The measurement of absolute lung volume without plethysmography

O Adam\textsuperscript{1}, R Shiner\textsuperscript{2}, P Calverley\textsuperscript{3}, J Solway\textsuperscript{4}, R Brown\textsuperscript{4}, J Fredberg\textsuperscript{5}.
Tel Aviv Israel\textsuperscript{1}; London\textsuperscript{2}, Liverpool\textsuperscript{3} UK; Chicago\textsuperscript{4}, Boston\textsuperscript{5} USA
CONFLICT OF INTEREST

• None of the academic physicians here received any honoraria or hold shares in the company making this device
• The physicians would receive a small share of any future profit such a device might make
• OA is an employee and shareholder in the company making this instrument.
Measuring lung volumes

- Helium dilution/N2 washout – gas mixing issues
- CXR/CT – radiation and inspiration issues
- Body plethysmography – the ‘gold standard’ but bulky and time constant issues
A NOVEL APPROACH
THEORETICAL BASIS

- \( F_c(0^+)/ F_m(0^-) = C_c/(C_g + C_c) \)

where \( F_{ti}(0^+) = F_m(0^-) \) at the instant of valve closure and \( F_c(0^+) \) is the flow due to gas rarefaction. Rearranging:

- \( V_g / V_c = F_m(0^-) / F_m(0^+) - 1 \)

where \( V_g \) is the absolute TGV at interruption
THE RIGID LUNG MODEL
PERFORMING A TLC MEASUREMENT

- Inspiratory Capacity
- Imperceptible interruptions
- Natural Breathing
- Slow Vital Capacity
TESTING IN HEALTHY ADULTS

• 137 healthy adults - 69 training group, 68 test group
• Age 28 years, 80 males, range 18-70
• Measured lung volumes in a ZAN-500 plethysmograph in 2 sites on one day, the PVM TLC
• 26 subjects repeated both tests
COMPARISON OF TLC_{PLETH} AND TLC_{PVM}
REPRODUCIBILITY OF PLETHYSMOSMOGRAPHY AND PVM

(TLC_{PLETH} \text{ Day-1} + TLC_{PLETH} \text{ Day-2})/2 (L)

(TLC_{PVM} \text{ Day-1} + TLC_{PVM} \text{ Day-2})/2 (L)
<table>
<thead>
<tr>
<th>Descriptive</th>
<th>Body Plethysmograph (Zan500)</th>
<th>Partial Volume Method (PulmOne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interruption Duration / Iterations</td>
<td>1.1 seconds / 3 - 7 loops</td>
<td>0.08 seconds / 20 – 30 interruptions.</td>
</tr>
<tr>
<td>Maneuver</td>
<td>Panting at a rate of 30-60 breaths per minute.</td>
<td>Panting at a rate of 10-40 breaths per minute.</td>
</tr>
<tr>
<td>Position</td>
<td>Cheeks supported. Seated Upright.</td>
<td>Cheeks supported. Seated Upright.</td>
</tr>
<tr>
<td>Measurement duration duration</td>
<td>11 ± 9 minutes.</td>
<td>2 ± 0.5 minutes.</td>
</tr>
</tbody>
</table>