2014/2015 Summer Studentship Project Application Form

Send to: Research Office, University of Otago Christchurch, PO Box 4345, Christchurch, by 3pm on **4 July** 2014

Supervisor Information (First named supervisor will be the contact):	
Supervisor's Name(s): Assoc Prof GM Shaw (CDHB, UOC), Prof JG Chase (Univ of Canterbury)	
Department: Intensive Care	Institution: Christchurch Hosp, UOC
Phone: Department: 364 1077 Mobile : 021 619 686	E-mail: geoff.shaw@cdhb.health.nz
Mailing Address: C/- Department of Intensive Care, Christchurch Hospital PO Box 8014, Christchurch	

Research Category (Choose one category only – to be used for judging the students' presentations):		
Clinical ✓		

Project Title (20 words MAXIMUM):

Optimising PEEP in mechanically ventilated patients

Project Description:

AIM: This study aims to improve care of mechanically ventilated patients in the intensive care unit (ICU) by providing clinicians with clear information about the condition of patient's lungs. The primary objective of this investigation is to recommend the best ventilator settings to maximise lung volume. This information is not available on any modern ventilator. It is our intention to model the lungs using mathematical methods to better inform intensive care clinicians about the lung condition, and how this evolves over time, so ventilation can be optimised.

Methods: This feasibility study will assess the impact of real-time pulmonary elastance "lung stiffness" model being developed and implemented in the Christchurch Hospital ICU. The optimal PEEP is where respiratory system elastance is lowest, but this metric is not available on conventional ventilators. This tool will be used to inform clinician decisions made at the bedside regarding the optimal pressures to ventilate a patient with acute respiratory distress syndrome (ARDS). This study is a first pilot study run to begin a proposed interventional study (ethics application in progress) and will seek to recruit up to 50 patients with mild, moderate, or severe ARDS. The interventions described below will test responses of the lung when it is ventilated at different levels of positive end expiratory pressure (PEEP) to determine the best ventilator settings specific to each patient at a particular time.

Clinical trial: (Student participation 8 weeks, Ethics filed in July 2014 will be ready for summer)

Inclusion Criteria:

1. Patient on mechanical ventilation.
2. Patients diagnosed with all degrees of ARDS (PF ratio <300) as per the Berlin Definition (2012) (The ARDS Definition Task Force, A. 2012), by intensive care clinicians.
3. Arterial line in situ.

Exclusion criteria:

1. Patients who are likely to be discontinued from MV within 24 hours.
2. Patients aged less than 16.
3. Patients who are moribund and/or not expected to survive for more than 72 hours.
4. Patients whose care could be compromised if given increased sedation and/or muscle relaxants for the purpose of assessing lung recruitment.
5. Lack of clinical equipoise by ICU medical staff managing the patient.

Protocol

Initial recruitment and calibration process is as follows:

1. A staircase recruitment manoeuvre (RM) is performed PEEP is increased in steps of 5cmH2O from a base level of 5cmH2O PEEP until peak airway pressure (PIP) reaches a limit of 55cmH2O (or lower, if clinician feels this is too high for the patient)
2. Each PEEP is maintained for 10-15 breathing cycles before a subsequent increase.
3. Elastance (Edrs Area and Median Edrs) is calculated at each PEEP
4. The minimum elastance PEEP is determined and recommended to the beside clinician

5. If the clinician feels this PEEP is appropriate, they will re-perform steps 1 and 2. PEEP, but only reducing PEEP to the recommended level

Model Adjustment:

Every 3 hours or when the patient is turned in the bed the following adjustments to the PEEP level will be made to determine the minimum elastance. As the patient's condition improves both the optimal PEEP and elastance will fall

Data recorded

Demographics

1. Patient Gender, height, weight and ethnicity
2. Primary Patient diagnosis contributing to ARDS/inhibited lung function in the patient.
3. Secondary Patient diagnosis contributing to ARDS or impaired inhibited lung function

Physiological data

1. Airway pressure - For estimating dynamic elastance
2. Air flow - For estimating dynamic elastance
3. FiO2 (Inspired oxygen concentration), PaO_2,SpO_2 - For recording desaturation events
4. Blood Pressure, Heart Rate
5. End Tidal CO_2, PCO_2
6. Patient position - To account for data variation that results from patient position varying

Outcome measurements

1. Length of MV and patient outcome – As an indicator of long term condition of the patient
2. Amount of sedation – To account for possible data variation resulting from different sedatives

Analysis: **(Student participation 2 weeks)**

1. Clinician compliance with recommendations
2. Oxygen "dose". (Level of inspired oxygen x time)
3. Frequency and severity of destaurations (temporary lack of oxygen)
4. Length of mechanical ventilation and ICU stay
5. Statistical comparisons of performance using non-parametric statistical tests (e.g. Wilcoxon and Mann-Whitney). All performance distributions will be reported as non-parametric values (median, IQR, 90%CI).
6. Descriptive statistics to describe the magnitudes of pulmonary elastance and variability in specific cohorts

Significance: Mechanical ventilation (MV) is applied to over 50% of patients and is, in itself, associated with reduced outcome. The cost of a MV patient is approximately twice as costly as any other critical care patient. Reductions in length of mechanical ventilation and length of stay offer significant potential reductions in cost, and improvement in outcomes. This prospective evaluation will help determine the effect size to power a proper randomized trial. The potential of model-based therapeutics to improve care will thus be realised by this clinical interventional trial. This project will extend our capability to provide world class care in an area of clinical importance, while also providing a leading research and clinical experience for the student scholar.

Expectations: The student will be exposed to methods and practice of basic research and clinical practice pilot study design He/she will be involved in the collection of data, provision of care, and decision making and will thus have experience of a wide range of clinical data. They will also assist with statistical methods to verify the results.

Their work will form part of a larger research programme carried out by senior academic staff (Prof JG Chase), Masters and PhD students from the University of Canterbury, and Assoc Prof GM Shaw from ICU. Results from this work will be published in appropriate medical and biomedical engineering journals.

Timeframe: Ideally the student will be involved in all clinical work and training, as well as in data analysis. The first 8 weeks will provide supervised, hands-on, experience of an interventional study in critically ill patients. This will be followed by analysis to determine the safety and performance of the resulting more optimised approach. Data analysis and documentation of results will take another 2 weeks at the end.