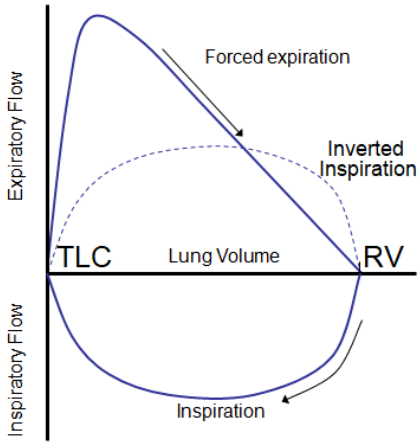
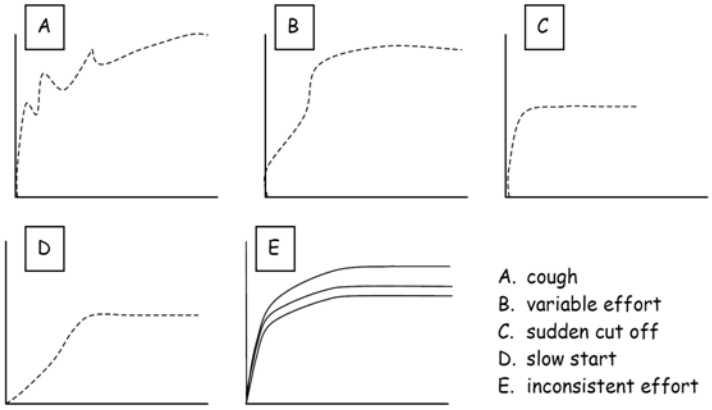
# Unit II – Problem 4 – Physiology Lab: Dynamic Spirometry

- **Spirometry gives three important measurements. Those are:**
  - **$FEV_1$:** it is the volume of air that the patient is able to breath out in the 1st second of forced expiration.
  - **FVC**: it is the total volume of air that the patient can exhale forcibly in one breath.
  - **$FEV_1$/FVC ratio:** this ratio is expressed as a percentage.
  - **Peak flow**: it is the volume of air that the patient is able to breath out in first 1000th of a second of forced expiration.



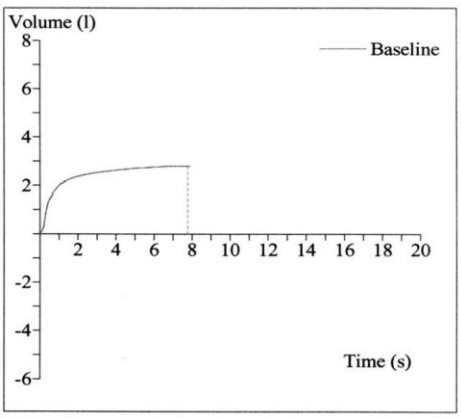

- **What are the steps to be taken when patient undergoes examination with spirometry (for measurement of $FEV_1$ and FVC):**
  - Take as large breath of air as possible.
  - Put the filter into your mouth ensuring there are no leaks at the sides of your mouth.
  - Attach a nose clip to prevent air leakage.
  - Blast as quickly as possible and for as long as possible.

**Figure 7. EXAMPLES: POORLY PERFORMED CURVES**



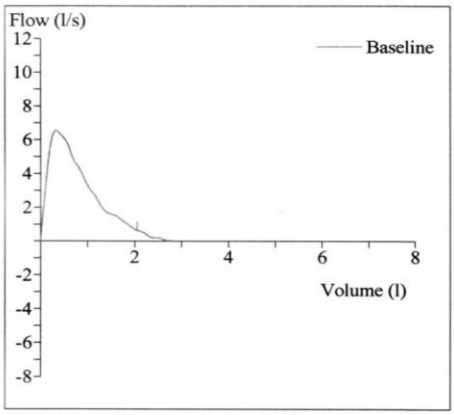

- **The normal curve:**
  - **Volume-time:**
    - ✓ The vertical scale indicates total volume (l) the patient has blown out.
    - ✓ The horizontal scale indicates the total time (s) the patient has been blowing out for.
    - ✓ Note: the initial part of the curve which is steep followed by a gradual flattening of the curve.

**Best Volume Time Graph**



- **Flow-volume loop:**
  - ✓ The vertical scale indicates litres of air breathed out per second (L/s) at that moment in time.
  - ✓ The horizontal scale indicates total volume expired (L).
  - ✓ Note: the sharp peak at the beginning of the curve followed by an initially sharp trough that gradually flattens out.

**Best Flow Volume Loop Graph**




- **Normal values:**
  - **$FEV_1$** > 80% predicted.
  - **FVC** > 80% predicted.
  - **$FEV_1$/FVC** ≥ 70% predicted.
- **Spirometry interpretation: obstructive vs. restrictive lung diseases**
  - **Obstructive lung disease:**
    - ✓ FVC: normal or ↓
    - ✓ $FEV_1$: ↓
    - ✓ FEF 25-75%: ↓
    - ✓ $FEV_1$/FVC ratio: ↓
    - ✓ TLC: normal or ↑
  - **Restrictive lung disease:**
    - ✓ FVC: ↓
    - ✓ $FEV_1$: ↓
    - ✓ FEF 25-75%: normal or ↓
    - ✓ $FEV_1$/FVC ratio: normal or ↑
    - ✓ TLC: ↓
  - **Or to make interpretation more easy:**
    - ✓ Look to $FEV_1$/FVC ratio:
      - ❖ *If it is decreased* = obstructive lung disease.
      - ❖ *If it is normal or increased* =
        - ➢ Restrictive lung disease (if other values are decreased).
        - ➢ Normal (if other values are normal).
- **Measurements:**

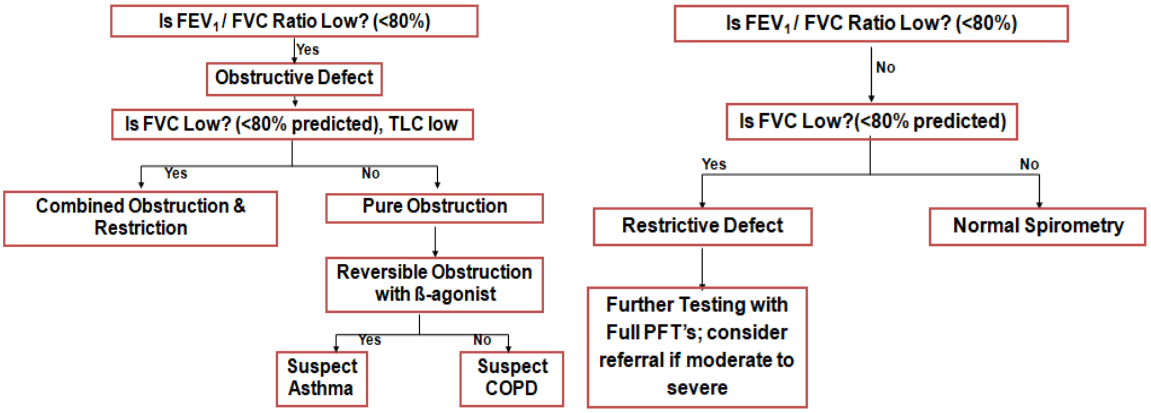
| Severity of obstruction | |
|---|---|
| **Severity** | **Post-bronchodilator $FEV_1$ (% of predicted value)** |
| **Mild airflow obstruction** | > 80% |
| **Moderate airflow obstruction** | 79-50% |
| **Severe airflow obstruction** | 30-49% |
| **Very severe airflow obstruction** | < 30% |

| Severity of restriction | |
|---|---|
| **FVC** | **% of predicted** |
| **Mild** | 65-80% |
| **Moderate** | 50-65% |
| **Severe** | < 50% |

- **Asthma vs. COPD:**

| | COPD | Asthma |
|---|---|---|
| Smoker or ex-smoker | Nearly all | Possibly |
| Symptoms under the age 35 | Rare | Often |
| Chronic Productive Cough | Common | Uncommon |
| Breathlessness | Present and progressive | Variable |
| Night time waking with breathlessness and or wheeze | Uncommon | Common |
| Significant diurnal or day to day variability of symptoms | Uncommon | Common |

  - **Asthma**: it is a reversible obstructive lung disease (spontaneously or with treatment) in which susceptible individuals have hypersensitivity reaction and increase in airway response due to different stimuli.
  - **COPD**: airflow obstruction is usually progressive, not fully reversible and does not change markedly over several months. The disease is predominantly caused by smoking (20 pack years is considered a significant factor for developing COPD).
- **Bronchodilator reversibility test:**
  - 400 mcg Salbutamol is administered via large volume spacer and spirometry repeated after 10-15 minutes. Before taking bronchodilator test, the patient should stop short acting $\beta_2$-agonists for 6 hours.
  - **Results:**
    - ✓ An $FEV_1$ that increases by < 400 mls = COPD
    - ✓ An $FEV_1$ that increases by > 400 mls = asthma
    - ✓ If $FEV_1$/ FVC ratio increases more than 12% = reversible asthma.
- **Diagnostic flow diagrams for obstructive vs. restrictive lung diseases:**




- **Flow-volume curve:**
  - **Normal:** starts Forced Expiratory with lung volume of 7 L.
  - **Obstructive**: starts with lung volume of 8.5 L and ends with high RV.
  - **Restrictive:** stars at low volume of 4.5 L and ends with low RV.