CLINICAL PREDICTORS OF DURATION OF MECHANICAL VENTILATION IN THE ICU

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OBJECTIVES

- To discuss some of the factors that may predict duration of invasive mechanical ventilation in the ICU and propose a model to quantify their effects using the McMaster ICU database.
- To discuss methodological issues relating to examination of this question.
Primary Research Objective:
- To identify the patient and institutional factors influencing duration of mechanical ventilation in patients admitted to the ICU. These will be compared with previously published literature.

Secondary Objectives:
- To quantify mechanical ventilation practices in the four ICUs affiliated with the McMaster Critical Care Division.
- To identify temporal trends in the practice of mechanical ventilation.
- To evaluate the outcomes of mechanical ventilation.
BACKGROUND – MECHANICAL VENTILATION

- Developed in the 1950s for treatment of polio patients
- Resulted in ARR in mortality of 70% within this population
Value of grouping high-needs patients together for intensive care recognized; “respiratory intensive care units” established in US and Europe

Johns Hopkins Bayview Medical Center became the first multidisciplinary intensive care unit (ICU) in the United States in 1958.

First ICU covered by an in-house physician (anesthesia resident) 24/7.
Today
- Complex patients
- Aging population that we are keeping alive longer
- Advancing technology
- New ventilatory modes and strategies

Patients receiving mechanical ventilation:
- 3% of all acute care hospitalizations
- 30% of all ICU admissions
- Incidence increasing
CURRENT ISSUES

- Mechanical ventilation is costly
  - High resource needs
  - Increasing incidence
  - Associated poor outcomes

- $27 billion == 12% of annual health care costs in the US

- Prolonged mechanical ventilation (PMV) (>6 hours/day for > 21 days) especially problematic
  - Greater costs
  - Elevated morbidity and mortality
  - Decreased quality of life
  - Neurocognitive dysfunction
  - Increased caregiver burden

- 24% of survivors of PMV state that they would not have chosen mechanical ventilation had they been capable of making the decision
PREDICTION OF DURATION OF MECHANICAL VENTILATION – WHY?

- Resource optimization
- Clinical trials design
- Establishing ICU goals of care
- Facilitating surrogate decision-making
No evidence-based predictors

Many studies but these lack generalizability
- Variable definition of PMV
- Specific patient populations and settings

Limited predictive value in:
- Shock on ICU admission day 1
- Changes in serum albumin
- Lung Injury Score (LIS) $\geq 1$
Largest study by Seneff et al prospectively examined 5195 medical and surgical patients within the APACHE III database.

Contribution of patient and disease-related variables to duration of MV used to develop a predictive equation.

When applied, this accounted for 60% of patient variability; remainder attributed to institutional factors.

Study weaknesses:
- Non-consecutively admitted patients
- CABG, MI and burn patients excluded
- Patients only included if intubated on admission day 1
- MV data only collected up to day 7; ventilation beyond this time inferred by equation.
Primary Research Objective:

- To identify the patient and institutional factors influencing duration of mechanical ventilation in patients admitted to Hamilton region ICUs. These will be compared with previously published literature.
Secondary Objectives:

- To quantify mechanical ventilation practices in the four ICUs affiliated with the McMaster Critical Care Division.
- To identify temporal trends in the practice of mechanical ventilation.
- To evaluate the outcomes of mechanical ventilation.
McMaster Critical Care Program maintained a database of all patients admitted to the four Hamilton region ICUs from 2001-2008.

Contains information pertaining to mechanical ventilation, as well as ventilatory modes and settings, throughout the ICU admission for every admitted patient.

Includes admission details, 1°/2° diagnoses, comorbidities, invasive interventions and admission physiology.
Inclusion Criteria:
- All patients admitted to the 4 Hamilton region ICUs from 2001 – 2008

Exclusion Criteria:
- Age <17 years old
- Dependency on MV prior to admission ICU admission
- Transfer from an ICU outside of the Hamilton region during a single admission
- Transfer to an ICU outside of the Hamilton region prior to cessation of mechanical ventilation
- Admission to the ICU for ≤ 12 hours
To identify factors predictive of duration of invasive mechanical ventilation in ICU patients.

Outcome: Duration of initial period of invasive mechanical ventilation (number of hours from the time mechanical ventilation was first initiated during a given ICU admission to the time it was discontinued for >48 hours).

Analyses: Multivariable quantile regression model, with examination of the 20th, 50th and 80th percentiles
1. To quantify mechanical ventilation practices in the four ICUs affiliated with the McMaster Critical Care Division.

- **Outcome:**
The following will be quantified for all patients meeting inclusion criteria:
- frequency of invasive and noninvasive MV
- duration of MV
- ventilatory settings used
- use of complementary interventions
- need for reintubation after extubation.

- **Analyses:**
  - descriptive statistics, including mean, median and standard deviation
  - data from each ICU included in study will be compared using the appropriate statistical test
2. To identify temporal trends in practice of invasive mechanical ventilation.

- Outcome: The relation of year of admission to duration of mechanical ventilation, ventilatory settings used, use of complementary interventions and need for reintubation after extubation will be examined.

- Analyses:
  - descriptive statistics (mean, median, standard deviation) for each admission year from 2003 to 2010
  - comparison of parameters for all years using the appropriate statistical test
  - examination of multivariable quantile regression model with specific attention to year of admission covariate
3. To identify outcomes of mechanical ventilation.
   - **Outcome:** The relationship of duration of MV to hospital and 30-day mortality after initiation of MV will be assessed.
   - **Analyses:**
     - descriptive statistics (including mean, median and standard deviation)
     - multivariable regression
     - Cox proportional hazards ratio
To prospectively validate identified predictors
To compare the strength of identified predictors with the ability of attending physicians to predict duration of mechanical ventilation
Based on findings, to take steps towards developing a clinical tool to predict duration of mechanical ventilation in the ICU
THANKS!

- Dr. Lehana Thabane
- Toni Tidy
- Drs. Buckley and Paul