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Contents

A Case of Pheochromocytoma and the Clinical Biases Which Contributed to Misdiagnosis

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Introduction: Pheochromocytoma is a rare neuroendocrine tumour classically associated with adrenergic symptoms including palpitations, hypertension, paroxysmal headaches and diaphoresis, though clinical presentation is variable. Incidence is estimated at 0.8 per 100,000 people, however this is likely an underestimation as half of these tumours are identified at autopsy. We present a case of a previously well, 59-year-old female misdiagnosed with acute coronary syndrome during a hospital stay that ended with a fatal intracranial hemorrhage. A pheochromocytoma was found at the time of organ donation, which in retrospect, explained the patient's presentation.

Objectives: The analysis of this case will highlight the subtleties of pheochromocytoma presentation as well as sources of clinical bias which contributed to premature diagnostic closure and misdiagnosis.

Methods: Literature reviews of both atypical presentations of pheochromocytomas and clinical biases were performed using PubMed and studies were included based on their relevance to the clinical case.

Results: A multitude of case reports exist, depicting the unusual and varied presentation of a pheochromocytoma. Many of these case reports include presentations of pheochromocytomas with features of acute coronary syndrome or cardiac decompensation, however, none of these explicitly identified the cognitive bias that contributed to the missed diagnosis. Our case highlights multiple sources of diagnostic error including availability bias, framing effect, and diagnostic anchoring.

Conclusion: While presentations of pheochromocytoma are rare, they can also be subtle and cognitive biases can result in anchoring on a more common, but incorrect, diagnosis. It is important to have a high index of suspicion for pheochromocytoma as when it does exist, it is commonly missed. Furthermore, it is important to be aware of and guard against the various types of cognitive bias that impact patient outcomes.

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A Cross-Sectional Epidemiological Prevalence Survey of Patients Receiving Oxygen in a University Hospital – The "WHARF" Project

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Introduction: Oxygen (O_2) is considered to be a standard therapy for patients with acute respiratory failure. Information about how O_2 is delivered in a university hospital is scarce. We have initiated a multiphase program to improve the care of these patients called "Ward Hypoxemia and Acute Respiratory Failure (WHARF) Project" at St. Michael's Hospital (SMH). The 1st phase was a one-day prevalence survey of patients receiving O_2.

Objectives: We aimed to collect epidemiologic data of patients receiving O_2 at SMH. This included the emergency department (ED), most inpatient wards and all ICUs. We excluded the post-anesthesia care unit and the palliative care wards. We wanted to early identify the patients who will require rescue therapy and to determine the characteristics of O_2 delivery, including prevalence of hyper-oxygenation (operational criteria of $SpO_2 > 97\%$ while receiving O_2).

Methods: A specifically-designed clinical record form (CRF) was developed and reviewed by a working group. The data collected included: patients' characteristics, significant past history, reason for O_2 use, O_2 delivering devices and settings, arterial blood gas if available. On Dec 15th, 2016, 20 team members (nurses, respiratory therapists, research assistants and research fellows) went across assigned areas of SMH to collect the data. Filled CRFs were later validated and the missing data completed. We also followed up patients for 90-day hospital outcome.

Results: We screened 423 patients (ED n=38, Wards n=318, ICU n=72). Twenty-one percent of the patients were on O_2, with the highest prevalence in the ICU (42, 58%). The most common reason for O_2 use was congestive heart failure (19%) followed by pre/post-operative order, neurological conditions and pulmonary diseases. The most commonly used device was nasal prongs (54%) followed by invasive mechanical ventilators (26%). The number of patients requiring urgent consultation from the critical-care response team was only 4 out of 90 and the number of patients developing new ARDS within 7 days was 2 out of 90. At day 90, 12% of the patients had died in the hospital and 9% was still admitted. Hyper-oxygenation was common, affecting 42% of the patients. The prevalence was higher in the ICU (52% VS 37% in the wards). The median [IQR] of SpO_2 for overall patients was 97% [94-99%]. The devices causing high incidence of hyper-oxygenation were tracheostomy mask (4/4), followed by mechanical ventilators (17/23; 74%). There was no statistically significant difference between the FiO_2 set on the ventilators for those who were hyper-oxygenated and normo-oxygenated (0.40 [0.38-0.50] VS 0.40 [0.34-0.46] respectively). A secondary chart analysis indicated that ICU patients who were labelled as hyper-oxygenated spent 80% of the 24h hyper-oxygenated.

Conclusion: Hyper-oxygenation is a common problem in patients receiving O_2. The prevalence is higher in the ICU despite having more rigorous monitoring. Instability of the patients with fluctuation of the SpO_2 may influence the clinicians' decision to set higher target of SpO_2 to be on the safe side. The next phase of WHARF study will use a questionnaire to explore attitudes and decision makings of the clinicians facing various case scenario regarding O_2 management.

% of patients receiving O$_2$ by categories of locations

| No. of patients with O$_2$ (/Total) | 5/33 | 43/318 | 42/72 | 90/423 |
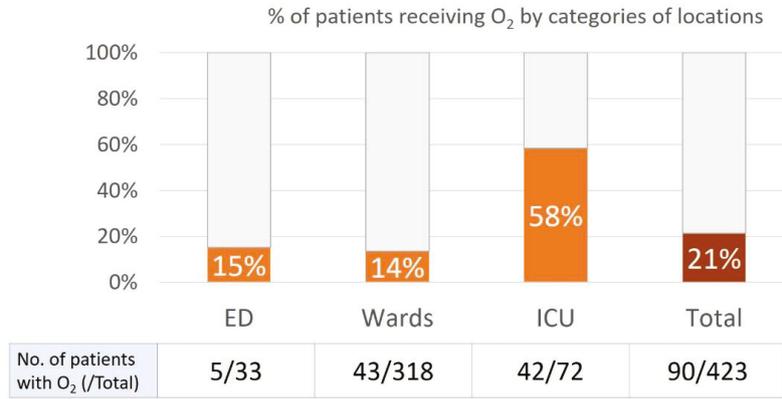
Figure 1. Prevalence of patients receiving O$_2$ therapy

Number of patients on O$_2$ with SpO$_2$ > 97%

	%ED	%ward	%ICU	%Overall
	0/5	16/43	22/42	38/90
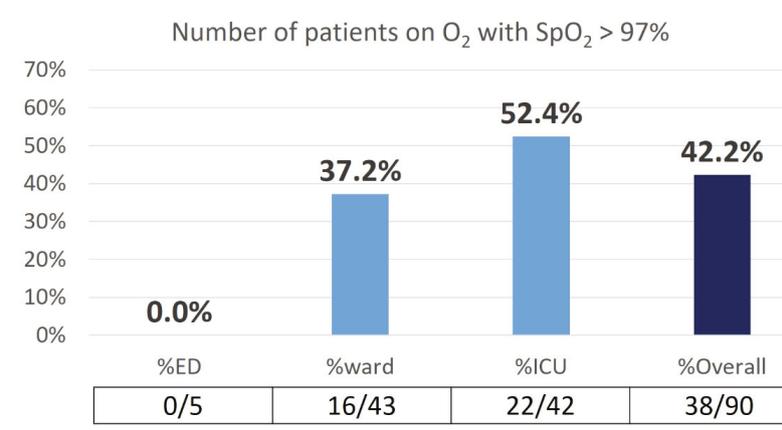
Figure 2. Prevalence of hyper-oxygenation in patients receiving O$_2$ at each location.

	ED	Ward	ICU	Overall
Median (IQR)	94.0 (91.5-95.5)	97.0 (94.0-99.0)	98.0 (95.0-99.0)	97.0 (94.0-99.0)
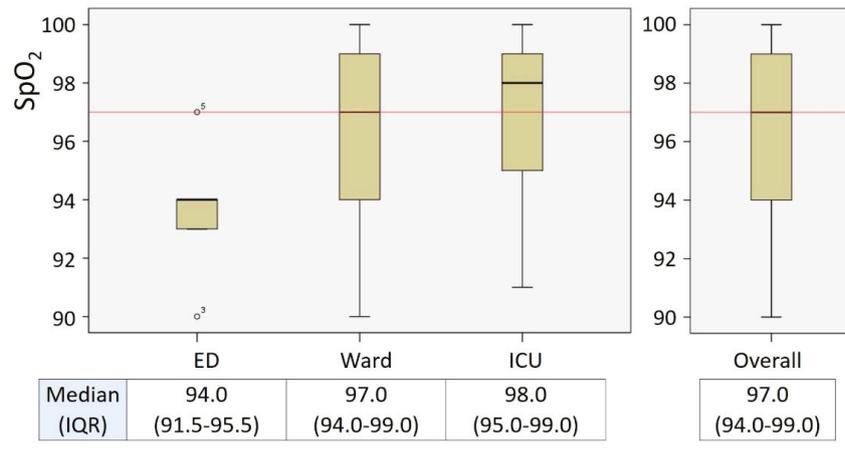
Figure 3. The measured SpO$_2$ of the patients receiving O$_2$ on the survey day. The red line demarcates the value 97%.

A Descriptive Analysis of Deferred Consent in a Study of Diaphragm Activity in Mechanically Ventilated Patients in The Intensive Care Unit (ICU)

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Introduction: Patient eligibility for research in the intensive care unit (ICU) can occur at any time of day or week. Deferred consent, consent from the patient or substitute decision-maker (SDM) after research has commenced, is a common alteration in the ICU when conducting observational research or studying low risk, time-sensitive interventions or transient phenomenon (1). Utilization of a deferred approach can overcome challenges experienced as a result of patient incapacity and SDM availability. SDMs and patients have endorsed deferred consent as an acceptable mechanism for research consent in the ICU (2, 3). Herein we describe time to deferred consent from SDMs in an observational study of diaphragm activity in mechanically ventilated patients.

Objectives: To describe consent outcomes, including timing, in an observational study of diaphragm activity in mechanically ventilated patients in the ICU.

Methods: DIVIP, Assessing Diaphragm Muscle Inactivity in Mechanically Ventilated ICU Patients, is an observational study which involves serial recording of electrical activity of the diaphragm and daily diaphragm ultrasound (NCT02434016) for up to 5 days. The first ultrasound must be performed within 24 hours of mechanical ventilation. The Research Ethics Board at St. Michael's Hospital approved the use of a deferred consent model for patient enrollment in the study and for the conduct of the first ultrasound. The research team has up to 5 days after enrollment to assess the patient for capacity and/or identify and contact an SDM (in-person or by phone) for consent for continued participation and the completion of up to 5 ultrasounds. Data from our local screening log was reviewed to identify outcomes and timing of our deferred consent approach.

Results: From April 2016 to the end of July 2017, we enrolled 29 patients into the study. Deferred consent was obtained from SDMs in 15 patients (52%). Most consents (11/15; 73%) occurred within 24 hours, allowing us to obtain the maximum number of ultrasounds in these patients. Consent for continued participation could not be obtained for 14 patients with the most common cause being no identifiable SDM (6/14; 43%), followed by patient extubation prior to consent (29%). In only one patient was the absence of consent the result of a designated SDM not being reachable within the 5-day study window. Considering all patients with an identified SDM, consent rates of 81% (13/16) and 94% (15/16) were possible with time windows of 48 hours and 5 days respectively.

Conclusion:
A deferred consent model supported patient enrollment in our observational study. For patients with identifiable SDMs, a less restrictive window to make contact permitted SDM involvement in the majority of consents. Our experience in utilizing a deferred consent approach has informed the design of consent approaches in other studies by our group and may be useful to others conducting low risk, time-sensitive research in the ICU.
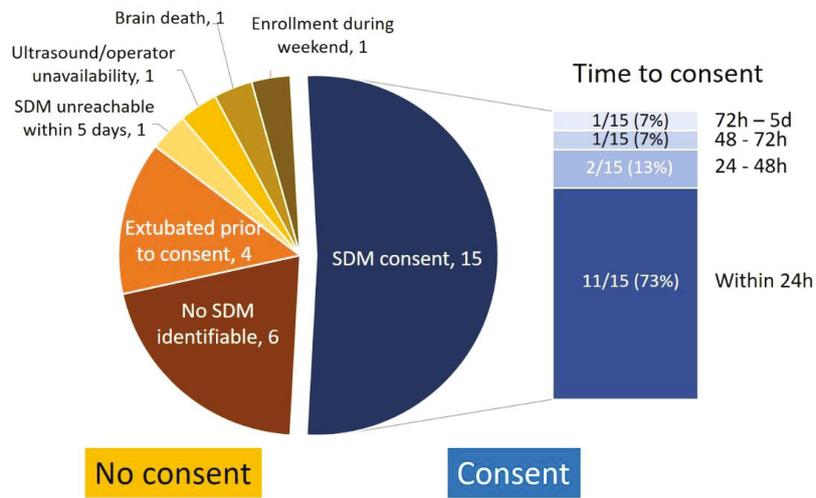
Figure1: Proportion of patients with absence of consent by different reasons compared to those with obtained consent (timing to consent was shown on the right)
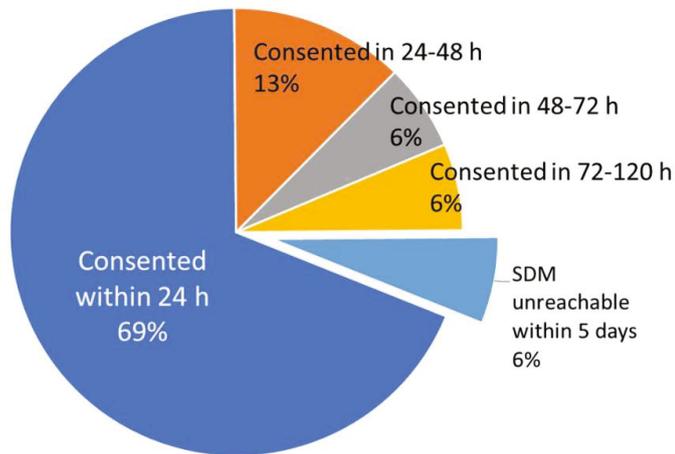
Figure2: Proportion of patients with an identifiable SDM (after excluding any other issues preventing the consent process) categorized by the timing to consent

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A Model for Assessing Impact of Graded Passive Exercise on Global Hemodynamics, Brain and Heart Perfusion in Septic Patients: Feasibility and Safety Study in Healthy Adults

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Introduction: Sepsis is a common syndrome associated with high ICU mortality and long-term complications. Despite advances in our understanding of sepsis pathophysiology, specific therapies are still lacking. Passive exercise is one potential therapy that may improve survival and long-term outcomes via the modulation of skeletal muscle blood flow (1) and distal organ perfusion (2). However, the effect of passive exercise on organ perfusion in septic patients has never been measured. Furthermore, the dose of passive exercise required to affect distal organ perfusion will likely vary among septic patients given the heterogeneity of their baseline comorbidities, exercise tolerance, and illness severity. We developed a model of graded passive exercise that can be used to study global hemodynamics, brain and heart perfusion in septic patients, and tested its feasibility and safety in a cohort of healthy adults.
Objectives: To assess the effect of a graded passive exercise model on global hemodynamics, cerebral blood flow and cardiac function in a cohort of healthy volunteers, and to test the feasibility and safety of this model prior to its application in septic patients.
Methods: We passively exercised 11 healthy volunteers using an in-bed cycle ergometer. After collecting resting baseline data, we increased the ergometer cadence from 5 rotations per minute (RPM) to 55 RPM in 10 RPM intervals each lasting 5 minutes. During each interval, we recorded continuous global hemodynamics and cerebral blood flow using the Finapres® NOVA and transcranial doppler (TCD), respectively. We also measured regional and global left ventricular (LV) function at each cadence level using speckle tracking analysis, a sensitive technique to detect changes in regional and global LV contractility.
Results: Graded passive exercise has no effect on global hemodynamics, except for a 7% increase in mean arterial pressure (MAP). There were no changes in cerebral blood flow or cardiac function. The graded passive exercise model was well tolerated by all participants.
Conclusion: In healthy adults, our model of graded passive exercise is feasible, safe and has no clinically significant impact on global hemodynamics, cerebral blood flow or cardiac function. This model can now be safely applied to septic patients.

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A Systematic Review of Non-Mortality Tools Used to Report Long-Term Outcomes in Chronically Critically Ill Patients.

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Introduction: Modern critical care medicine has improved survival among the critically ill population. Increasing number of critically ill patients survive the acute phase of illness and go on to a state of prolonged intensive care utilization and chronic critical illness. These patients experience high mortality and poor long-term outcomes.

Objective: To systematically review available literature for tools employed to report long-term outcomes in the chronically critically ill.

Methods: Literature search was performed using MEDLINE, EMBASE and Cochrane Central Register of Controlled Trials (CENTRAL). The search strategy was limited to French and English languages with no date limit to publication period. Literature review and data extraction was performed independently and crosschecked by 2 reviewers using a predefined data extraction form. Study inclusion criteria included randomized and observational study designs, conducted in participants with ≥16 years of age, admitted to an intensive care unit who received mechanical ventilation for ≥6 days with median mechanical ventilation of ≥ 14 days and or a tracheostomy for prolonged ventilation support. A snowballing process, which included relevant review articles, was carried out to identify any additional studies. We used the World Health Organization's International Classification of Functioning, Disability and Health framework to categorize the tools.

Results: Of 4877 titles screened, 23 studies, published between 1999 and 2017 were included. More than three quarters of the studies (83%) were included based on duration of mechanical ventilation being ≥ 14 days and the other 17% based on the presence of a tracheostomy. Most studies (52%) were performed in North America and where mostly cohort (69%) and single center (74%) studies. Mean age of prolonged ventilated patients ranged from 39 years to 79 years with proportion of male patients ranging from 48% to 74.4%. Mean mechanical ventilation duration reported ranged from 14 days to 45 days and ICU stay ranged from 16 days to 49 days. Outcome assessment tools differed amongst the studies: Majority of the tools were dedicated towards assessment of Tissue Impairment (51%); followed by Quality of life (27%) and Activity limitation (19%). The Medical Outcomes Study-SF-36 questionnaire being the most frequently reported tool (n=7) followed by the 6-minute-walk-test (n=4). Discharge disposition was reported in 61% of the studies and only few studies reported socio-demographic factors: family status (n= 3); education (n=4); income or employment status (n=4); race/ ethnicity (n=4). Two studies reported on Perceived Social Support.

Conclusions: Various tools have been employed to assess long-term outcomes across studies. There is a paucity of studies looking at the phases of Activity Limitations and Participation Restrictions, which inform Quality of Life. A standardized approach and more research in these phases of disablement process would enable study analysis and comparisons to help targeting of long-term patient care towards developing an outcome-oriented care propositions in this emerging patient population. The World Health Organization's International Classification of Functioning, Disability and Health could serve as a helpful framework.

Antimicrobial Resistance and Associated Interventions in Low- and Middle-Income Country Intensive Care Units: Scoping Review

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Introduction: Antimicrobial resistance (AMR) is a growing concern worldwide and is increasingly recognized in low- and middle-income countries (LMICs), particularly in intensive care units (ICUs). Several interventions may reduce the burden of AMR.
Objective: The objective of this study was to map the breadth of interventions and their impact on AMR in LMIC ICUs and identify gaps in the literature.
Methods: We conducted a scoping review according to standard methods, and searched Medline, Embase, LILACs, Africa-Wide and PAIS International databases (up to November 2016) and OpenGrey, IDEAS, UCL IRIS, Grey Literature Report, African Index Medicus, African Journals Online, Med Carib, IMSEAR, WPRIM, WHOLIS grey literature sources as well as the WHO, MSF and African Development Bank websites (up to April-May 2017). Two reviewers independently and in duplicate screened citations and selected studies that evaluated interventions to reduce AMR in LMIC ICUs and that included a historical or contemporaneous control group.
Results: We retrieved 383 articles for full text screen from 3869 de-duplicated citations from conventional databases and 17 articles from 2477 citations in grey literature sources. Out of 400 articles selected for full text review, 5 were not accessible. Ninety-four studies published between 1991 and 2016 met our inclusion criteria, of which 3 are pending translation. Non-English languages among included articles (n=10) are French, Spanish, Chinese and Turkish.
Most studies were cohort studies with a historical control group (n=50, 55%); the remainder were cohort studies with a contemporaneous control group (n=5, 6%), randomized controlled trials (n=4, 4%) and cross-over studies (n=1, 1%). We also found 31 cohort studies (34%) of outbreaks; these typically had a very short baseline control period. Studies were conducted in adult ICUs (n=29, 32%), neonatal ICUs (n=18, 20%), pediatric ICUs (n=5, 5%), combined ICUs (n=13, 14%); 26 studies (29%) did not report this information.
Of 60 non-outbreak studies, the most common interventions evaluated were hand hygiene (n=28, 47%) and infection control practices (n=27, 45%), followed by antimicrobial-related interventions (n=20, 33%), patient or healthcare worker decolonization (n=17, 28%), environmental decontamination or ICU relocation (n=9, 15%), limitation of stress ulcer prophylaxis (n=3, 5%), laboratory interventions (n=1, 2%) and other interventions (n=2, 3%). Antimicrobial-related interventions included stewardship (n=7, 12% of total), restriction (n=8, 13%) and cycling (n=1, 2%). Interventions were implemented through education (n=35, 58%); policies, guidelines, or protocols (n=19, 32%); and audit and feedback (n=15, 25%). Studies reported on microbiological-related outcomes (for example, resistance patterns; n=50, 83%), patient-related outcomes (for example, new healthcare-associated infections, n=45, 75%; mortality, n=22, 37%; ICU length of stay, n=22,

37%), process of care outcomes (for example, intervention compliance, n=24, 40%; defined daily dose of antibiotics prescribed, n=22, 37%), and costs (n=10, 17%). **Conclusion:** We found 91studies of a wide range of AMR interventions in LMIC ICUs, confirming the value of a scoping review to compile and summarize this literature. Current studies are limited by heterogeneity of design, interventions, and measured outcomes. RCTs of feasible, scalable, and generalizable interventions are required to identify optimal approaches.

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Ascertaining the Learning Needs of the Multi-professional Members of the Canadian Critical Care Trials Group: A Multimodal Survey

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Introduction: The role of the newly formed National Platform Research Coordinator (NPRC) is to support the research and academic activities of the Canadian Critical Care Trials Group (CCCTG). The NPRC is responsible for supporting CCCTG members in 4 key domains including a) core documentation resources; b) research support; c) research training and mentoring; and d) patient and family engagement in critical care.

Objective: We sought to evaluate the relative importance of activities in these 4 domains to the members of the CCCTG. This assessment will provide insight to the NPRC and the CCCTG regarding how best to support the learning needs of the multi-professional CCCTG members.

Methods: We developed a 14 item questionnaire to rate the importance of key academic activities within the aforementioned 4 domains on a scale from 1 (not important at all) to 10 (extremely important). We provided participants the opportunity to comment on additional activities not included in the questionnaire. We collected respondents' demographic data including professional affiliation(s), role within the CCCTG, and length of time in that role. Before administering the questionnaire, we pilot tested it with 6 CCCTG members and assessed its clinical sensibility. Along with the electronic version distributed via SurveyMonkey®, we administered a paper version of the questionnaire at the 2017 Winter CCCTG scientific meeting. All responses were anonymous and questionnaire completion was voluntary. The need for a full Research Ethics Board (REB) application was waived by the Hamilton Health Sciences REB.

Results: From January 2017 to July 2017, the questionnaire was distributed to 458 CCCTG members. 141 (30.8%) CCCTG members completed the questionnaire. Of the 141 respondents, 47.5% were MDs, 39.7% RCs, and 12.8% other allied health care professionals. Approximately one third of the respondents were in the first five years of their profession (38.3%) and another third for more than 15 years (31.9%). The topic of greatest importance in the 'core documentation' domain was 'maintenance of standardized operating procedures (SOPs)' (7.9/10).

The research support domain, which prioritized 'Clinical Trials Ontario' and 'REB support', received the lowest rankings (6.1-6.5/10). However, multiple respondents noted the requirement for increased REB support for members outside of Ontario. The highest-ranked activity in the 'training and mentoring' domain was 'workshops pertaining to screening and consent' (7.4/10). RNs ranked 'Good Clinical Practice and regulatory training', as well as 'manuscript/abstract writing/preparation', 0.5 points above the total averages. Junior professionals ranked 'finding a good mentor' higher by 0.7 average points than those who had been in their profession for more than 15 years.

In the domain of 'patient and family engagement', 'preparing for multisite trials' tied for the top-rating survey-wide response along with SOP maintenance (7.9/10). Respondents also felt strongly about 'engaging new members' (7.6/10) and

'integrating patient engagement into grants and research programs' (7.7/10).

Conclusion: In its role, the NPRC will focus on improving access to SOPs, developing training opportunities regarding screening and consent, building professional and community partnerships and providing research ethics support to members outside of Ontario. Finally, the NPRC should focus efforts on building mentorships between new and more experienced CCCTG members.

References:

SurveyMonkey®, Retrieved from www.surveymonkey.com

Atrial Fibrillation in Cardiothoracic Critically Ill Patients

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Introduction: Acute onset atrial fibrillation (AF) after cardiac surgery is a common dysrhythmia which causes significant morbidity and prolonged intensive care and hospital length of stay (LOS) [1].

Methods: After approval by the local Clinical Risk and Compliance unit was obtained, we retrospectively identified patients who underwent cardiothoracic surgery between January 2017 to March 2017. Adult patients undergoing coronary artery bypass grafting (CABG), valve surgery or a combination of graft and valve surgery were included. Those with pre-existing AF; heart or lung transplant recipients and patients requiring mechanical circulatory support were excluded. A total of 138 patients were included. Data collected from a retrospective review of the electronic chart system of these patients was analysed. Variables reviewed included: electrolytes and electrolyte replacement, requirement of cardiovascular support, $PaO_2:FiO_2$ ratio, whether AF prophylaxis (beta-blockers, calcium channel blockers, amiodarone) was given in accordance with NICE guidelines and their relationship with the onset of AF. Multivariate logistic regression with age and gender adjusted for, was used to assess the association between variables.

Results: Out of 138 patients, 108 (79%) were male and 30 (21%) were female. The mean age of the cohort was 65 years of age. Fifty (36%) patients developed post-operative AF. This correlated with an increased mean hospital LOS post-op compared to patients without AF, with mean LOS being twelve (7.4) and eight (4.6) days respectively ($P < 0.001$). Eighty-three (62%) patients received AF prophylaxis before surgery. Out of the 83 patients, 82 (95%) were already on anti-AF medications (beta-blockers, Calcium channel blockers and amiodarone) as part of their regular medication regimen. However, receiving AF prophylaxis was not associated with a reduction in the incidence of post-operative AF ($P < 0.32$). Hypokalemia (K < 4.0 mEq/L) was associated with a higher risk of developing post-operative new onset AF but this was not statistically significant (OR 1.52, $P< 0.53$, CI (0.4-5.7)). Perioperative acidemia (pH<7.35) was also linked with a higher risk of post-operative new onset AF but this was not significant statistically (OR 1.15, $P < 0.86$, CI (0.2 – 5.3)). Our analysis also illustrates that mild/ moderate hypoxemia (Berlin Criteria) [2] is associated with a greater chance of developing postoperative new onset AF (OR 3.99, $P < 0.00.1$, CI (1.8 – 8.7)). Out of 60 patients with mild/moderate hypoxemia, 31 went on to develop postoperative AF. The mean $PaO_2:FiO_2$ ratio in the mild/moderate hypoxemia group was 32 (5.1).

Conclusion: Our service evaluation shows a statistically significant relationship between hypoxemia and the onset of AF after cardiac surgery. This warrants further investigation and future studies to look more closely at the oxygenation targets for cardiac surgical patients. We also observed a prolonged LOS in post-op AF cohort of patients. Therefore, treating the AF efficiently and effectively in accordance with national evidence-based guidelines would likely be cost-effective in the long term. We were unable to correlate the timing of AF onset as it is poorly documented on the electronic chart system, therefore unable to assess compliance with local and national guidelines.

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Bioimpedance Measured Volume Overload Predicts Adverse Outcomes in ICU Patients

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Introduction: Indiscriminate fluid administration and attendant volume overload is associated with adverse outcomes in patients admitted to the ICU. As the clinical assessment of volume status is poor with high inter-observer variability, there is urgent need for an objective, reproducible measure of volume status. Bioelectrical impedance analysis (BIA) is a technology that provides a rapid, non-invasive measurement of TBW, ECW and ICW and thus may aid the physician in the clinical assessment of volume status.

Hypothesis: Higher ECW/TBW in mechanically ventilated ICU patients is associated with increased ventilator days, incidence of AKI requiring dialysis and in-hospital mortality at 28 days.

Methods: We included adult patients admitted to the Montreal General Hospital ICU February 2016-January 2017 who required mechanical ventilation within 24 hours of admission in a pilot study. Patients with a cardiac pacemaker or defibrillator, limb amputation and those on chronic dialysis were excluded. The BIA device was used to measure ECW/TBW on days 1, 3, 5 and 7. Briefly, this device is attached to the hands and feet via 8 electrodes and the differential impedance, depending on tissue type and water content, to a low level of applied current is measured. The normal range of ECW/TBW is 36.0-39.0%. Patients discharged home before 28 days were assumed to be alive.

Results: 36 patients were enrolled. Mean age was 62 years and 31% were female. Most patients were admitted from the emergency department or the operating room and the most common reason for admission was sepsis. Mean APACHE II score was 18.7, median ventilator days were 5 and median length of stay in ICU was 7 days. Overall, 6% of patients required dialysis and 22% died within 28 days. Day 1 ECW/TBW correlated with ventilator days (r=0.494). Patients who died had a higher day 1 ECW/TBW (41.6% vs 40.4%, p-value 0.022) as did those who required dialysis (42.0% vs 40.6%, p-value <0.001). Cumulative fluid balance and CVP did not correlate with the outcomes of this study.

Discussion: Bioimpedance technology objectively quantifies the degree of volume overload defined by ECW/TBW. Our results are consistent with existing evidence that volume overload leads to tissue edema and progressive organ dysfunction in critically ill patients. It was notable that approximately 20% of otherwise eligible patients could not be enrolled due to presence of medical equipment interfering with correct electrode placement. In addition, the BIA device requires accurate measurement of weight which is difficult to obtain in the ICU.

Conclusion: ECW/TBW is associated with adverse outcomes in mechanically ventilated patients. BIA technology may be a useful adjunct to the clinical assessment of volume status, however, there are barriers to its routine use in an ICU population. Further study is needed to determine whether BIA guided interventions improve clinical outcomes.

Characteristics and Outcomes of Cancer Patients Admitted to ICU

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Introduction: Cancer is one of the leading causes of morbidity and mortality worldwide. Some will require unplanned ICU care. The characteristics and outcomes of these patients are sometimes not well defined to treating ICU physicians, leading to inconsistent prognostication and therapeutic decisions. Some of these patients are allowed to receive advanced care despite poor prognosis leading to futile treatment and eventual mortality. However, outcome of ICU care in cancer patients have improved, which calls for a more refined triaging of cancer patients to ICU. Studies that describe the characteristics and outcomes of cancer patients is lacking in our population.

Objectives: To describe the characteristics of patients with hematological and solid cancers who require ICU admission and to review their outcomes.

Methods: We retrospectively collected data from patients with hematological and solid cancers admitted to a large academic ICU unit over a six year period (2011-2016). We excluded patients admitted electively for elective post-oncological surgery care. Logistic regression analyses will be conducted to examine the association between ICU mortality and the following covariates: Age, ICU length of stay (LOS), APACHE score, prior cancer therapy within three months, need of mechanical ventilation (MV), need of renal replacement therapy (RRT), and presence of febrile neutropenia. Survival at 30 and 90 days will be measured. Stepwise selection procedure will be used to develop the multivariate logistic model. Kaplan- Meier survival curves will be plotted for both study groups and compared using log-rank test. Two-Tailed p-value of 0.05 will be considered significant.

Results: There were a total of 473 admissions to ICU of patients with cancer. 221 admissions were hematological malignancies and 252 admissions were those with solid tumours. Average LOS in ICU was 9.9 days. Mean age was 51.2 years, whereas mean APACHE scores were 22.4 for hematological and 21.4 for solid tumours. 33.4% of patients had received cancer therapy within 3 months. 74.3% needed MV, and 15% needed RRT. 26.8% were admitted with febrile neutropenia. Overall survival was 40.4% at 30 days, with 37.1% of hematological and 43.3% of solid tumour patients surviving 30 days. Survival decreases at 90 days to 25.6% overall, with similar numbers for hematological and solid tumours (26.2 and 25% respectively).

Conclusion: Outcome of ICU patients with cancer is worse than the average ICU patient but these patients should not be denied ICU aggressive therapy solely based on their cancer status. More refined prognostication models should be constructed to help clinicians caring for oncology patients determine the utility of ICU admission once a need arises.

Characteristics, Outcomes, and Cost Patterns of High-cost Patients in the Intensive Care Unit

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Introduction: Critical care medicine is expensive. It is estimated that almost 1% of the gross domestic product is spent on critical care alone.[1] Additionally, intensive care unit (ICU) costs are expected to rise as usage escalates due to an aging population and the increasing severity of illness among hospitalized patients.[2,3]

It has been well described in the literature that a small proportion patients account for a disproportionate amount of health care spending.[4–10] Longitudinal data has shown that only a minority of these patients remain in the high-cost group over time,[15,22] rendering reactive strategies less useful. Identifying these patients up front may present an opportunity for focused intervention to reduce spending, albeit there is a paucity of literature describing these patients in the ICU setting. To date, we are only aware of a single retrospective study reported in the ICU literature.[11] A better understanding of the cost pattern predictors may help anticipate resource demands and provide an opportunity to mitigate costs.

Objectives: To describe the characteristics, cost patterns, and outcomes for high-cost patients in the ICU.

Methods: This was a retrospective observational cohort study conducted at two medical/surgical ICUs in a tertiary care academic centre. Included patients were critically ill admissions aged 18 years or older. This was a cost comparison study. Patients were divided into cost groups with the highest 10th percentile being compared to the 90th percentile regarding their characteristics, cost patterns and outcomes.

Results: A total of 7849 patients (8449 encounters) were included, with 7063 in the low-cost group and 786 patients in the high-cost group. The high-cost group had a mean age of 60.7 years. The high-cost group had a longer length of stay with a mean duration of 32.6 days in the ICU. The median direct cost per patient in the high-cost group was $148327 (IQR 114007 - 224610), and the top 10% of patients amounted to 49% of direct costs. Non-survivors were more likely to have a premorbid diagnosis of congestive heart failure, OR 1.84 (95% CI 1.27 - 2.68), chronic obstructive pulmonary disease, OR 2.32 (95% CI 1.64 - 3.28), or to be admitted after a procedural complication, OR 2.93 (95% CI 1.24 - 6.90).

Despite the difference in cost, the in-hospital mortality rate was 27.8% in the high-cost group, compared to 29.5% in the low-cost group ($p = .341$). Only 10.7% of the high-cost group were ultimately dispositioned home, compared to 29.4% in the low-cost group ($p < .0001$), and 33.6% of patients were transferred to long term care facilities.

Conclusions: In summary, in a population of high-cost ICU patients, we found that

the top 10% of patients are responsible for half of the total cost. Among these, only a minimal proportion are sent home. Premorbid chronic obstructive pulmonary disease and patients admitted from procedure complications independently predicted high-cost status among non-survivors and may represent a population where cost strategies could be further explored.

Table 1. Characteristics of included patients

	All (n = 7849)	<90th percentile (n = 7063)	>90th percentile (n = 786)	p-value
Age, mean yrs	62.2	62.3	60.7	.0121
Category, %				
- 18-45	16.0	15.9	17.3	.2736
- 46-69	46.8	46.3	51.2	.1125
- 70-79	21.4	21.4	20.7	.8452
- 80+	15.8	16.4	10.8	.0071
Sex, male	56.4	56.1	59.6	.0631
ER visits within 12 months, mean	2.9	2.8	3.1	.2005
ICU encounters within 12 months, mean	1.05	1.01	1.34	< .0001
Length of stay, mean days				
- Acute length of stay	19.7	13.2	61.2	< .0001
- ICU length of stay	8.7	6.1	32.6	< .0001
- Total length of stay	22.4	14.9	89.9	< .0001
Disposition, mean				
- Home	27.2	29.4	10.7	< .0001
- Home with support services	15.6	15.6	15.4	.8384
- Signed out against medical advice	0.6	0.7	0.1	.0295
- Transferred to acute care	14.3	13.9	17.6	.0024
- Transferred to long term care	14.6	12.1	33.6	< .0001
- In hospital mortality	29.3	29.5	27.8	.3413

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Clonidine for Sedation in Critically Ill Adults: A Retrospective Chart Review

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Introduction The alpha$_2$ agonist clonidine may be used as an adjunct for ICU sedation and analgesia to decrease traditional sedative and opioid requirements. However, clonidine can cause hypotension and bradycardia.

Objectives 1) To describe clonidine dosing regimens used for sedation in a mixed medical surgical ICU, as well as associated adverse events (i.e., hypotension, bradycardia, rebound withdrawal), and 2) to determine if clonidine has sparing effects on traditional drugs used for pain, sedation and agitation.

Methods We conducted a retrospective chart review of all critically ill adult patients that received at least one dose of clonidine for sedation between 2011-2016. We categorized patients as low dose (LD ≤ 0.4 mg/day) or high dose (HD > 0.4 mg/day) based on the maximum total daily clonidine dose for the analysis.

Results Of the 166 patients that met inclusion criteria, 78 (47%) received HD. The median duration of clonidine was 5 days (2, 8); therapy was discontinued without weaning for 115 (69%) patients. Hypotension was the most prevalent adverse effect amongst all patients (19.6 % with SBP < 90 mmHg and 44.6% with MAP < 65 within the first 72 hours). However, there were no significant differences between dose groups in observed rates of hypotension. Incidence of withdrawal symptoms were higher for LD compared to the HD within 25-48 hours post-clonidine discontinuation, (28% vs. 13% for rebound hypertension, p = 0.017 and 49% vs. 31% for rebound tachycardia, p = 0.022). There was a greater reduction in mean daily opioid dose for HD versus LD (mean -218.8 mcg vs. -42.5 mcg of fentanyl equivalents, p = 0.049). The decrease in sedative and non-sedative usage post-clonidine initiation was not significant. Antipsychotic dose increased for HD compared to LD (5.7 mg olanzapine equivalents vs 0 mg, p = 0.04).

Conclusions We found clonidine daily doses were titrated beyond 0.4 mg/day in nearly half of patients; therapy was abruptly stopped for two-thirds of patients. Incorporating a tapered approach may minimize withdrawal symptoms post-clonidine cessation. Hypotension was the most prevalent adverse event but no difference based on daily dose. Titrated clonidine decreased patients' opioid but not sedative requirements.

Code Medical Emergencies in Oncological Patients

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Introduction: Code medical emergencies have become very common in the unexpected clinical deterioration of oncological patients. The code medical emergency team is essential in responding and with their clinical expertise, 'help rescue' these patients.

Objective: To examine the frequency and types of code medical emergencies in oncological patients reviewed by code medical response teams.

Design: A retrospective study of all the code medical emergencies at Princess Margaret Hospital for a 1-year period from January 2016 to December 2016.

Patients: One hundred sixty-three oncological patients required intervention from the code medical emergency team.

Setting: A single academic medical centre (200+ bed) with a dedicated focus on oncological patients.

Interventions: Data abstraction from Rapid response database.

Measurements and Main Results: A total of 163 code medical emergencies (CMEs) occurred during the period of January 2016 to December 2016, inclusive. The majority of our code medical emergencies occurred between the hours of 10:00 to 18:55, 120 CMEs (74%) and 35 CMEs (22%) between the hours of 7:55 to 9:55 am. In our cohort, the most frequent etiology of the CMEs was presyncopal or syncopal episodes, a total of 49 patients (30%). From the 163 code medical emergencies, 94 patients were outpatients (58%), 24 patients inpatients (15%), 9 patients were visitors at PMH and 3 patients were staff. From the 163 CMEs, 59 were transported to Urgent Care Clinic for further workup, 23 went to the emergency department and 24 patients remained on the inpatient wards.

Conclusions: Oncology patients utilize rapid response teams at a very high rate. The majority of the CMEs occur during the day and most frequently are further treated in the Urgent Care Clinic. This impacts on healthcare costs, length of stay and overcrowded emergencies rooms.

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Colour Stability Testing for Pantoprazole Formulations: Can Blinding be Maintained in a Randomized Trial?

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Background: REVISE is a randomized, blinded, placebo-controlled trial examining the effect of intravenous (IV) pantoprazole compared to placebo (0.9% sodium chloride; normal saline [NS]) on rates of upper gastrointestinal bleeding, pneumonia and *Clostridium difficile* infection in the ICU. Pantoprazole is chemically stable, retaining its potency at 0.8mg/ml when mixed in NS for up to 28 days in the fridge (2-8°C)[1,2]. However, some studies evaluating pantoprazole in solution have observed a change in colour over time, which may affect the integrity of blinding in a clinical trial. We previously documented colour stability for 5 days[3]. The objective of this study was to extend these observations to 10 days by evaluating any change in colour under refrigerated conditions (2-8°C) for 2 different pantoprazole parenteral formulations currently marketed in Canada.

Methods: Under sterile conditions (laminar flow hood), Pharmacy Research Personnel prepared 5 sample minibags for each of the 2 parenteral pantoprazole products (10 x 50mL) (Table). The final concentration of pantoprazole was 40mg/50mL (0.8mg/mL). Each mini-bag was labeled and stored protected from light and refrigerated at 2-8°Celcius. A continuous temperature measurement device was in the refrigerator throughout the testing period, recording the minimum and maximum temperature daily for 10 consecutive days.

On each of the 10 study days, one 50mL minibag of each product formulation was selected. Using a transparent 10 ml syringe, 5 x 10 mL of reconstituted pantoprazole was withdrawn from the minibag, and compared with 10 mL of NS in an identical syringe (placebo). Syringes were placed on bright white paper for 20 minutes (the duration of typical study drug administration) under room light at room temperature, and daily photos were taken. The same 2 research coordinators performed all assessments. In duplicate but independently, they inspected the syringes, comparing each pantoprazole-containing syringe with the placebo syringe, seeking any colour change. This was repeated for a total of 10 days.

Product Name	Product Description	Manufacturer
Pantoprazole for Injection	40mg/vial (lyophilized powder)	Fresenius Kabi
Pantoprazole Sodium for Injection	40mg/vial (lyophilized powder)	Sandoz Canada Inc

Results: Duplicate independent observation by visual inspection and using daily photographs of syringes of each reconstituted pantoprazole solution (0.8mg/mL) compared to syringes of placebo (NS) revealed no colour change over 10 days in either of the products at any time. Within the limitations of visual inspection, there was 100% crude agreement between 2 Research Coordinators. These findings suggest that the REVISE study drug can be prepared by Pharmacy Research Personnel and stored in the pharmacy or ICU up to 10 days under refrigerated conditions (2-8°) without jeopardizing its identity.

Conclusions: This colour stability study confirms that pantoprazole can be stored for 10 days without risking unblinding on the grounds of colour change, facilitating cost-effective study drug batching in the international REVISE Trial.

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Comparing the Effect of Continuous and Intermittent Feeding on The Ventilator-Associated Pneumonia in Intensive Care Unit Patients

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Aim and Background: Ventilator-Associated pneumonia (VAP) is the second common infections with high mortality (24-40%). In this study designed to determined effect of continuous(infusion) and intermittent(bolus) feeding on the Ventilator-associated Pneumonia in ICU Patient.

Methods and Materials: This randomized controlled trial was performed on 76 patients admitted in ICU. They were randomly allocated to equal two groups (n=38). In case group, continuous feeding and in controlled group intermittent feeding was performed during the first five days. The incidences of early pneumonia (the first 3 to 5 days) and increase WBC (White Blood Cell) and PMN (Poly Morph Nuclear) in both groups were compared during the first 5 days.

Findings: The rate of increase in WBC (>11000/ml) and PMN (band cell>50%) in continuous group was 8 patients (10.5%) and in intermittent group were 7 patients (9.2%) (pv=0.32). The incidences of early pneumonia (CPIS >or=6) in case group were 4 patients (5.3%) and in control group were 7 patients (9.2%)(pv=0.77).

Conclusions: The results of this study showed that incidence of early VAP in case group was lesser, but this difference was not significant. Also, there was no significant difference in increase of WBC and PMN in both groups. Keywords: Intermittent ventilator-associated pneumonia, continuous feeding, intermittent feeding, endotracheal tube, prevention.

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Comparison Between Dexmedetomidine, Midazolam and Propofol for Sedation in Mechanically Ventilated Intensive Care Patients

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Background and Aims: Patients on ventilatory support in intensive care unit (ICU) require sedation and analgesia to facilitate mechanical ventilation and endotracheal tube tolerance. Clinical outcomes such as heart rate and blood pressure may be improved with dexmedetomidine as compared with benzodiazepines and propofol in studies. The objective of this study was to determine the clinical effectiveness of a sedation infusion protocol for dexmedetomidine.

Material and Methods: A total of 90 adult, mechanically ventilated patients meeting the standard criteria for weaning, randomized into 3 groups of 30 patients each, received intravenous infusion of dexmedetomidine (0.2-0.7 mcg/kg/h)(DG) or midazolam (0.04-0.2 mg/kg/h)(MG) or propofol (1-3mg/kg/hr) (PG) as needed for Ramsay sedation scale 2-4. Extubation performed following with standard extubation. Time for extubation and vital parameters were regularly recorded.

Results: The time to extubation in the DG was essentially lower than the other groups. Heart rate and blood pressure was essentially lower in DG than the other groups at the majority of the circumstances.

Conclusions: Dexmedetomidine has clinically significant advantages in facilitating extubation due to its shorter time to extubation, more hemodynamic stability, and absence of respiratory depression.

Continuing Connections with Bereaved Family Members: Post-Mortem Experiences from the 3 Wishes Project

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Background: We developed the 3 Wishes Project, eliciting and implementing wishes to try to bring peace to the final days of a critically ill patient's life, to ease the grieving process.
Objective: To describe the elements and impact of the postmortem components of the 3 Wishes Project for dying patients, family members, ICU clinicians and the 3 Wishes team.
Methods: *Structured* postmortem components of the 3 Wishes Project were a) ICU staff and project team sympathy cards for each family; b) elicitation and/or implementation of some postmortem wishes; and c) interviews with family members and clinicians of each decedent to learn about their perspectives on the project, which we conducted days to weeks postmortem. *Unstructured* postmortem components were a) letters from family members to ICU staff and project team; b) unplanned return visits by families to debrief on terminal events, counseling requests (psychological or spiritual), reconnecting with ICU staff or project team, c) reflective notes from 5 project team members and d) hospital memorial services. The experiences of patients, family members, and clinicians were examined through analysis of interviews with 86 family members and 150 clinicians (100% participation). The interviews with family members were conducted in-person (53, 61.6%), by phone (31, 36.0%) or email (2, 2.3%) and analyzed using conventional content analysis.
Results: For 100 patient-family dyads, 452 wishes were implemented [314 (69.5%) antemortem and 138 (30.5%) postmortem]. Postmortem wishes included mementos and tributes to the patient, ongoing family support, observances, and acknowledgements. Offerings were from the ICU staff or project team to patients and families (e.g., dream catcher); or from the families to the ICU staff (e.g., baked goods), project team (e.g., patient's art work), future patients (e.g., room decorations) or families (e.g., frames for word clouds); or from the community to current (e.g., birthday cake) or future patients (e.g., knitted blankets). The 3 Wishes Project facilitated family re-engagement with ICU, hospital and project staff, through scheduled, structured components of the project, and also through spontaneous postmortem communications and visits. While some family members found it difficult being back in the hospital, all described the returning experience as meaningful during the grieving process.
Conclusions: Whether offered formally or informally, with or without therapeutic intent, continued connections with family members of deceased patients appear to be valued, supported by ICU clinicians and welcomed by families in grief.

Continuous Renal Replacement Therapy is Associated with Acute Myocardial Injury in Critically Ill Patients.

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Introduction: Intermittent renal replacement therapy is associated with dialysis-induced acute myocardial injury, in both chronic[1] and acute[2] treatments. Continuous Renal Replacement Therapy (CRRT) is often favoured in critically ill patients with acute kidney injury (AKI), hypotension or shock. Lower ultrafiltration rates, characteristic of CRRT, reduce systemic hemodynamic stress and may be cardio-protective. We assessed the impact of CRRT on the development of acute segmental myocardial injury, in critically ill patients requiring dialysis for AKI.
Objectives: To assess the impact of CRRT on global and segmental left-ventricular function in critical ill patients requring dialysis for AKI. Out hypothesis was that CRRT, with its charecteristically lower ultrafiltration rates, would not induce cardiac stunning (i.e. will be cardioprotective).
Methods: We used 2D-echo and speckle tracking analysis software (EchoPAC, GE Healthcare) to measure global and segmental left-ventricular myocardial longitudinal strain in 12 critically ill patients presenting with AKI. Measurements were made at baseline immediately prior to and 4, 8 and 24 hours after initiation of CRRT.
Results: Measurements were completed in 11 patients. 10/11 patients developed new regional wall motion abnormalities, with 8 developing these as early as 4 hours after CRRT start. The number of affected segments varied from 1 to 11 (out of 12). Of 11 patients, 7 (58%) died in the ICU, with 5 of those dying within 2 days of CRRT initiation.
Conclusions: Our results show that CRRT is associated with new regional myocardial injury. This injury was associated with high mortality. These results are concerning with respect to the presumed safety of CRRT (compared to other dialysis modalities) in critically ill patients. Further direct comparison of CRRT with other dialysis modalities is warranted to assess the potential for relative cardio-protection.

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Cost Analysis of Early vs Late Trachestomy in Intensive Care Settings

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Introduction: Up to 12% of the 800 000 patients who undergo mechanical ventilation in the United States every year require tracheostomies. A recent systematic review conducted by Hosokawa et al showed that early tracheostomy was associated with better outcomes: more ventilator-free days, shorter ICU stays, less sedation and reduced long-term mortality. However, no cost-analysis on the timing of early tracheostomies have been conducted.

Objectives: To conduct a cost-analysis on the timing of tracheostomy in mechanically ventilated patients

Methods: We collected individual length of hospital stay and length of ICU stay data from the studies included in the systematic review from Hosokawa et al. We also searched for any recent randomized control trials on the topic that were published after this review. Average daily hospital and ICU costs per patients were obtained from a cost model by Kahn et al. We estimated hospital and ICU costs by multiplying LOS with respective average daily cost per patient. We calculated difference in costs by subtracting hospital costs, ICU costs and total direct variable costs from early tracheotomy to late tracheotomy. 95% confidence intervals were estimated using bootstrap re-sampling procedures with 1000 iterations.

Results: The average weighted cost of ICU stay in patients with an early tracheostomy was $ 5 063 less when compared to patients with late tracheostomy (95% CI: 355 - 9770, I^2 = 89.8%). This was calculated using a random effects model. A sensitivity analysis shows consistent cost reductions even with longer LOS in the early tracheostomy group. Subgroup analysis revealed that very early tracheostomies (less than 4 days) cost on average $4492 USD less than late tracheostomies (95% CI: -1309 – 10294, I^2 = 94.1%) and that early tracheostomies (less than 10 days but greater than 4) cost on average $6385 USD less than late tracheostomies (95% CI: - 4396 – 17165, I^2 = 70.0%)

Conclusion: This study shows that early tracheostomy can significantly reduce direct variable and likely total costs in the intensive care unit based on length of stay alone. This is in addition to the already shown benefits of early tracheostomy in terms of ventilator dependent days, reduced length of stays, decreased pain, and improved communication. Further prospective studies on this topic are needed to definitely prove the cost-effectiveness of early tracheostomy in the critically ill population.

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CYCLE Pilot: Prologue to a Multi-Centre RCT of Early In-Bed Cycling in the ICU

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Introduction: Survivors of critical illness are at risk of developing long-term physical disability. Early rehabilitation interventions, such as in-bed cycling, may improve functional outcomes. Before embarking on a large randomized controlled trial (RCT) with mechanically ventilated patients, assessment of the feasibility of routine physiotherapy (PT) interventions plus early in-bed cycling (Cycling) versus routine PT alone (Routine) and development of monitoring strategies throughout the hospital stay are of key importance. Given the complex clinical environment, the vulnerability of critically ill patients, and the novelty of an intervention that is rare in present practice, the CYCLE Pilot RCT (NCT02377830) was designed to determine the feasibility of a future large trial.

Objective: To itemize and characterize trial preparation and execution activities during the CYCLE Pilot RCT in participating Intensive Care Units (ICU) and the study Methods Centre.

Methods: In 7 Canadian sites, we retrospectively reviewed timelines to study initiation (e.g., research ethics board (REB) approval, first enrolment), site activities (e.g., start-up visits, protocol education, intervention delivery, outcomes measurement), and additional preparatory activities by the Methods Centre. Data sources included regulatory and Methods Centre documentation (e.g., approvals, communications, meeting agendas, coordinator notes). We report descriptive statistics as counts and proportions, and medians and quartiles (Q1-Q3).

Results: The study was submitted to and approved by 5 individual REBs for implementation in 7 medical-surgical ICUs. Time from REB submission to first enrolment (median, quartiles) was 185 days (146-209) [REB submission to approval was 69 days (28-103), and REB approval to first enrolment was 51 days (28-188)]. From March 2015 to June 2016, we screened 864 patients for eligibility, and randomized 66 patients (7.6%) to Cycling (n=36) or Routine (n=30) study arms. Overall, we screened a median of 12 (11-15) patients for each participant enrolled. Across the 7 ICUs, we provided 11 in-bed cycling training sessions (7 (6-8) hours) and trained 36 physiotherapists to cycle; 21 (58.3%) provided cycling during the trial. We conducted 11 outcome measure training sessions (3 (2-3.5) hours) with 58 therapists and assistants; 35 (60.3%) performed study measurements. Three centres each required an additional training session due to therapist turnover or maternity leaves. We provided 7 training sessions to 15 research coordinators and

taught 19 people to conduct data entry; 14 (73.7%) entered data for the study.
Conclusion: Trial planning and execution is multi-faceted and incorporates ethical oversight, patient screening, intervention delivery, and detailed patient tracking for outcomes assessment. Early in-bed cycling research in the ICU requires consideration of site individuality (as demonstrated by the large variation in timelines), intensive training of key professionals in cycling and in research procedures, and establishment of efficient screening methods. The analysis of activities undertaken as a prologue to the CYCLE RCT highlights their scope and magnitude, and may help others interested in evaluating novel ICU rehabilitation interventions to develop procedures and timelines, train dedicated personnel, and allocate resources to build the foundation for a future large trial.

Developing a Longitudinal Post-Critical Care Ultrasound (CCUS) Course Curriculum: Identifying Barriers and Determining Interest

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Introduction: Point-of care-ultrasound has become an invaluable tool for the critical care physician. A Canadian Consensus Group have laid the framework for standards of training (Arntfield et al. 2014). This training statement provides a framework for achieving proficiency that includes: a formal course (hands-on and didactic), portfolio development, competency assessment, and long-term quality assurance practices to maintain skills. Courses have become popular among those wishing to develop ultrasound skills but post-course training is complicated by limited access to expert supervision.

Objectives: The primary objective of this study was to complete a needs assessment and determine interest for a longitudinal post-critical care ultrasound (CCUS) course curriculum.

Methods: Surveys were sent to 145 past attendees of a large Canadian CCUS course run in 2015 and 2016. Attendees were a mix of residents and staff in Intensive Care, Emergency Medicine, and Internal Medicine. Curriculum was based on the Canadian CCUS training statement and was identical in both years and no support for post-course training was provided. The survey focused on post-course ultrasound training with attention to barriers to its use as well as if access to mentorship following the course would have enriched their CCUS skill retention and application.

Results: Fifty-eight attendees completed surveys (40%). Thirty-six respondents (62.5%) reported having difficulty maintaining CCUS skills after taking the course. Of those that had difficulty, 75% reported lack of mentorship or supervision to evaluate images, 33.3% reported lack of machine availability, 30.6 reported forgetting technical skills, and 8.3% reported local culture as the reason.

Attendees reported completing more CCUS exams per week immediately post-course and at long term follow-up, compared to pre-course, but the number of exams per week showed trends toward decline at long term follow-up, compared to post-course.

Thirty-seven respondents (63.8%) reported they did not log their CCUS exams, but 79.3% would use one if they were provided a convenient option.

In considering ways to support CCUS skills post-course, attendees ranked possible solutions as follows: ongoing access to modules (75.9%), virtual attendance to ultrasound image review sessions at an academic hospital ICU (69%), ultrasound image review/quality assurance (65.5%), video conference with course faculty (39.7%).

Conclusions: In our examination of participant outcomes following CCUS course attendance, we found that despite CCUS uptake increasing, the absence of ongoing supervision and mentorship imposes a problematic barrier for participants seeking proficiency with the modality. Based on survey results, significant opportunity for and interest in post-course educational support exists. Given limited access to expert support, efforts should focus on delivering virtual support via video conferenced access to course faculty, case review and quality assurance of images.

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Does Dexmedetomidine (vs. Propofol) Improve Outcomes in Adult after Cardiac Surgery?

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Introduction: Current guidelines suggest that non-benzodiazepine sedatives are the preferred sedative agents in mechanically ventilated adults in the intensive care unit (ICU). Among those agents, it is uncertain whether dexmedetomidine is better than propofol for sedation in patients after cardiac surgery.

Objective: We undertook a systematic review and meta-analysis of randomized controlled trials (RCTs) to examine the efficacy and safety of dexmedetomidine, compared to propofol, in adult patients after cardiac surgery.

Methods: Two reviewers independently searched PubMed, Embase, OVID Medline, and the Cochrane Library up to January 31st, 2017. The same reviewers completed abstract screening, study selection, data abstraction, and risk of bias assessment using the Cochrane Collaboration's tool for assessing risk of bias. We used the GRADE approach to assess the quality of evidence.

We included RCTs that enrolled adult post-cardiac surgery patients, comparing dexmedetomidine to propofol, and reported any of the following outcomes: delirium, duration of mechanical ventilation, ICU length of stay, opioid requirements, and mortality. We pooled the estimate of effects across studies using a random-effects model. The results were summarized as risk ratio (RR) for binary outcomes, and mean difference (MD) for continuous outcomes.

Results: Out of 20 studies that met inclusion criteria, we included eight RCTs (1002 patients). Dexmedetomidine was associated with a lower risk of delirium (RR 0.29, 95% confidence interval [CI], 0.09-0.90; p=0.03), shorter duration of mechanical ventilation (hours; mean difference -0.93; 95% CI -1.24 to -0.63; p<0.00001), and lower need for opioids (mg of morphine-equivalents; mean difference -14.64, 95% CI -14.80 to -14.47; p<0.00001) compared to propofol. However, there was a higher incidence of bradycardia (RR 3.21, 95% CI 1.18-8.70; p=0.02), and hypotension (RR 1.30, 95% CI 1.05-1.62; p=0.02) with dexmedetomidine compared to propofol. There were no statistically significant differences in ICU length of stay, mortality, or incidence of atrial fibrillation between dexmedetomidine and propofol sedation regimens.

Conclusions: Moderate quality evidence revealed that dexmedetomidine reduces postoperative delirium, shortens the duration of mechanical ventilation, and lowers opioid requirements after cardiac surgery, but may increase the incidence of bradycardia and hypotension compared with propofol.

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Early Identification of Children with Type 1 Diabetes Mellitus Presenting to Hospital with Diabetic Ketoacidosis: A Pilot Study

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Introduction: Pediatric diabetic ketoacidosis (DKA) is a common, life-threatening, metabolic emergency that can complicate type one diabetes mellitus (DM1). Many aspects of DKA emergency treatment are not supported by high-level evidence and few randomized controlled trials (RCTs) have been done in this population. Studying time-sensitive emergency interventions can be challenging due to the need to rapidly identify and enrol potential participants. We conducted a pilot study to explore feasibility considerations and inform planning of a future RCT.

Objectives: Our primary objectives were to determine the feasibility of an RCT of children with DM1 and DKA based on: 1. Timely identification of eligible participants by the research team, 2. Ability to obtain consent for data collection. We also sought to evaluate a variety of study process feasibility metrics and to characterize current DKA treatment practices.

Methods: *Design:* Prospective observational pilot study. *Setting:* McMaster Children's Hospital (MCH). *Timeframe:* 6 months (01/02/2016 to 31/07/2016). *Participants:* Children 0-17 yrs of age with known or suspected DM1 who met DKA diagnostic criteria and were expected to require/required hospital admission. *Recruitment:* The study was promoted to the Pediatric Emergency Medicine, Pediatric Critical Care, and Pediatric Endocrinology services. Healthcare providers were asked to page the research team for any DKA case presenting for treatment. The PICU was also screened on weekdays to identify any potential participant for whom the research team was not paged. Eligible participants and/or their substitute decision-makers (SDM) were approached for consent. Consenting participants or their SDM were asked a scripted hypothetical question regarding willingness to consent to a future interventional study. *Ethics:* Study conduct was approved by the Hamilton Integrated Research Ethics Board (Project #1201). *Data:* Demographic, treatment and laboratory data were abstracted from medical records and entered into the REDCap database. *Analysis:* We used descriptive statistics to summarize our data. Analysis of primary outcomes was by calculation of simple proportions and associated 95% confidence intervals. An 80% pass threshold for research team notification and consent rate were selected a priori for feasibility determination.

Results: Twenty-eight children were screened over the study period with 25 eligible for inclusion. The research team was notified for 20/25 [80%; 95% CI: 59-93%] eligible individuals. Consent was obtained for 23/25 [92%; 95% CI: 74-99%]. Mean (sd) age of study participants was 10.8 (+/- 4.8) yrs and 13/23 (57%) were male. Forty-eight percent (11/23) were transferred to MCH after first presenting to another hospital while 19/23 (83%) were admitted to PICU. Starting insulin infusion rate was variable with 65% (15/23) receiving 0.1 U/kg/hr, 30% (7/23) receiving 0.05 U/kg/hr, and 4% (1/23) receiving 0.8 U/kg/hr. Ninety-six percent (22/23) of children received a 0.9% normal saline IV fluid bolus at treatment initiation. All survived to hospital discharge. Of consenting participants or their decision makers, 100% (23/23)

indicated they would consider participating in a future trial evaluating IV fluid therapy in the treatment of DKA.

Conclusion: We demonstrate feasibility of early identification and consent for children presenting with DKA and DM1. A future interventional trial appears feasible.

Effects of Fiberoptic Bronchoscopy on Mechanical Ventilation Pressures in ICU Patients

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Introduction: The presence of a bronchoscope through the endotracheal tube (ETT) increases peak inspiratory airway pressures. This is thought to be caused by an increase in airway resistance[1-3]. This may reduce minute-ventilation (MV) as ventilation stops being delivered once the ventilator inspiratory pressure limit is reached. Increasing inspiratory pressure limit during fiberoptic bronchoscopy (FOB) is a strategy used to help maintain MV. However, it is unclear if such strategy results in gas trapping and increased transpulmonary pressures. In the clinical setting, plateau pressures (Pplat) are commonly used to estimate transpulmonary pressures. Based on bench testing data, increasing inspiratory pressure limit preserve the MV with limited impact on Pplat in most circumstances[4,5]. Whether increasing inspiratory pressure limit result in increased Pplat remains to be assessed in the clinical setting.

Objectives: The aim of this study was to evaluate the impact of FOB on Pplat in patients ventilated in volume-controlled mode. We hypothesized that increasing inspiratory pressure limit during FOB would not significantly affect Pplat.

Methods: We conducted a prospective cohort study of mechanically ventilated patients in the ICU of a tertiary center teaching hospital of both medical and surgical patients (CHU de Québec – Université Laval / Hôtel-Dieu de Québec). The study was approved by the local Research Ethic Board. The inclusion criteria were age ≥ 18 years and mechanically ventilated in a volume-controlled mode through an endotracheal or tracheotomy tube. The exclusion criterias were prior inclusion in the study, refusal by the treating physician, unavailability of the research team and Pplat ≥ 30 cm H2O before FOB. As standardized in our unit, the inspiratory pressure limit was increased up to 80 cmH2O during FOB. No other intervention was made. The primary outcome was variation of Pplat from baseline during FOB. We stratified by ETT size (≤7.5 or ≥ 8.0) as ETT tube size was found to affect MV and Pplat in our physiological bench study.To detect a minimally clinically significant difference of 3 cm H2O from baseline Pplat, and a difference of 5 cm H2O between ETT groups, a total of 36 patients were enrolled (18 in each ETT group). We assumed a standard deviation of 5 cmH2O around Pplat, a power of 80% and an alpha level of 0.05.The secondary outcomes were variations in peak airway pressure and PEEP, desaturations and clinical adverse events. All analysis will be conducted using SAS 9.4.

Results: 34 patients have been included in the study as of April 2017. We expect to complete the study by May 2017. Results of our analysis will be presented.

Conclusion: Our study questions the optimal ventilator settings to safely perform FOB in critically ill mechanically ventilated patients. It will provide evidence on whether Pplat increases or not when inspiratory pressure limit is increased. If Pplat increases, this would justify further investigation of its clinical consequences. It could also introduce the importance to monitor Pplat during FOB. If Pplat does not increase, this would support the hypothesis of increased peak airway pressures

induced mainly by increased airway resistance. This would support the practice to increase inspiratory pressure limit as a safe and simple measure to optimize MV during FOB.

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Emergency Department Nurses' Knowledge and Experience with the New Sepsis-3 Criteria: A Survey

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Introduction: Sepsis is challenging to identify, particularly in those patients that present in the early stages of infection (early presenters). Early recognition reduces the time to treatment, which ultimately saves lives. In 2016, new Sepsis-3 criteria, specifically qSOFA (quick Sepsis-related Organ Failure Assessment) were identified. It is unknown how frontline Registered Nurses (RNs) working in the Emergency Department (ED) are operationalizing these new criteria.

Objective: We sought to understand how RNs in the ED use the new Sepsis-3 criteria and their clinical experience to identify patients with suspected infection or sepsis, requiring timely treatment.

Methods: To understand RNs' operationalization of sepsis, including the new Sepsis-3 criteria, a 7-item survey was developed and distributed to all RNs at the Hamilton General Hospital; an urban tertiary-care ED. During phase 1 the questionnaire was piloted with a convenience sample of 7 RNs in which feedback was obtained on sentence structure to 6 questions. Phase 2 tested for clinical sensibility of the questionnaire, a convenience sample of 7 respondents provided feedback using a 5-point Likert scale. The clinical sensibility testing covered several domains: appropriateness, redundancy, and survey completion time. We invited feedback on education around the new Sepsis-3 criteria and preferred learning strategy. Phase 3 included distribution of the final survey using paper versions and electronically via SurveyMonkey®. Respondents were asked to provide demographic data: sex, education, and clinical experience.

Results: The survey was distributed to 79 ED RNs, of which 50 (63%) completed the survey. The average time to completion was 3.8 minutes. Respondents identified hypotension (64.0%), heart rate (58.0%), and temperature (54.0%) as the best characteristics to identify patients with suspected sepsis. Using a Likert scale, 48 (96%) respondents scored an average of 4.3 out of 5 for their level of confidence with early recognition of patients with sepsis. Despite the new Sepsis-3 criteria published 1 year ago, 33 (66.0%) respondents were not familiar with qSOFA, 13 (26.0%) were aware it existed but had not been educated on it, 4 (8.0%) were familiar with the criteria but relied on other variables to identify septic patients, and none claimed to have thorough understanding of the qSOFA criterion for sepsis. The majority (82%) of respondents agreed that the Sepsis-3 criteria is effective in identifying patients with potential sepsis, and a medical directive should be available for RNs to identify and initiate treatment of septic patients or those at risk.

Conclusion: We have identified a knowledge gap in nursing understanding of the new Sepsis-3 criteria. In this cohort of ED nurses, hypotension was identified as the number one indicator for sepsis patients, thus matching 1 of the 3-qSOFA criteria. Respondents identified an interest in learning about Sepsis-3 and qSOFA via a variety of educational modes. Furthermore, ED nurses support the use of a medical directive in suspected septic patients. A larger study of Emergency Department nurses to yield further information and impact on practice is recommended.

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Epidemiology of Unexpected Intensive Care Unit (ICU) Admissions from The Hospital Ward: A Multi-Centre Retrospective Study

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Background: Reducing hospital harm is an important patient safety goal. Unexpected ICU admissions from the ward are high morbidity, high cost events that are important to examine to improve patient safety. The objective of this study is to describe opportunities to improve care by characterizing the cause and timeline of unexpected ICU admissions from the ward in an academic, integrated, healthcare system.

Methods: We conducted a retrospective study of a consecutive cohort of patients admitted to eight general medical and surgical wards at two academic hospitals from January to June 2014. A team of trained reviewers abstracted charts for demographic data, co-morbid status, ward admission diagnosis, ICU admission diagnosis, ICU and hospital length of stay, unexpected ICU transfer, and death. Patients unexpectedly admitted to the ICU from the ward were included in the analysis. Patients admitted for routine post-operative monitoring were excluded unless the reason for surgery was unexpected. Two reviewers coded the diagnoses independently, met to compare coding and reviewed discrepancies as a team until agreement was reached. We described the cause and timeline of unexpected ICU admissions from the ward and compared the diagnosis leading to ICU admission with the diagnosis at ward admission.

Results: We analyzed 164 unexpected ICU admissions from 7130 total ward admissions. There were 23.0 unexpected ICU admissions / 1000 ward admissions. The three most common diagnostic conditions associated with unexpected ICU admission from the ward were, infection (22.6%), respiratory failure (18.3%), and CHF (9.1%). 71.5% of infections associated with ICU admissions were not noted at the time of ward admission. We found that 50.6% of unexpected ICU admissions occurred within 3 days of ward admission, and 82.9% of ICU admissions occurred within 8 days.

Conclusion: Common reasons for unexpected ICU admission from the ward are infection, respiratory failure and CHF. The majority of infections leading to ICU admission are diagnosed after hospitalization. Unexpected ICU admissions typically occur within a week of hospitalization with half occurring within the first 3 days of hospitalization. Strategies to reduce the risk of unexpected ICU admission should focus on early prevention and management of infection, respiratory failure and CHF.

Evolution and Expansion of Wishes in the 3 Wishes Program

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Background and Objectives: The 3 Wishes Program facilitates personalized end-of-life care by eliciting and implementing at least 3 wishes to honour a dying patient and their family. The objective of this analysis was to describe the evolution of wishes implemented since its inception in 2013.

Methods: The 3 Wishes Project started January 2013 in the St. Joseph's Healthcare Hamilton ICU, a 21-bed medical-surgical tertiary care unit. Patients and families were invited to participate after a decision was made to withdraw advanced life support or after the intensivist estimated that the probability of dying in the ICU was $\geq$ 95%. Patients were excluded if they were in the ICU for less than $\leq$12 hours. A project team member or bedside clinician elicited and implemented at least 3 wishes of the patient, family or clinicians that honoured the patient and family. From the original 5 wish categories, in triplicate, 3 investigators interpreted and reclassified 1376 wishes into a new taxonomy of 12 categories (*connections, providing food and beverage, humanizing the environment, humanizing the patient, music, family care, rituals and spiritual support, preparations and final arrangements, word clouds, keepsakes and tributes, organ donation and paying it forward*). We calculated the percentage of each wish category and analyzed the distribution of wish categories annually.

Results: Since the 3 Wishes Demonstration Project, more than 200 patients have been enrolled and over 1300 wishes implemented. Initially, research was led by a small team 1 week per month. The 3 Wishes Project has become the 3 Wishes Program, an interdisciplinary collaboration of frontline staff, spiritual care clinicians, and the research team, who together deliver personalized end-of-life care for most decedents. Accordingly, the number of patients enrolled increased 4-fold, and the number of wishes increased 6-fold; from 20 patients and 76 wishes in 2013 to 81 patients and 443 wishes in 2016. The most common wish category in 2013 was *providing food and beverages* (26.9%) while in 2016 it was *humanizing the environment* (15.2%). The most common 4 wish categories implemented in 2013 accounted for the majority of wishes implemented (67.2%), while in 2016 these 4 categories accounted for less than half of wishes implemented (49.7%). A wider portfolio of wishes in a broader array of categories was implemented over time, demonstrating diverse ways in which patients dying in the ICU can be honoured.

Conclusions: In this interprofessional end-of-life program, wish categories have evolved and expanded over 4 years. This diversification may reflect the empowerment of families and clinicians to engage; the authenticity and creativity of the encounters; and the motivation of meaningful shared celebratory stories in the 3 Wishes Program.

Factors Associated with Physicians' Predictions of Long-Term Mortality of Critically Ill Patients

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Introduction: Physician's estimate of the prognosis of patients' is essential to shared decision making in the intensive care unit (ICU). The variables influencing these judgments are not well understood.

Objectives: The aim of this study is to determine which individual physician and patient characteristics influence physician's predictions of patient's mortality at 6 months. Additionally, we explored which of these factors are associated with the confidence of the predictions.

Methods: Secondary analysis of a prospective cohort study that evaluated how well ICU physicians predicted patients' long-term outcomes. Recruitment occurred from October 2013 to May 2014 in 5 ICUs in the University of Pennsylvania. Patients were included if they required mechanical ventilation > 48 hours, vasopressors >24 hours, or both. ICU attending physicians were asked to predict whether patients were expected to live or die in 6-months, and to report their confidence in these predictions. Using univariate and multivariable logistic regression, we assessed the association between baseline physician and patient characteristics with study outcomes: 6-month mortality prediction (yes/no) and confidence of the prediction (yes/no). We graphically explored the linear association between continuous predictors and outcomes. We calculated c statistics for each logistic regression model and goodness of fit was measured using Hosmer Lemeshow.

Results: Of 340 eligible patients, 303 were enrolled. Forty-seven physicians contributed at least one prediction per patient. Patient's median age was 62 years old (IQR 53-71) and 57% (N=157) were male. Physicians median age was 41 (IQR 38-53) and 80% (N=37) were male. Mortality at 6 months was predicted for 33% (N=99), of which 43% (N=130) died. The final multivariable model (Table 2) explaining physicians' predictions of mortality included patient's age (OR 1.03; 95%CI 1.01-1.05), the presence of malignancy (OR 2.70; 1.54-4.74); medical (vs. surgical patients) (OR 5.87; 95%CI 2.70-12.7) and patient's APACHE score (OR 1.02; 95%CI 1.01-1.02). This model deemed good discrimination (C statistic=0.77; 95% CI 0.72-0.83) and calibration (difference between expected and observed p value=0.87). The same variables were also associated with patient's actual mortality at 6 months (Table 3). Physician's age (OR 0.93; 95% CI 0.90-0.96), physician's male gender (OR 0.53; 95% CI 0.32-0.88) and years since graduation (OR 0.94; 95% CI 0.91-0.97) were associated lower confidence of the prediction (Table 3). A higher APACHE score was also associated with lower confidence (OR 0.99; 95% CI 0.98-0.99).

Conclusion: Physician and patient factors are associated with predictions of mortality and patient's actual mortality at 6 months. These include patient age, presence of malignancy, being a medical patient and severity of illness. Physician age, being male, years of experience and severity of illness were inversely associated with confidence in these predictions. This information should be considered when physicians reflect on how they make predictions for critically ill patients.

Table 1. Baseline characteristics of physicians and patients and its univariate association with outcomes			
	Summary characteristics[1]	Mortality Prediction at 6 months	Mortality Occurred at 6 months
		Odds Ratio (95% CI)	Odds Ratio (95% CI)
Physician variables N=47			
▪ Age, years median (IQR)	41 (38-53)	1.10 (1.02-1.18)	0.96 (0.90-1.03)
▪ Male gender	37 (80)	1.27 (0.27-5.93)	1.47 (0.32-6.80)
▪ Years since graduation	14 (11-27)	1.10 (1.02-1.18)	0.96 (0.90-1.03)
Patient variables N=303			
Demographics			
▪ Age, median (IQR)	62 (53-71)	1.02 (1.00-1.04)	1.03 (1.02-1.05)
▪ Male, N (%)	173 (57.10)	0.95 (0.59-1.55)	0.77 (0.48-1.22)
▪ Race			
▪ White (reference)	191 (63.04)	1	1
▪ African American	98 (32.34)	1.21 (0.73-2.03)	1.29 (0.79-2.11)
▪ Level of Education, college or more	147 (49.83)	0.91 (0.55-1.49)	0.680.43-1.09)
▪ Patient's previous residence,			
▪ Home	283 (93.71)		
▪ Chronic facility	19 (6.29)	0.83 (0.31-2.16)	0.42 (0.16-1.10)
▪ Employed	85 (28.43)	1.09 (0.88-1.35)	1.21 (0.98-1.49)
▪ Hospitalized in previous year	213 (73.20)	1.43 (0.81-2.55)	2.28 (1.31-3.98)
▪ Able to walk up 10 consecutive stairs in the month before	244 (80.79)	1.00 (0.54-1.84)	0.85 (0.48-1.53)
▪ Toileting independently before hospitalization	267 (88.41)	0.93 (0.44-1.95)	0.84 (0.41-1.72)
▪ **Previous morbidity**			
▪ Neurological condition (stroke, etc.)	59 (19.47)	1.43 (0.79-2.59)	1.11 (0.62-1.99)
▪ Congestive heart failure	114 (37.62)	0.93 (0.57-1.55)	1.17 (0.73-1.88)
▪ Coronary artery disease	103 (33.99)	0.63 (0.37-1.06)	0.74 (0.46-1.22)
▪ Chronic obstructive pulmonary disease	66 (21.78)	1.43 (0.81-2.52)	1.24 (0.71-2.16)
▪ Renal failure requiring dialysis	30 (9.90)	1.63 (0.76-3.52)	1.81 (0.84-3.87)
▪ Malignancy (treated for cure or metastatic)	96 (31.68)	2.96 (1.77-4.94	2.77 (1.68-4.58)
▪ Liver disease	35 (11.55)	1.62 (0.79-3.31)	3.79 (1.75-8.20)
▪ Cognitive impairment	17 (5.61)	1.87 (0.70-5.02)	3.35 (1.14-9.72)
▪ Psychiatric comorbidity	104 (34.32)	1.00 (0.60-8.24)	0.71 (0.44-1.16)
▪ **Variables related to ICU admission**			
▪ Primary ICU Diagnosis			
▪ Surgical	88 (29.04)	1	1
▪ Medical	215 (70.96)	4.22 (2.17-8.24)	3.61 (2.05-6.37)
▪ APACHE 3 score, mean (SD)	98.16 (32.16)	1.02 (1.01-1.03)	1.02 (1.02-1.03)

1. Data is presented as number of patients and proportions for categorical data and median (IQR) or mean (SD) for continuous data.

IQR: interquartile range; SD: standard deviation; APACHE: Acute Physiology and Chronic Health Evaluation III

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Feasibility of a Web-Based Neurocognitive Battery for Assessing Cognitive Function in ICU Survivors: A Pilot Study.

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Introduction: Long-term cognitive dysfunction is common in ICU survivors (1). Its temporal course remains unclear, impeding identification of appropriate time windows for therapeutic target discovery and interventions. This is partly due to lack of neurocognitive tests that are comprehensive, easy to administer and do not require presence of trained personnel. Cambridge Brain Sciences (CBS) is a validated web-based neurocognitive test battery previously used in large cohort studies, can be self-administered by patients, and allows testing frequencies not feasible with standard paper-based methods, making it an attractive method for objectively quantifying ICU-related cognitive dysfunction. However, CBS has never been evaluated in ICU patients.

Objectives: To determine the feasibility of using web-based neurocognitive battery for assessment of cognitive function in ICU survivors.

Methods: We recruited adult (age ≥ 18 years), non-delirious patients who were intubated for a minimum of 24 hours from two ICUs in London, Ontario. Patients with a documented history of dementia or neurological diseases were excluded. Demographic and clinical variables were recorded from medical records. Patients completed at least one CBS battery in the ICU, or shortly after discharge from ICU. Patients were considered impaired on a cognitive test if they scored > 2 standard deviations (SD) below the healthy population norms corrected for age and sex. Feasibility issues associated with web-based cognitive testing in ICU patients were recorded.

Results: Of 44 patients approached, 21 underwent cognitive testing and 18 (6 females) were included in the analysis, with 15 of these completing the full 12-test battery. Median age was 62 years (SD 13.2), NEMS score 18 (SD 5.6), and ICU length of stay 5 days (SD 5.0). Twelve patients were tested in the ICU and 6 were tested within 1-4 days of transfer to ward. Fifteen of 18 patients were impaired on at least one test, with the median impairment of 2 tests (range 0-8).

Feasibility issues with CBS included: unclear test interface (difficulty focusing on the appropriate part of computer monitor); patient fatigue due to battery length (with 3 of 18 completing partial battery only); complex test instructions; lack of progress feedback; test sounds disturbing other patients in shared rooms; and patient inexperience with using a computer mouse.

Conclusion: Web-based cognitive testing is feasible in ICU patients. Feasibility issues need to be addressed in order to optimize this form of testing in ICU survivors. Our results will inform modification of a web-based battery for ICU needs, and help with the design of future observational studies.

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Frailty in Critical Care: Patient Mobility as a Clinical Predictor

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Introduction: Frailty is an increasingly recognized phenomenon in the healthcare of older-adults. Patient mobility is an important and well-recognized marker of clinical frailty[1]. Early mobilization in the intensive care unit (ICU) improves patient outcomes[2,3]. Changes in mobility of individuals who are acutely unwell is under studied and has important implications on recovery and prognosis.

Objectives: To investigate patient mobility as a clinical predictor in a critically ill older-adult patient population. Specifically, to investigate whether severity of illness at time of ICU admission is predictive of mobility performance and to assess whether changes in patient mobility correlate with in-hospital mortality.

Methods: A single center prospective cohort study involving critically ill patients aged 65 and older admitted to the QEII's medical-surgical ICU. APACHE II scores were calculated at time of ICU admission to stratify critical illness severity. Physiotherapists integrated the HABAM into routine daily mobility assessments in the ICU. Additional items relevant to mobility in the ICU were added to the HABAM based on interdisciplinary team consensus – creating a modified CritCare-HABAM. Patient descriptive and changes in patient mobility up to four days in ICU were analyzed against in-hospital mortality using univariate regression analysis. Changes in patient mobility were also analyzed according to admission APACHE II score. This represents the first participants enrolled and completed hospitalization. Enrolment is ongoing.

Results: A total of 38 patients were recruited and 34 were mobilized at least two days in ICU. Average APACHE II score was 23.3 (SD 6.57). Ten participants (26%) died in hospital. The CritCare-HABAM predicted in hospital mortality if there was a failure to improve in any of the three mobility domains or two-out-of-three domains ($p=0.023$ and $p=0.039$, respectively) whereas if there was failure to improve in any of the three mobility domains of the HABAM, there was a trend for significance ($p=0.059$). Neither increased severity of critical illness (APACHE II > 23) nor frailty (Clinical Frailty Scale > 4) were associated with decreased mobility performance ($p=0.19$).

Conclusion: The HABAM can be used in the ICU and changes in mobility predict in hospital death.

HIERARCHICAL ASSESSMENT OF BALANCE AND MOBILITY©

| Date of admission to hospital ____DD/____MM/_____YY |
| Ward _____ |

PATIENT ID

Score	Recorder's Initials																		
	Date Assessed (DD)																		
	(MM)																		
	Day	-14	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
	BALANCE																				
21	Stable ambulation																				
14	Stable dynamic standing																				
10	Stable static standing																				
7	Stable dynamic sitting																				
5	Stable static sitting																				
0	Impaired static sitting																				
	TRANSFERS																				
18	Independent and Vigorous																				
16	Independent																				
14	Independent but slow																				
12	1 person standby																				
11	1 person minimal assistance																				
7	1 person assist																				
3	2 person assist																				
0	Total lift																				
	MOBILITY																				
28	Unlimited, vigorous																				
26	Unlimited																				
25	Limited >50m, no aid																				
21	Unlimited, with aid																				
19	Unlimited with aid, slow																				
18	With aid >50m																				
16	No aid, limited 8-50m																				
15	With aid 8-50m																				
14	With aid <8m*																				
12	1 person standby/+/- aid																				
9	1 person hands-on/+/-aid															✓					
7	Lying-sitting independently																				
4	Positions self in bed																				
0	Needs positioning in bed																				

Notes

CritCare – Hierarchical Assessment of Balance and Mobility

ICU Admission Date: [DD/MM/YY] ____ / ____ / ____

ICU Admission Diagnosis:

Patient Identification

Score		-14	01	02	03	04	05	06	07	08	09	10	11	12	13	14→
	Recorder's Initials															
	Date Assessed (DD)															
	(MM)															
	ICU Day															
	CAM ICU +/-															
	APACHE II															
	BALANCE															
	Stable Ambulation															
	Stable Dynamic Standing															
	Stable Static Standing															
	Stable Dynamic Sitting															
	Stable Static Sitting															
	Impaired Static Sitting															
	TRANSFERS															
	Independent															
	Independent but Slow															
	1 Person Standby															
	1 Person Minimal Assistance															
	2 Person Assist for Stand/Step Transfer															
	2 Person Assist for Pivot Transfer															
	Total Lift															
	MOBILITY															
	Ambulates >10m independently +/- aid															
	Ambulates <10m independently +/- aid															
	Ambulates >10m Ax1 +/- aid															
	Ambulates <10m Ax1 +/- aid															
	Ambulates >10m Ax2 +/- aid															
	Ambulates <10m Ax2 +/- aid															
	Independent lying to sitting															
	1 person assist lying to sitting															
	2 person assist lying to sitting															
	Independent bed mobility (bridge, scoot ,turn)															
	Requires assistance for bed mobility															
	Able to actively participate in bed exercises															

Physiotherapy Baseline Mobility Assessment Notes

Figure 1. HABAM and CritCare-HABAM Mobility Performance

HABAM	Significance	P-value
Improve in Mobility, Balance and Transfers	No	0.398
Improve in at least Two Domains	No	0.115
Any Improvement	No	0.059
Any Decline	No	0.473

Table 1. HABAM Performance and Mortality Correlation

CritCare-HABAM	Significance	P-value
Improve in Mobility, Balance and Transfers	No	0.206
Improve in at least Two Domains	**Yes**	0.039
Any Improvement	**Yes**	0.023
Any Decline	No	0.492

Table 2. CritCare-HABAM Performance and Mortality Correlation

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Hyperchloremia in Critically ill Pediatric Patients, the HyCCiP Study

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Introduction: The debate over what maintenance intravenous (IV) solution is the most appropriate for children has been ongoing for decades (1). Hypotonic fluids were the preferred choice for hospitalized pediatric patients(2). However, recent evidence has demonstrated that hypotonic fluids increase the risk of iatrogenic hyponatremia, its associated morbidities, and mortality (3-6). In contrast, isotonic fluids reduce the risk of hyponatremia (3-6) and are thus the currently recommended fluid of choice for maintenance IV fluids in children. However, it is unclear whether this has translated into clinical practice. Further, isotonic fluids may be associated with hyperchloremic metabolic acidosis (HCMA), which itself may be associated with increased morbidity and mortality (7-12).

Objectives: In critically ill pediatric patients admitted to the Pediatric Intensive Care Units (PICU), we sought to evaluate:

1   IV maintenance fluid prescription practice patterns
2   The incidence of iatrogenic hyperchloremia and HCMA, as well as associated morbidities
3   Predictors of HCMA in critically ill children

Methods: This retrospective chart review was conducted at McMaster and Stollery Children's Hospitals. All patients aged under 18 years admitted between January 1st, 2015 – January 31st, 2016, who received at least 50% of their maintenance fluid requirements parenterally, were included. The primary outcome was IV maintenance fluid prescription practices in the first 72 hours of admission. Secondary outcomes included the incidence of iatrogenic hyperchloremia and of HCMA in the first 72 hours of admission, predictors of iatrogenic HCMA, and the association between HCMA and clinical outcomes. We calculated that a sample size of 700 patients would enable us to achieve our primary and secondary outcomes. Descriptive analyses were used to present demographic data and the primary outcome, and regression analyses were used to evaluate the predictors of HCMA.

Results: Of 771 patients admitted between January 1st, 2015 – January 31st, 2016, 541 were eligible. The median age was 69 months and 56% were males. 400 (74%) were medical patients and 141 (26%) were surgical patients. Normal Saline was the most commonly prescribed solution for IV maintenance over the first 72h of admission, followed by Ringer's Lactate, and hypotonic solutions (Figure 1; 74.1%,

23.4%, and 2.5%, respectively). Ringer's Lactate prescriptions increased while normal saline prescriptions decreased over time, in parallel to the daily prevalence of hyperchloremia. The incidence of hyperchloremia and HCMA over the first 72h of admission was 93.8% and 34.9%, respectively. Ongoing analyses will determine predictors of HCMA and their potential association with adverse events.

Conclusion: Isotonic solutions comprised the overwhelming majority of IV maintenance fluid prescriptions, while balanced salt solutions are not used in these centers. Ringer's lactate use increased over the first 72h in response to increasing hyperchloremia. Iatrogenic hyperchloremia and HCMA appears to be extremely common in PICUs, observed here at a rate much higher than that reported in critically ill adults. The results of this study will provide a rationale to evaluate what type of isotonic solutions may be more appropriate in critically ill children, in order to minimize IV fluid associated morbidities.
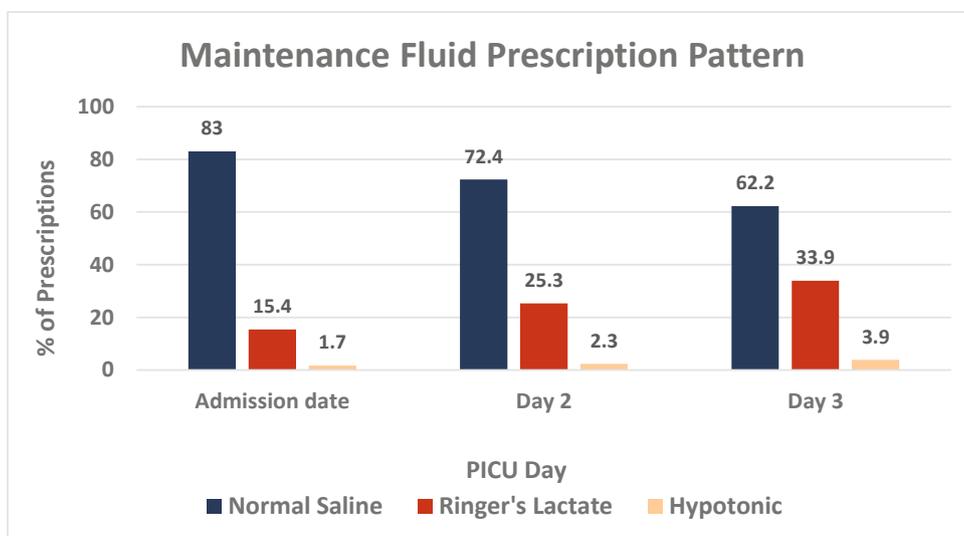
Figure 1. IV maintenance fluid prescriptions over the first 72h of PICU admission

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ICU Delirium, Clinical Outcomes and Cost: Systematic Review & Meta-Analysis

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Objectives: To investigate the association between delirium and duration of mechanical ventilation in patients with delirium. The primary outcome is Intensive Care Unit Length of Stay (ICU LOS). The secondary outcomes are hospital LOS, an association between delirium and mortality in the ICU or the hospital and cost-effectiveness.

Design: Systematic review and meta-analysis of published studies. Update on previous systematic review and meta-analysis by Salluh *et al.* 2015.

Data sources: PubMed, Embase, CINAHL, Cochrane Library, and PsychINFO, without language criteria, up to October 2016.

Eligibility criteria for selection studies: The additional studies were included from January 2015 to October 2016, where patients were adults only and were evaluated for delirium with a validated screening or diagnostic instrument. The included studies reported the ICU LOS. Two reviewers independently screened citations, reviewed studies, abstracted data, and resolved disagreements by consensus. Only prospective observational cohorts or clinical trials of adults were assessed for quality.

Results: Delirious patients had significantly higher mortality during (overall risk ratio 2.55, 82.67% confidence interval 1.94 to 3.35; $P<0.001$). Patients with delirium also reported longer hospital LOS and ICU LOS. The overall hospital LOS standard mean difference for overall studies is 1.07, 97.85% confidence interval 0.70 to 1.43; $P<0.001$. The overall ICU LOS mean difference is 4.93, 98.3% confidence interval 3.98 to 5.88; $P<0.001$. As per this updated review and meta-analysis, there is an association between delirium and ICU LOS and hospital LOS which ultimately leads to increase in cost. The cost analysis of recent studies showed that the cost of ICU stay is 40.8% and hospital stay is 41.4% more in delirious patients. Sensitivity analysis looking at recent studies and high quality papers, showed consistent results.

Conclusions: Delirium results in increased risk of mortality, long length of stays in hospital and long length of stays in ICUs. In delirium patients, the mortality rate, hospital LOS, and ICU LOS are associated with an increase in cost.

ICU Discharge Function Predicts Poor Hospital Discharge Outcomes: Lessons from the CYCLE Research Program

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Introduction: Physical function 7 days post-ICU can predict function 1 year later([1]), however the relationship between physical function at ICU discharge and more proximal outcomes is unknown. The Physical Function ICU Test-scored (PFIT-s) is a reliable and valid measure of function in patients with critical illness. It includes 4 items (shoulder and knee extensor strength, amount of assistance required to stand, stepping cadence), and scores range from 0 to 10, with higher scores reflecting better function.([2], [3]) While studies from Australia([4]) and the United States([5]) identified positive relationships between higher PFIT-s scores and better hospital discharge disposition, the generalizability of these findings in Canada are unknown.

Objectives: To predict the relationship between PFIT-s scores at ICU discharge and outcomes at hospital discharge in a cohort of Canadian ICU survivors.

Methods: This is a secondary analysis of 2 studies from the CYCLE Research Program: TryCYCLE (NCT01885442), a single-centre, 33-patient prospective cohort study of early in-bed cycling([6]), and CYCLE Pilot (NCT02377830), a 7-centre, 66 patient RCT of early in-bed cycling and routine physiotherapy interventions versus routine physiotherapy interventions alone([7]). Both of these studies included adult patients within the first 4 days of mechanical ventilation and first 7 days of ICU admission who could ambulate independently pre-hospital with or without a gait aid, and had no other exclusions. At ICU discharge, trained physiotherapists collected the PFIT-s. We prospectively identified whether ICU survivors with PFIT scores met any of 3 conditions comprising a composite outcome of poor health status at hospital discharge: 1) mortality, 2) readmission to ICU, or 3) discharge requiring paid assistance (e.g., home care, rehabilitation, assisted living, etc.). For continuous variables, we calculated the mean and standard deviation (SD); for binary variables, we calculated counts and percentages. We conducted a logistic regression to predict the association of PFIT-s score and poor health status at hospital discharge. We conducted all analyses with SAS version 9.4 for Windows, Cary NC.

Results: We included 74 patients with PFIT-s scores at ICU discharge (26 patients from TryCYCLE and 48 from the CYCLE Pilot RCT). The mean (SD) PFIT-s score was 5.7 (2.2). At hospital discharge, 46 (62.2%) of patients had poor health status (11 (14.5%) died, 8 (10.8%) were readmitted to ICU, 35 (47.3%) required paid assistance at hospital discharge; numbers total >46 because a patient could experience >1 outcome). Using logistic regression, we found that higher PFIT-s scores (better function) were significantly associated with a lower odds of developing poor health status (odds ratio 0.59, 95% confidence interval (0.43, 0.81)).

Conclusion: A 1-point increase in PFIT score (out of 10) at ICU discharge significantly decreased the odds of developing poor health status at hospital discharge (mortality, readmission to ICU, or requirement for paid assistance) by

40%. This analysis underscores the prognostic value of physical functional disability after ICU discharge and its potential use predicting poor health status at hospital discharge. These findings may be useful in the evaluation of rehabilitation interventions designed to optimize patients' function and independence after hospitalization.

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Impact of Streptococcus pneumoniae Colonization in Critically Ill Children with Viral Bronchiolitis

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Introduction: Viral bronchiolitis is one of the most prevalent causes of illness requiring hospitalization among children worldwide[1] and one of the most common reasons for admission to pediatric intensive care. It has been hypothesized that co-infection with bacteria results in more severe clinical outcomes. However, the effects of bacterial colonization, affecting upwards of 15% of healthy children[2], on critically ill patients with bronchiolitis have yet to be proven. Current clinical management consists primarily of supportive therapies with the role of antibiotics remaining controversial.[3]

Objectives/Methods: A retrospective review of all critically ill children admitted to the BC Children's Hospital Pediatric Intensive Care Unit (PICU) from 2014-2017 with a diagnosis of bronchiolitis was performed. Routine testing in this timeframe consisted of complete pathogen testing, including PCR for *Streptococcus pneumoniae*. Analyses were performed to determine the impact of bacterial colonization and antibiotic use on a primary outcome of PICU length-of-stay, with secondary outcomes of hospital stay and duration of ventilation.

Results: There were 92 patients with complete pathogen testing performed during the assessed timeframe. A comparison between children with detected *Streptococcus pneumoniae* (n=22*)* and those without (n=70) revealed no significant (p=0.20) differences in severity of illness on presentation as per PRISM III scores (mean=3.0). Patients colonized with *S. pneumoniae* had significantly shorter PICU stays (p=0.002), hospital stays (p=0.0001) and duration of non-invasive ventilation (p=0.002). Multivariate analyses reveals that these effects on length of PICU stay and duration of ventilation do not persist after controlling for antibiotic use, presence of radiographic consolidation, age, and severity of illness (p=0.15, p=0.32). The relationship between colonization and duration of hospital stay persists after controlling for these variables (p=0.008).

Conclusions: Children with viral bronchiolitis colonized with *S. pneumoniae* appear to have shorter hospital stays but similar length of PICU stays and duration of ventilation compared to children who are not colonized. Consistent with current literature[4], the results of this study suggest bacterial colonization is not associated with increased severity of presenting illness or negative clinical outcomes.

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Improving Team Communication During Intubation in The Critical Care Unit

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Introduction: Critically ill patients that require intubation are at high risk of hypoxia and cardiovascular instability. One in 4 major adverse airway events occur in the intensive care unit or emergency department. Timely and effective communication among team members is crucial during this high-risk procedure. Evidence from military and pre-hospital medicine has shown that standardized checklists limit human error and improve team communication and patient safety. The aim of this project was to implement the use of a team time-out with the communication of an intubation plan and team member concerns and increase the use of these tools to up to 80% in ICU intubations.

Methods: The study was conducted in medical-surgical intensive care units at two academic hospitals in Toronto. We identified current deficits in team communication by engaging stakeholders involved in intubations. We surveyed ICU nurses, physicians, and respiratory therapists to understand the perception of team efficacy in communication, equipment preparation, and patient safety and monitoring. We also audited ICU intubations to identify whether intubation plan, airway assessment, team concerns, and team member roles were verbalized prior to conducting the procedure. We used the survey and audit data to design and implement a pre-intubation communication tool. The implementation process involved 1) education sessions with physicians, respiratory therapists, and nurses, and 2) printed reminders in the ICU and intubation equipment cart.

Results: Three main deficits in pre-intubation communication were identified. In the observed intubations, only 40% included team time outs, 70% had intubation plans verbalized, and 50% had team member concerns addressed. Fewer than 50% of survey respondents felt that any of these areas were consistently communicated during intubations. The final communication tool contained 6 components: 1) team time out, 2) indication for intubation, 3) team member roles, 4) equipment readiness, 5) intubation plan, and 6) final concerns. A post implementation audit and stakeholder survey is in progress.

Conclusion: Intubation in critically ill patients is a high-risk procedure. Our assessment of current intubation practice identifies deficits in team communication that have potential impact on team member preparation and patient safety. We have implemented a bedside tool consisting of six key items. Educational sessions were provided to staff to understand and use the tool. We will be surveying the staff about usefulness of the tool and we are currently considering venues for further dissemination like inter-professional rounds, in situ simulation.
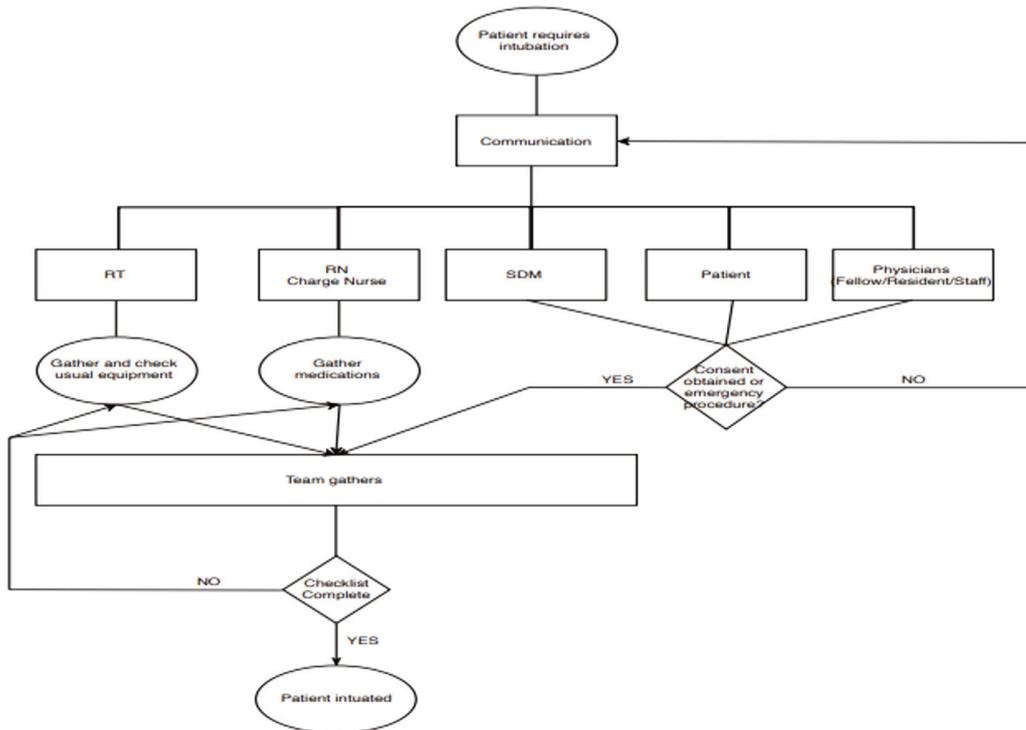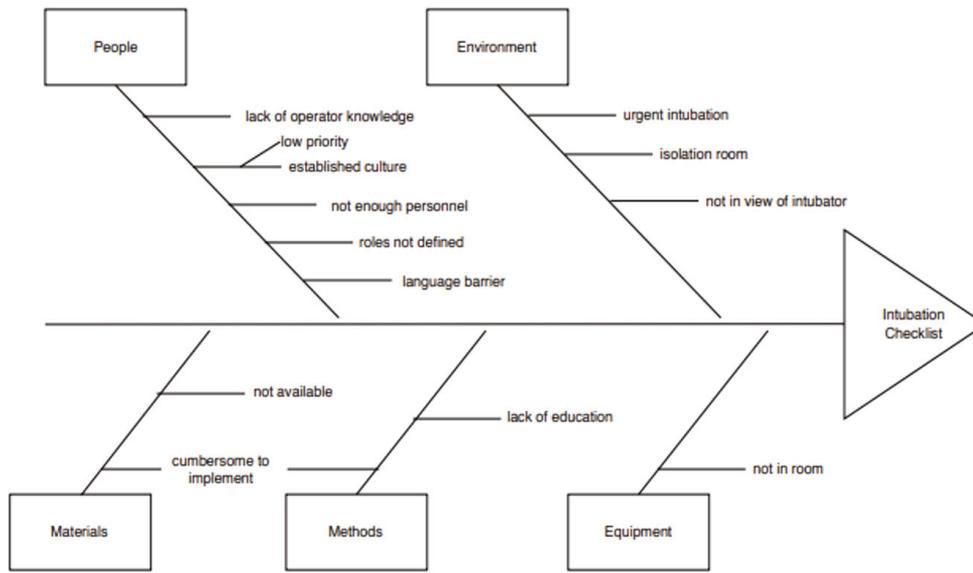
Improving the Prescribing of IV Fluids

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Introduction: Intravenous (IV) fluids are some of the most commonly prescribed day-to-day drugs. They have their indications, benefits, side-effects and complications. Evidence suggests that such prescriptions are rarely ever done correctly despite the presence of clear guidelines [1,2]. This is thought to be due to lack of knowledge and experience, placing patients at increased risk of harm, also incurring unnecessary costs to the hospital.

Objective: To ensure that all IV fluid prescriptions are safe, appropriate and adhere to NICE guidance by August 2017.

Methods: Review and improve the prescribing process of "IV fluid prescribing" via three simultaneous approaches (figure 1).

Teaching sessions were delivered to all junior doctors in order to improve knowledge and awareness of appropriate IV fluid prescribing and promote familiarity with the current NICE IV fluid guidelines. This included a 'feature session' at our local hospital Grand Round.

A point-of-care aide-memoire containing a summary of the information needed for correct prescription was designed and printed. This complimented the teaching sessions and supported good clinical practice.

Using serial Plan-Do-Study-Act (PDSA) cycles, a novel "IV fluid bundle" (figure 2) was developed, fine-tuned and trialled on five wards, (three surgical, two medical). The aim of the bundle was to ensure that patients were clinically reviewed in order to assess their volaemic status in order that appropriate IV fluids could then be selected and prescribed safely.

Results: The impact of these interventions was assessed on the trial wards via a weekly point prevalence audit of the IV fluid bundles for the duration of the trial. Parameters looked at were: incidence of deranged U&E's, incidence of AKI and the number of days between the latest U&E's and the patient's IV fluid prescription. With only a 50% uptake we were able to significantly improve outcomes. Of all of the patients on the IV fluid bundle, 100% had a documented review of both fluid status and balance. The incidence of deranged U&E's decreased from 48% to 35%. Incidence of AKI decreased 14% to 10%. The average number of days between the latest U&E's and a fluid prescription decreased from 2.2 days to 1.0 day.

Conclusion: Prescribing IV fluids is a complex task. It is an area of clinical practice that requires significant improvement both locally and nationally.

The project included carefully structured interventions geared towards tackling the confounding issues (education, awareness and organisational systems) identified from previous audits and process mapping.

Changing prescribing habits is an extremely challenging goal for many reasons. The introduction of a change that incorporates something clear and simple has a minimal effect on compliance. The design of a simple IV fluid bundle ensured minimal interference.

Since commencing the project, we have seen an improvement in the knowledge base around IV fluid safety. We have also noticed a clear improvement in the prescription of IV fluids in our trust.

Even though only a small representative sample of wards were selected for the fluid bundle trial, feedback was highly positive and reports were that the bundle was a help, not a hindrance.

We anticipate that further improvements will be achieved once the bundle has been incorporated into the hospital's electronic prescribing system eliminating confusion

as to where fluids should be prescribed. Fluids are drugs and should be safely prescribed as such.
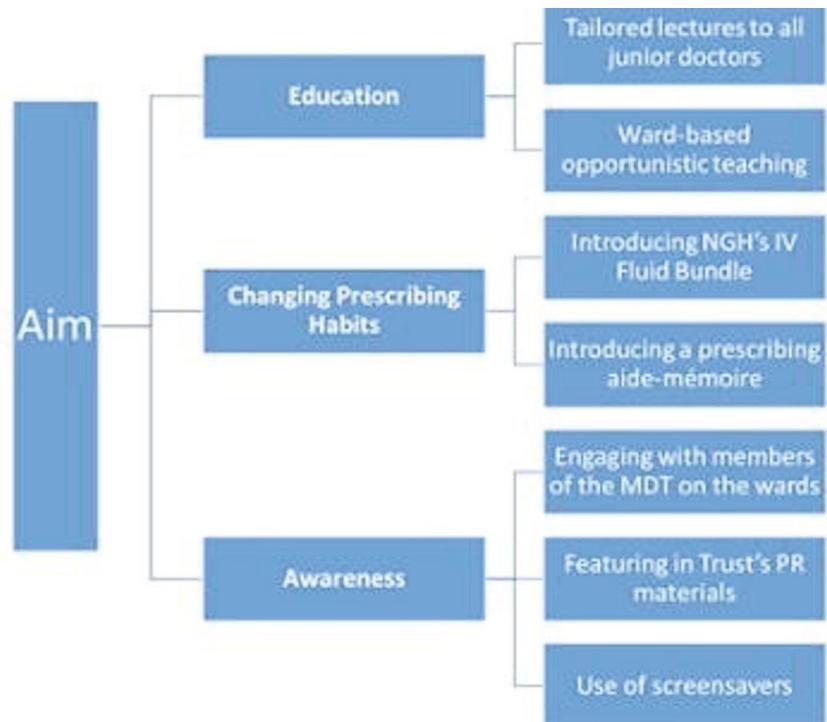
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Northampton General Hospital
NHS Trust

ADDRESSOGRAPH
LABEL

IV Fluid Bundle

Note: IV Fluids are drugs. Before prescribing IV fluids you must review the following:

1. Patient's fluid status (hypo/eu/hypervolaemia) — Now

    Assess using: clinical judgement, vital signs and fluid balance including urine output.

2. Patient's weight (on Vitalpac) — Within last 4 days

3. Patient's Urea and Electrolytes (on Vitalpac) — Within last 24 hours

4. Patient's fluid balance charts (Input and output) — Over the last 24 hours

File behind ********
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Fluid Status — Clinical Signs	
Hypovolaemia	**Hypervolaemia**
Thirst	
Hypotension (Systolic BP < 100)	
Tachycardia (HR > 90)	
Tachypnoea (RR > 20)	Peripheral oedema
Delayed capillary refill time (CRT > 2s)	Pulmonary oedema
Cold shutdown peripheries	Raised JVP
Reduced urine output (UO < 0.5 ml/kg/hr)	
Altered Urea: Creatinine ratio	

Review the back for guideline summary

Step 1 - Check Weight, Urea and Electrolytes

	Date	Weight	Na⁺ (135 - 145)	K⁺ (3.5 - 5.0)	Urea (3.5 - 6.7)	AKI Stage
Baseline						

This step can be completed by the nursing staff.

Step 2 - Check Fluid Balance (preceding 24 hours)

	Date	Input	Output	Balance	Fluid Status (hypo/eu/ hypervolaemic)	Can patient eat & drink?
Baseline						

This step is to be completed by the medical staff.

Nurses: Do not administer any prescribed IV Fluids without steps 1 and 2 being completed and reviewed by a doctor in the last 24 hours.

Step 3 - Prescribe IV fluids only below (i.e. not on ePMA/paper drug charts)

	Infusion Fluid		Additions to Infusion								Infusion times			Signatures	
Date	Approved Name/Strength	Volume	Medicine (Give additional instructions if required)	Dose	Amount	Route	Infusion pump rate (ml/hr)	Sign & Print & GMC	Batch #		Start	Stop	Volume given	Given by:	Checked by:

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Resuscitation	Maintenance
Give a **STAT** crystalloid fluid bolus (up to 500ml in less than 30 minutes). Re-assess the patient using **ABCDE approach** and monitor **urine output**. If no response ➔ Repeat fluid bolus as above. If adequate response ➔ Initiate maintenance fluids and monitor the patient Re-assess the patient using **ABCDE approach.** If inadequate response **after 2000ml of fluid boluses** ➔ Escalate to a senior member of the team.	Normal daily IV fluid and electrolyte requirements: **IV Water Volume:** 1.25 ml/Kg/hr **Na^+/K^+/Cl^-:** 1 mmol/Kg/day **Glucose:** 50 – 100 g/day **Urine Output:** 0.5 – 1 ml/kg/hr Review excess losses from fluid chart If patient requires IV fluids for more than 24 hours the patient will require **daily monitoring of U&E's.**

Hyponatraemia	Hypernatraemia	Hypokalaemia	Hyperkalaemia
Serum Na^+ < **135 mmol/L**	Serum Na^+ > **145 mmol/L**	Serum K^+ < **3.5 mmol/L**	Serum K^+ > **5.5 mmol/L**
Establish underlying cause of hyponatraemia. Correct hyponatraemia slowly to prevent complications. **SEEK SENIOR ADVICE** *Seek expert advice before considering hypertonic saline (1.8% NaCl)*	Encourage oral intake if possible. Correct hypernatraemia slowly to prevent complications. **SEEK SENIOR ADVICE** Manage as per NGH guidelines on the intranet. **DO NOT USE FLUIDS CONTAINING SODIUM**	Check ECG for changes **MILD (3.0 – 3.4)** Sando-K 2 tablets TDS Kay Cee L 25ml TDS Check level in 3 days **MODERATE (2.5 – 2.9)** Sando-K 2 tablets QDS Kay Cee L 25ml QDS Check level in 3 days **SEVERE (<2.5)** IV Replacement using 40mmol KCl in fluids BD or TDS Check level the next days Check serum Mg^{2+} level	***MEDICAL EMERGENCY*** Assess using **ABCDE** approach Send VBG **AND** laboratory sample to confirm Check ECG for changes **MILD (5.5–5.9)** Repeat in 6 hours in unwell patients or daily if stable Review medications & diet **MODERATE/SEVERE (>6)** Give 10ml Calcium Gluconate 10% IV over 3-5 mins via large vein. Give 10units Actrapid IV in 100ml of 20% glucose over 15 – 30 mins. Give 10-20mg nebulised salbutamol. **SEEK SENIOR ADVICE** Manage as per NGH guidelines on the intranet

Types of Fluids							
IV Fluid	Na^+	K^+	Cl^-	Ca^{2+}	Lactate	Glucose	Calories
	mmol/l	mmol/l	mmol/l	mmol/l	mmol/l	g/l	cal/l
0.9% NaCl	150	0	150	-	-	-	-
Hartmann's	131	5	111	2	29	-	-
5% Dextrose	-	-	-	-	-	50	200
0.18% NaCl & 4% Dextrose	30	-	30	-	-	40	160

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Incidence of Over-Sedation, Under-Sedation and Pain in Prolonged Ventilated Patients in Pediatric Critical Care

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Introduction: Sedation and analgesia are used to manage ventilated pediatric patients comfortably and safely. However, over-sedation can cause complications including prolonged mechanical ventilation[1] and Iatrogenic Withdrawal Syndrome (IWS).[2] Under-sedation puts patients at risk for unplanned extubation and agitation[3]. The use of standardized sedation and analgesia assessments can reduce under and over-sedation.[4] In our center, the protocol for sedation and analgesia titration relies on set targets for: State Behavioral Scale (SBS)[5] and Comfort B scale (CBS)[6], respectively. The way targets are ordered and met will affect quality of care. This project was part of a large initiative to decrease IWS incidence in our unit.

Objectives: (1) To determine the frequency of over-sedation, under-sedation and pain in pediatric patients intubated for longer than 5 days (2) to identify how the targets for SBS and CBS are ordered and how frequently.

Methods: This quality assurance project utilized data from a retrospective chart review that included patients intubated and ventilated for 5 or more days aged from birth to 18 years old from February 2015 to January 2016. Patients with a tracheostomy, ECMO, hemodialysis, and patients that died before sedation wean were excluded. Presence of under-sedation (US) was defined by SBS>0, presence of over-sedation (OS) was defined as SBS<-1 and presence of pain as CBS > 17[4]. The targets for sedation and analgesia were collected daily and categorized as first order set, second order set, third order set and fourth order set.

Results: 45 patients were included. The median age was 23 months (IQR 3.5-138), 40% of patients had a respiratory illness, 42% had a pre-existing condition, their PELOD-2 [7]score median was 5 (IQR: 4, 7). All but 1 patient experienced OS in some point of their time ventilated. Only 4 patients did not experience US or pain during the days that they were ventilated. Figure 1 shows the percentage of patients that experienced over-sedation or under-sedation per days after intubation. A total of 454 ventilation days were analyzed in this chart review 252 (55.5%) there was documented over-sedation,181(39.9%) under-sedation and 165 (36.3%) pain. 93.3% of patients had at least one set of SBS and MCS targets ordered, 77.8% in the first day of admission, and 60% had targets orders reviewed once. Table 1 attached is showing the targets of SBS and CBS ordered ranging from-1 to -2 and 8 to 14 respectively.

Conclusions: This study showed that patients in our institution were frequently over-sedated, reflecting targets that were ordered in lower ranges than those recommended by literature[4], which enabled over-sedation. MD orders of sedation and analgesia were identified as a root cause for over-sedation and consequently IWS. Simple and easy changes in documentation and daily bedside safety checklist were established in order to optimize use of sedation and analgesia and decrease complications related to over and under-sedation.

Table 1- Medical orders for sedation (SBS) and analgesia CBS

MD orders for sedation targets	SBS [1]		CBS [2]	
	min	max	min	max
First set median (IQR)	-2 (-2,-2)	-1(-2,-1)	8(6,10)	12 (10,14)
Second set median (IQR)	-2(-2,-1)	-1(-2,0)	8(8,12)	12 (12,14)
Third set median (IQR)	-1 (-2,-1)	-1 (-1,0)	10 (8,10)	14 (12,15)
Forth set median (IQR)	-2 (-2,-1)	0(-1,0)	10 (7,12)	12 (10,13)

(1) Sedation Behavioral Scale
(2) Comfort Behavioral Scale
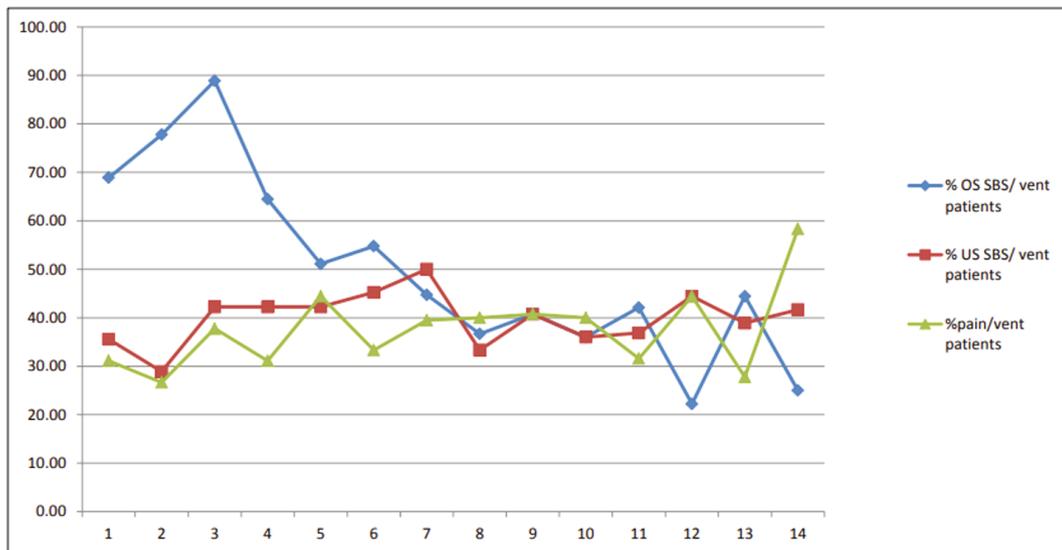
Figure 1: Daily frequency of over-sedation (OS)[1], under-sedation(US) [2] and pain [3] in ventilated patients

(1) Over sedation: SBS < -1; (2) Under-sedation: SBS >0; (3) Pain: CBS >17

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IV Maintenance Fluids at McMaster Children's Hospital: A Survey of Physicians

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Introduction: There are multiple controversies regarding fluid management in pediatrics, such as the ideal maintenance fluids, crystalloids vs colloids for volume expansion, and what appropriate volume of fluids to administer. In addition, awareness of the incidence of hyperchloremia and its associated morbidities is rising.

Objectives: To describe physicians' stated practices and preferences regarding IV fluids in hospitalized children, specifically with respect to: preferred solutions for maintenance and volume expansion, volume of administration, and frequency of monitoring; as well as their knowledge of IV fluid composition.

Methods: Self-administered electronic survey, to trainee and attending physicians at McMaster Children's Hospital. We generated items according to domains of interest, and pre-tested the survey. Surveys were emailed with up to 2 reminders, from May and July 2016.

Preliminary Results: 140 physicians responded: 53 (52%) staff, 11 (11%) fellows and 38 (37%) residents. The majority of respondents prefer isotonic maintenance fluids for all age groups: infants (77%), preschoolers (86%), children (89%) and adolescents (91%). However, some clinicians prefer hypotonic solutions particularly in for infants (16% of respondents) and preschoolers (12%). With respect to additives, 78% respondents routinely prescribe potassium; dextrose is not routinely prescribed in adolescents in 31% respondents. Respondents monitored serum electrolytes once daily or less frequently 38% in patients receiving IV fluids. Respondents typically were aware of the sodium content of 0.9% NaCl solutions (88% correct responses), while 53% correctly reported the sodium content of Ringer's Lactate (RL). Respondents were less aware of chloride content (66% and 36% correct responses for 0.9% NaCl and RL respectively). Respondents were generally unaware of the sodium and chloride content of other solutions (5-11% correct responses for plasmalyte, 5% Albumin). Regarding volume expansion, 0.9%NaCl is the preferred solution in 85% respondents, followed by RL (14%). In a septic shock scenario, 24% and 69% would consider starting inotropes after 40 mL/kg and 60 mL/kg respectively, of volume expansion.

Conclusions: Isotonic solutions are now the preferred maintenance solution. Clinicians do not have good knowledge of electrolyte content of commonly prescribed fluids beyond 0.9%NaCl. There may be a shift in practice towards a more conservative approach to volume expansion prior to inotropes.

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Mechanical Ventilation in Critically Ill Pregnant Women: A Systematic Review

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Introduction: Approximately 0.2 % of pregnant women will require mechanical ventilation (MV) due to critical illness, trauma, or complications associated with pregnancy [1]. Evidence-based management recommendations are lacking and clinicians are faced with uncertainties when defining their MV plan tailored to maternal and fetal physiology [2]-.

Objectives: This systematic review aims to describe MV strategies outlined in studies of critically ill pregnant women.

Methods: We performed an electronic search using MEDLINE, EMBASE, CINAHL, the Cochrane Library, PROSPERO and the Joanna Briggs Institute EBP databases (Jan 1980 to Sept 2016) using keywords and MeSH terms to identify English-language publications describing the use of invasive or non-invasive MV in pregnant women. We excluded case reports and case series reporting less than 5 women published earlier than 2002 due to publication of evidence of the benefit of lung protective ventilation. Reference lists of included articles were manually searched. Two authors independently performed title and full text screening, and data extraction.

Results: We retrieved 5034 studies and included 74 articles for data extraction and analysis. We found 44 case reports, 29 case series, and one case control study describing a median of 1 (IQR 1-10.75) women per study (total 924 women). Acute respiratory distress syndrome was the most common reason for ventilation (46 studies, 62%), most commonly due to influenza (26/46 studies, 57%)). Other frequent indications were status asthmaticus, pneumonia, and pulmonary edema. Overall maternal mortality was 21%.

Non-invasive ventilation (NIV) (bi-level and continuous positive pressure ventilation) was used in 19 studies (24%) for 127 women. NIV failure, defined as need to provide invasive MV was required for 58/127 women (46%).

Invasive ventilation was provided to 842 women in 70 studies (95%). Ventilator parameters were specified in 62% of studies. Most frequently reported modes were volume (184 women) and pressure control ventilation (11 women). Non-conventional modes such as airway pressure release ventilation were also used (7 women). When described, tidal volumes ranged from 5 to 10 ml/kg; positive end-expiratory pressure (PEEP) from 5 to 32cm H_2O. Few descriptions of inspiratory peak or plateau airway pressures were provided.

Adjunctive respiratory therapies were described in 43 studies (58%). Most frequently used were neuromuscular blocking agents (44 women); tracheostomy (33 women); venovenous extracorporeal membrane oxygenation (32 women); inhaled vasodilators (20 women); prone positioning (19 women); and high frequency oscillatory ventilation (11 women). Other therapies infrequently described were recruitment maneuvers and tracheal gas insufflation.

A total of 323 deliveries were described including 134 (41%) during MV of which 106 (79%) were delivered by caesarean section. The impact of delivery on respiratory function was rarely reported.

Conclusion: This systematic review describes various MV strategies used in critically ill pregnant women. There is limited evidence that MV strategies used in the general ICU population are well suited to pregnancy. Existing data are insufficient to make recommendations on how MV should be modified for the critically ill pregnant woman.

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Microbiology of Post-Operative Pulmonary Infections after Thoracoabdominal Aortic Aneurysm Repair

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Introduction: Postoperative pulmonary complications occur in up to 50% of patients after surgical repair of thoracoabdominal aortic aneurysms (TAAA). Early and repeated bronchoscopy is often necessary for pulmonary toilet in the postoperative phase, and early onset of pneumonia (≤7 days after surgery) is common. Clinical observations suggest a preponderance of gram-negative organisms in microbiological samples drawn during this early period.

Objective: This retrospective cohort study sought to characterize the frequency and underlying microbiology of postoperative pulmonary infections.

Methods: e conducted a single-center, retrospective cohort study of TAAA repairs performed by a single surgeon between 2013 and 2016. Information pertaining to eligible patients' demographics, comorbidities, Crawford classification other surgical characteristics, microbiology, antibiotic use, and outcomes, including duration of ventilation, mortality, intensive care unit (ICU) and hospital length of stay (LOS), were abstracted from their medical records.

Results: The cohort included 27 patients who underwent 28 TAAA repair surgeries. The mean age was 55.4 years (IQR 51y and 64y) and 19 (70.3%) were male. With respect to comorbid disease, 8 patients had cardiac disease and 10 had Marfan's syndrome or other connective tissue disorders. Of the procedures, 9 were urgent or emergent repairs, 19 were Crawford Types 1 or 2 repairs and 9 were Types 3, 4, or 5 repairs. Three patients died, including 1 from ARDS leading to multi-organ failure. Ten (37%) had pneumonia requiring antibiotics within 7 days after surgery. In all 8 cases with positive cultures, gram negative species were the predominant microbe. The median ICU LOS was 25.5 days among individuals with pneumonia versus 7 days for those without (p=0.02).

Conclusion: This cohort study provides new data on the frequency of early pulmonary infections and their concomitant microbiology in this postoperative population. Gram negative species predominate despite the early post-operative timing. These data may provide insights into new approaches for perioperative antimicrobial prophylaxis, such as broadening of antibiotic coverage, selective digestive tract decontamination, or probiotic administration.

Figure 1: Crawford Extent Classification

Open Source Document: Diagnosis and treatment of thoracic aortic aneurysm. J Korean Med Assoc. 2014 Dec;57(12):1014-1025. https://doi.org/10.5124/jkma.2014.57.12.1014. Accessed July 21, 2017.
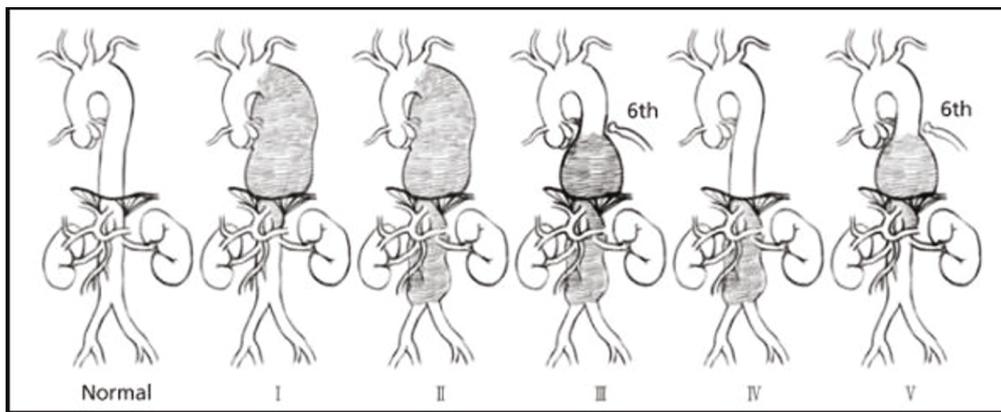
Table 1: Characteristics Of Study Cases

	No pneumonia	Pneumonia
Number of cases	18	10
Proportion male	66.7%	80.0%
Mean age, years	55.9	53.5
Proportion Crawford Extent 1 and 2	72.2%	90.0%
Mean Duration of CPB*, minutes (median)	97.0 (65.5)	149.5 (148.5)
Mean ICU LOS, days (median)	8.6 (7.0)	28.9 (22.5)
Mean Hospital LOS, days (median)	22.1 (15.0)	43.0 (35.0)
Mean Day 1 SOFA score (median)	10.3 (11.0)	11.1 (12.0)
Mean Intraoperative blood transfusions (median)	5.8 (5.0)	13.4 (12.5)

*CPB: cardiopulmonary bypass

Table 2: Microbiology of Cases Diagnosed With Pneumonia

Case 1	Commensal
Case 2	Klebsiella
Case 3	Commensal, heavy growth
Case 4	Enterobacter, Burkholderia cepacia
Case 5	Moraxella
Case 6	Enterobacter, Haemophilus
Case 7	Enterobacter
Case 8	Pseudomonas
Case 9	MSSA, Klebsiella
Case 10	Proteus

Monitoring Intensive Care Unit Performance: Impact of a Novel Individualized Performance Scorecard in Critical Care Medicine – A Mixed-Methods Study Protocol

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Background: Patients admitted to a Critical Care Medicine (CCM) environment, including an Intensive Care Unit (ICU), are among the most susceptible to harm, and also account for significant resource utilization. Given this, a strategy to optimize health care provider performance is required. Performance scorecards have been utilized by healthcare institutions for the purposes of monitoring clinical performance and driving quality improvement. Unfortunately, most scorecards use overall outcomes that are hard to attribute to an individual. Furthermore, individuals will often tailor their practice to optimize scorecard variables (so-called "gaming"), instead of patient-centred care. While scorecards have been introduced in CCM to monitor safety, there is no widely-accepted or standardized scorecard that has been utilized for overall CCM performance.

Objectives: We aim to improve quality of care, patient safety, and patient and family experience in CCM practice through the utilization of a standardized, repeatable and multidimensional performance scorecard, designed to provide a continuous review of ICU physician and nurse practice, as well as departmental metrics.

Methods and Analysis: This will be a mixed-methods, controlled before and after study to assess the impact of a multidisciplinary clinical quality scorecard (specifically designed for CCM). Scorecard metrics were developed through expert consensus and existing literature. Attempts have been made to address "gaming" actions by incorporating multiple, opposing measures (so-called "Balanced Composites"). The study will include 19 attending CCM physicians and approximately 300 CCM nurses. Patient data for scorecard compilation is collected daily from patient bedside flow sheets. Pre-intervention baseline data will be collected for 6 months for each participant. After this, each participant will meet with the Department Head or Nursing Coordinator, at which time they will receive their individualized scorecard measures. Following a 3-month washout period, post-intervention data will be collected for 6 months. The primary outcome will be change in performance metrics (including mortality, ICU length of stay, sedation, pain management, mobility, etc) following the provision of scorecard feedback to subjects. A cost analysis will also be performed. The qualitative portion will include interviews with participants once the intervention phase has been completed. Interviews will be analyzed in order to identify recurrent themes and subthemes, for the purposes of driving scorecard improvement.

Ethics and Dissemination: The study protocol has been approved by the local research ethics board. Publication of the study results is anticipated in 2018 or 2019. If this intervention is found to improve patient and unit-directed outcomes, with evidence of cost-effectiveness, it would support the utilization of such a scorecard as a quality standard in CCM.

Table 1 – Validated Performance Metrics For Scorecard Inclusion

Variable	Tool to be Utilized
Pain (for patients that can self-report)	Numeric Rating Scale (NRS), Visual Analog Scale (VAS) [15, 16]
Pain (for patients that are unable to self-report)	Critical Care Pain Observation Tool (CPOT) [17]
Delirium	Confusion Assessment Measurement for the ICU (CAM-ICU) [18]
Sedation	Richmond Agitation and Sedation Scale (RASS) [19]
Mobility	ICU Mobility Scale (IMS) [20]
Mechanical Ventilation Weaning	Spontaneous Breathing Trials [22]
Fluid Balance in Acute Lung Injury	Conservative Fluid Strategy [21]
Blood Glucose Management	Avoidance of Hyperglycemia [23, 24]
Physician Feedback	Ottawa 360 Tool
Family and Patient Satisfaction	Ottawa 360 Tool
Central Line Associated Bloodstream Infection (CLABSI)	Presence and Duration of Central Lines [26]

Table 2 – Performance Scorecard

Measure	Individual Score	Population Median Score	Target Score
1. Mortality (%)			
2. Efficiency			
a. No. Admitted Patients / Day			
b. No. Patients Discharged / Day			
3. Sensorium			
a. % of CAM+ Patients			
b. % of CAM+ Patients receiving sedation			
c. % of patients with RASS score -4 or -5			
4. Analgesia			
a. CPOT Daily Score			
b. % of Patients with CPOT > 2			
c. Mobilization Score			
5. Ventilation and Weaning			
a. % of Patients maintained on Ventilator			
b. Extubation %			
c. Re-intubation Rate <48hrs after Planned Extubation			
d. % SBT of Ventilated Patients			
6. Fluid Balance			
a. Median Fluid Balance			
b. Median Fluid Balance / 24 hrs			
7. Prevention			
a. % Patient Days with 1 Blood Glucose >12			
b. % Patient Days with Central Line			
c. % Patient Days receiving nutrition			

Non-Invasive Administration of Inhaled Nitric Oxide in Critically Ill Adults and its Effects on Right Ventricular Function - A Cohort Study

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Introduction: In patients with acute right ventricular (RV) failure, decreasing RV afterload by administering inhaled vasodilators represents an interesting therapeutic approach, which has for now only been described in conjunction with endotracheal intubation[1-4], whereas positive pressure mechanical ventilation and sedation can both be hemodynamically deleterious in such patients[5].

Objectives: We aimed to assess the hemodynamic effects of non-invasively administering inhaled nitric oxide (iNO) in critically ill patients with acute RV failure, as well as demonstrate the feasibility and explore the safety profile of this approach.

Methods: This is a retrospective cohort study in which we evaluated the clinical course of all hemodynamically unstable patients with RV failure in whom iNO was initiated without intubation and mechanical ventilation in the intensive care unit (ICU) of our two centers between 2013 and 2017. The primary outcome was modifications in RV function parameters after starting iNO, and secondary outcomes included ICU length of stay, mortality, and occurrence of specific side effects (acute kidney injury as per the RIFLE[6] definition, significant bleeding prompting clinical intervention and persistent headache in the patient or nursing staff).

Results: 18 patients were included in the analysis, 12 (67%) received iNO after cardiac surgery (mean EuroscoreII 19 ± 14) and 6 (33%) received iNO in a non-surgical context. Median [Q1; Q3] iNO concentration was 20 [20; 20] ppm and therapy duration was 24 [12; 46] hours. Most patients received iNO through nasal prongs (66.7%) or high flow nasal cannula (27.8%). Within one hour and compared to just before initiation of therapy, iNO reduced mean pulmonary artery pressure (PAP) from 28.4 to 25.3 mmHg (P=0.01), central venous pressure (CVP) from 17.5 to 13.1 mmHg (P<0.001), the ratio of mean PAP on mean arterial pressure[7] from 39% to 33% (P<0.001) and the RV function index[8] (systolic PAP/indexed cardiac output) from 23.2 to 18.6 (P=0.03). The pulmonary artery pulsatility index[9, 10] ((systolic PAP – diastolic PAP)/CVP) increased from 1.45 to 2.24 (P=0.002), as did the indexed cardiac output from 2.0 to 2.6 l/min/m^2 (P=0.004). These rapid hemodynamic changes were not associated with significant modifications of vasopressor and inotrope doses. ICU mortality was 27.78% and median ICU length of stay was 7 [5; 9] days. Two significant bleeding episodes and one acute kidney injury occurred during iNO therapy but none was felt to be attributable to iNO. No headache was reported by the patients or nursing staff.

Conclusion: Non-invasively administered iNO was associated with favourable hemodynamic effects in ICU patients with acute RV failure. This is the first report regarding such a therapeutic approach for these clinically challenging patients. Our results suggest the safety and feasibility of this therapy for which further prospective study is warranted.

Figure 1: Right ventricular function parameters before and after initiation of non-invasively administered inhaled Nitric Oxide
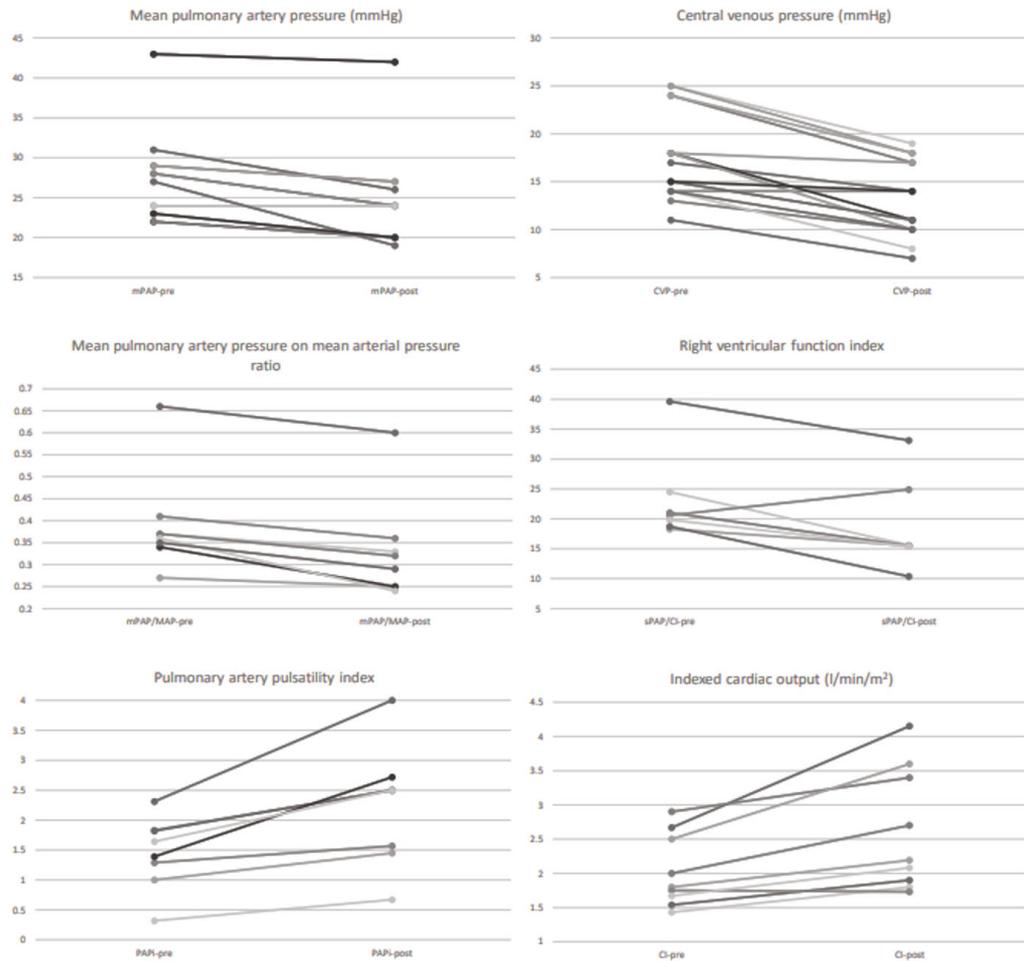
Values are obtained within one hour before and after initiation of inhaled nitric oxide therapy.
CI : indexed cardiac output; CVP: central venous pressure; MAP: mean arterial pressure; PAP: pulmonary artery pressure; PAPi: pulmonary artery pulsatility index as defined as (systolic PAP – diastolic PAP) / CVP; Right ventricular function index as defined as systolic PAP/indexed cardiac output.

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Perioperative Management of a Case of Thoracoabdominal Aortic Aneurysm

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Introduction: Thoraco abdominal aneurysm repair is a complex vascular surgery with high post-operative morbidity and mortality. The patient in this case report was diagnosed as a case of thoraco-abdominal anuerysm on CT angiogram. Case report: A 56 year old gentleman, ASA IV, presented for repair of De Bakey type III, dissected thoraco-abdominal aortic aneurysm. preoperative investigations were normal. Anaesthesia was induced with Midazolem, Etomidate, Fentanyl and Rocuronium after applying the standard monitoring. Before induction lumbar drain was inserted and the transduced pressure was 13 mm Hg. a left radial arterial line was placed. A left sided double lumen tube of size 37 was tried initially but due to compression of left main bronchus by the aneurysm the tube was placed on the right side .After two attempts an ETT size 8.5 was passed with a bronchial blocker. central venous and swans ganz catheter were inserted. One lung ventilation was established. Anaesthesia was maintained with 40% oxygen and Isoflurane (0.9-1.3). A total of 1000 micrograms of fentanyl was administered throughout the case. A TEE probe was placed for monitoring of left ventricular function. The patient was heparinized; common femoral artery and vein were cannulated and then cooled to 20ºC. In the process. The aneurysm was then opened longitudinally. A 28mm Vascutek Dacron was anastomosed end to end. The operative findings revealed a very large dissecting aneurysm starting flush with left subclavian artery. The CSF pressure was continuously monitored during the procedure and CSF was passively drained when the pressure exceeds 13 mm Hg. During the case 10-20 mls of CSF was drained to maintain the pressure between 9-13 mm Hg. The patient was then shifted to CICU where he kept ventilated. He was then weaned from ventilator and extubated on fourth post op day but was reintubated on sixth post op day for drowsiness due to raised serum ammonia levels. Gradually the GCS restored to 10/10. Afterwards the patient had sepsis, acute kidney injury and ventilator associated pneumonia. Blood cultures were positive for carbapenem resistant Klebsiella pneumoniae. Tracheal cultures revealed acinetobacter. Antibiotics were started after taking ID on board. Tracheostomy with insertion of PEG was performed for prolong ventilation. Finally the patient was weaned off from ventilator and discharged home after approximately two and a half months. Conclusion: We presented a patient who underwent extent II TAAA repair, using permissive hypothermia, LHB, CSF drainage, and cold crystalloid renal perfusion. This technique offers the potential benefit of providing protection against brain, cardiac, renal, visceral, and spinal dysfunction without having to use adjuncts such as LHB, CSF drainage, selective perfusion of renal and visceral arteries, regional spinal cooling, or sequential aortic clamping.

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Pharmacists' Role in Critical Care: Environmental Scan of Current Practices in Canada

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Introduction: Clinical Pharmacists have been members of the multidisciplinary team providing direct patient care in Critical Care since the 1970's. Practice has grown and developed in different parts of the country independently of each other, guided by American research and position papers. An environmental scan of current practices in Canada does not currently exist in the published literature.

Objectives: To describe current practices of ICU Pharmacists in Canada.

Methods: An open-form survey consisting of 14 questions was distributed to all members of the Canadian Society of Hospital Pharmacists, Critical Care Practice Speciality Network via email. Follow-up telephone correspondence inviting participants working in critical care was then performed.

Results: A 10% response rate included 31 respondents from across Canada; 71% of those practiced within a tertiary care centre, 93% in mixed medical / surgical units. The mean size of intensive care units was 21 beds (Median 20, Range 6-44, IQR 12-27) and mean pharmacist to patient ratio was 13 to 1 (Median 12, Range 6-23, IQR 10-17). (Table 1) A team of pharmacists shared ICU coverage in 77% of cases. Within those teams, 30% of staff have advanced training with either a Post-baccalaureate Doctor of Pharmacy (PharmD) or Masters degree, and 39% of organizations require an entry-to-practice degree and some on-the-job training as a minimum to practice in Critical Care. Advanced-degree training found more commonly in Vancouver and Toronto, where the Faculties of Pharmacy have offered PharmD degrees for more than a decade.

Patient care rounds are completed in a standardized fashion in 55% of centres, with another 11% of centers reporting a similar format determined by the Attending Physicians. (Table 2) Within rounds, the Pharmacist has an allotted time to present in 52% of critical care units, with the remainder either expected to support and comment on presentations from other members of the team or as agreed upon with the Attending Physician. Clinical Pharmacists provide 8 hour/day coverage in 92% of centres, five days a week in 84%, with 4 hours (range 3-8) devoted to rounding. During rounds, pharmacists describe their contribution as most commonly reviewing current medications; adjusting medication dosing for organ dysfunction; reviewing antimicrobial therapy; providing therapeutic drug monitoring; and ensuring appropriate prophylaxis for stress ulcers, venous thromboembolism, and ventilator associated pneumonia. Pharmacists report using a checklist 33% of the time to prepare for rounds.

A standardized patient monitoring form is used at 55% of sites and 80% of pharmacist documentation occurs outside the legal record on pharmacy documentation records. Pharmacists indicate that the majority of their suggestions/interventions on rounds are included in the Physician's Progress notes in 87% of centres. Supplementation of the physician progress notes occurs in 56% of centres when the Pharmacist determines greater detail is required or if the pharmacist's recommendation is discordant with the decision from rounds.

Conclusion: Pharmacists' practice in critical care is variable in Canada. Higher credentialing is found in areas where a post baccalaureate PharmD program has been in existence for greater than 10 years. Documentation of interventions largely

occurs within the physicians progress note and the majority of pharmacist documentation occurs outside of the legal record.

Table 1: Demographics

Location (n=31)	
Atlantic Provinces	4 (8%)
Quebec	1 (2%)
Ontario	10 (21%)
Manitoba	2 (4%)
Saskatchewan	2 (4%)
Alberta	5 (10%)
British Columbia	7 (15%)
Type of Institution (n=31)	
Tertiary	22 (71%)
Community	7 (23%)
Region, City, or group of hospitals	2 (6%)
Size of Institution, number of beds, Mean(Range)[IQR]	502 (150-1325) [344-550]
Size of ICU, number of beds, Mean(Range)[IQR]	21 (6-44)[12-27]
Type of ICU (n=30)	
Mixed Medical / Surgical	28 (93%)
Medical	2 (7%)
Level of pharmacist training of team members	
Entry to Practice (Bachelors, Entry to Practice PharmD)	10%
Accredited Canadian Pharmacy Residency	13%
Advanced Degree (post- baccalaureate PharmD, Masters)	29%
Board Certified Pharmacotherapy Specialist	3%
Mixed	45%
Minimum Pharmacist Training Required for ICU Practice	
Entry to Practice (Bachelor, Entry to Practice PharmD)	39%
Accredited Canadian Pharmacy Residency	36%
Advanced Degree (post- baccalaureate PharmD, Masters)	26%
Size of Pharmacist Team sharing coverage, Average(Range)[IQR]	4 (2-9)[3-4]

Table 2: Pharmacist Clinical Coverage of Critical Care

Hours of Pharmacist ICU Coverage per day (n=27)	
4	1 (4%)
6	1 (4%)
8	25 (92%)
Hours devoted to rounds on a daily basis, Average(Range)[IQR] (n=9)	4 (3-8) [4-6]
Days per week of Pharmacist Coverage	
4	3%
5	84%
7	13%
Pharmacist : Patient Ratio, Average(Range)[IQR]	13 (6-23) [10-17]
Pharmacist Employ standardized Patient Monitoring Form (PMF) (n=31)	17 (55%)
PMF Shared between ICU Team Pharmacists (n=23)	16 (70%)
PMF Shared with Clinical Pharmacist with ward handover (n=30)	11 (37%)
PMF not included in legal record (shadow charting) (n=30)	24 (80%)
Standardized Rounds Structure (n=31)	17 (55%)
Rough Rounding Structure (n=31)	11 (35%)
Allotted time for Pharmacist to present during rounds (n=31)	16 (52%)
Pharmacists' rely on Prescribers' Progress Note to capture interventions from rounds (n=31)	27 (87%)
Pharmacist supplement Prescribers' Progress Note when discordant or more details necessary (n=30)	17 (56%)
Pharmacist Write Orders on Rounds (n=31)	
Yes	3 (10%)
No	23 (74%)
Sometimes	5 (16%)

Pleural Drainage Enhances Diaphragmatic Pressure Generation in Mechanically Ventilated Patients

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Introduction & Objective: Pleural drainage is sometimes proposed as a means of facilitating weaning from mechanical ventilation, but the mechanism of benefit from this procedure is unclear [1,2]. Experimental data and prior observations in non-mechanically ventilated patients suggest that draining effusions may improve diaphragm mechanics [3,4] but this hypothesis has not been tested in mechanically ventilated patients. We undertook to determine whether pleural drainage enhances diaphragmatic pressure generation in mechanically ventilated patients.

Methods: We enrolled mechanically ventilated patients with large pleural effusions on chest radiograph who had been selected by the medical team to undergo pleural drainage. An esophageal catheter was placed to record esophageal (Pes) and transdiaphragmatic pressure (Pdi) and diaphragm electrical activity (Edi). Pressures and Edi were recorded while subjects were placed on a CPAP trial with zero airway pressure (for up to 10 minutes as tolerated) before and after pleural drainage. Changes in Pes were corrected for swings in gastric pressure (Pga) due to expiratory abdominal muscle activity. The primary outcome was neuromuscular coupling (NMC) of the diaphragm, defined as the ratio of Pdi to Edi [5]. We also examined changes in NMC of the respiratory system (Pes/Edi), neuroventilatory coupling (NVC, tidal volume Vt/Edi), dynamic compliance (Cdyn = Vt/P_L, transpulmonary pressure), and respiratory timing parameters.

Results: Four patients were enrolled, Three of four subjects could not complete the 10-minute CPAP trial prior to drainage (median 6.6 minutes). All subjects underwent pleural drainage (volume drained 400cc–1510cc). Immediately following pleural drainage, all subjects completed the 10-minute CPAP trial without distress. Venous CO_2 tensions were unchanged before and after drainage. Diaphragm NMC increased following drainage (Figure 1A, p<0.001), although the improvement was observed in 3 of 4 patients (NMC increased by 17% to 50%). Respiratory NMC increased in all subjects (Figure 1B, p<0.001, range 19%-87%). Increases in NMC were accompanied by decreases in end-expiratory Pes, though one subject exhibited a paradoxical increase in end-expiratory Pes. Cdyn improved in 2 of 4 subjects (Figure 1C). These combined changes in NMC and Cdyn gave rise to significant improvements in NVC (Figure 1D, p<0.001, range 13%-77%). One subject exhibited a significant (57%) decrease in respiratory rate after drainage without changes in venous PCO_2.

Conclusion: We observed significant improvements in diaphragm NMC, respiratory NMC, and CPAP trial tolerance following pleural drainage, consistent with the hypothesis that pleural effusions impede weaning from ventilation by impairing diaphragm mechanics. These findings suggest that pleural drainage may provide the greatest benefit to patients with reduced maximal inspiratory pressure-generating capacity.

Figure 1. Physiological effects of pleural drainage in mechanically ventilated

patients. Neuromuscular coupling of the diaphragm (A, top left) and respiratory system (B, top right) improved in 3 out of 4 patients following drainage, while dynamic compliance (C, bottom left) improved in 2 out of 4 patients. These changes gave rise to consistent improvements in neuroventilatory coupling (D, bottom right).
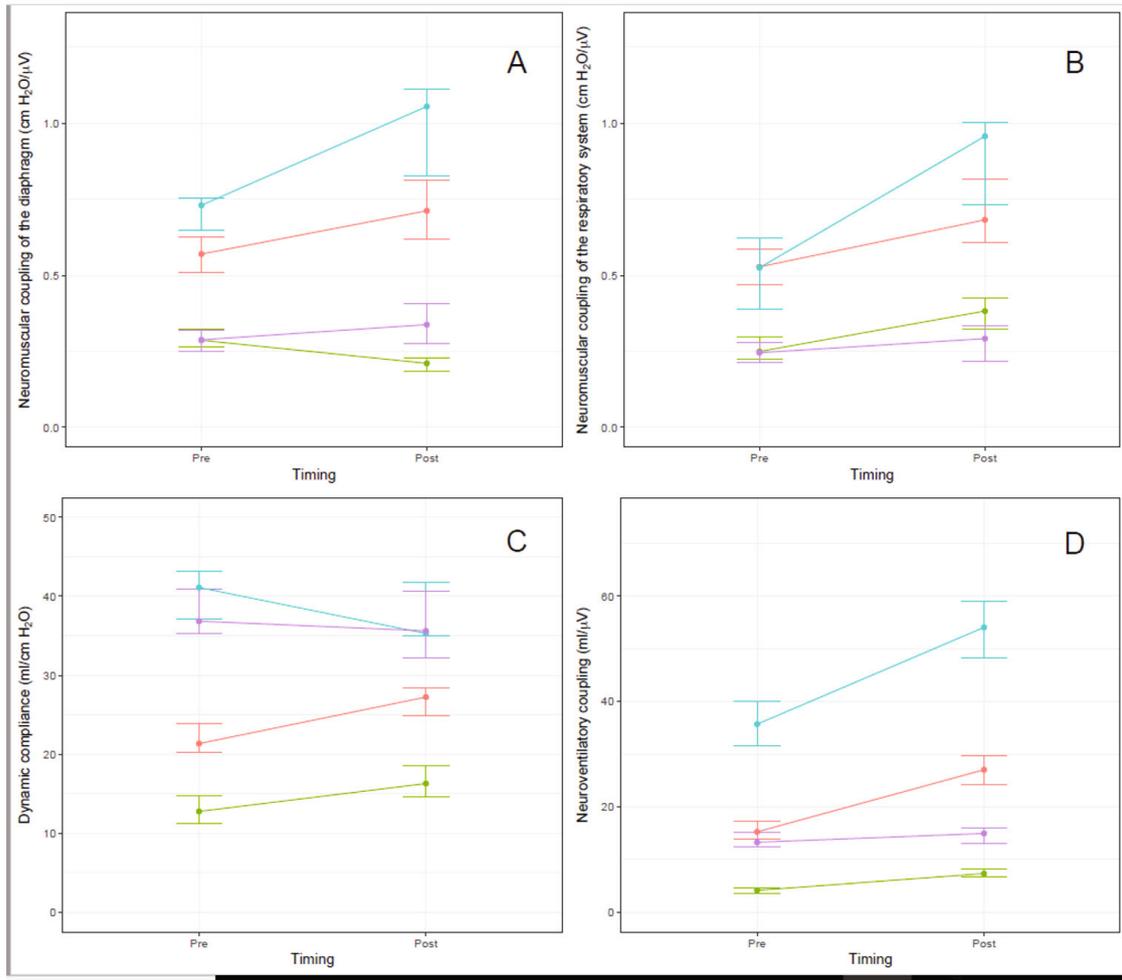
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Predicting In-Hospital Mortality in Pneumonia-Associated Septic Shock Patients Using Classification and Regression Tree (Cart) Methodology

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Background/Aim: Bacterial pneumonia and septic shock are associated with substantial morbidity and mortality. Classification and Regression Tree (CART) methodology allows the development of predictive models using binary splits and offers an intuitive method for predicting outcome using processes familiar to clinicians. We aimed to improve determinations of prognosis at the time of admission for pneumonia and septic shock using CART model analysis.
**Methods:** CART models were applied to all pneumonia-associated septic shock patients between 1996 and 2015 (n=4222) from the international, multicenter CATSS database. The association between patient and practice-related factors (time delay to appropriate antimicrobial therapy, severity of illness) and in-hospital mortality were evaluated. The accuracy in prediction of outcome (AC), sensitivity (SN), specificity (SP), and area under receiver-operating curve (AUROC) of the final model were evaluated in training (n=2111) and testing (n=2111) sets.
Results: In the overall cohort (n=4222, mean age 62 years, 61% male), overall mortality at hospital discharge was 51%. Sixty-three percent (n=2652) were culture positive (tracheal aspirate/sputum or blood), 21% (n=876) had co-existent bacteremia and 35% (n=1075) had nosocomial infections. Of culture positive patients, the most common pathogens were staphylococcus sp. (n=702/2652, 27%), streptococcus sp. (n=658, 25%), pseudomonas sp. (n=267, 10%), Escherichia coli (n=225, 8.5%), Klebsiella sp. (n=183, 6.9%) and Haemophilus influenzae (n=118, 4.4%). On ICU admission, mean (SD) APACHEII was 26(8) and lactate 4.1 (3.9) mmol/L. While in ICU, 89% (n=3760) required mechanical ventilation and 11% (n=464) required new renal replacement therapy. Of 3048 patients who received appropriate antimicrobial therapy after the development of hypotension (shock), the mean delay to therapy was 10.9 hours. In the training set (n=2111) a new CART model (see Figure 1) using APACHEII ≥ 28, lactate ≥ 6.3 mmol/L, age > 65 and delay to appropriate antimicrobial therapy ≥ 6.6 hours yielded predictive AC 73%, SP 75%, SN 71% and AUROC 0.75. In the testing set (n=2111), the CART model offered predictive AC 69%, SP 72%, SN 65%, AUROC 0.72.

Model	Accuracy	Specificity	Sensitivity	AUROC
Training (n=2111)	0.73	0.75	0.71	0.75
Testing (n=2111)	0.69	0.72	0.65	0.72

Conclusion: Overall mortality in patients with pneumonia and septic shock is high (~51%). Delay to appropriate antimicrobial therapy, admission severity of illness (APACHEII), serum lactate and advanced age discriminated those patients who

survived to hospital discharge and those who did not. CART offer simple prognostic models with good performance.
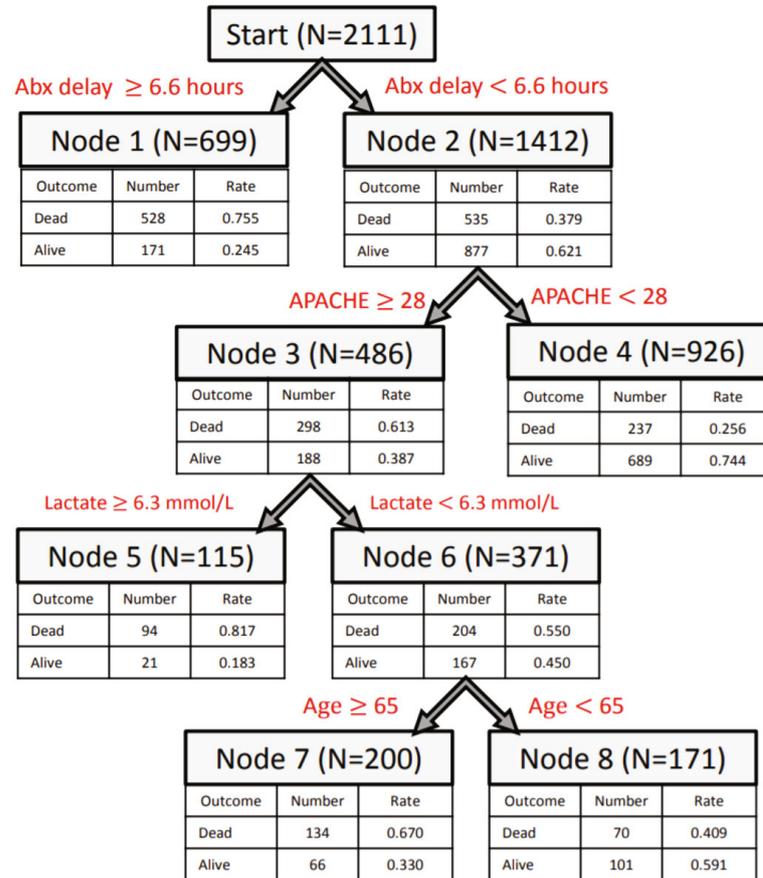
Predictive Value of Myoglobin and Creatine Phosphokinase for Development of Acute Kidney Injury in Traumatic Rhabdomyolysis

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Introduction: Rhabdomyolysis (RM) is a clinical syndrome secondary to skeletal muscle injury (1–4). The products of muscle breakdown, notably myoglobin causes renal failure (1–4). Traditionally, serum Creatinephosphokinase (CPK) is being measured to assess and manage RM to prevent acute kidney injury (AKI)(4). When myoglobin is the direct cause of renal injury, estimation of serum myoglobin than CPK, a surrogate marker in RM would be more reliable in assessing the risk of AKI severity and guide the management of RM(5). This study is an attempt to establish serum myoglobin levels which would predict establishment of renal failure in RM, compared to serum CPK in patients treated with "crush protocol".

Objectives: Primary: of the study is to determine if serum myoglobin is a more reliable marker than CPK for development of AKI in traumatic RM.
Secondary:
a) To determine serum myoglobin level which predicts development of AKI
b) To determine need for renal replacement therapy (RRT).
c) To determine duration of mechanical ventilation (MV), ICU length of stay (ICULOS) and in hospital mortality in patients with and without AKI.

Methods: A prospective observational study in with traumatic RM. Inclusion criteria: Age (18-70yrs), trauma induced RM (excluding compartment syndrome). Exclusion criteria: Patients with chronic renal failure and RM due to other aetiologies. Informed consent or assent was obtained as appropriate. Patients admitted following trauma were screened and twere recruited when serum CPK was >5,000 IU/L during screening or subsequently during the course of ICU admission. All patients received standard treatment including intravascular volume optimization and hemodynamic stabilisation along with initiation of "crush protocol" (Fig:1) when serum CPK >5,000 IU/L. Serum myoglobin (Roche Diagnostics electrochemiluminiscent assay) was estimated along with CPK. Urine pH was determined 8th hourly as part of crush protocol. Renal function was monitored with hourly urine output and serum Creatinine. AKI was diagnosed using AKIN criteria(6).
The discriminating capacity to determine AKI using peak serum myoglobin and peak CPK levels were analysed using the ROC curve and optimal cut off values were chosen. Categorical data were expressed as frequency and percentages. Continuous variables are presented as mean (SD) or median (IQR) based on normality. The relationship between categorical variables and AKI was analysed using the Chi-square test. The relationship between continuous variables and AKI was analysed using the independent t-test or rank sum test based on normality. All data was analysed using STATA I/C 13.1 version.

Results: (DETAILED IN Table 1):
Of the 14 patients with AKI, 10 had stage 1, 2 each had stage 2 and 3 AKI and one patient needed RRT. To predict AKI, peak serum myoglobin value of ≥5,160ng/ml was found to have 78.57% sensitivity and 79.17% specificity and peak CPK value of ≥12,388U/L was found to have 64.29% sensitivity and 59.21% specificity. Development of AKI did not increase ICULOS, duration of MV or Mortality.

Conclusion: Following traumatic RM, in patients on crush protocol, serum myoglobin is a more sensitive and specific marker than serum CPK for predicting AKI. Myoglobin level >5,000ng/l is associated with an increased risk of AKI. Monitoring serum myoglobin is useful for identification of risk of AKI and response to

therapy in traumatic RM. Serum myoglobin can be used to prognosticate AKI in traumatic rhabdomyolysis.

Crush protocol for Rhabdomyolysis

Fig.1

Serum CPK ≥ 5000 U/L

Investigations
- Daily/ twice a day CPK
  - If serum CPK ≥ 20,000U/L increase target fluid intake and output by 50%
- Daily Serum Na^+ and K^+
  - Based on serum sodium change I/V fluid to $^1/_2$NS, $^1/_4$NS or 5% dextrose
- Twice a week Mg^{2+}, PO_4, Ca^{2+}/Albumin
  - Correct Hypocalcemia only for Hyperkalemia / hypotension
- Daily Serum osmolarity
  - Discontinue Mannitol if > 310 mOsm/Kg

- **Volume resuscitation**
- 100ml 7.5% $NaHCO_3$ in 1 litre Normal Saline @ 2ml/Kg/hr
- **Free radical scavenging** Mannitol 0.25g/Kg iv Q6H

Alkalinisation of Urine

Daily Blood pH (arterial/venous blood gas)

Blood pH >7.5 with HCO_3 >27 mmol

Yes → Stop $NaHCO_3$

Hourly urine output

Check urine pH Q8H

Urine output < 2ml/Kg/hr

Yes

No

< 6 | 6 - 7 | > 7

- Maintain adequate Intravascular volume
- Maintain adequate blood pressure

Continue the same

Blood pH < 7.5

Yes

No

If Target urine output not achieved, consider Torsemide bolus

- Administer 50ml $NaHCO_3$ bolus
- Recheck urine pH after 2 hrs

- Stop $NaHCO_3$
- Continue diuresis
- Consider Azetazolamide

Continue the same

IMPORTANT CONSIDERATIONS
- Avoid fluid overload especially in respiratory failure
- If CPK persistently high, consider limb ischemia/ compartment symdrome
- No mannitol for anuria/ AKI
- Consider RRT for hyperkalemia or AKI
- Avoid nephrotoxic agents (NSAID, Aminoglycoside etc)
- Stop when CPK <3000U/L

Graph 1: ROC curve CPK/ Myoglobin

	Non AKI	AKI	*p* value
Number of patients	76 (83.33%)	14 (16.67%)	
APACHE II	14.31±5.96	17.83±8.70	0.3916
Duration of MV (days)	3.70±3.59	6.18±6.69	0.3030
ICU LOS (days)	5.41±3.24	12.09±18.66	0.4498
Peak CPK (U/L)	16650.89±19237.54	29170.07±31383.75	0.0317
Peak Myoglobin (ng/ml)	5112.86±8794.74	23104.79±43709.20	0.0007(Level of significance 1%)
Mortality	23	5	0.686

Table 1: Results

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Regulatory Barriers to Research in Deceased Organ Donor Care

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Introduction: Improving the care of deceased organ donors could increase the number of organs recovered by 20%. Clinical research contributes to improvements in care. The medical management of deceased organ donors is an emerging field of research in critical care that faces unusually complex challenges, many of which are regulatory in nature.

Objective: To report on the regulatory barriers to research in this field as experienced in the context of the Canada-DONATE National Cohort Study currently underway in four Canadian provinces.

Methods: This study is nested within a 12 month, observational study in 34 active deceased donation hospitals in Canada. This study enrols consecutive adult deceased donors, following a neurological (NDD) or a circulatory (DCD) death and their corresponding organ recipients with a waiver of research consent. To systematically assess some important challenges to this research, we documented the times to regulatory approvals by: hospital research ethics boards, privacy offices, and contracts offices, as well as organ donation organization and other provincial privacy offices (where applicable). We also documented specific issues that resulted in approval delays.

Results: We had a total of 15 unique Research Ethics Boards (REBs) for 34 sites, 9 of which were hospital/institute specific, and six provincial. There was no significant difference between mean time for applications that went through a hospital compared to provincial REB (46.56 days (SD: 29.72) vs 20.67 days (SD: 20.05), p =0.1). Eight sites required local privacy office reviews prior to study start day, for purposes of data sharing agreements. In most cases, this was completed concurrently during the time of clinical trial agreements and research ethics, but caused a delay in the startup of one site. Provincial privacy reviews were required for data sharing agreements with three organ donation organizations. We have completed two privacy reviews, which took an average of 113 days. Although this process did not cause a delay in implementing the study, it has hindered Canada-DONATE from collecting recipient data in one province. This application is still ongoing after 646 days. Lastly, the clinical trial agreements took on average 115 days (SD: 45.24) from when the site first received a template copy until the contract was fully executed. The variability in regulatory processes across sites is likely due to 1) unique requirements at the site level (e.g. internal privacy office), 2) provincial legislation, 3) the need for REB approval for both donors and recipients and 4) the perception that donation and transplantation should be keep separated.

Conclusion: Research in organ donor care has unique regulatory and ethical barriers. Current research frameworks should be adapted to fit this reality and must take into consideration provincial legislation.

Risk Factors for Sleep Disruption in Critically Ill Patients: A Systematic Review of the Literature

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Introduction: Sleep disruption in ICU patients is common and may be associated with adverse outcomes including impaired healing response and delirium (1). There have been no systematic reviews of the literature to identify risk factors for sleep disruption in ICU.

Objectives: We conducted a systematic review to identify all premorbid and ICU-acquired risk factors associated with sleep disruption in ICU patients.

Methods: A systematic search of PubMed, MEDLINE, EMBASE, Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, CINAHL, Scopus, ISI Web of Science, and the International Pharmaceutical Abstracts was conducted by a professional medical librarian to identify relevant English language articles. Titles and abstracts were screened (JL, SM, KB) and full-text review (KH, JL, SM, KB) was undertaken to identify original studies that met the following inclusion criteria: adult ICU patients, reporting of sleep measures, and reporting of one or more possible risk factors for sleep disruption during the ICU stay. The results of studies that reported the proportion of patients affected by a risk factor were combined and will be presented in aggregate.

Results: We screened 1329 titles and abstracts and identified 13 studies that reported premorbid risk factors (Figure 1) and 36 studies that reported ICU-acquired risk factors (Figure 2) for sleep disruption in ICU patients.

A compendium of all of the risk factors identified and their frequencies was developed. Among premorbid variables, poor sleep quality at home and use of sleep aids prior to admission were found to be risk factors for sleep disruption in ICU patients. Premorbid medical conditions showed no association with sleep disruption.

During the ICU stay, the most frequently reported symptom-related risk factors included pain and psychological stress. The environmental risk factors most frequently reported to disrupt sleep in ICU were nursing care, environmental noise, and lights. Among disease-related variables, disease severity was inconsistently found to be a risk factor.

Pharmacological risk factors reported included use of any sedative agent, benzodiazepines, propofol, morphine, midazolam, and steroids. Among these, steroid use was a risk factor for sleep disruption while the results were conflicting for other agents.

There were conflicting data with respect to mechanical ventilation (MV) as a risk factor for sleep disruption. MV-induced central sleep apnea and patient-ventilator asynchrony were risk factors associated with sleep disruption.

Conclusion: This review provides a systematic analysis of all premorbid and ICU-acquired factors associated with sleep disruption in ICU patients. Establishing an inventory of the premorbid risk factors associated with sleep disruption in ICU will allow clinicians to identify those patients who are at highest risk, allowing for a more timely interventions to prevent sleep disruption and its sequelae in ICU patients. Identifying ICU-acquired risk factors for sleep disruption is crucial in the establishment of evidence-based local protocols that aim to reduce the burden of

sleep disruption in ICU patients, informs future research on this prevalent problem, and provides a framework for establishing guidelines for the prevention and treatment of sleep disruption in ICU patients.

Figure 1. Pre-ICU risk factors associated with sleep disruption in ICU: study flow diagram.

Figure 2. ICU-acquired risk factors for sleep disruption in ICU: study flow diagram.
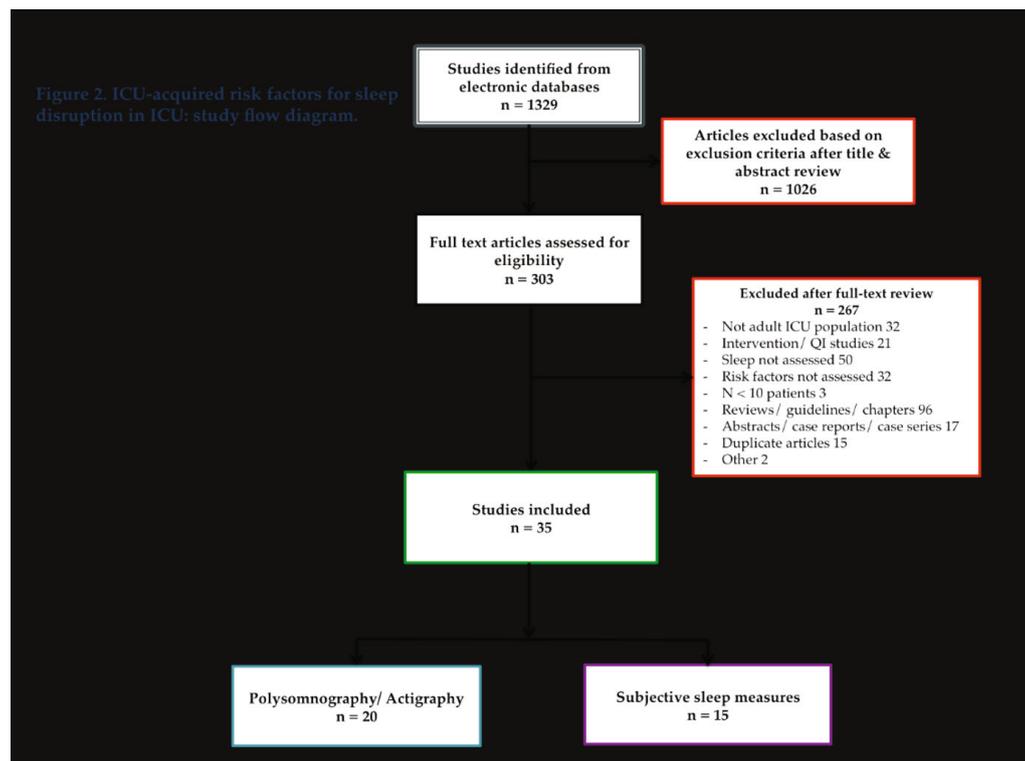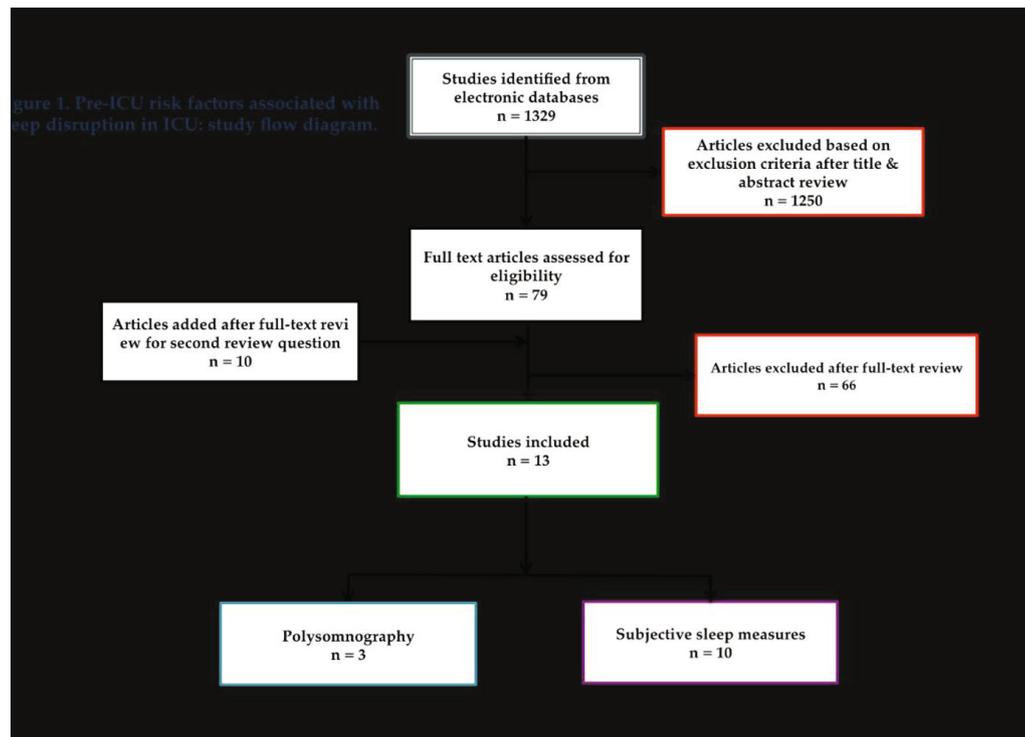
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Risk Prediction Models for Maternal Mortality: A Systematic Review and Meta-Analysis

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Background: Pregnancy- and peri-partum-related critical illness leads death for 3-14% of affected women. Identifying patients at risk could facilitate preventive strategies, guide therapy, and help in clinical research.

Objectives: To systematically review and meta-analyze risk prediction models for maternal mortality.

Search strategy: MEDLINE, EMBASE and Scopus, from inception to May 2017.

Selection criteria: Trials or Observational studies evaluating risk prediction models for maternal mortality.

Data collection and analysis: Two reviewers independently assessed studies for eligibility and methodological quality, and extracted data on prediction performance.

Main results: Thirty-eight studies that evaluated 12 different mortality prediction models were included. Four models were developed primarily from obstetric populations, and 8 models from general patient populations. The *Collaborative Integrated Pregnancy High-dependency Estimate of Risk (CIPHER)* model had the best performance and a low risk of bias for critically ill patients (discrimination: Area Under Receiver Operating Curve (AUC) 0.819 (0.781 – 0.858), calibration: graphic plot [intercept 0.01, slope 1.07]). The *Maternal Severity Index* had the best performance and a low risk of bias for other hospitalized patients (discrimination: AUC 0.826 [0.802 – 0.851], calibration: Standardized Mortality Ratio 1.02 [0.86 – 1.20] in external validation studies). Overall, prediction models developed from non-obstetric populations, such as the SAPS2 and APACHE2, showed good discrimination (AUC 0.92 (0.90 – 0.95) and 0.88 (0.84 – 0.92), respectively), but were more likely to over- or under-estimate maternal mortality.

Conclusions: Mortality risk prediction models developed from obstetric patient populations, such as the Collaborative Integrated Pregnancy High-dependency Estimate of Risk (CIPHER) model and the Maternal Severity Index, have very good discrimination and calibration with a low risk of bias.

Survey on Barriers to Critical Care and Palliative Care Integration

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Introduction: Up to 87% of Canadian deaths occur in hospitals – of that proportion, up to 25% of hospitals deaths occur in the special care units, such as the intensive care unit (ICU). Patients admitted to the ICU are often suffering from critical or incurable conditions that require close observations and acute medical attention. It is therefore conceivable that ICU patients and their families are likely to be the individuals under the most physical and psychological distress and would benefit most from end-of-life care (EOLC) and palliative care (PC). Recently, hospitals have started integrating palliative care in the ICU (ICU-PC), and it has shown to improve patients' symptom management and overall quality of life. ICU-PC models have also shown to reduce patients' stays in the ICU, which ultimately reduced the resource consumption of the ICU by over $300,000. Despite the numerous advantages, very few Canadian hospitals have adopted the use of ICU-PC.

Objective: The proposed project will be one of the first studies to explore the barriers towards integrating palliative care into a Canadian ICU and the impact of the integration. The project will also evaluate the perceived quality of the end of life care (EOLC) provided at participating institutions. Through this study, we also seek the feasibility of launching a national study to determine and create a nationally accepted ICU-PC model.

Method: This is a mixed method survey designed to assess the needs and barriers for ICU-PC integration. Surveys will be administered to evaluate barriers against ICU-PC integration, best ways to approach the integration, perception of the quality of the EOLC provided. Through a needs assessment, we will also investigate how the EOLC can be improved.

Results: A) Identification of potential barriers to ICU-PC integration and B) Assessment of perceived quality of EOLC

A) Healthcare professionals will be asked to identify potential barriers or hesitations that they have towards an ICU-PC integration in a survey.

B) Perceived quality of EOLC will be measured in a survey through seven domains:
1) patient- and family-centered decision making;
2) communication within the team and with patients and families;
3) continuity of care;
4) symptom management and comfort care;
5) emotional and practical support for patients and families;
6) spiritual support; and
7) emotional and organizational support for ICU staff.

Conclusion: This has not been elucidated at the time of submission, as the survey is just being distributed. Results will be available for presentation at the conference.

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Systematic Review and Metanalysis on the Use of Imaging for Neuroprognostication in Patients After Cardiac Arrest

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Objectives: Predicting neurological outcome in comatose survivors of cardiac arrest typically relies on clinical exam findings. We systematically reviewed the literature to evaluate the predictive accuracy of neuroimaging in this context.
Methods: We searched Medline (database inception-December 2016) to retrieve studies of computed tomography (CT) or magnetic resonance imaging (MRI) to predict poor neurological outcome in adult (>16 years) cardiac arrest survivors. We extracted methodological and outcomes data in duplicate and summarized the test performance using meta-analyses based on bivariate model where possible and univariate models otherwise.
Results: From 3046 citations, 32 included studies examined CT (n=15) or MRI (n=17) in a mean of 76 (range 9 to 283) patients. Twelve studies calculated the grey:white matter ratio (GWR) of Hounsfield units. Loss of grey-white differentiation had modest sensitivity (0.44, 95%CI 0.29-0.60) but high specificity (0.98, 0.94-0.99) for predicting poor outcome (positive likelihood ratio (LR+) 18.3, 8.47-39.5). Eleven studies evaluated diffusion-weighted imaging (DWI) on MRI, which had good sensitivity (0.76, 0.66-0.84) and high specificity (0.92, 0.83-0.96; LR+ 9.59, 4.63-19.9). Five studies evaluated DWI and (fluid attenuated inversion recovery) FLAIR MRI, which had highest sensitivity (0.83, 0.69-0.91) but lower specificity (0.88, 0.67-0.97; LR+ 5.31, 1.79-15.7).   We found marked heterogeneity in the timing of radiological examinations and timing and method of neurological assessments.
Conclusions: CT and MRI are useful for predicting poor neurological outcome after cardiac arrest. Low GWR on CT scan has the highest specificity and lowest false-positive rate, but also lowest sensitivity. Future research should directly compare these tests and their additive value to clinical examination.

Temporal Changes in Dynamic Cerebral Autoregulation of Critically Ill Patients

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Introduction: Cerebral autoregulation (CA) protects the brain from ischemic or hyperemic injuries via modulation of cerebral blood flow (CBF). CA may be impaired in critically ill patients, possibly contributing to high incidence of delirium and long-term cognitive impairment in this population. Prior studies showed both normal and impaired CA in critically ill patients, but both static and dynamic measures are often done at over a limited observation period potentially missing the changes in CA status over the course of a typical ICU day. In this study, we monitored CA over 8 continuous hours in a cohort of critically ill patients using Mx, the moving correlation coefficient between CBF and mean arterial pressure (MAP).

Objectives: To assess the status of CA over 8 hours of continuous observation in a cohort of critically ill patients admitted with sepsis or cardiac arrest.

Methods: We recorded middle cerebral artery blood flow velocity (MCAv) using transcranial Doppler and MAP over 8 hours in a cohort of mechanically ventilated patients. We then examined the data offline and removed sections with poor MCAv or MAP signal, as well as any artefacts (e.g. movement resulting in loss of Doppler signal), and calculated Mx as the moving correlation coefficient between remaining MCAv and MAP data using 300 second intervals. We plotted Mx data vs. time for each patient to determine the status of CA. Mx value > 0.3 was used as a cut-off to determine impaired autoregulation.

Results: We completed these measurements in 12 patients (8 septic, 9 male). The Mx vs. time profile varied considerably within and between patients. All patients displayed multiple transient spontaneous excursion of Mx above 0.3, suggesting a temporary loss of CA capacity. The frequency and duration of these excursions varied between patients. Excursions lasting more than 20 minutes were observed in only 6 patients, potentially rendering them vulnerable to ischemic or hyperemic injuries.

Conclusions: In our cohort, all patients experienced multiple episodes of impaired CA of varying frequency and duration, with half of them losing CA for an extended and potentially dangerous time period. Further research is needed to determine whether the frequency and/or duration of the observed excursions correlate with delirium or long-term cognitive impairment.

The Cost to Achieve Functional Recovery in the Very Elderly Admitted to Intensive Care Units: Hospital Perspective

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Introduction: Very elderly patients are often admitted to intensive care units (ICUs) despite known poor clinical outcomes [1-5] and frequent patient preference to avoid unnecessary prolongation of life [6-8]. While our recent report demonstrated the substantial costs of ICU admission in this population [9], costs of care in this group extend beyond the ICU have not been reported with respect to recovery of baseline functionality.

Objectives: The objectives of this study were to determine the in-patient costs (ICU and non-ICU) for the very elderly admitted to ICU in Canada and report the overall cost incurred per survivor with recovery of baseline physical function.

Methods: The data source for this study was a multicentre, prospective, observational cohort of patients aged 80 years or older admitted to 22 Canadian ICUs from 2009 to 2013 [2,3]. A subset of consenting individuals comprised a longitudinal cohort followed over 12 months. Costs were calculated from ICU and hospital length of stay for each patient and unit costs of for admission from Canadian academic hospital. Physical recovery at 12 months was defined as a Short Form-36 physical function score of at least 10 and no lower than 10 points below their pre-admission score [3]. Costs were expressed (in Canadian Dollars) as mean cost per patient per hospitalization, as well as total cost consumed per survivor and per survivor with recovery of baseline physical function.

Results: In total, 1,671 patients were included; 610 were enrolled in the longitudinal cohort. The average age was 85 years; median length of stay was 4 days in ICU and 17 days in hospital; hospital mortality was 35% (585/1,671). Of the 505 evaluable patients in the longitudinal cohort at 12 months, 24% (123/505) had survived with recovery of their physical function. The average cost of in-patient care per patient was $34,070±73,347. Total cost incurred was $52,423 per survivor to discharge and $163,108 per survivor with recovery of physical function at 12 months.

Conclusion: Very elderly patients admitted to ICU represent a group with very high total costs of hospitalization per functional survivor. In a resource-limited healthcare system, these figures are crucial for informing clinical decisions and policymaking, and reinforce the importance of early goals of care discussion to avoid both undesired and potentially non-beneficial interventions that carry substantial costs.

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The Effect of Cerebral Perfusion Pressure Guided Therapy on Acute Respiratory Distress Syndrome in Traumatic Brain Injury

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Introduction: Previously, increased cerebral perfusion pressure (CPP) > 70mmHg has been associated with the onset of acute respiratory distress (ARDS) after traumatic brain injury (TBI). Recently, the concept of individualized perfusion targets using real time autoregulation assessment has emerged and at times, requires CPP titration > 70mmHg. Given historical concerns with increased incidence of ARDS, the association between ARDS and increased CPP requires further research.

Objectives: To investigate the relationship between increased cerebral perfusion pressure in traumatic brain injury patients who develop acute respiratory distress syndrome versus those who do not.

Methods: We conducted a single center retrospective cohort study investigating the association of increased CPP in patients who developed ARDS versus those who did not. We collected demographic data pertaining to age, gender, GCS motor score, Rotterdam CT score and mechanism of injury. We also collected physiologic data for CPP, intracranial pressure, ventilation parameters, cumulative fluid balance and delta pressure. Finally, we collected outcomes measures pertaining to duration of ventilation, length of ICU admission, length of hospitalzation and six month neurological outcome.

Results: We conducted a retrospective analysis of 113 patients with severe TBI who underwent multimodal neuromonitoring. The mean age was 39 years (SD 17) and 26 / 113 (23%) were female gender. The median motor score was 3 (IQR 1 – 4). The median Rotterdam score was 3 (IQR 3 - 4). Sixteen patients (14%) developed ARDS according to the Berlin definition. There was no difference in the mean CPP during the first 7 days of admission between patients who developed ARDS (74mmHg SD 18 vs. 73mmHg SD 18, p=0.86) versus those who did not. There were no differences with respect to duration of mechanical ventilation, ICU length of stay, hospitalization or neurological outcome in both groups.

Conclusion: In our cohort of severe TBI patients who underwent invasive neuromonitoring, we did not observe an association between increased CPP in patients who developed ARDS versus those who did not.

Table 1. Baseline characteristics of cohort

	Total Cohort (n=113)	ARDS (n=16)	No-ARDS (n=97)
Age in years, mean (SD)	39 (17)	41 (18)	38 (17)
Male gender, n(%)	87 (77)	11 (69)	76 (78)
Admission hypotension, n(%)	40 (35)	9 (56)	31 (32)
Admission hypoxemia, n(%)	26 (23)	5 (31)	21 (22)
Glasgow Coma Scale median motor score (IQR)	3 (1 − 4)	3.5 (1 − 4)	3 (1 − 4)
One pupil non-reactive, n(%)	33 (29)	5 (31)	28 (29)
Mechanism of injury, n(%)			
Motor vehicle or motor cycle accident	34 (30)	4 (25)	30 (31)
Accidental fall	45 (40)	8 (50)	37 (38)
Pedestrian or cyclist struck	24 (21)	4 (25)	20 (21)
Other	10 (9)	0	10 (10)
Rotterdam score, median (IQR)	3 (3 − 4)	3 (3 − 4)	4 (3 − 4)
SD = standard deviation; IQR = interquartile range			

Table 2. Clinical interventions and outcomes stratified by NCC service

	Total Cohort (n=113)	ARDS (n=16)	No ARDS (n=97)	P value
Parenchymal ICP catheter use, n(%)	26 (23)	4 (25)	22 (23)	0.76
PbtO2 catheter use, n(%)	26 (23)	4 (25)	22 (23)	0.76
EVD use, n(%)	91 (81)	12 (75)	79 (81)	0.51
Craniotomy performed, n(%)	57 (50)	12 (75)	45 (46)	0.057
Craniectomy performed, n(%)	38 (34)	6 (38)	32 (33)	0.78
ICU days, median (IQR)	13 (7 – 18)	13.5 (11.5 – 21)	12 (6.5 – 16.5)	0.055
ICU free days, median (IQR)	13 (1.5 – 17.5)	9.5 (0 – 15.5)	13 (5 – 18)	0.19
Mechanical ventilation days, median (IQR)	11 (6 – 15)	13.5 (11 – 18)	10 (6 – 15)	0.017
Mechanical ventilation free days, median (IQR)	14 (5 – 20)	11.5 (0 – 16.5)	14 (7 – 20)	0.11
Neuromonitoring days, median (IQR)	6 (4 – 8)	7 (5 – 11)	6 (4 – 8)	0.30
Neuromonitoring free days, median (IQR)	20.5 (13 – 23)	20 (0 – 22)	21 (14 – 23)	0.26
Sedation days, median (IQR)	6 (4 – 9)	6 (4 – 8)	6 (4 – 16.5)	0.27
Sedation free days, median (IQR)	21 (9 – 23)	15.5 (0 – 23)	21 (13 – 23)	0.37
Hospital days, median (IQR)	42 (22 – 68)	45.5 (23.5 – 132.5)	41 (20 – 65)	0.31
Tracheostomy performed, n(%)	69 (61)	13 (81)	56 (57)	0.098
Glasgow Outcome Score at 6 months				0.11
Death	24 (21)	5 (31)	19 (20)	
Permanently Vegetative State	11 (10)	3 (19)	8 (8)	
Severe Disability	28 (25)	3 (19)	25 (26)	
Moderate Disability	29 (26)	5 (31)	24 (25)	
Good Recovery	21 (19)	0	21 (22)	
Favourable neurologic outcome (GOS 4 or 5)	50 (44)	5 (31)	45 (46)	0.29

EVD = external ventricular drain; PbtO2 = brain parenchymal oxygen tension; IQR = interquartile range; ICU = intensive care unit;

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The Epidemiology of Infections and Sepsis in The Prehospital Setting

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Introduction: Sepsis is a life-threatening syndrome caused by a dysregulated immune response to infection(1). Early recognition and intervention are critical to improve patient outcomes(2). In modern healthcare systems, paramedics often encounter patients with sepsis before other clinicians, offering an important opportunity for even earlier sepsis care(3).

Objective: We sought to estimate the incidence and examine clinical and operational characteristics of patients with infection or sepsis who are transported by paramedics in a Canadian Emergency Medical Services (EMS) system.

Methods: A one-year cohort of all EMS transport events in the province of Alberta, Canada was linked to in-hospital administrative databases. Infection and sepsis were identified using administrative Emergency Department (ED) diagnosis codes and EMS clinical information, consistent with recommendations from the Sepsis-3 definition(1). Clinical characteristics (e.g. age, sex, vital signs), operational factors (e.g. prehospital encounter time), and treatments provided by paramedics (e.g. intravenous[IV] fluid treatment) were evaluated in patients with infection or sepsis, and compared to those of other patients transported by paramedics.

Results: The incidence of infections (10%) and sepsis (2.1%) are notable within the paramedic-transported adult patient population, with more than half (56%) of these patients requiring admission to hospital. Fever (greater than 37.8 C) on presentation to paramedics was somewhat uncommon among patients with infections (17%), however, altered mental status (24.6%) and tachypnea (greater than 22 breaths per minute; 31.6%) were more common. Compared to other patients transported by paramedics, patients with sepsis were generally older (mean 75 vs. 60 years), female (56.4%) and more frequently had altered vital signs, most commonly altered Glasgow Coma Score (less than 15; 61%), tachypnea (48%), low oxygen saturation (less than 90%; 34%), or fever (24.5%). Patients with sepsis were more likely to have a high priority dispatch (38% vs. 31%), but also had longer prehospital intervals (mean 44 min vs. 39 min, p<0.001) despite shorter transport distances (mean 15 km vs. 16 km, p=0.004). IV lines were initiated in 55% of septic patients compared to 34% of non-septic patients. In septic patients with a systolic blood pressure less than 100 mmHg, 70% received an IV but only 26% of those patients received at least 500 mL of fluid before arriving in the ED. The in-hospital mortality rate for paramedic-transported patients with infection or sepsis was 6.6% and 19%,

respectively.

Conclusion: Infections and sepsis are common among paramedic-transported patients, and paramedics spend a considerable time with these patients prior to arriving in the ED. These patients frequently have altered vital signs, suggesting earlier recognition is feasible. The in-hospital mortality of these patients is high, supporting the need to study earlier interventions provided in the prehospital setting.

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The Evolution of Diaphragm Echodensity During the Early Course of Mechanical Ventilation Differs According to the Eventual Duration of Ventilation

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Introduction: Acute increases in muscle echodensity (sonographic signal attenuation or 'greyness') reflect muscle injury in athletes, patients in chronic muscular disease states, and muscle inflammation in critically ill patients. Diaphragm structure and function are known to deteriorate during mechanical ventilation, but changes in diaphragm echodensity have not been described to date.
Objectives: We set out to establish the reproducibility of a technique for quantifying diaphragm echodensity in mechanically ventilated patients and to characterize the trajectory of diaphragm echodensity according to clinical outcome and diaphragm function.
Methods: Thickness and echodensity of the right hemidiaphragm were measured on a daily basis for up to 14 days of mechanical ventilation. Maximal diaphragm thickening was measured on or before day 7 of ventilation. Echodensity was also measured in 10 healthy subjects. Three different ultrasound devices were employed for the study (Phillips Sparq, Mindray, Fujifilm Sonosite) but the same device and same gain level was employed for all measurements in each subject. Echodensity was quantified using gray scale histogram analysis of the diaphragm region traced out on images (ImageJ, NIH, Bethesda MD). The median grayscale value (range 0-255) was log-transformed to yield a normal distribution of echodensity values. Intra-observer repeatability on multiple images obtained on the same day was assessed in 30 patients. The evolution of diaphragm echodensity over time relative to each patient's baseline value was compared according to initial change in diaphragm thickness, maximal thickening fraction, and duration of mechanical ventilation.
Results: A total of 176 echodensity measurements were obtained in 37 mechanically ventilated patients (mean 3.57, SD 0.61). Intra-observer repeatability for echodensity measurements on sequential images was acceptable (limits of agreement ±0.36, ±12%). Echodensity values varied according to ultrasound gain but not according to ultrasound device or imaging depth. Mean echodensity at baseline in mechanically ventilated patients was not significantly different from healthy subjects (Figure 1, p=0.20); although in 41% of mechanically ventilated patients echodensity exceeded the 95th percentile in healthy subjects (3.8). Baseline echodensity was unrelated to age, sex, severity of illness, organ dysfunction, chronic comorbidity, or sepsis. The early evolution of echodensity differed according to patient outcomes. In patients who required less than 7 days of ventilation, echodensity tended to decrease during the first 4 days of the study, whereas it tended to increase in patients who required more than 7 days (Figure 2A). Similarly,

echodensity tended to decrease in patients who exhibited higher maximal thickening fraction after 1 week of ventilation whereas it tended to increase in patients who exhibited impaired maximal thickening fraction (Figure 2B). The evolution of diaphragm echodensity was unrelated to changes in diaphragm thickness over time (Figure 2C) or to variations in SOFA score and sepsis. Echodensity tended to increase over time at increasing inspiratory effort levels (diaphragm thickening > 30%, p=0.02).

Conclusions: Diaphragm echodensity can be measured with reasonable precision in mechanically ventilated patients. Increases in echodensity during the early course of ventilation are associated with poor clinical outcomes. Echodensity may be a useful biomarker of diaphragm injury.
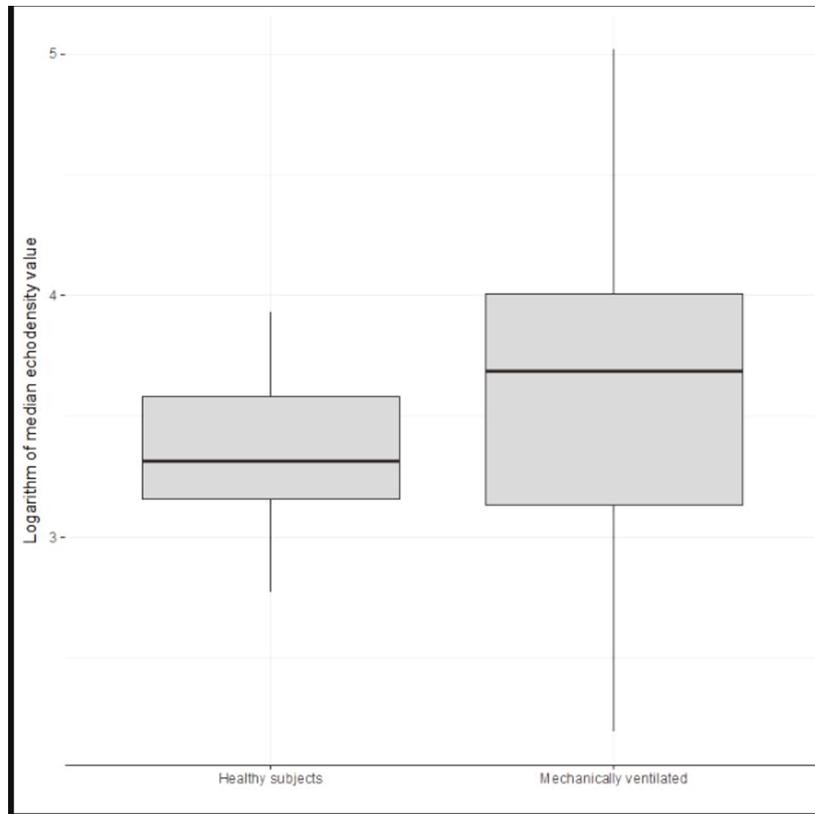

Figure 1. The distribution of echodensity in healthy subjects and in mechanically ventilated patients at study baseline. The mean values were not significantly different between groups (p=0.20). The upper limit of normal for echodensity (95th percentile in healthy subjects) was 3.8; 41% of ventilated patients exceeded this threshold at baseline.
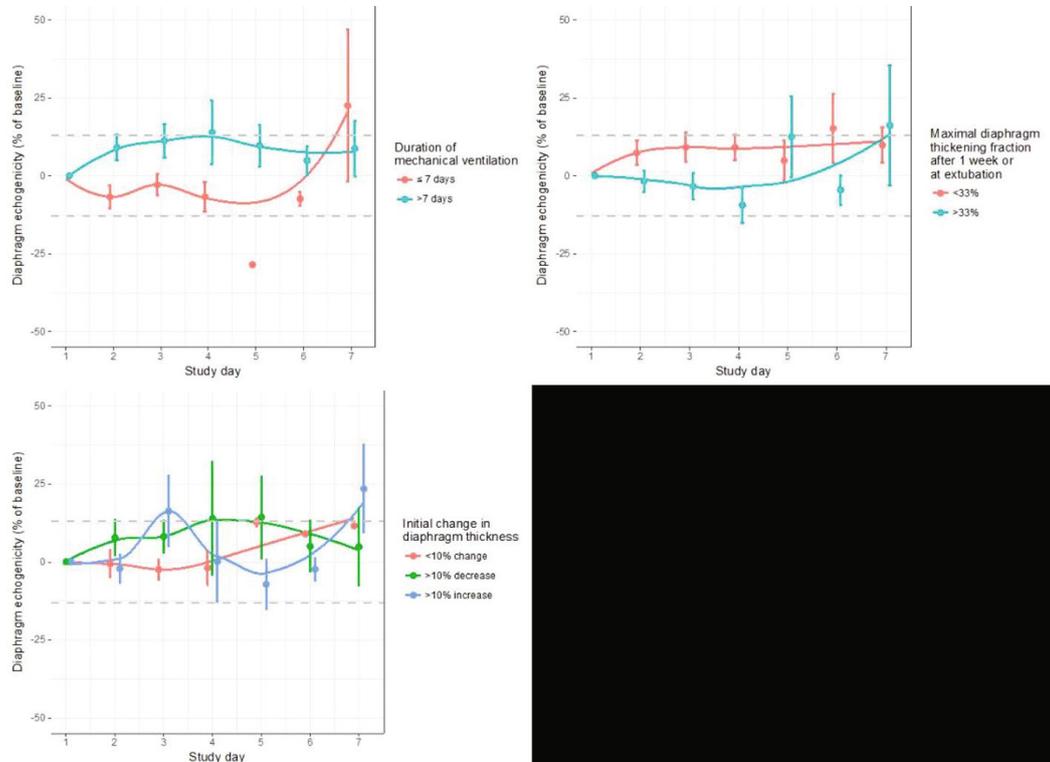
Figure 2. Evolution of diaphragm echodensity according to clinical outcomes. Diaphragm echodensity tended to increase over the first 4 days of ventilation in patients who required more than 7 days of ventilation (2A, top left), and in patients who developed impaired maximal thickening (2B, top right). There was no clear relationship between early changes in echodensity and early changes in diaphragm thickness (2C, bottom right).

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The Footprints Project: Individualizing Care and Influencing Clinicians in the ICU

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Background and Objectives: In the technologic ICU setting, clinicians may inadvertently forget the "lives lived" of their patients before hospitalization, and have difficulty humanizing their patients. Initiated by 2 bedside nurses to improve the sense of humanity in a critical care encounter, the Footprints Project was developed to share a patient's personal information during critical illness. The project includes a Footprints Form completed by family members to capture personal information about patients, some of which is transcribed onto a Footprints Whiteboard by the bedside in each patient's room. This mixed-methods multi-phase project aims to facilitate more holistic patient-centered critical care. The objective of this qualitative phase was to understand the impact of the Footprints Project on the experience of clinicians working in the ICU.

Methods: With 35 ICU clinicians, we conducted 10 semi-structured interviews (10 clinicians) and 5 focus groups (25 clinicians) 18 months after the Footprints Project was implemented. Focus groups and interviews were digitally recorded, transcribed verbatim and anonymized. Transcripts were analyzed by 4 team members using conventional content analysis. Codes were developed through periodic consensus meetings and organized into categories and themes once coding was completed.

Results: Our sample included 13 bedsides nurses, 1 charge nurse, 4 physiotherapists, 2 respiratory therapists, 2 chaplains, 1 unit clerk and 12 physicians (5 fellows, 4 residents and 3 intensivists). Clinicians described using information found on the Footprints Form and Whiteboard as a 'conversation-starter' for talking with patients and families, and as an aid for difficult discussions about prognosis. Main themes identified in this qualitative analysis included: Enhancing Initial Communication, Informing Clinical Interventions, Promoting Interprofessional Collaboration, Facilitating Meaningful Relationships with Patients and Families, and Fostering Culture Change within the ICU.

Clinicians reported using the Footprints Form and Whiteboard for diverse purposes, with several beneficial consequences. Sentiments about the untapped potential for the Footprints Project encouraged its more intentional use as a communication tool for both families and clinicians.

Conclusions: The Footprints Project is a non-digital initiative in the fast-paced ICU which influences clinicians in a myriad of ways, helping them to connect with patients and families, and colleagues, while having a positive influence on the culture of the ICU.

The Impact of Delayed Source Control and Antimicrobial Therapy in 196 Patients with Cholecystitis-Associated Septic Shock

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Background: Cholecystitis-associated septic shock carries significant mortality. Treatment includes early administration of antimicrobial therapy along with source control (cholecystectomy or percutaneous cholecystostomy drainage). There is uncertainty regarding the most appropriate time to achieve source control. Our aim was to determine whether timing of source control affects survival in cholecystitis patients with septic shock.

Methods: Nested retrospective cohort study of all cholecystitis-associated septic shock patients (met Tokyo guidelines for cholecystitis along with hypotension requiring vasopressors) from an international, multicenter database between 1996 and 2015. Multivariate logistic regression analysis was performed to determine associations between practice related factors (delay to source control and antibiotics) and severity of illness on in-hospital mortality. Classification and regression tree (CART) analysis was used to evaluate the interaction between non-linear covariates.

Results: Among 196 patients (mean age 69 years, 70% male), overall mortality was 37%. Compared to non-survivors (n=72), survivors (n=124) had lower mean admission Acute Physiology and Chronic Health Evaluation (APACHE) II scores (21 vs. 27, $p<0.001$) and lower median admission serum lactate (2.4 vs. 6.8 μmol/L, $p<0.001$). Survivors were more likely to receive appropriate antimicrobial therapy earlier (median 2.8 vs. 6.1 hours from shock, p=0.012). Survivors were also more likely to undergo successful source control earlier (median 9.8 vs. 24.7 hours, $p<0.001$). Adjusting for covariates, APACHEII [Odds ratio (OR) 1.13 (95% CI 1.06-1.21) per increment] and delayed source control >16 hours [OR 4.45 (1.88-10.70)] were independently associated with increased mortality ($p<0.001$ for all; c-statistic 0.800). CART analysis demonstrated patients with APACHEII of 15 to 26 benefitted most from source control within 16 hours ($p<0.0001$).

Conclusions: Patients with cholecystitis-associated septic shock have significant mortality. Admission APACHEII score and delay in source control >16 hours significantly affected hospital outcomes. This suggests urgent source control (within 16 hours) could improve outcomes in high-risk patients.

Multivariable Logistic Regression Analysis: Independent associations with in-hospital mortality in acute cholecystitis patients presenting with septic shock(revised)

	Univariable (N=196)		In final model	Multivariable model 2 (c-statistic 0.800, N=131)	
	OR (95% CI)	p-value		OR (95% CI)	p-value
Age	1.012 (0.992-1.034)	0.24	No		
Sex (female)	1.32 (0.76-2.01)	0.47	No		
Bloodstream Infection	0.68(0.37-1.23)	0.20	No		
Time delay to Antibiotics (> 6 hours)	3.121 (1.430-6.814)	0.004	No*		
Time delay to Source control (>16 hours vs ≤ 16 hours)	4.295(1.936-9.526)	<0.001	YES	4.448 (1.883-10.695)	0.001
Lactate (mmol/L)	1.28 (1.15 -1.43)	<0.001	No*		
Number of organ failures (admission)	1.76 (1.40 -2.21)	<0.001	No*		
APACHEII (admission)	1.14(1.9- 1.20)	<0.001	YES	1.132 (1.061-1.208)	<0.001

- Odds ratios (OR) presented in the Univariable column are unadjusted (crude)
- ORs are presented with 95% confidence interval
- 65 patients not included in multivariable model either were missing at least one variable or received appropriate antimicrobials or source control ion before developing septic shock
- Model performance was good (c-statistic 0.800)
- *P-value not significant in the final model for time to antibiotics (0.35)

Figure. Classification and regression tree (CART) analysis of 192 with acute cholecystitis and septic shock
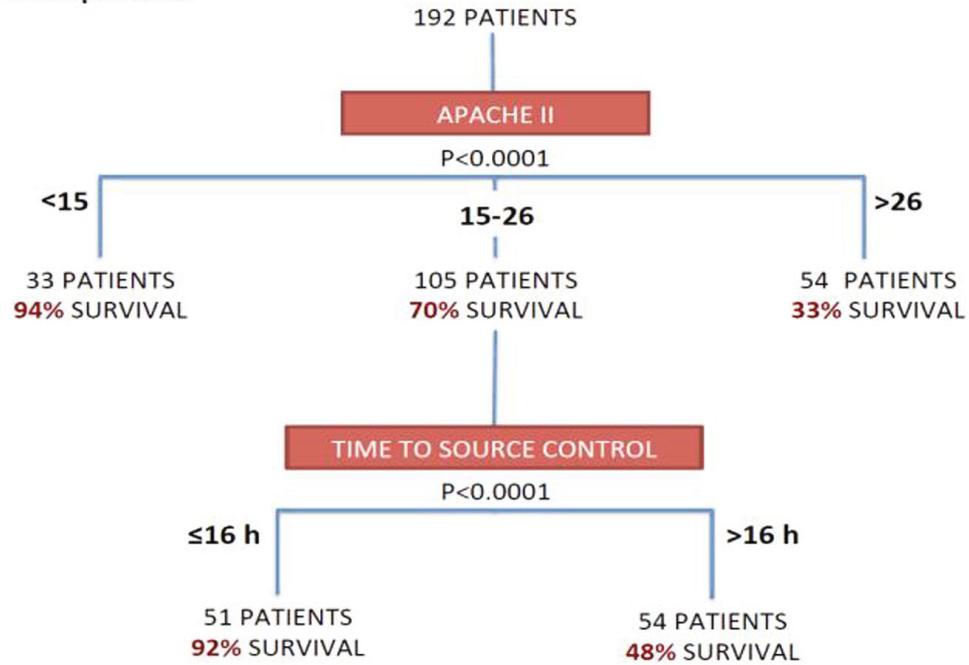
The Prognostic Value of Chart Review-Based Clinical Frailty Scale Scores in the Intensive Care Unit

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Introduction: Frailty denotes the loss of functional reserve capacity and is prevalent in approximately 30% of patients admitted to the Intensive Care Unit (ICU). Frailty is a multidimensional construct with important prognostic implications, but may be difficult to capture and measure in critically ill patients. The 9-point judgement-based Clinical Frailty Scale (CFS) is a validated clinical tool that has been used in many settings to screen for frailty. The CFS may be a useful risk stratification instrument that can help to predict the chance of adverse outcomes for critically ill patients. In 2 ICU studies, frailty has been associated with an increased risk of mortality, increased length of hospital stay and adverse hospital outcomes.
Objectives: The objective of this study was to evaluate the prognostic value of CFS scores generated by research coordinators (RC) via chart review for critically ill patients. We used the CFS as a dichotomous variable, whereby frail was defined as a CFS score $\geq$ 5 and non-frail was defined as a CFS score <5.
Methods: In a prospective 2-center cohort study, we enrolled patients ≥18 years of age admitted to 2 ICUs in Hamilton, Canada for <24h. The RC generated CFS scores using 3 steps: 1) chart review, 2) family interview (if possible), and 3) patient interview (if possible). Subsequently, based on all accumulated data, the RC generated an overall impression captured in a Final CFS. Length of stay and vital status for both ICU and hospital discharge were recorded for all patients.
Results: Of 336 patients screened, 150 patients were enrolled. 70 patients (46.7%) were identified as having pre-hospital frailty based on the initial chart review. The mean age of the frail cohort was significantly greater than those who were not frail (68.0 ± 11.8 v. 60.1 ±17.2, p=0.002). Both frail and non-frail patients had similar mean acute physiology and chronic health evaluation (APACHE) II scores (22.5 ± 7.7 v. 20.4 ± 6.9, p=0.09). In the frail cohort, 50% (n=35) of the patients were female, compared to 31% in the non-frail cohort (n=25). Frailty was not associated with a significantly increased length of ICU stay (1.01 days, p=0.58) or hospital stay (3.60 days, p=0.24) using median regression analyses. Frailty was associated with a trend toward increased risk of ICU mortality (hazard ratio (HR) 1.29, 95% CI: 0.60-2.78, p=0.51) and in hospital mortality (HR 1.12, 95% CI: 0.58-2.17, p=0.073), after adjusting for APACHE II score, use of mechanical ventilation and inotropes.

Conclusion: Although not statistically significant, frail patients had a higher risk of ICU and hospital mortality compared to their non-frail counterparts, after adjusting for illness severity. These preliminary data suggest that CFS scores used in an ICU setting may provide useful information that could help to guide conversations with families of critically ill patients, as well as being useful for clinical ICU research.

The Use of Standardized Management Protocols for Critically Ill Patients with Non-traumatic Subarachnoid Hemorrhage: A Systematic Review

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Introduction: The ICU management of subarachnoid hemorrhage (SAH) is challenging, due in part to the severity of the underlying insult, competing systemic injuries, and unpredictable clinical course. Even with specialist management in dedicated critical care settings, morbidity and mortality from this condition remains high. Complex care decisions in SAH management may be simplified with the use of standardized management protocols (SMPs), which provide clinicians with an algorithm to guide patient care. However, despite their postulated benefit, it is currently unknown if SMPs are associated with improved clinical outcomes in patients with SAH.

Objectives: We conducted a systematic review to determine whether the use of SMPs is associated with improved outcomes in patients admitted to the ICU with non-traumatic SAH. Primary outcomes included mortality at 6 months or greater and neurologic outcome at hospital discharge and follow-up. Secondary outcomes included length of stay in hospital, duration of mechanical ventilation, rates of aneurysm rebleeding and vasospasm, and healthcare costs. We additionally assessed the quality of the published literature in this domain with a validated grading tool.

Methods: We developed comprehensive search strategies for MEDLINE, EMBASE, WoS, CINAHL, and CENTRAL to identify studies for inclusion. We also scanned the gray literature and reviewed published abstracts from relevant conference proceedings to locate further potential material. Our search yielded 9,585 articles, of which 9,151 were excluded by title and abstract screening. 404 studies were reviewed in full, and 15 observational studies were selected for final inclusion. Information on study design, baseline characteristics, and patient outcomes was extracted from each article into a pre-piloted data collection form and aggregated for analysis. Study quality was assessed according to a modified version of the Newcastle Ottawa Scale (NOS).

Results: Most studies presented either a descriptive pathway or a flow diagram, with the majority of SMPs addressing the ICU management of delayed cerebral ischemia and corresponding vasospasm. Of the 15 studies, 9 did not include a control group. 5 of these studies assessed functional outcomes but did not report them according to a recognized performance scale. 3 studies did not specify when they measured one or more of their primary outcomes. A total of 6 studies assessed SMP-related outcomes against a control group; 5 of these 6 studies showed statistically significant ($p < 0.05$) improvements in one or more primary or secondary outcomes in the protocol-managed group. Only 2 studies reported level of adherence to the SMP. Overall study quality varied significantly based on NOS grading. Meta-analysis of the data was not possible given the dearth of studies meeting our inclusion criteria. Additionally, we noted significant sources of heterogeneity (variation in study design, non-standardized outcome reporting, and

SMP design) between studies, rendering further inferences or statistical analysis difficult.

Conclusion: The efficacy of SMPs in SAH management cannot be determined from the available literature. Based on a subset of 6 studies that permitted direct comparisons with a control group, SMPs may hold promise as a low-cost initiative to improve clinical outcomes in SAH management. This data should be regarded as preliminary; further studies are needed to rigorously examine the efficacy of SMPs for non-traumatic SAH.

Country	Article Type	Protocol management group	Control group present (*y/n*)	Type of Protocol	Management description		Primary Outcomes	Secondary Outcomes
					Protocol group	Control group		
USA	Journal Article	*n*=118	*n*	Flow diagram	Driven by control of vasospasm	N/A	Mortality, functional outcomes	DCI
USA	Journal Article	*n*=54	*n*	Flow diagram	Driven by ICP targets	N/A	Mortality, functional outcomes	Multiple
Jordan	Journal Article	*n*=52	*n*	Descriptive protocol	Driven by control of vasospasm	N/A	Mortality, functional outcomes	Multiple
Thailand	Journal Article	*n*=200	*n*	Flow diagram	Driven by ICP targets	N/A	None reported	Multiple
USA	Journal Article	*n*=324	*n*	Descriptive protocol	Driven by general Neuro-ICU management and control of vasospasm	N/A	Mortality, functional outcomes	None
Switzerland	Journal Article	*n*=30	*n*	Descriptive protocol	Driven by control of vasospasm	N/A	Mortality, functional outcomes	DCI
United States	Journal Article	*n*=279	*y (n*=174)	Descriptive protocol	Driven by hemodynamic parameters	No pulmonary measurements	Mortality	Multiple
Switzerland	Journal Article	*n*=198	*y (n*=150)	Flow diagram	Driven by control of vasospasm	Non-protocolized care	Funcational outcomes	DCI, hydrocephalus
Canada	Conference Abstract	*Not specified*	*Not specified*	Admission orders	Driven by general Neuro-ICU management	Historic control - received care before protocol was implemented	None reported	Length of stay
Spain	Conference Abstract	*n*=65	*n*	Descriptive protocol	Driven by general Neuro-ICU management	N/A	Mortality, functional outcomes	DCI, hydrocephalus
Canada	Journal Article	*n*=13	*y (n*=12)	Descriptive protocol	Driven by control of vasospasm	Did not receive induced hypertension treatment	Funcational outcomes	DCI
United States	Journal Article	*n*=122	*n*	Descriptive protocol	Driven by general Neuro-ICU management	N/A	None reported	Multiple
United States	Journal Article	*n*=43	*n*	Flow diagram	Driven by control of vasospasm	N/A	Mortality	Multiple
Korea	Journal Article	*n*=442	*y (n*=423)	Flow diagram	Driven by emergency care protocol	Care before emergency treatment protocol implemented	Funcational outcomes	Rebleeding
United Kingdom	Journal Article	*n*=129	*y (n*=92)	Flow diagram	Driven by early surgery and vasospasm control	Non-protocolized care	Mortality, functional outcomes	Rebleeding

Use of Inhaled Antibiotics as a Preventive Measure for Respiratory Tract Infections in Pediatric Patients with a Tracheostomy: A Retrospective Descriptive Study

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Introduction: Ventilator-associated respiratory tract infections are a cause of morbidity and mortality in children with a tracheostomy. In addition, they cause greater exposition to broad-spectrum antibiotics. The use of inhaled antibiotics as a preventive measure to reduce ventilator-associated infections has not been studied in children with a tracheostomy.

Objectives: To determine if the use of preventive inhaled antibiotics in this population reduces the risk of acquired respiratory tract infections and reduces exposition to broad-spectrum antibiotics.

Methods: A retrospective study was performed by reviewing charts of all patients aged between 0 to 18 years old with a tracheostomy, hospitalised at the CHU Sainte Justine between January 2004 and November 2016 and treated with inhaled antibiotics as a preventive measure. The primary outcome was exposition to broad-spectrum antibiotics in the 3-month period before and after the beginning of the preventive treatment with inhaled antibiotics. Adverse effects were also evaluated.

Results: Six patients (median age: 10.0 months, interquartile: 8.3-11.0) were included in our analysis. One of them received colimycin, 3 received tobramycin and 2 were treated with both alternately. The median time of treatment was 74 days (69-161). Patients were exposed to broad spectrum antibiotics during 18 days (5-31) in the 3 months preceding the treatment versus 2 days (0-3) in the 3 months following the treatment initiation, $p= 0,115$ (Wilcoxon). The number of respiratory tract infections went from 2 (1-3) to 1 (0-1) during the same periods, $p=0,066$. Adverse effects most commonly reported were cough (n=2) and increased respiratory secretions post-inhalation (n=4). No new colonisation with antibiotics-resistant bacteria was observed in the 12 following months.

Conclusion: Although limited by the small sample size, these results support the design of future studies to evaluate the potential clinical impact of preventive inhaled antibiotics in children with a tracheostomy.

Figure 1:Exposition to broad-spectrum antibiotics in the 3-month period before and after the initiation of treatment with inhaled antibiotics
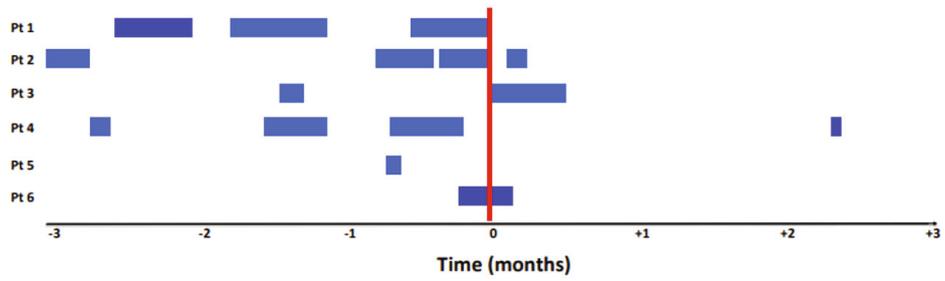
Utility of Clostridium difficile Severity Criteria in the ICU: A Multicentre Retrospective Cohort Study

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Introduction: *Clostridium difficile* infection (CDI) is a common, potentially deadly hospital-associated infection that can complicate critical illness. Published CDI severity criteria attempt to risk stratify patients with CDI and suggest an initial treatment regimen; however, whether the criteria and management guidelines apply to infections developing in critically ill patients is uncertain.

Objective: To characterize patients with ICU-acquired CDI and determine the utility of published severity criteria in predicting hospital mortality.

Methods: We conducted a retrospective cohort study of adults with ICU-acquired CDI in 3 university-affiliated hospitals from 2010-2015. Patients were identified using standardized Ontario surveillance criteria from local infection control databases. We collected data from hospital records and applied 3 severity criteria from the American College of Gastroenterology (ACG), Society for Healthcare Epidemiology of America/Infectious Diseases Society of America (SHEA/IDSA), and the European Society of Clinical Microbiology and Infectious Diseases (ESCMID).

Results: Among 111 patients with ICU-acquired CDI, the mean (SD) age was 65.1 years (16.3) with a mean APACHE II score of 21.3 (7.0). Most patients received invasive mechanical ventilation (102, 91.9%), while 66 (59.5%) had shock requiring vasopressors, and 25 (22.5%) received renal replacement therapy. The median (Q1, Q3) time to CDI diagnosis from ICU admission was 11 days (9,22). Prior to CDI, 110 (99.1%) patients received at least one antibiotic for a median of 11 days (7,18); 108 (97.3%) received proton pump inhibitors and 14 (12.6%) received histamine-2 receptor antagonists. ICU and hospital mortality were 21.6% (n=24) and 33.3% (n=37), respectively. ICU and hospital lengths of stay were 16 days (10,31) and 39 days (24,77), respectively. CDI recurred in 20 patients (18.0%). Hospital mortality for patients with non-severe vs severe CDI according to these 3 illness severity criteria were: ACG: 23.0% (14/61) vs. 46.0 %, (23/50), p=0.01; SHEA/IDSA: 19.0% (8/42) vs 42.0% (29/69), p=0.01; and ESCMID: 26.6% (17/64) vs 42.6% (20/47), p=0.08 (Table 1).

Conclusions: In this 3-center study, almost all patients with ICU-acquired CDI received invasive mechanical ventilation, antibiotics and proton pump inhibitors. ACG and SHEA/IDSA severity criteria may be useful for stratifying patients with ICU-acquired CDI based on the risk of death in hospital.

Table 1: Hospital mortality for patients with non-severe CDI vs. severe CDI

	Non-severe CDI	Severe CDI	p value
ACG	14/61 (23.0%)	23/50 (46.0%)	p = 0.01
SHEA/IDSA	8/42 (19.0%)	29/69 (42.0%)	p = 0.01
ESCMID	17/64 (26.6%)	20/47 (42.6%)	p = 0.08

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