End-tidal CO₂ (EtCO₂) is the measurement of carbon dioxide (CO₂) in the airway at the end of each breath. Capnography provides a numeric reading (amount) of the EtCO₂ and a graphic display (waveform) of CO₂ throughout the respiratory cycle.

CO₂ produced by cells, is transported via the vascular system and diffused into the alveoli to be exhaled. PaCO₂, the partial pressure of CO₂ in arterial blood, is normally 2–5 mmHg higher than EtCO₂ in the airway.

### Capnography • Intubated Patient

**Applications on intubated patients:**
- Verification of ET tube placement
- Monitoring and detection ET tube dislodgment
- Loss of circulatory function
- Determination of adequate CPR compressions
- Confirmation of return of spontaneous circulation

**Examples:**
- Sudden loss of waveform, EtCO₂ near zero
  - ET tube disconnected, dislodged, kinked or obstructed
  - Loss of circulatory function
- Decreasing EtCO₂ with loss of plateau
  - ET tube cuff leak or deflated cuff
  - ET tube in hypopharynx
  - Partial obstruction
- CPR Assessment
  - Attempt to maintain minimum of 10 mmHg
- Sudden increase in EtCO₂
  - Return of spontaneous circulation

### Capnography • Non-intubated Patient

**Applications on non-intubated patients include:**
- Assessment of asthma and COPD
- Documented monitoring during procedural sedation
- Detection of apnea or inadequate breathing
- Measurement of hyperventilation
- Evaluation of hyperinflation

**Examples:**
- Plateau has curved, “shark-fin” appearance
  - Asthma
- COPD
- Slow rate with increased EtCO₂
  - Hyperventilation
  - Partial airway obstruction
- Rapid rate with decreased EtCO₂
  - Hyperventilation

### Normal Ranges:
- Arterial PaCO₂ 38–45 mmHg
- Airway EtCO₂ 35–45 mmHg (4–6 Vol. %)

### Normal Waveform:

- **A-B** Respiratory baseline
- **B-C** Expiratory upstroke
- **C-D** Expiratory plateau
- **D** End-tidal value—peak CO₂ concentration—at the end of exhalation
- **D-E** Inspiratory downstroke

### Applications:
Capnography is an objective monitoring tool for patients in respiratory distress and patients undergoing procedural sedation. It may be used to confirm, monitor and document ET tube intubation. A nasal-oral cannula is used to assess, monitor and document the respiratory status of the non-intubated patient. EtCO₂ monitoring with LIFEPAK defibrillator/monitors may be used on patients of any age.

### Monitoring and Printing:
Capnography waveforms on the monitor screen are condensed to provide adequate information in the 4-second view. The correct respiratory rate is displayed in breaths per minute (bpm). Printouts of the waveforms are in real time and therefore may differ in duration.

### Note:
Examples are illustrations for training purposes. Level of sedation and severity of condition may affect respiratory rate and EtCO₂ level in patients.

### Troubleshooting Tips for EtCO₂ Monitoring with LIFEPAK defibrillator/monitors:

<table>
<thead>
<tr>
<th>Observation</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALARM APNEA message appears.</td>
<td>No breath has been detected for 30 seconds since last valid breath (≥8 mmHg).</td>
</tr>
<tr>
<td>CO₂ FILTERLINE OFF message appears.</td>
<td>FilterLine® disconnected or not securely connected.</td>
</tr>
<tr>
<td>CO₂ FILTERLINE BLOCKAGE message appears.</td>
<td>FilterLine is twisted or clogged. Airway adapter clogged.</td>
</tr>
<tr>
<td>CO₂ FILTERLINE PURGING message appears.</td>
<td>FilterLine tube twisted or clogged, or rapid altitude change occurred.</td>
</tr>
<tr>
<td>EtCO₂ values are erratic.</td>
<td>Leak in the tubing. Ventilated patient breathes spontaneously.</td>
</tr>
<tr>
<td>EtCO₂ values are consistently higher or</td>
<td>Physiological cause. Ventilator malfunction. Improper calibration.</td>
</tr>
<tr>
<td>lower than expected.</td>
<td></td>
</tr>
<tr>
<td>XXX appears in place of EtCO₂ value.</td>
<td>CO₂ module not calibrated successfully, or CO₂ module fails.</td>
</tr>
</tbody>
</table>

### The LIFEPAK® 12 defibrillator/monitor with Microstream® capnography provides the most versatility and ease of use:
- Superior moisture handling eliminates need for water traps or additional filters
- No calibration required between patients
- Does not require user corrections or compensation for commonly used gasses (O₂, N₂O, etc.)