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Analysis of "Big Data" obtained from neonatal ventilators using the Python computer language

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Background

- Mechanical ventilation remains an important therapy in neonatal intensive care, large neonatal units ventilate ~1500-2000 days yearly
- Modern ventilators contain powerful computers which measure, calculate and display many respiratory parameters
- Clinicians frequently ignore data and trends displayed by ventilators
- Ventilator data are not routinely stored

Objectives

- To collect ventilator data at high sampling rate and analyse them computationally
- To provide the clinician with ***simple*** indicators of ventilation and ventilator-patient interaction

Data Collection

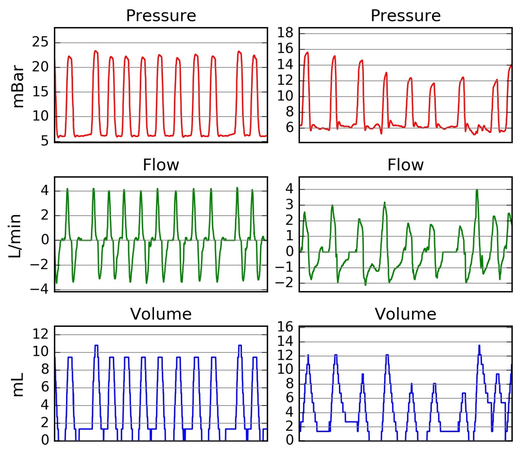
- Service evaluation to assess ventilator settings and alarms
- Downloaded ~160 days of ventilator data from 60 ventilated neonates' Recordings were >24 hours, usually 2-4 days
- Sampling rate was 100 Hz (100 / second)
- Collected **over 1.3 billion data points**
- Data were stored as .csv files, ~650 Mbyte data / 24 hours

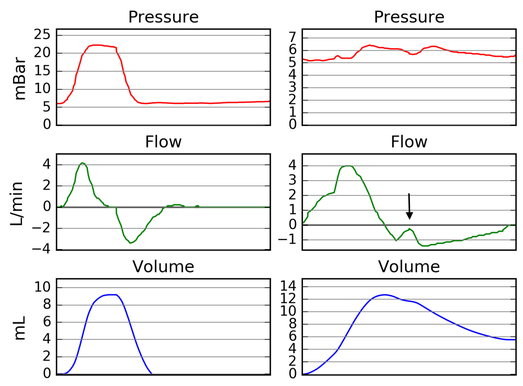
Data Analysis

Data Analysis was performed using the Python programming language and its data analysis packages

Application

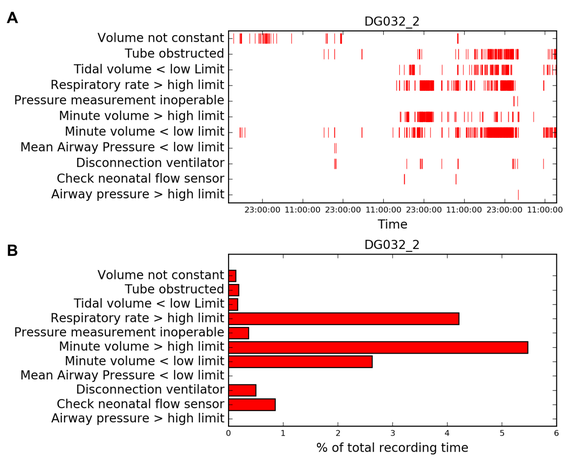
- The downloaded and stored data can be used to fully reconstitute ventilator waveforms and loops at any time during the recording.
- The quality of ventilatory management can be assessed during case reviews.
- Individual breaths and patient-ventilator interactions can be studied.

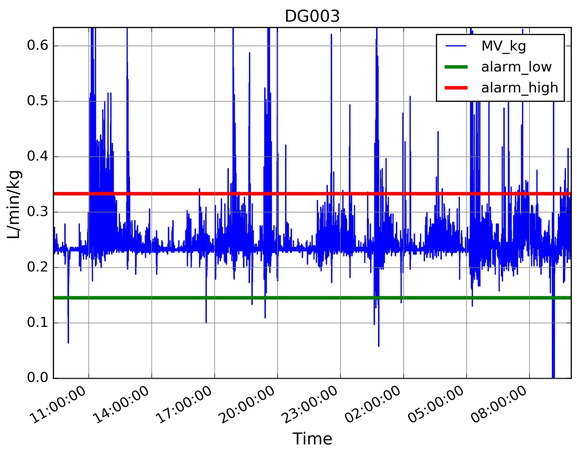




Application

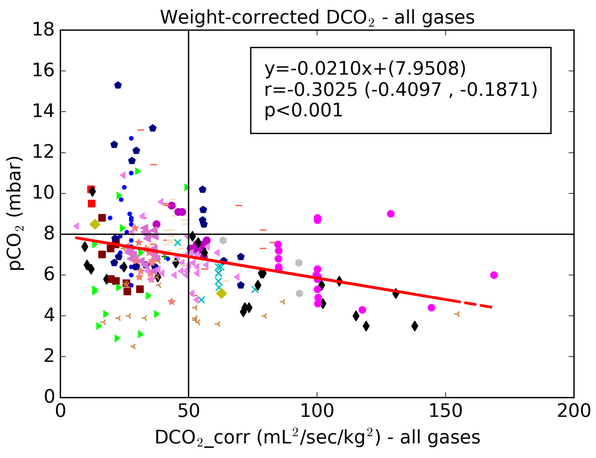
- Ventilators alarm frequently. Inappropriate settings and ignored alarms represent a risk for patient safety.
- The frequency and duration of alarm events can be retrieved from the data.
- What are the causes of frequent alarms?
- How quickly are alarms responded to by staff?

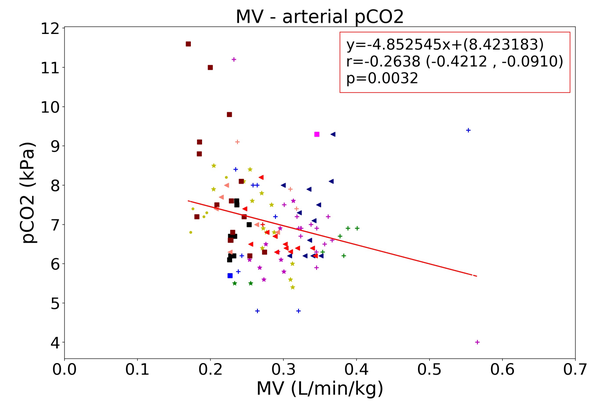




Application

- What is the relationship between ventilator parameters and physiologic variables such as blood gases?
- How to set and change the ventilator settings to ensure normal blood gases?





References

1. McKinney W. *Python for Data Analysis*, 2nd Edition, O'Reilly, 2017
2. Belteki G, Lin B & Morley C. Weight-correction of carbon dioxide diffusion coefficient (DCO_2) reduces its inter-individual variability and improves its correlation with blood carbon dioxide levels in neonates receiving high-frequency oscillatory ventilation. *Pediatric Pulmonology,* accepted for publication