SURVEY OF ALARM LIMIT SETTINGS FOR ADULT CAPNOGRAPHY USERS

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Introduction: Capnography or end-tidal carbon dioxide ($etCO_2$) is used to monitor ventilation, provide respiratory rate and measure adequacy of ventilation through the measurement of exhaled carbon dioxide. In addition, waveforms provide continuous and real-time feedback on airflow (i.e., apnea) and visual analysis of waveform shape is an indicator of airway obstruction/hypopneas, abnormal ventilatory patterns (hypo/hyperventilation), and as a diagnostic indicator for diseases with airway constriction.[1] Usage has become the standard of care for monitoring ventilation in anesthetized patients in the Operating Room (OR) and is commonplace in the Intensive Care Unit (ICU) for intubated patients. Since the commercialization of sidestream capnography technology and non-invasive exhaled CO_2 oral/nasal sampling interfaces, the use of non-intubated capnography has expanded outside of the OR and ICU into environments of the hospital where caregivers may be less familiar with these monitors (e.g., Procedural Sedation, Patient Controlled Analgesia, Emergency Department, and General Floor).

The alarm settings on these monitors are important and have the potential to prevent untoward events and even deaths by alerting caregivers to dangerous situations such as apnea and significant changes in CO_2 levels. However, excessive alarms including clinically-irrelevant alarms ('nuisance alarms' or false-positive alarms created by artifact) have been shown to desensitize caregivers to clinically-significant alarms and become a threat to patient safety.[2,3,4] In addition, they are a source of aggravation to patients and family members, potentially reducing compliance with monitoring. Recently, algorithms have been developed which have been shown to significantly reduce such clinically insignificant alarms.[5,6]

Additionally, frequent non-clinical alarms may be created by inappropriately setting alarm limits at levels too close to normal ranges. Literature on how best to set alarm limits currently used is lacking. Our goal was to survey experienced users of capnography to determine the ranges of capnography alarm settings commonly used. Such information may be useful to new users in developing their own alarm limit protocols or defaults.

Methods: To conduct our survey, an invitation to participate in a survey of alarm limits was sent to a list of experienced users. Recipients were provided with a link to a web portal (SurveyMonkey.com) for completion of the survey. Those that responded were asked to enter their institutions current alarm defaults based upon the population being served (adult, pediatric, or neonatal with results of the latter two being described elsewhere). Data was compiled and analyzed (Microsoft Excel) for mean, median, mode, and the range of values for each of these populations.

Results: Twenty one experienced users responded for adult applications of capnography. Potential entry errors due to use of different measurement units (i.e., kPa versus mmHg) were confirmed with the participants and omitted if unable to confirm.

	EtCO2 High	EtCO2 Low	FiCO2 High	RR High	RR Low	No Breath (Apnea)
Mean	53.8	20.2	7.3	30.3	7.1	18.3
Median	52.5	22.5	8	29	8	20
Mode	60	30	8	30	8	20
Low	40	8	2	18	3	3
High	60	30	15	50	12	30

Conclusions: Capnography use is has expanded outside traditional use environments creating many new clinical users that may be less familiar with capnography. Having access to alarms limits from experienced users may assist new users in developing their own alarm limits settings. Each institution and ordering physician should recognize that alarm limits should be adjusted based on the population being served and specific patient needs.

References:

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