Alarm Management QA Project

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Introduction

- Alarm fatigue is a growing concern in the health care arena
  - 80 – 99% of alarms are considered nonactionable[1]
  - Desensitization decreases response rates
  - FDA reported 500 alarm-related deaths in 5 years
  - Alarms add to the noise pollution of the ICU
- Joint Commission published the need for alarm management as a Hospital National Patient Safety Goal[2]

1. Ruskin, K. Alarm Fatigue: Impacts on Patient Safety. Current Opinion. 2015

Background: Project One

- Desire to better understand how our department is setting alarm parameters
- Policy provides guidelines for setting alarms
  - Focused on lung protection
  - Pip 10-15 cm H_2O above actual
  - VT high per clinical judgment, suggested < 12 mL/kg PBW
- Prior to this QA, we have not assessed alarm settings at the departmental level for sometime

How are alarms set, related to actual measured value?

Methods

- Data gathered manually from documentation (MiChart-Epic)
- Demographics: ICU, shift, Ventilator brand, and mode
- Actual values compared to set high or low:
  - RR
  - VT
  - VE
  - Ppeak
  - Apnea
  - iNo

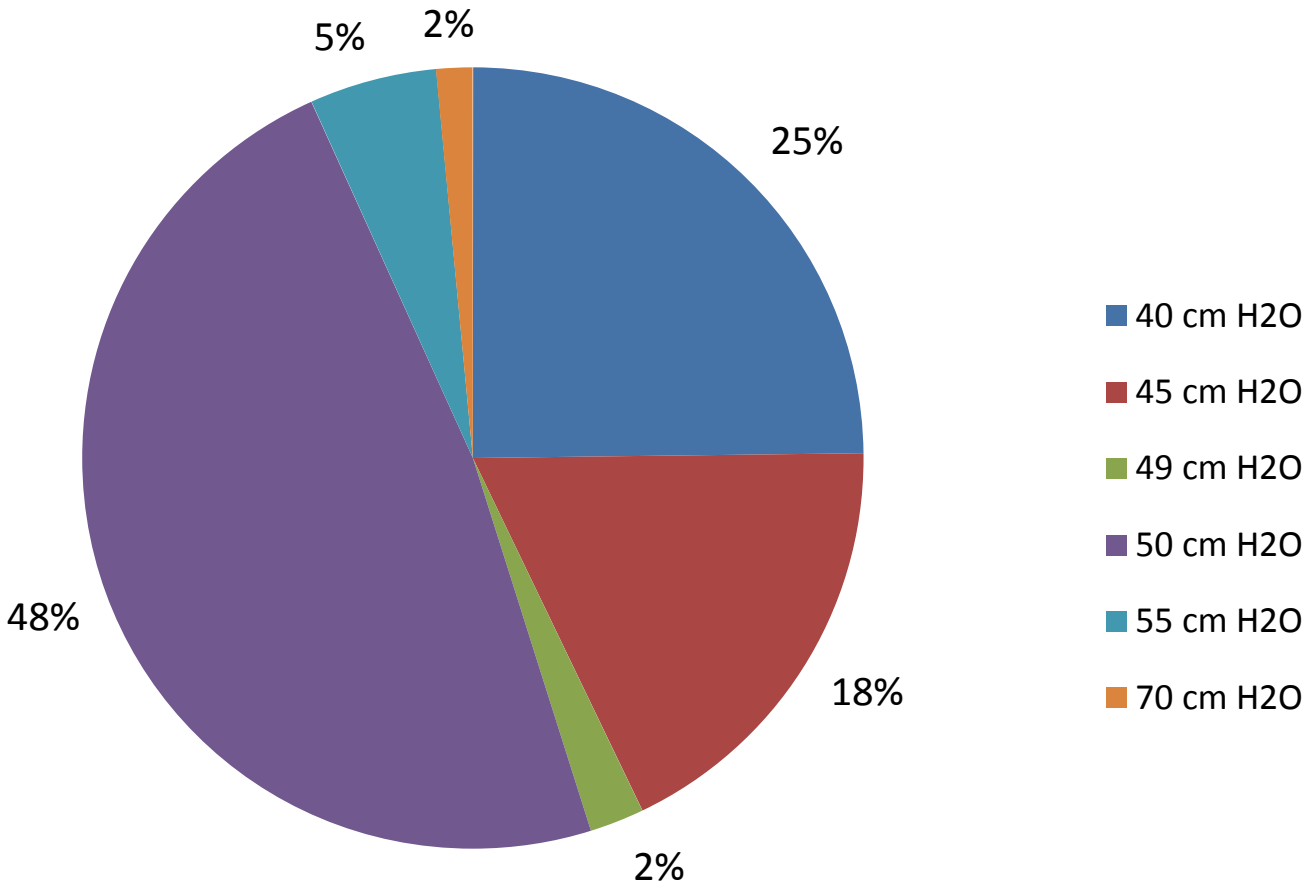
Results

Data from 45 patients was obtained,134 samples total

High Ppeak Limit:

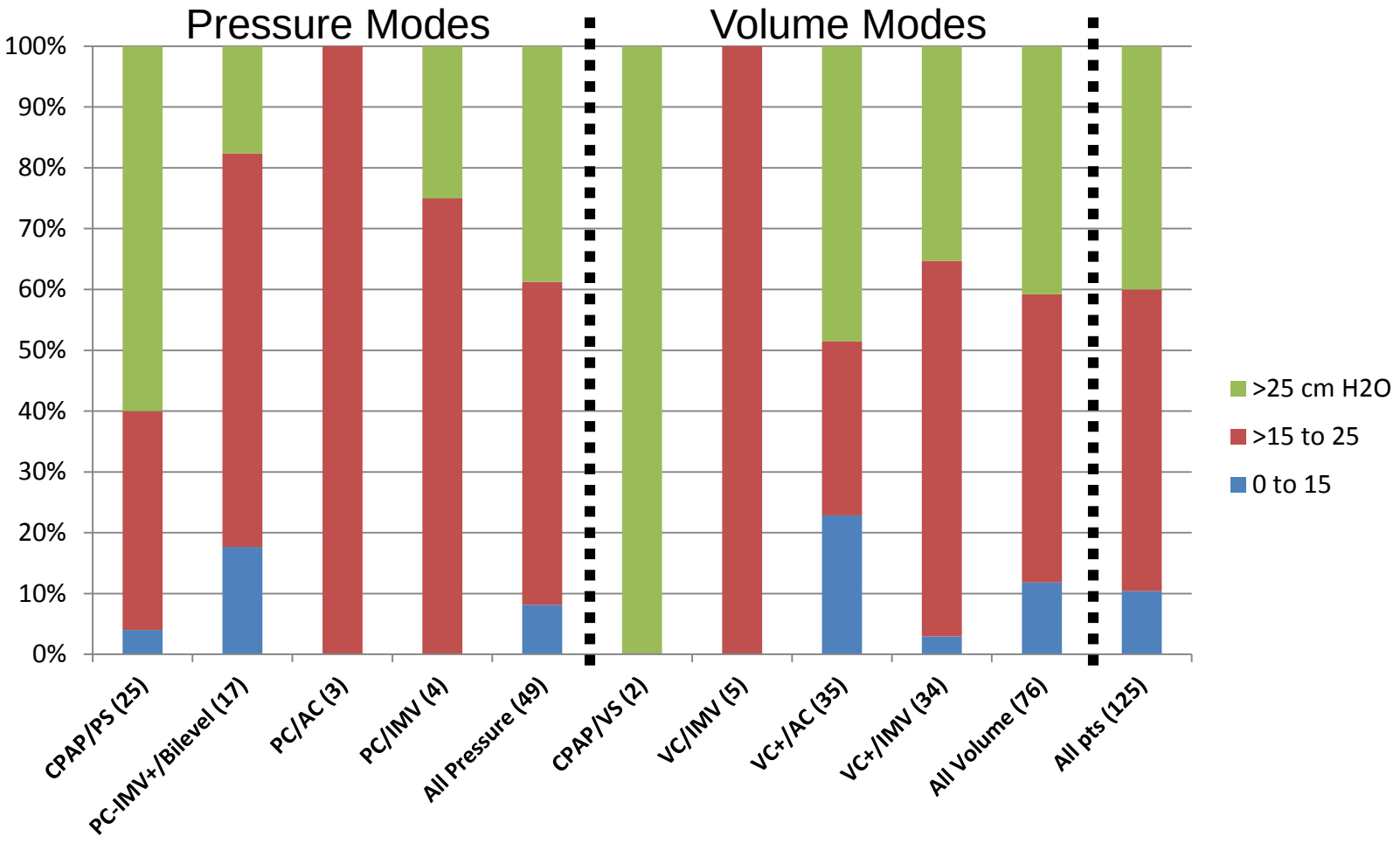
- 75% of Ppeak limits were set >40 cm H2O; 55% were set >50 cm H2O
- 90% of Ppeak limits were set >15 cm H2O above the actual Ppeak, 40% were set >25 cm H2O above, regardless of mode of ventilation
- 60% of CPAP/PS events were set >25 cm H2O above actual Ppeak

High Ppeak: Set Level



Percent of charting episodes (n=125) with high pressure alarm at a given setting (in cm H2O)

Difference in Ppeak Limit and Actual



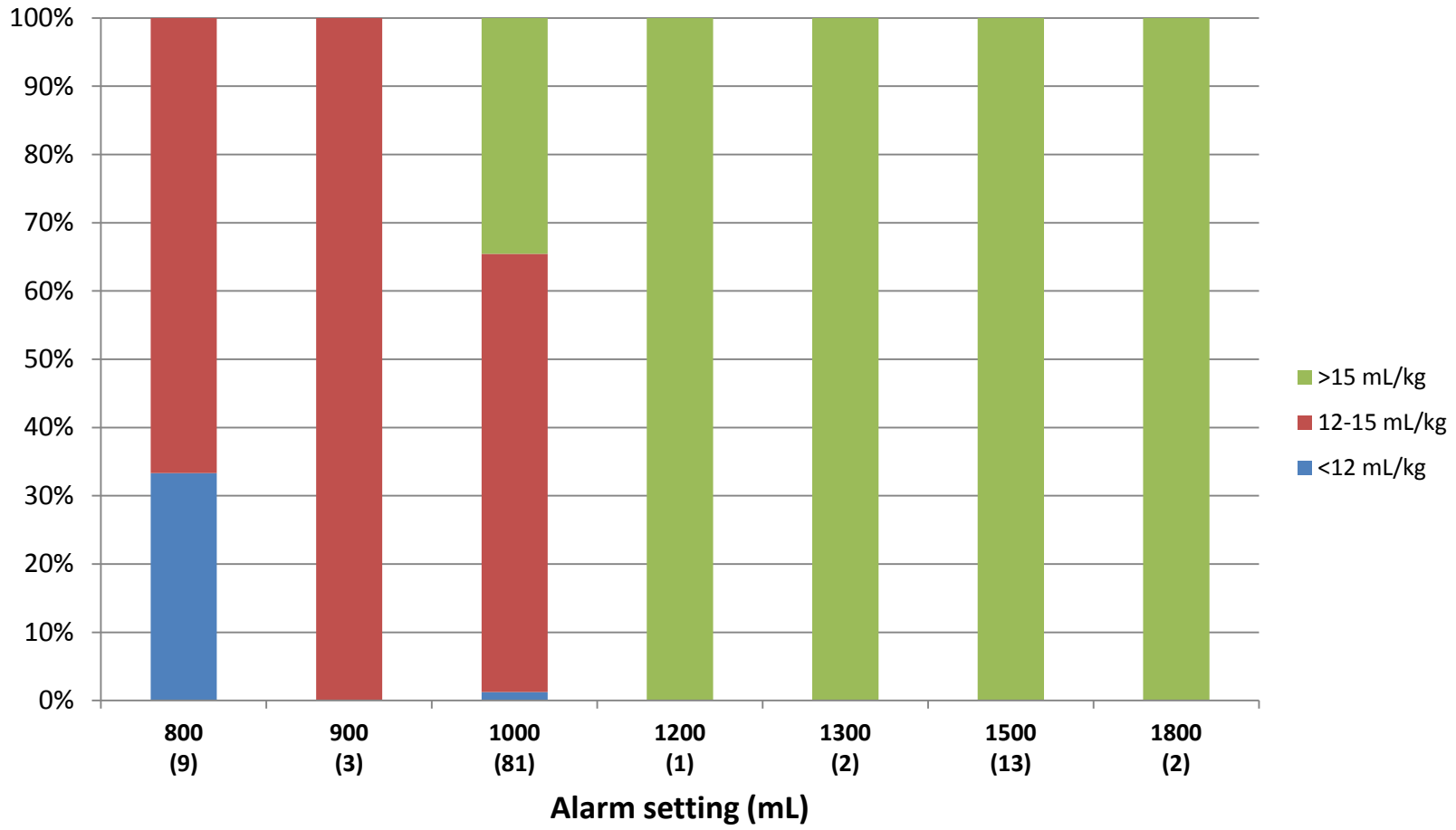
Percent of chartings with difference between set high pressure limit and actual peak pressure in various ranges (ideal generally <15), stratified by pressure and volume modes of ventilation

Results cont.

High VT Limit:

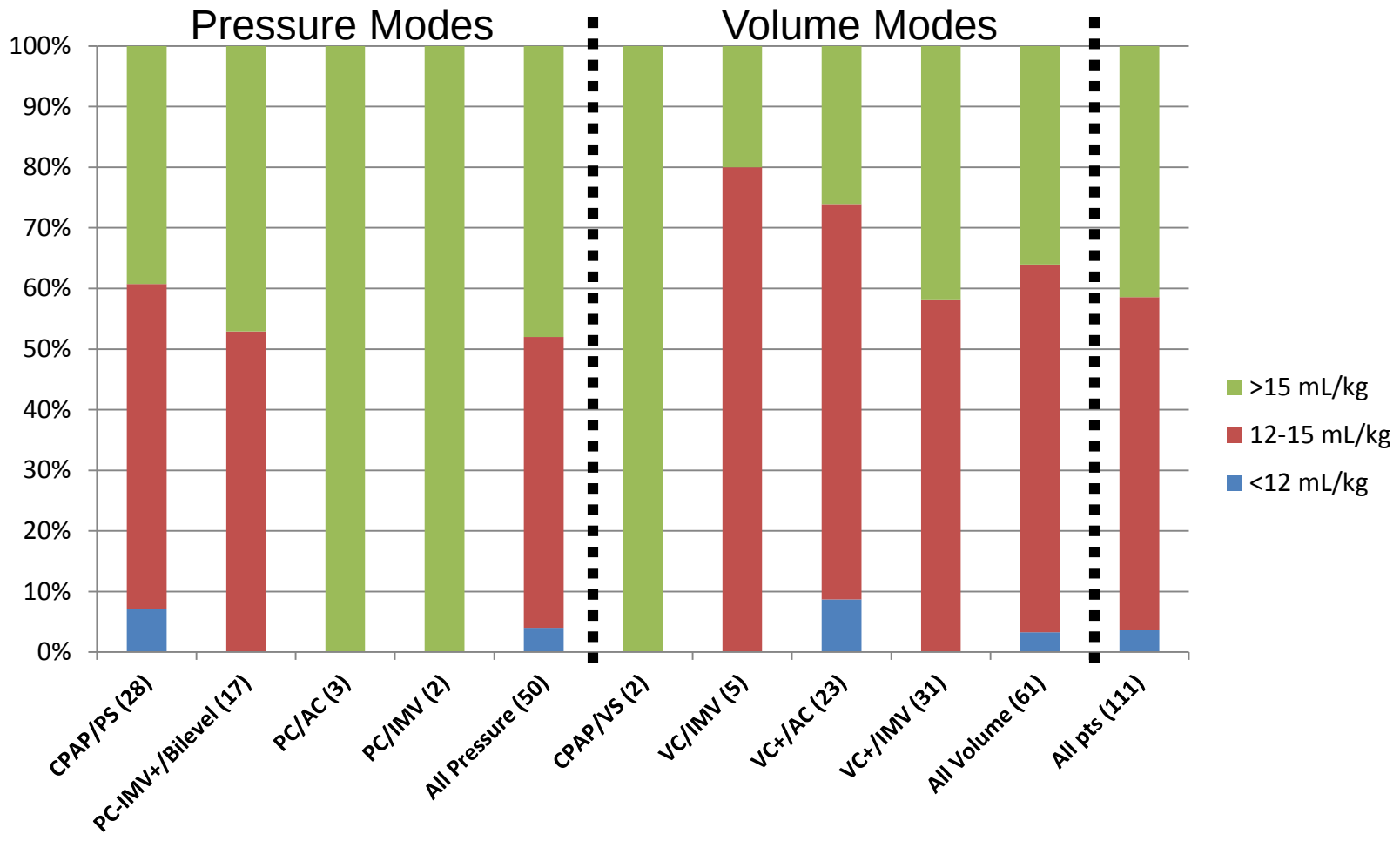
- ~73% of limits (81/111) were set to 1000 mL; 35% of these result in >15 mL/kg
- When set >1000 mL, 100% of time this is >15 mL/kg; when set to <1000 mL, 100% of time this results in <15 mL/kg
- >95% of limits are set >12 mL/kg; 42% are set >15 mL/kg
- Because VT can vary with pressure ventilation, it is important to protect against excessive ventilation, yet ~50% are set to >15 mL/kg

VT, High: Setting vs mL/kg Range



Percent of charting with high VT limit expressed as a function of mL/kg of predicted body weight, stratified by alarm (limit) setting (eg, when limit is set to 800 mL, 32% of times that reflected a limit of <12 mL/kg or when set to 1200 mL or greater, it represented >15 mL/kg)

VT, high: Indexed to mL/kg Range



Percent of chartings with high VT limit expressed as a function of ml/kg of predicted body
weight, stratified by pressure and volume modes of ventilation

Background: Project Two

- Desire to better understand what alarms are occurring and their frequency in our ICUs
- Prior to this QA, we have not assessed alarm settings at the departmental level for sometime

Which vent alarms are triggered most often, are they adjustable vs not, and what level of priority are they?

Methods

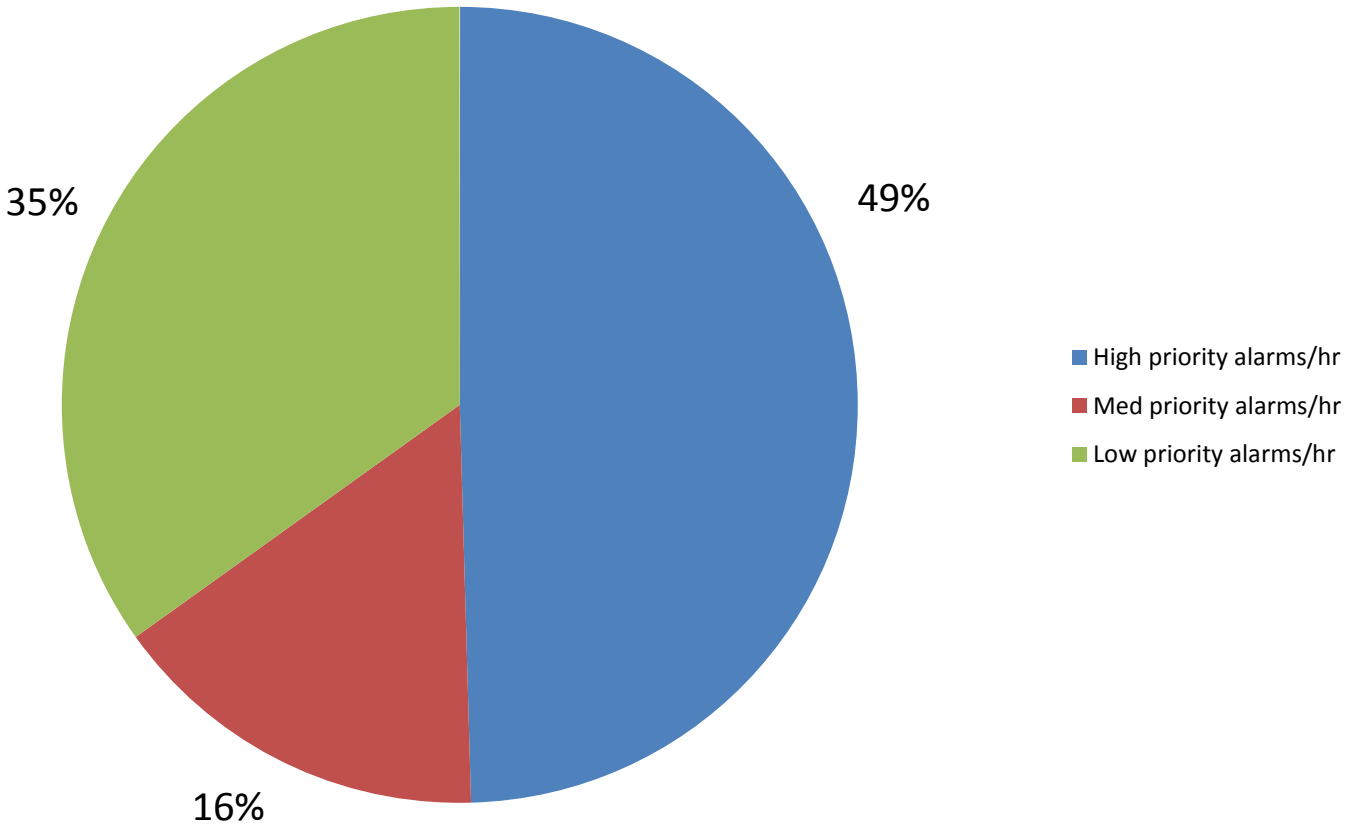
- All ICUs were ask to participate
- The 7-day trend, alarm and log data was downloaded from 41 Draeger V-500 ventilators
- Data was collected and summarized in excel
- Data was processed using SPSS

Results

41 different alarms were identified; 8 of the alarms are user adjustable, 33 are non adjustable.

- For all patients combined, an average of 76 alarms were logged per day (3.1/h); 38 (1.6/h) high priority alarms, 12 (0.5/h) medium and 26 (1.1/h) low priority.
- 20% of the alarms are user adjustable; 80% are not adjustable, although possibly influenced by management strategies
- Almost 60% of the alarms were triggered by 5 alarms:
  - Airway pressure high (1193, 16%); *adjustable*
  - Pressure limited, VT not reached (1193, 16%)
  - High PEEP (844, 11.3%)
  - Leakage (662, 8.9%)
  - VT high (508, 6.8%) *adjustable*

Priority Alarm (%)



Percent of alarm priority, for the department (41 ventilators)

Dräger Alarm Frequency per Hour

(>/= 1/hr (>.5 & <1/hr)

(Note: value represents mean number of times the alarm sounded per hour, of those with a given alarm, ie, 0.5 = 1 alarm every 2 hours, 0.2 = 1 alarm every 5 hours)

		Dept (41)
High Priority	Airway obstructed?	0.15
	* Airway pressure high	0.95
	* Airway pressure low	0.08
	Airway pressure negative	0.04
	Apnea	0.02
	Battery discharged	0.01
	Battery low	0.02
	CO_2 measurement failed	0.71
	CO_2 sensor	0.16
	CO_2 zero calibration?	0.02
	Disconnection?	0.19
	* CO_2 high	0.32
	* $etCO_2$ low	0.30
	Flow sensor? Ventilation impaired	0.04
	* MV high	0.06
	* MV low	0.10
	No O2 supply	0.12
	PEEP low	0.04
	Respiratory rate high	0.19
	Standby mode activated	0.08
Medium Priority	Apnea Ventilation	0.07
	Battery activated	0.14
	Check CO_2 cuvette	0.87
	Flow measurement inaccurate	0.05
	Nebulizer uses Air only	0.01
	PEEP high (Med P)	0.45
	Perform device & circuit check	0.02
	Pressure measurement inaccurate	0.04
	Rotary knob stuck or pressed too long	0.01
	* VT high	0.19
	VT high (minimum pressure)	0.42
	* VT low	0.03
Low Priority	Air supply low, GS500 active	0.08
	Continuous nebulization activated	0.06
	Leakage	0.20
	MEDIBUS communication failed	0.05
	Nebulization finished	0.05
	Pressure limited	4.03
	Pressure limited! VT not reached	1.04
	Suction maneuver overused?	0.07
	VT not reached	0.15

* User adjustable alarm

Limitations

- Small sample size
- Limited to the V500 for downloads
- Limited to 7 days of data

Conclusion

- The Ppeak high and VT high limits should be adjusted downward when indicated to meet patient safety standards
- Need to find a balance of safe settings and nonactionable alarms
- Educate staff on the importance of safe alarm settings
- A drill down into specific cases is necessary to identify management practices that might reduce alarms
- On the V-500 a majority of alarms are not adjustable
- General alarm settings may not be ideal for all