</td>
<td>*4.78</td>
<td>4.17</td>
<td>87%</td>
<td>4.31</td>
<td>90%</td>
<td>3%</td>
</tr>
<tr>
<td>FEV1 (L)</td>
<td>*3.92</td>
<td>3.12</td>
<td>80%</td>
<td>3.47</td>
<td>89%</td>
<td>11%</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>0.82</td>
<td>0.75</td>
<td>91%</td>
<td>0.81</td>
<td>98%</td>
<td>8%</td>
</tr>
<tr>
<td>FEF25-75% (L/s)</td>
<td>4.31</td>
<td>2.37</td>
<td>55%</td>
<td>3.23</td>
<td>75%</td>
<td>36%</td>
</tr>
<tr>
<td>PEFR (L/s)</td>
<td>9.24</td>
<td>8.56</td>
<td>93%</td>
<td>8.67</td>
<td>94%</td>
<td>1%</td>
</tr>
<tr>
<td>Exp time (s)</td>
<td></td>
<td>8.66</td>
<td></td>
<td>6.31</td>
<td></td>
<td>-27%</td>
</tr>
</tbody>
</table>
Current

- No local all-inclusive prediction equations available in SA
- Using European Community for Steel and Coal (ECSC) prediction equations as a norm in SA
- Using one correction factor for all races
- Ideally choose predicted values most like the ethnic group of patient to be tested
R – RACE
A – AGE + REFERENCE AUTHOR = PREDICTED VALUES
S – SEX
H - HEIGHT (WEIGHT)
Pitfalls & challenges of current methods

- ECSC: males only - not representative and considered too high. Women were not tested but were published at 80% of males.
- Need to correct for race.
- Adult data available for those aged between 18-70 years.
- Quanjer/Polgar – paediatric authors.
- The separation of children/adolescents and adults is artificial and leads to disjointed predicted values at the transition from adolescence to adulthood.
- The models fit the measured values poorly, particularly in children.
- Differences in predicted values by various authors are very large.
The Past

- Evaluating results against predicted values
- 10% correction for all non-Caucasian individuals
Displaying the predicted FEV1 in white males according to 30 different authors.
Reveals a quite worrying picture.
For the same height and age predicted values may differ by 1 litre or more.
Predicted values for children and adolescents are quite disjointed from those for adults.
These prediction equations were used in many parts of the world for diagnostic purposes! A worrisome state of affairs.

Predicted FEV1 in white males. Derived from software downloadable from [www.spirxpert.com/GOLD.html](http://www.spirxpert.com/GOLD.html)
Result of current methods

- Evaluating data for screening using predicted values is wrought with inadequacies and presents several practical difficulties especially with a view to testing indigenous populations.
The Present

- Global Lung Function Indice’s (GLI) reference values now available published 2012
- In 2008 over 30,000 records had been generously made available from all over the world - GLI
- 70 groups from all over the globe
- Tens of thousands of records made available which provided an opportunity to estimate the lower limit of normal more accurately
- Downfall is no data included from Africa

- Pro’s: Accurate across all ethnic groups
- Con’s: Need to add data from African Africans to the current GLFI values
The Future

- Use LLN and ULN
"Lower Limit of Normal" for spirometric test results

- The ‘normal range’ is the range of values which encompasses 95% of a healthy population.
- The lower limit of normal (LLN) is the cut-off below which results from only 2.5% of healthy individuals will fall.
- The upper limit of normal (ULN) represents the threshold above which results from only 2.5% of healthy individuals will be found.
- Accordingly 95% of the healthy population is considered to have “normal” test results, whereas in 2½% they are “too low” and in 2½% “too high”, resulting in 5% false-positive test results.
- Results of spirometric tests characteristically lead to values for FEV₁ and VC which are too low rather than too high in disease. This probably explains why in respiratory medicine the lower limit of normal is defined as that value which identifies the lower 5th centile of a healthy population of non-smokers.
Conclusion

- Values near the limits of normal should be interpreted with caution.
- Use of correction factors is understood as an approximation.
- Use a correction factor of 0.9 (10%) in African and Asian individuals and 0.95 (5%) in those of mixed race when European based reference equations (e.g. ESCS) are being used.
- It is necessary to start teaching and encouraging the use of the subject as his own control for longitudinal studies. The weaknesses of predicted values and the variations and controversies surrounding ethnic issues are then laid to rest.
References


