**Introduction:**
Capnography (EtCO2) is the current standard of care for monitoring ventilation in patients under general anesthesia. However, in non-intubated patients, EtCO2 monitoring is challenging and clinicians therefore often rely on pulse oximetry, a late indicator of respiratory depression, or on subjective assessment. A noninvasive respiratory volume monitor (RVM) provides accurate and continual monitoring of minute ventilation (MV), tidal volume (TV) and respiratory rate (RR). Here, we compared RVM and EtCO2 monitoring in patients receiving propofol-based sedation.

**Methods:**
In an observational study approved by Partners IRB, simultaneous data were recorded by an RVM (ExSpiron, Respiratory Motion, Inc.) and capnography (Capnostream 20, SmartCapnoLine, Covidien) during colonoscopy procedures. Baseline MV, TV, and EtCO2 were established prior to sedation. Periods of High EtCO2 (>50mmHg or >130% baseline), Low EtCO2 (<20mmHg or <70% baseline), and Low MV (<40% baseline) were identified. The number of High EtCO2 and Low EtCO2 events that were preceded by Low MV events was quantified.

**Results:**
50 patients (22 males, 52±16years; 26.1±6.3kg/m2) were monitored for 33.2±14.7min. Table 1 summarizes the percent of monitored time with reported data for the two devices. Fig 1 depicts MV decrease following propofol and cannula dislodgement following a jaw thrust. Table 2 presents the number of EtCO2 events across all patients. Low MV events preceded all 9 High EtCO2 events by 7.7min. Low MV events preceded 43 out of 47 of the Low EtCO2 events by 2.9min. The 4 Low EtCO2 events that did not correspond to a change in MV were potentially false alarms.

**Conclusion:**
In non-intubated patients, the RVM identified all High EtCO2 events and detected the decrease in MV 7.7min before EtCO2. The RVM provides reliable measurements when capnography data is unavailable and is not subject to the EtCO2 limitations of nasal cannula placement, dilution with O2, and mouth breathing.

**Table 1:**

<table>
<thead>
<tr>
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<th>RVM</th>
<th>Capnography</th>
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<tbody>
<tr>
<td>% Time with Data</td>
<td>MV / EtCO2</td>
<td>99.2 ± 1.3%</td>
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<tr>
<td>% Time with Data</td>
<td>RR</td>
<td>99.2 ± 1.3%</td>
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*Percent of Monitored Time with Data Reported*

**Table 2:**

<table>
<thead>
<tr>
<th>Alarm Criteria</th>
<th>High EtCO2</th>
<th>Low EtCO2</th>
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<tbody>
<tr>
<td>EtCO2 &gt; 50 mmHg or EtCO2 &gt; 130% Baseline EtCO2</td>
<td>EtCO2 &lt; 20 mmHg or EtCO2 &lt; 70% Baseline EtCO2</td>
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</tbody>
</table>
# of Alarms | 13 | 47
---|---|---
# of Alarms with Corresponding LMVe | 13 | 43
Delay between LMVe and EtCO2 Alarm | $7.7 \pm 2.7 \text{ min}$ | $2.9 \pm 0.6 \text{ min}$

*Low Minute Ventilation Events and EtCO2 Alarms*

**Image 1:**

MV (top) decreases in response to propofol (purple), resulting in an LMVe at 13:45. EtCO2 (middle) stays relatively constant at the start of the LMVe without triggering either high or low EtCO2 alarms. A jaw thrust (13:46), results in dislodged nasal canula. MV increased slightly, but still remained low (40% MVBaseline). EtCO2 increased to >50 mmHg and remained high.