

## **The Clinical Application of Noninvasive Minute Ventilation Monitor in the Perioperative Setting: Preliminary Results from 4 Sites Within Kaiser Permanente Medical System**

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**Introduction/Identification of problem:** Non-invasive respiratory volume monitoring (RVM) has implications for managing the respiratory status of perioperative patients by measuring and reporting minute ventilation (MV) tidal volume, and respiratory rate. We evaluated the effectiveness of the RVM in providing information, reducing the incidence of alarms, alarm fatigue.

**Purpose of the Study:** Combined effects of medication on respiratory function can be devastating. Avoidable respiratory depression is highlighted in the Anesthesia Closed Claim Project, detailing malpractice claims. Patient monitoring lacks useful warning of impending respiratory compromise, with both SpO<sub>2</sub> and EtCO<sub>2</sub> being late indicators, fraught with alarms from patient motion or probe malposition.

**Methodology:** An RVM (ExSpirom1Xi, Waltham, MA) was used for perioperative care in the post-anesthesia-care-unit (PACU) and on the general hospital floor (GHF). RVM alarms and response to alarms were recorded and analyzed. Alarms were divided into four categories: 1) actionable and addressed, 2) actionable and not addressed, 3) self-corrected, and 4) technical. The action taken to resolve each alarm was recorded and further categorized. Self-corrected alarms resolved without staff intervention, usually by the patient being stimulated by the RVM alarm. Technical alarms were considered a nuisance.

**Result:** 247 patients (age: 60.9 ± 13.9 yrs., 143 females) were enrolled and monitored in the PACU and GHF for a total of 2321 hours. We noted 605 RVM alarms, ~1 alarm every 4 patient-hours. Of these alarms, 64% were actionable and addressed. 16% were actionable and “not-addressed” and 13% were self-resolved. Only 6% of RVM alarms were technical (nuisance) and didn’t require intervention. The most common intervention was direct patient stimulation, accounting for ~2/3 of all interventions in the PACU and ~80% of all interventions on the GHF. With a focus on early warning, none of the patients with MV alarms had respiratory related negative events.

**Conclusion:** Inadequate respiratory monitoring has led to drug-related respiratory compromise to become the leading cause of preventable perioperative death. Using SpO<sub>2</sub> and EtCO<sub>2</sub> to curtail these deaths led to an increase of nuisance alarms and overburdening of RN staff without clear improvement in mortality. We found the RVM-generated alarms to be mostly actionable, with a high intervention-to-false-alarm ratio, which can improve patient.