CapnoBase: Signal database and tools to collect, share and annotate respiratory signals

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Introduction

» The development of robust algorithms for the processing of biomedical signals requires high resolution signals.

» For algorithm tuning and validation, large datasets containing annotated clinical scenarios are required.

» Rare respiratory events during anesthesia can be difficult to obtain.

» The collection and annotation of data is very time consuming.

» The comparative performance of an algorithm can only be assessed using a benchmark dataset.

» ***There is currently no public benchmarking dataset for respiratory signal analysis available.***

» **CapnoBase** is a collaborative research project.

» It provides easy to use research tools

» A database of annotated respiratory signals including a benchmark dataset is provided to the research community.

Methods

» An **in-vivo data set** was recorded during 59 pediatric and 35 adult surgeries at the British Columbia Children's Hospital and St. Paul's Hospital, Vancouver.

» CO_2 gas concentration (pCO2), gas flow and gas pressure signals from ventilated and spontaneously breathing subjects were obtained.

» All signals were sampled at 25 Hz and recorded at 300 Hz.

» Segments of special interest were extracted from the cases.

» A **simulated data set** was generated with a mathematical computer model of the human cardio-respiratory system [1].
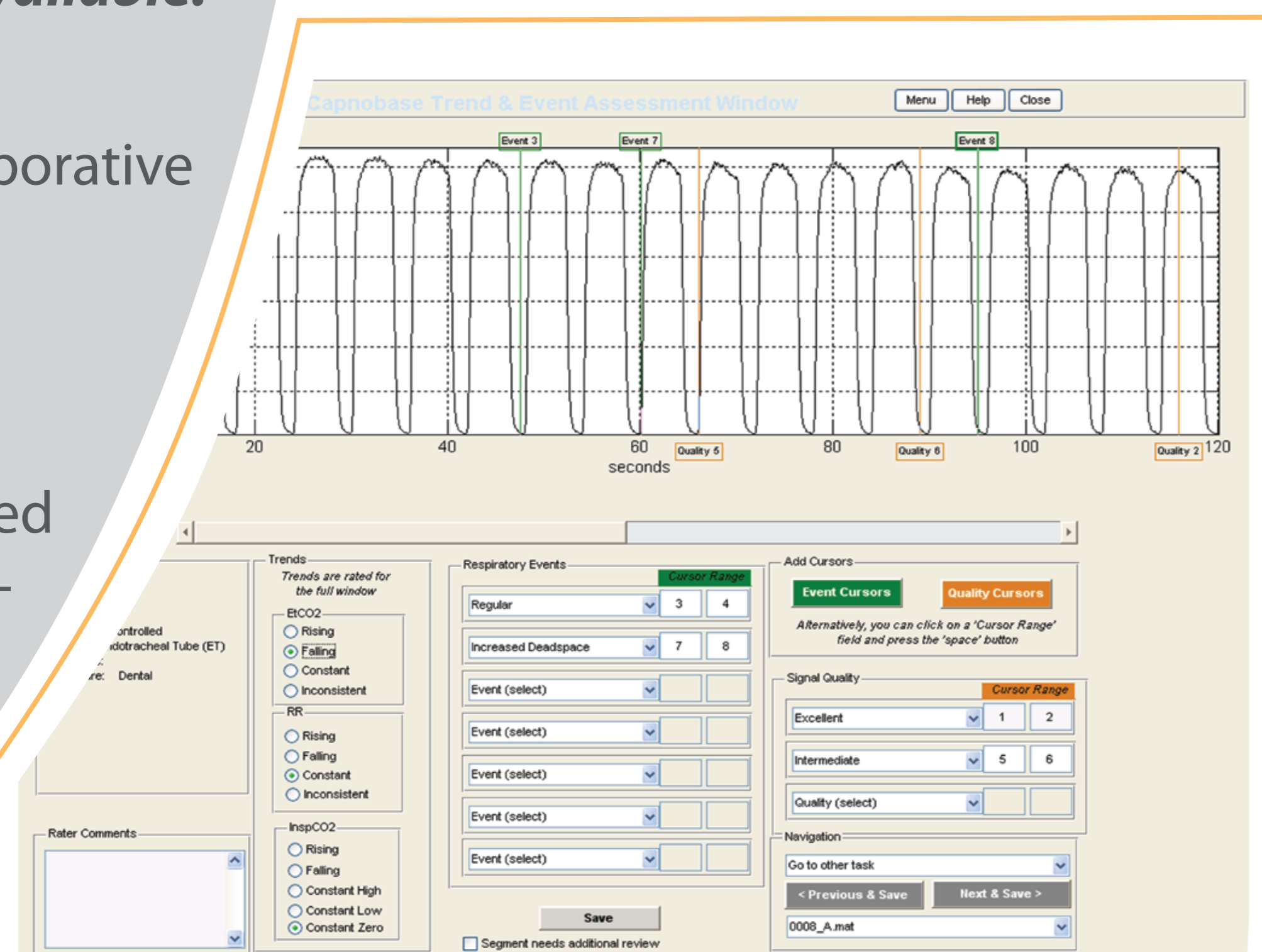
» Different ventilated patient conditions were simulated.

Figure 2: The online database allows users to easily search for scenarios of interest and download the data sets.

» We developed GUI **software tools** to evaluate and annotate the respiratory signals (Figure 1).

» The pCO2 and flow signals were aligned by an expert.

» The EtCO2, inspiratory pCO2, and the start of inspiration and expiration for each breath were annotated.

» Segments were evaluated independently by two anesthesiologists

» Trends in the signal, special clinical events and the quality of the individual capnogram shapes were identified.
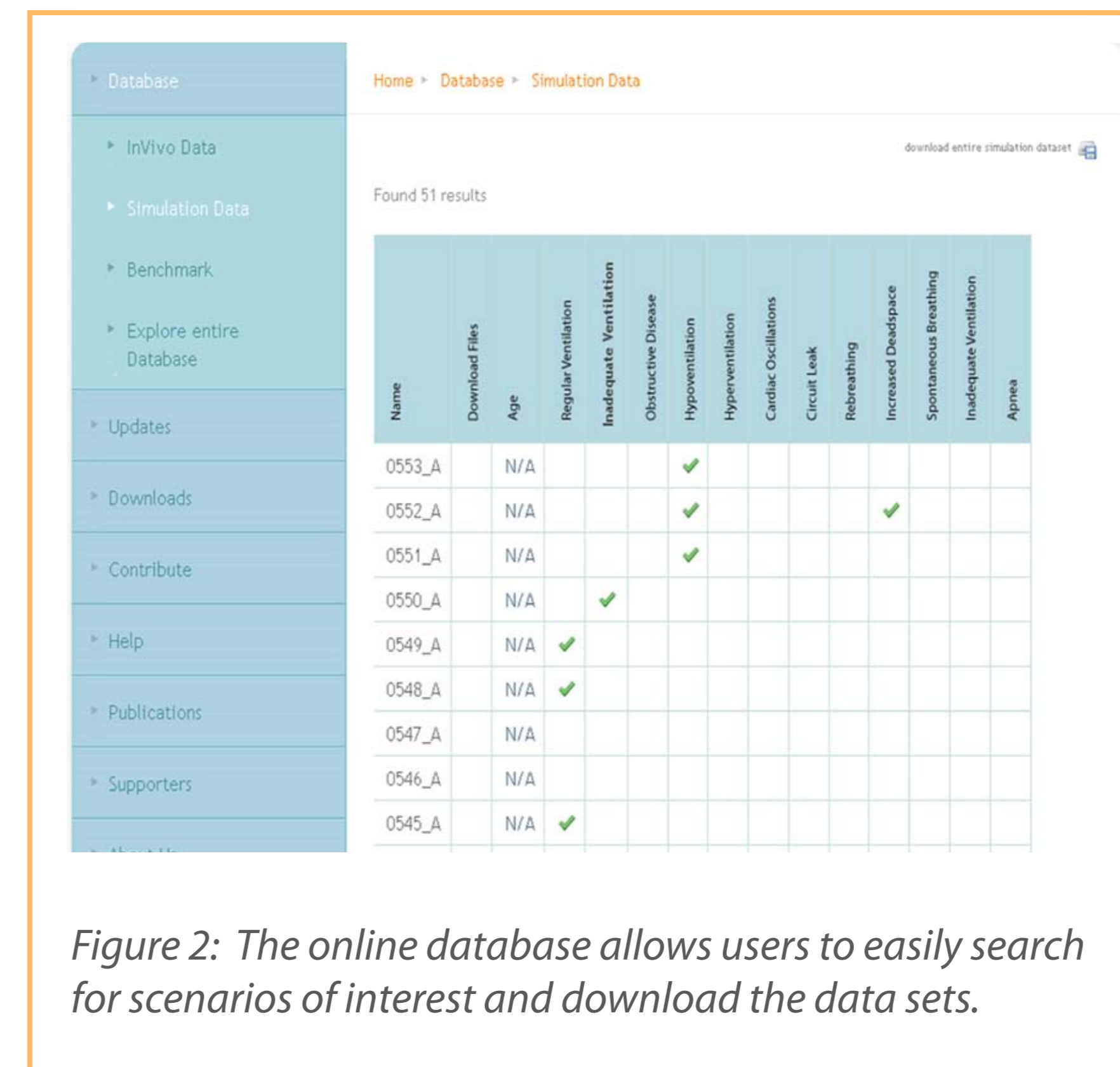

Figure 1: The Matlab GUI software tool permits researchers to annotate data.

Results

» A set of 50 simulated and 190 in-vivo signal segments of at least 2 minutes in length were rated and included in the database.

» Forty-four in-vivo cases were selected to build a benchmark data set.

» The cases contain observable events such as cardiac oscillations, apnea, hypo- and hyperventilation, rebreathing, change to spontaneous breathing and change in tidal volume or respiratory rate (Table 1).

» The data sets are available and searchable online at www.capnobase.org (Figure 2).

	total segments	apnea	hypoventilation	hyperventilation	rebreathing	cardiac oscillations	increased deadspace	obstructive desease	change to spontaneous breathing
in-vivo	146	c	c	c	c	c	0	0	0
simulation	50	0	17	0	0	2	3	0	0
benchmark	44	c	c	c	c	c	0	0	0

Table 1: Distribution of scenarios in the 3 different data sets.

Conclusion

» A web platform www.capnobase.org to foster collaboration between researchers developing algorithms for respiratory signal analysis has been developed.

» Participation of other researchers is keenly anticipated.

» The benchmark datasets will allow for comparative performance analysis of a range of different algorithms.

» The complete database and the evaluation tools are available for students and the wider research community.

Acknowledgements

References

[1] Tang, Y., Turner, M.J. & Baker, A.B. Effects of alveolar dead-space, shunt and V/Q distribution on respiratory dead-space measurements. *British journal of anaesthesia* 95, 538-48 (2005).