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Critical Care Canada Forum 2021 Abstracts

Contents

A Retrospective Review of Critically Ill Pregnant Patients with COVID-19: A Single Centre Experience

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Introduction: Pregnant patients appear to be at increased risk of severe Coronavirus Disease 2019 (COVID-19), necessitating hospitalization, Intensive Care Unit (ICU) admission and need for invasive mechanical ventilation (1-5). However, there exists a paucity of data detailing ICU management, and recent literature on COVID-19 in pregnant individuals does not include the variants of concern (VOC) which are likely associated with greater severity of illness (6). This paper aims to describe the presence of VOC in severe COVID-19 in pregnancy, the management of severe COVID-19, and maternal and obstetrical outcomes in our high-volume tertiary referral center in Toronto, Ontario.
Objectives: To describe the characteristics, management, and maternal and obstetrical outcomes of severe COVID-19 pneumonia during pregnancy.
Methods: Mount Sinai Hospital is a University-affiliated tertiary referral center in Ontario, Canada, with a high-risk obstetric unit, a level 3 neonatal ICU, and an adult ICU with experience managing pregnant patients. We conducted a retrospective case series of all pregnant patients who tested positive for SARS-CoV-2 and were admitted to ICU between March 2020 and June 2021. Data collected included patient demographics, obstetrical data, a mutation or VOC, pre-existing comorbidities, and COVID-19, ICU and hospital course. Ventilation parameters, including PEEP level, peak pressure and driving pressure, were recorded. Maternal and obstetrical outcomes were also collected. The oxygen saturation ratio to the fraction of inspired oxygen (SpO2/FiO2 ratio) was calculated to track oxygenation changes peri-delivery. No statistical comparisons were performed, and data were summarized as proportions for categorical variables and mean (± standard deviation) or median (range or IQR) for continuous variables. Research Ethics approval was obtained for a retrospective chart review.
Results: 21 patients were admitted to the ICU, 14 (67%) transferred from surrounding hospitals. Mean gestational age was 27.9 weeks (range 22 – 36.6 weeks). All but the first patient (March 2020) were treated with corticosteroids for COVID-19, and 15 received tocilizumab. After variants of concern (VOC) testing became routine (Feb 2021), VOC were identified in 12/16 patients. 11 patients (52%) required invasive mechanical ventilation (8 with severe acute respiratory distress syndrome [ARDS]), and all received neuromuscular blockade initially. The median PEEP level was 16 cmH2O (range 12-20 cmH2O), median high PaCO2 was 55 mmHg, and median low oxygen saturation was 90%. 6 ventilated patients (55%) required prone positioning, and one received extracorporeal life support (ECLS). Delivery was only performed for routine obstetric indications. Of the 6 deliveries, 5 occurred during invasive mechanical ventilation. Indications for delivery included fetal distress (3), preeclampsia (1), spontaneous labour (1), and an induced vaginal delivery for intrauterine fetal demise. The median gestation of the live-born neonates was 34.2 weeks, and all except one have been discharged home. 14 pregnant patients (67%) did not deliver during their critical illness and were discharged home. There were no maternal deaths.
Conclusion: We used evidence-based management strategies for COVID-19 and ARDS and experienced favourable outcomes across these severely ill pregnant individuals, all of whom survived to hospital discharge. Close surveillance,

communication and collaboration between the multidisciplinary team likely contributed to these outcomes.

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Figure 1: Epidemiology graph of COVID-19 hospitalizations in Ontario (left y-axis), with admissions of pregnant women to Sinai ICU (right y-axis), demonstrating VOC status

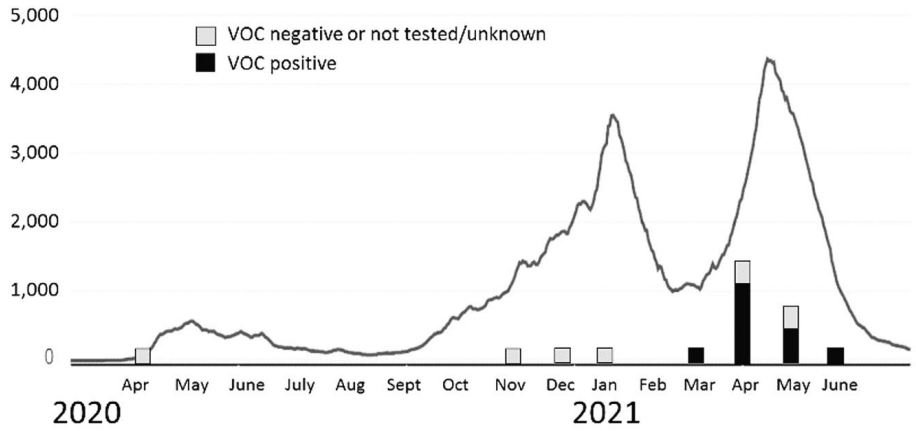
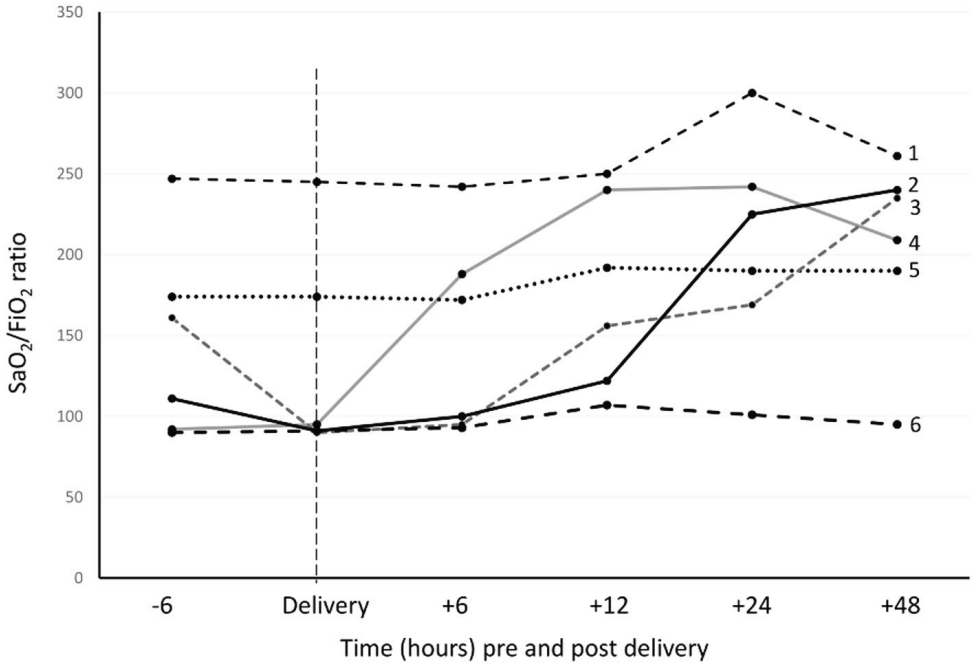


Figure 2: Oxygenation changes peri-delivery, showing SaO_2/FiO_2 ratio predelivery, immediately after delivery and 6, 12, 24 and 48 hours after delivery. Patients are numbered 1 to 6. Patients 2 and 4 (solid lines) were intubated shortly before delivery.



A Systematic Review of Heart Rate Variability as a Measure of Stress in Medical Professionals

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Background: Understanding the physiological effects of responding to crises is a critical component in understanding how to manage and prepare medical professionals to be crisis responders. Heart rate variability is the variation in rate between a succession of heart beats. This variation is affected by physiologic processes, like respiration or metabolic rate, but is also influenced by the autonomic nervous system. As such, heart rate variability has been proposed as a non-invasive tool to measure the acute autonomic nervous system response and stress response.
Objective: The aim of this systematic review is to consolidate heart rate variability literature in the context of medical emergencies to determine if heart rate variability changes predictably from baseline when responding to medical crises. This may demonstrate utility as an objective, non-invasive measure of stress-response.
Methods: A systematic literature review of 6 databases yielded in 413 articles, 17 of which met our inclusion criteria. Articles were then analyzed using the GRADE scoring system.
Results: Out of the 17 articles reviewed, 11 demonstrated statistically significant results showing heart rate variability responding in a predictable manner to stress. Three articles utilized a medical simulation as the stressor, six used medical procedures, and eight used medical emergencies encountered during clinical work. Overall a predictable trend in heart rate variability metrics of SDNN, RMSSD, PNN50, LF%, LF/HF was observed when responding to stress.
Conclusion: This systematic literature review showed that heart rate variability amongst health care providers responding to stressful scenarios follows a predictable pattern of change and expands our understanding of the physiology of stress in health care providers. This review supports the use of HRV to monitor stress during high fidelity simulation to ensure appropriate physiologic arousal is achieved during the training of medical personnel.

Activating the Unthinkable: Critical Care Triage

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Introduction: In the event of a pandemic or disaster, preparedness is crucial. It is essential to have predetermined guidance for health care professionals on how to prioritize critical care services when the demand exceeds the available resources potentially during the current COVID-19 pandemic, for future pandemics or any other unanticipated healthcare crisis. As such, clinical and operational leaders in Alberta have developed a critical care triage protocol and strategy for implementation in the worst-case scenario of overwhelmed critical care capacity. Critical Care Triage in Alberta encompasses both a framework to guide the overall principles and foundational underpinnings and an activation plan to facilitate the collaborative provincial approach across 106 acute care hospitals. Together, this will ensure that triage decisions are ethical, fair, and transparent. Using a pre-developed and objective protocol safeguards health care professionals and the public against the perception that the unthinkable task of critical care triage is ad hoc and will reinforce how the health care system would aim to provide the best care to the greatest number of people.
Objective: To operationalize critical care triage in Alberta's provincial integrated health system by providing a framework to guide and execute clinical decisions made in a setting of extreme resource limitation. Health care professionals can be reassured in making complex decisions through a team based approach and clear processes. The goal is to avoid ad hoc decision-making and ensure an ethical, equitable, and transparent process is universally applied.
Method: The Critical Care Triage protocol was developed by provincial committees for adult and pediatrics and included intensivists, emergency and internal medicine physicians, nurses, operational leaders, and ethicists. The process included extensive consultations with patient and family advisory groups, medical specialist groups, legal entities, professional associations and patient advocacy groups. The process of development also included extensive work with clinical ethics to embed ethical guiding principles, and a review of literature including existing protocols in other jurisdictions.
Result: The work of the committees resulted in a standardized triage protocol where critical care resource decisions are made based on evidence and a shared model for decision making. The framework provides the foundation for critical care triage in Alberta and clear plan for how to activate and action triage. This consists of ethical principles, how triage will be applied and governed, an outline of the key roles and educational needs as well as communication and awareness considerations. Clinical resource tools, documentation templates, education guidelines, and family support. To strengthen adherence to the principles of triage in Alberta, a governance structure linked with the provincial emergency command center will provide accountability and reinforce decision-making. Importantly, Alberta now has the processes required and the tools to support a triage response if it were to become necessary.
Conclusion: No one has trained for a situation such as this, thus it is imperative that healthcare professionals are supported to meet the challenges they may face. Alberta's Critical Care Triage framework provides the foundational understanding and processes of Alberta's approach to triage with a well prepared pre-determined province wide plan

Adaptation of a Pediatric ECLS Program to Support Adult Patients with COVID-19 on VV-ECMO During the COVID-19 Pandemic

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Background: Veno-venous ECMO (VV-ECMO) may be used for patients with acute respiratory failure related to Coronavirus Infectious Disease 2019 (COVID-19). During the third wave of the COVID-19 pandemic in Ontario, the province experienced a surge in the number of adults requiring ICU admission and ECMO for COVID-19. The Hospital for Sick Children's (SickKids) PICU participated in expanding the provincial ICU capacity by admitting critically ill adult patients with COVID-19, with the ability to provide ECMO if required.
Objectives: We review the steps undertaken to adapt the pediatric COVID-19 ECMO practices and ensure readiness to pivot to support adults on ECMO with personnel, equipment and supplies, and the approaches used to sustain the program during the 3-month period.
Methods: SickKids ECLS Program collaborated with the University Health Network's (UHN) ECLS Program to understand adult COVID-19 VV-ECMO management practices. UNH's COVID-19 VV-ECMO management practices and post decannulation guidelines were obtained, reviewed, and incorporated into existing ECMO management guidelines. Clinicians from the SickKids ECLS Program participated in UHN's weekly virtual ECLS patient summary rounds and UHN surgeons were invited to attend daily virtual bedside ECLS rounds in the SickKids PICU for added real time decision making and support. A virtual education session was developed and recorded to share current evidence based adult COVID-19 VV-ECMO management guidelines and to highlight practice differences. Cannulas and membranes suited for adults were ordered. Cardiology, Thrombosis, and ENT consultant services adapted their imaging, laboratory testing and procedural support as required.
Results: From April to June 2021, 36 adult patients with COVID-19 were admitted to SickKids PICU. Thirty required intubation and mechanical ventilation and eight were supported on VV-ECMO. Five were cannulated and decannulated in the PICU; 3 were transferred in already cannulated and transferred back to UHN on ECMO. Median time on VV-ECMO at SickKids was 19 days. 50% of ECMO patients also required continuous renal replacement therapy connected through the ECMO circuit. Four patients were separated from VV-ECMO, extubated, and discharged to an adult hospital COVID-19 ward; 3 patients were transferred back to UHN on VV-ECMO for continued management, and one patient died after compassionate separation from ECMO due to multi-organ failure. Minor differences between pediatric and adult practices were associated with anticoagulation (using PTT as heparin laboratory monitoring and discontinuing heparin for bleeding complications). Major practice differences included: using bedside percutaneous ECMO cannula insertions with

transesophageal echocardiogram guidance, percutaneous tracheostomy insertion using disposable bronchoscopes, decannulation from ECMO without vascular reconstructions, and avoidance of ECPR.
Conclusion: The SickKids ECLS Program was successfully able to rapidly adapt and care for critically ill adults with COVID-19 requiring VV-ECMO through education sessions for staff, collaboration with the UHN ECLS Program and integration of adult practices into an already mature pediatric ECLS program. Relevant experience gained from the management of adult patients will be incorporated into existing pediatric VV-ECMO management and applied to the older pediatric and adolescent patients cared for in the future.

Advancing Care for Children with Spinal Muscular Atrophy (SMA) and their Families: Developing Best Practice Recommendations

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Background: In Pediatric Critical Care practice, Spinal Muscular Atrophy (SMA) is the most frequently seen degenerative neuromuscular disease. Emerging therapies have improved the long-term outlook for these children. Ensuring excellent care during times of critical acute illness is increasingly important to avoid the negative long-term consequences of poor growth, muscle loss, chronic respiratory failure, and the developmental and psychosocial harms associated with prolonged critical illness hospitalization.
Objective: We report on the development and implementation of evidence-based pediatric critical care guidelines informing team-based care for children with SMA and their families. Guideline development, dissemination, uptake, evaluation, and sustainment strategies will be described.
Method: A realist literature review was completed by an interprofessional team. Current local practices were compared to the evidence extracted from the literature and key practice improvement domains were collaboratively determined. Best practice guidance for multidisciplinary care was developed within each priority domain, integrating evidence, stakeholder, and expert opinion. Guidelines were then refined to fit in the local context of care and available resources. The resulting practice guidelines were disseminated through education and specific process tools in preparation for program-wide implementation. A formative and summative integrated evaluation plan was designed that included measures of guideline adherence, education outcomes, user feedback, and the sustainment of new practice behaviors.
Results: A search of 5 databases and expert knowledge of the literature identified 404 titles of which 120 were included for full-text review. Evidence from six emerging priority domains: respiratory care, family experience, nutrition, outcomes, pharmacological care, physiotherapy care, and rehabilitation were extracted. Practice recommendations for each domain were translated into the organization's electronic medical record as a set of standardized admission orders. Recommendations not suited to standardized orders were incorporated into a best practice guidelines document. Implementation interventions were developed including discipline/role-focused education presentations, self-learning modules, and a program-wide awareness campaign. All of the tools developed were adapted for access during pandemic restrictions and integrated into standing educational platforms.
Conclusion: Children with SMA and their families have unique needs during critical illness. Advancements in treatment are encouraging for enhancing the quality of life for these children and the critical care team needs to ensure that care is aligned with the best evidence to ensure these quality outcomes are achieved. Ongoing rapid-cycle evaluation of these guidelines and the resulting practice and systems changes are necessary to sustain practice improvements and ensure the evolving needs of this fragile population are met.

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An Evaluation of Pediatric Medical Emergency Team Follow-Up from Emergency Department for At-Risk Patients

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Introduction/Background: Admissions to the Pediatric Intensive Care Unit (PICU) from an inpatient ward have been reported to have a 1.65 times higher odds of mortality compared to children who were directly admitted from the Emergency Department (ED) [1] and readmission within 48 hours to PICU is associated with increased mortality [2]. An evaluation of a pediatric critical care response team (PCCRT) at a tertiary children's hospital reported that approximately half of patients who required evaluation by the PCCRT in the ED were later admitted to the PICU in less than 24 hours on an inpatient ward, demonstrating this group to be an at-risk population [3,4]. However, the use of PCCRTs to follow children assessed to require a PICU consult by the ED after admission to a general ward environment has not been previously described. We implemented a follow-up program to routinely assess patients on inpatient units after a PICU consult deemed PICU admission was not necessary. This program, termed Transitional Assessment Post-Transfer (TAPT), consists of one dedicated critical care nurse and one dedicated respiratory therapist, was implemented in July 2017.
Objectives: To evaluate the proportion of admissions to PICU that occurred within 24 hours of admission to a general in-patient unit after PICU consultation in ED, prior and following implementation of a PCCRT follow up program.
Methods: Following research ethics board approval, the study team conducted a retrospective analysis of the records of patients admitted to the PICU within 24 hours of admission to a pediatrics unit to review cases where the PCCRT was either directly activated or initiated following PICU consultation in the ED prior to admission to the general in-patient wards.
The hospital charts of the patients involved in the eligible cases of PCCRT involvement were then reviewed by the study team to collect dates and times of relevant assessments, patient characteristics, vital signs at key transfer periods, diagnoses, time to PICU admission from discharge from ED, if a code blue was called, and PICU length of stay.
Results: There were 23 patients who were admitted to the PICU within 24 hours of hospital admission to a general pediatrics unit who had received a PICU or PCCRT consultation in ED, 12 (7.2%) prior to and 11 (7.1%) post-implementation of the TAPT program. The median time to PICU admission was 8 hours prior, and 12 hours following implementation. The mean length of stay in PICU was 2.44 days prior and 1.75 days following. Only 4% of the admissions to PICU within 24 hours of hospital admission had a PICU or PCCRT consultation in the ED. There was a 0% mortality in both groups.
Conclusion: Overall, there is no change in the absolute proportion of admissions to the PICU within 24 hours of admission to the general pediatric ward, following implementation of a PCCRT follow up program if PICU or PCCRT were initially consulted in the ED. However, the time to PICU admission shows a trend towards increased time on the ward before transfer to PICU for these patients, and a shorter mean length of stay in the PICU. Importantly, only 4% of patients who were transferred to PICU within 24 hours of hospital admission had a PICU or PCCRT consultation in the ED, indicating early clinical deterioration. This is group presents opportunities for further study to determine any points of potential intervention.

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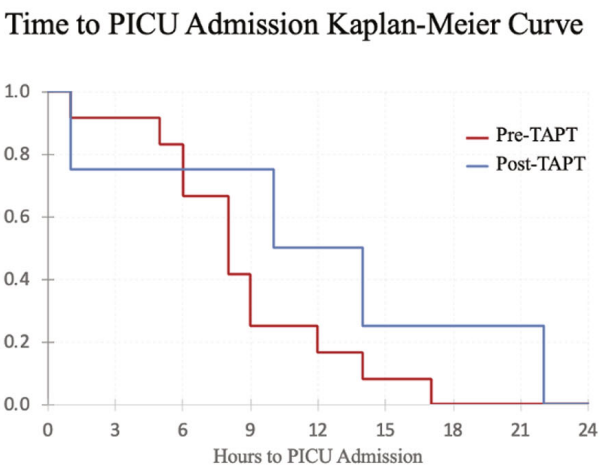

Figure 1. Kaplan-Meier curve demonstrating time to PICU admission. Mean time to PICU admission pre-TAPT implementation of 8 hours, and 12 hours post-TAPT implementation.

	Pre-TAPT	-TAPT
Proportion		
Included	12	11
Pool	167	155
Share	7.2%	7.1%

Figure 2.

Included indicates number of patients meeting inclusion criteria of PICU consultation in ED and admission to PICU from pediatric ward within 24 hours of hospital admission. Pre-TAPT pool consists of patients admitted from January 25, 2014, to July 17, 2017. Post-TAPT pool consists of patients admitted from July 18, 2017, to July 17, 2020.

Characteristic	Study Sample (N= 23)	Pre-TAPT (N=12)	Post-TAPT (N=11)
Gender			
Male	70	67	73
Female	30	33	27
Age (months)			
0-12	22	17	27
13-24	22	17	27
25-36	4	0	9
37-48	4	8	0
49-60	9	17	9
>60	26	42	9
Reason for hospital admission			
Respiratory	74	67	73
Infectious	4	8	0
Neurologic	9	8	9
Hematologic	13	8	18
Gastrointestinal	4	8	0
Cardiac	0	0	0

Figure 3. Patient Characteristics. Data are presented as *n*(%).

An Observational Pilot Study Investigating the Role of Coagulation in the Diagnosis of SEPSIS in the Emergency Department (SEPSIS-ED)

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Introduction: Coagulation biomarkers are important in the prognosis of septic patients. Our objective is to determine if coagulation biomarkers can improve sepsis diagnosis in the emergency department (ED).
Objectives: The primary objective is to identify the changes in the coagulation biomarkers occurring in septic patients presenting to the ED. The secondary outcome is to identify a panel of biomarkers (including inflammatory and coagulation markers) with the routinely used laboratory tests and clinical scores of abnormal vital signs and organ dysfunction to aid in sepsis diagnosis.
Methods: SEPSIS-ED is an observational cohort study with planned recruitment of 250 adult patients presenting to two ED's with the suspicion of sepsis. Samples are collected at two-time points: initial patient presentation to the ED (T1) and four hours after the initial sample collection (T2). Plasma cell-free DNA (cfDNA) levels are determined by the silica-membrane based DNA purification method and UV spectrophotometry. Protein C (PC), DNase I (deoxyribonuclease I), and ADAMTS13 (a disintegrin and metalloproteinase with a thrombospondin type 1 motif member 13) levels are measured using enzyme-linked immunosorbent assays.
Results: We report preliminary data on 195 patients presenting with the suspicion of sepsis to the ED, including 53.3% males with a mean age of 69.4 ± 17.9 years. CfDNA and DNase I levels at both time points were not significantly different from the healthy controls (HC). PC levels decline four hours after admission to the ED. In addition, ADAMTS13 levels were significantly lower than the HC, with a decline four hours after the initial presentation to the ED.
Limitations: The study is limited by a moderate study size and the presence of only two study sites. Even though we aim to evaluate patients early in the disease process by using the ED, the precise onset of sepsis cannot be accurately determined due to the heterogeneity of the pathophysiological process.
Conclusion: Our preliminary data suggests suspected septic patients presenting to the ED have an associated coagulopathy (as demonstrated by a decrease in ADAMTS13) and adequate DNase I levels to neutralize the cfDNA levels. Our results provide a rationale to explore the impact of coagulation markers facilitating earlier and accurate sepsis diagnosis.

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AnaConDa in Intensive Care: Implementation of Volatile Anesthetic Agents to Mitigate Sedation Shortages during COVID-19

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Background: The unprecedented demand for sedative agents during the COVID-19 pandemic resulted in worldwide shortages of commonly used intravenous sedation medications such as propofol and fentanyl. One method of conserving the supply of sedative agents is administering volatile anesthetics for long-term sedation. Volatile anesthetic agents, such as isoflurane, have been used for general anesthesia in operating rooms for more than 150 years, but are not routinely used to sedate mechanically ventilated patients in the intensive care unit (1). The safe administration of volatile anesthetics requires the means to safely deliver these medications with standard ventilators within established protocols while ensuring the safety of the critical care environment and the healthcare professionals that work there (2-4). The Anesthetic Conservation Device (AnaConDa) is a single-use device that allows for the safe delivery of isoflurane to patients in critical care settings.
Objective: The implementation of a safe supplemental sedation regimen using isoflurane with AnaConDa in a COVID-19 intensive care unit to mitigate the impact of sedation shortages.
Methods: A coordinated, multidisciplinary approach involving respiratory therapists, pharmacists, nurses and physicians was used to operationalize the safe use of AnaConDa into daily practice. A comprehensive review of the literature and prior protocols, stakeholder meetings and expert engagement, including physicians and staff involved in previous research were used to create a guidance document for isoflurane administration using the AnaConDa.
Results: Over the course May and June 2020, training resources and a staff education plan were developed and implemented to ensure patient, staff and environmental safety. Education and training sessions were conducted for respiratory therapists, critical care nurses, pharmacists, residents and fellows on the routine operation of the AnaConDa, required patient monitoring and the identification and management of potential complications of volatile anesthetic gasses. A total of 44 respiratory therapists, a core group of 30 critical care nurses were trained using in-services and supported by bedside training as necessary. A total of 6 patients successfully received supplemental sedation using the AnaConDa in the post implementation phase. Additional supportive materials were developed, including a standard order set, documentation flowsheet, and a bedside clinical reference guide. Further safety protocols for isoflurane administration included flags in the electronic patient records and designated, secure storage locations.
Conclusion: We successfully created capacity to safely deliver a supplemental method of sedation therapy for critically-ill COVID-19 patients requiring mechanical ventilation in intensive care. This method of sedation is part of a comprehensive strategy to achieve sedation goals the intensive care. This included the creation of approved order sets, educational material, interprofessional staff training and ongoing staff

support amidst the many competing priorities during the pandemic. Ongoing clinical trials are required to establish the effects of inhalational sedation on ventilation, delirium, and clinical outcomes.

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Ancillary Test Diagnostic Accuracy for Death by Neurological Criteria/Brain Death: A Systematic Review and Meta-Analysis

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Introduction: Ancillary tests are widely used to diagnose death by neurological criteria (DNC), particularly in patients with unreliable or incomplete clinical examinations[1-3]. Despite their importance in DNC determination, ancillary test use in clinical practice is heterogeneous and their respective diagnostic accuracy is unclear.
Objective: To synthesize the diagnostic accuracy (sensitivity and specificity) of ancillary tests used in clinical practice to diagnose DNC among comatose patients.
Methods: We performed a systematic review and meta-analysis by searching MEDLINE, EMBASE and Cochrane Central databases from their inception to April 21, 2020[4]. We selected published abstracts and manuscripts reporting cohort and case-control studies, as well as case series, including deeply comatose patients who underwent ancillary testing (neuroimaging, neurophysiology) for DNC determination. Accepted reference standards were clinical examination, four-vessel angiography, and radionuclide imaging. Two individuals independently extracted data and assessed study risk of bias using the QUADAS-2 tool. We estimated ancillary test sensitivities and specificities using a mixed-effects Bayesian hierarchical model with studies nested within ancillary test types.
Results: The search strategy yielded 4208 publications, of which 40 satisfied selection criteria (N=2744 ancillary tests applied). One study had low risk of bias on all QUADAS-2 domains. Reference standards were clinical examination in 37/40 (92.5%) studies and four-vessel angiography in 3/40 (7.5%) studies. Ancillary tests were CT-angiography (4-point, 7-point and 10-point scales, and no intracranial flow criteria), CT-perfusion scan, radionuclide imaging (with technetium [99m Tc] pertechnetate angiography, 99m Tc diethylenetriamine pentaacetate [DTPA] angiography, 99m Tc hexamethylpropylene amine oxime [HMPAO] angiography, 99m Tc HMPAO perfusion with and without single-photon emission computed tomography [SPECT], 99m Tc HMPAO angiography, and other criteria), transcranial Doppler ultrasound, cortical electroencephalography, magnetic resonance imaging (time-of-flight angiography, diffused weighted imaging and apparent diffusion coefficient [DWI/ADC]), magnetic resonance venography and evoked potentials (brainstem auditory and somatosensory). Data was most abundant for transcranial Doppler ultrasound (40.4% of applied ATs), CT-angiography (4-point scale; 11.0%) and electroencephalography (9.6%). The Figure reports pooled ancillary test sensitivities and specificities, with respective 95% highest density intervals. Overall, ancillary tests had variable pooled sensitivities (0.81-1.00) and specificities (0.84-1.00). Wide highest density intervals were observed for several ancillary tests, reflecting significant uncertainty in pooled diagnostic accuracy estimates.
Conclusion: Studies assessing the diagnostic accuracy of ancillary tests for DNC have unclear or high risk of bias. Most ancillary tests have imperfect or imprecise diagnostic accuracy (sensitivity and specificity). Further research is required to identify accurate ancillary tests for DNC determination.

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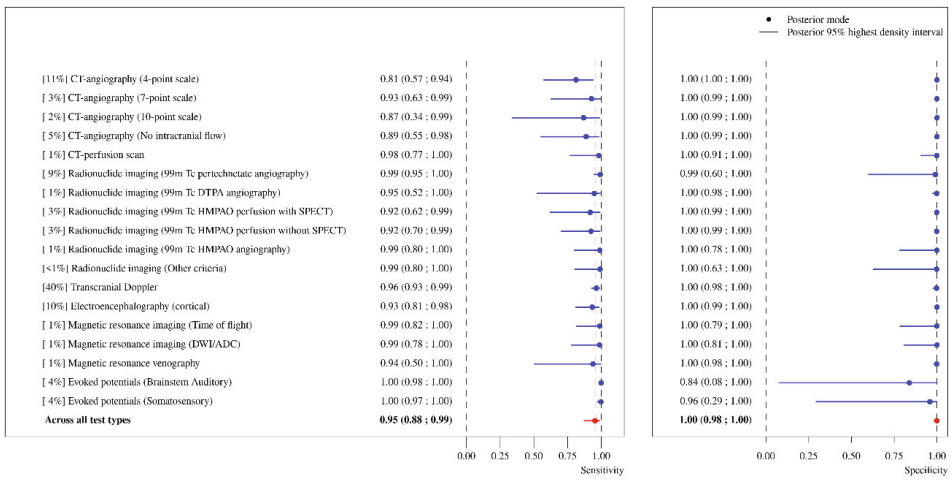
Figure 1. Pooled ancillary test sensitivities and specificities, with respective 95% highest density intervals



ARDS in the Age of COVID-19 - A survey of Canadian Critical Care Physicians

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Background: Coronavirus Disease 2019 (COVID-19) has created a worldwide pandemic, increasing the incidence of patients developing acute respiratory distress syndrome (ARDS). Having no cure, ARDS needs to be therapeutically managed with various strategies and salvaged with rescue therapies if patients continue to deteriorate. Unfortunately, it has been shown that there is variability in the treatment of ARDS patients across Canadian Intensive Care Units (ICUs), but exactly how is yet to be determined[1]. Differences in practice needs to be clarified to ensure the best use of scarce resources and optimal patient outcomes during this pandemic.
Objective: The objective of this study is to determine how Canadian critical care physicians apply evidence-based strategies to the management of ARDS in the context of the COVID-19 pandemic.
Methods: In a national cross-sectional survey, we developed, tested, and administered an electronic questionnaire to 12 critical care departments across Canada. Critical care attendings and fellows were included in the survey distribution. The questionnaire included assessment on critical care physicians' demographic data, ARDS management strategy importance (5-point Likert scale), ARDS management thresholds (multiple-select questions), and opinion on ARDS COVID-19 (open-text). Data was collected through a secure web-based electronic platform (Qualtrics).
Results: A total of 74 critical care physicians participated in the survey. The majority of respondents had specialty training in internal medicine (49%), greater than 10 years of experience in critical care medicine (42%) and were located at a university-affiliated centre (91%). ARDS net ventilation and prone positioning were seen as the most important management strategies with 97% and 89% of respondents, respectively, stating they were very or extremely important. Inhaled nitric oxide and physical examination were the least important, with 67% and 34% of respondents, respectively, stating they were not at all important or slightly important. The most common thresholds for use of ARDS management techniques included daily (59%) physical examination, clinical deterioration (90%) on chest x-ray, ventilator dys-synchrony (75%) for muscle relaxants, PF ratio 100 – 150 (84%) for prone positioning, right ventricular (RV) dysfunction (53%) for inhaled nitric oxides, routine (49%) for steroids, and as per local extracorporeal membrane oxygenation (ECMO) centre protocol (84%) for EMCO referral. Common themes when asked for additional management strategies that were seen as beneficial for COVID ARDS included medications (34%), medical interventions (42%), and conservative approaches (36%). Specifically, the most common included Tocilizumab (17%), PEEP (positive end-expiratory pressure) titration (15%), and delayed intubation and prognostication (12%).
Conclusion: In the context of COVID-19 pandemic, there is some agreement amongst critical care physicians about what is important in the management of ARDS, whether it be management strategies or thresholds for use. However, there is a disconnect with individuals' thoughts and actions, specifically when looking at perspectives on physical examination. When not prompted, there was still some form of consensus on beneficial strategies for treating ARDS COVID. Overall, these factors combined suggest variability in practice between physicians may not be as inconsistent as previously thought.

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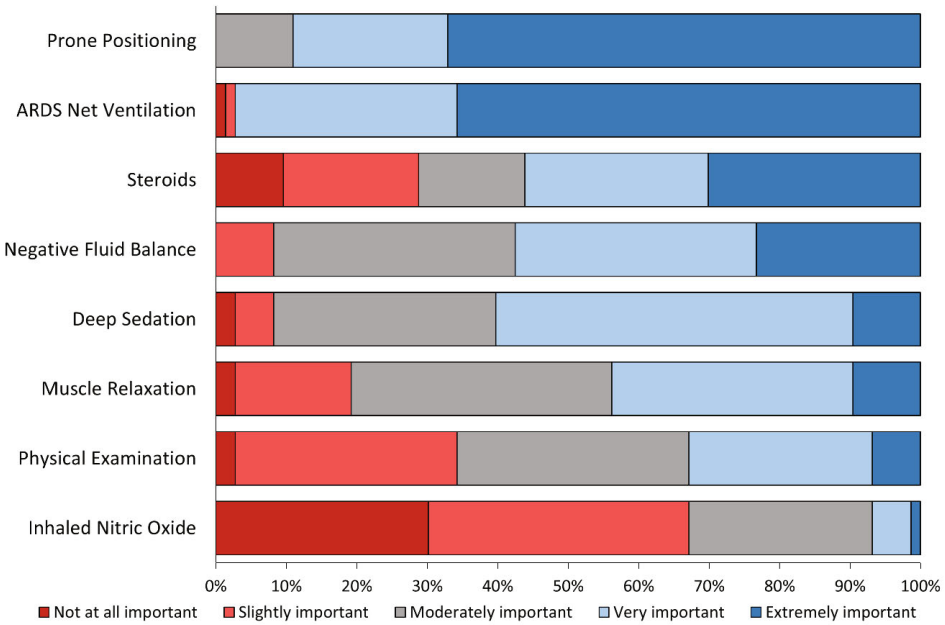

Figure 1: Importance of various management strategies in acute respiratory distress syndrome (ARDS) patients to critical care physicians (*N*=73).

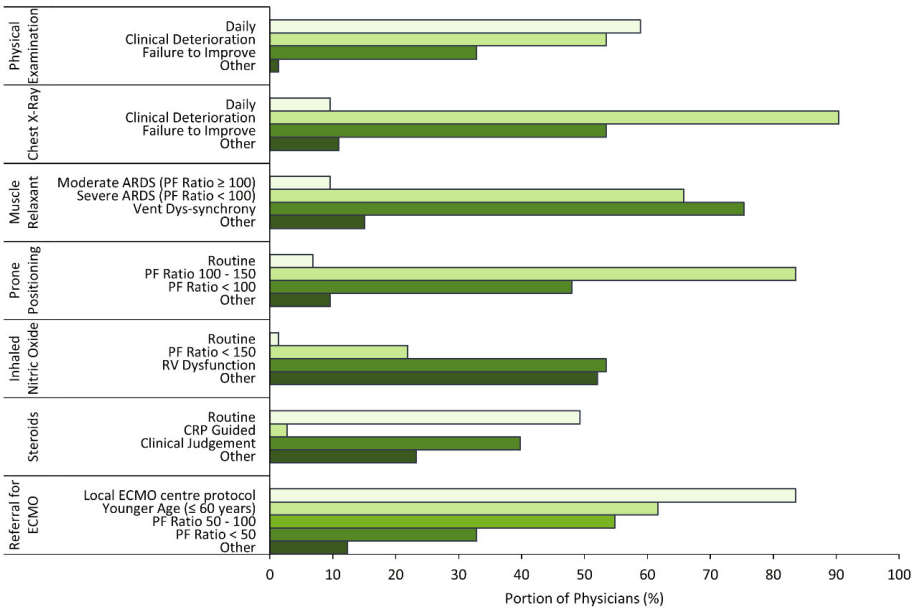

Figure 2 : Critical care physicians' thresholds for use of various acute respiratory distress syndrome (ARDS) management techniques (*N*=73). PF: Partial pressure arterial oxygen to fractional inspired oxygen; RV: right ventricular; CRP: C-reactive protein; ECMO: extracorporeal membrane oxygenation.

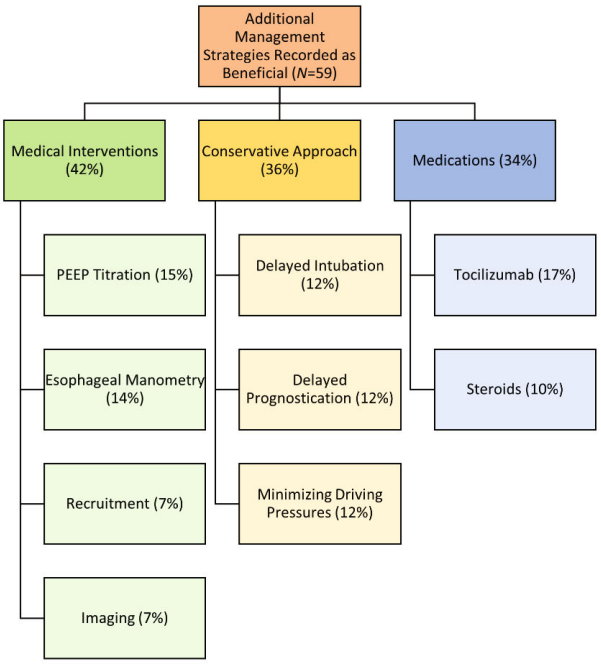

Figure 3: Flowchart illustrating common themes when physicians were asked what additional management strategies were beneficial in treating COVID ARDS. Percentages represent portion of physicians' answers (*N*=59) that referred to the corresponding theme, with some physician answers containing multiple themes.

Assessment of an Intraoperative Arterial Line Error-Checking Algorithm Compared to Manual Review in a Critical Care Population

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Introduction: High frequency data streams of vital signs can be used to generate individualized hemodynamic targets for critically ill patients. However, central to this precision medicine approach to resuscitation is our ability to screen these data streams for errors and artifacts. Arterial line data which is used to derive these targets are prone to artifacts due to reasons such as blood sampling, malpositioning, line flushing, and calibration procedures. Various methods have been used to assess artifacts including models that implement arbitrary thresholds or average data over large time intervals[1]. More stringent methods for artifact cleaning are needed to capture changes that appear physiologic and to preserve data granularity. There is no consensus on the best method for data cleaning.
Objectives: To determine whether an error-checking algorithm that assesses the relationship between systolic, diastolic, and mean arterial blood pressure data developed for intraoperative use[1] can be applied to high volumes of arterial line data in an ICU population.
Methods: High frequency blood pressure data from a nested cohort of ICU patients enrolled in the CONFOCAL-2 study were analyzed. Systolic, diastolic, and mean arterial pressure values were derived from waveforms captured at 240Hz and sampled at 0.5Hz. Minute averages were calculated and used for assessment by a trained researcher and the error-checking algorithm. For manual analysis, the researcher retrospectively reviewed the high frequency mean arterial pressure data point-by-point and removed any values that were deemed non-physiological. Artifacts were defined as values that increased or decreased rapidly (e.g., >20mmHg transient fluctuations from preceding MAP values) and returned to values similar to those preceding the large change in a short period of time or were non-physiological (e.g., negative values). The algorithm was implemented using the pre-set parameters and identified artifactual data by integrating minute-by-minute blood pressure changes as well as the relationship between the spacing of systolic, diastolic, and mean arterial pressure values over time. All analyses were performed in R version 4.1.1.
Results: Arterial line blood pressure data was extracted from 16 patients over 9 months (April-December 2018). 41,093 minute-by-minute data points were reviewed manually by a trained researcher and using the algorithm. Manual review resulted in the identification of 117 (0.28%) artifacts. Meanwhile, the algorithm identified 104 (0.25%). Compared to manual review, the algorithm had a 37.6% sensitivity and 99.8% specificity using pre-set parameters for acceptable fluctuations in diastolic, systolic, and mean arterial blood pressure values.
Conclusion: The error-checking algorithm had low sensitivity and high specificity in detecting arterial line blood pressure artifacts compared to manual data cleaning. Additional work is needed to optimize performance in a critical care setting including adjusting decision parameters and manual annotation of known arterial line disruptions. Given the growing use of artificial intelligence in critical care research, methods to validate the quality of high frequency data is important to optimize algorithm performance and prevent spurious associations based on artifactual data.

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Association of Dynamic Changes of Partial Pressure of Carbon Dioxide with Poor Neurological Outcome in Aneurysmal Subarachnoid Hemorrhage: A Retrospective Observational Study

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Background: Carbon dioxide (CO_2) closely regulates cerebral blood flow (CBF) and actively participates in different aspects of brain physiology such as hemodynamics, oxygenation, and metabolism[1, 2]. Reductions in arterial partial pressure of CO_2 ($PaCO_2$) and the following hypocapnia may modify the variables mentioned above and comprise secondary insults in aneurysmal subarachnoid hemorrhage (aSAH)[3-5]. Moreover, the duration of hypocapnia was independently associated with poor outcomes in aSAH. However, the current study may focus on only one abnormal value of $PaCO_2$, and the role of dynamic changes in $PaCO_2$ on unfavorable outcomes in aSAH has not been investigated well.
Objectives: To investigate the independent effect of the dynamic changes of $PaCO_2$ on outcome in patients with aSAH.
Methods:154 consecutive patients with aSAH presenting to the Department of Intensive Care Unit (ICU), Beijing Tiantan Hospital, were retrospectively enrolled. Arterial blood gas values were measured and collected at random time intervals during the ICU treatment's first ten days. The time-weighted average (TWA)-$PaCO_2$ was calculated by the sum of the average $PaCO_2$ values among consecutive time points multiplied by the intervals between consecutive time points and dividing the sum by the total time. Patients were categorized into two groups (TWA-hypocapnia, TWA-$PaCO_2$ <35 mm Hg; TWA-normocapnia, TWA-$PaCO_2$ 35-45 mm Hg). The study's primary outcome was the modified Rankin score (mRs) at three months, which was ascertained from clinic notes of routinely scheduled 3-month aneurysm clinic follow-up visits by staff blinded to the CO_2 exposure status of the patient. The study's secondary outcomes were symptomatic vasospasm and delayed cerebral ischemia (DCI). Univariable and multivariable logistic regression analysis was used to assess the independent effect of TWA-hypocapnia on 3-month neurological outcomes.
Results: Overall, a total of 45 (29.2%) had an unfavorable outcome at three months, who were older (mean age 50.8 vs 58.1, $p < 0.001$), had worse clinical status on admission: Hunt and Hess score (median 2 vs 3, $p < 0.001$) and Modified Fisher Score (median 3 vs 4, $p < 0.001$) and World Federation of Neurological Surgeons (median 2 vs 2, $p < 0.001$), and higher rates of the use of mechanical ventilation (16.5% vs 68.9%, $p < 0.001$) and opioids (36.7% vs 62.2%, $p = 0.004$). TWA-hypocapnia was more common among patients with unfavorable outcome (55.6% vs 38.5%, $p = 0.053$). Multivariable logistic analysis indicated that no independent effect of TWA-hypocapnia on neurological outcome (odds ratio [OR] 2.11, 95% confidence interval [CI] 0.83-5.38, $p = 0.119$).
Conclusion: The dynamic changes of CO_2 may not be independently associated with a poor neurological outcome in aneurysmal subarachnoid hemorrhage patients.

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Attitudes Toward Presumed Consent Legislation in Organ Donation: A Systematic Review and Meta-Synthesis

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Introduction: To improve organ donation and transplantation rates, Nova Scotia, Canada enacted presumed consent legislation, also referred to as deemed consent, January 18, 2021. This is the first jurisdiction in North America to consider all adults to be organ donors unless they opt out of the program ahead of time. The goal of this project was to review and synthesize published reports of knowledge and attitudes toward deemed consent legislation.
Methods: Using qualitative content analysis, we conducted a meta-synthesis systematic review of quantitative and qualitative literature assessing the knowledge and attitudes of public, healthcare personnel and other stakeholders toward deemed consent. We searched MEDLINE, EMBASE, CINAHL, and PsycINFO, and scanned the internet for relevant organ donation registry websites. There were no date or language restrictions on eligible studies. Pairs of reviewers read all reports, categorized messages into codes, and then iteratively grouped the codes into main themes. We used GRADE methodology to assess the certainty of evidence for quantitative studies and for qualitative studies we used the Critical Appraisal Skills Program (CASP) qualitative research checklist.
Results: The 51 studies eligible for this review included cross-sectional surveys, qualitative studies, and systematic reviews. Review findings suggested that knowledge and attitudes toward deemed consent depend upon multiple factors, including the messaging and education around legislation campaigns, the involvement of varied gatekeeper or stakeholder groups when contemplating changes, as well as cultural and social factors that affect public opinions.
Conclusions: The combined message from included references suggest that legislative decision and policy makers should not underestimate the importance of complementary initiatives aimed at increasing successful organ donation and transplantation. Without them, consent model changes may not have the desired impact on donation and transplantation activity.

Grant Acknowledgement: This study is funded by Health Canada as part of the Legislative Evaluation: Assessment of Deceased Donation Reform project, which is a partnership between the Nova Scotia Health, the Nova Scotia Department of Health and Wellness, the Canadian Donation and Transplantation Research Program, Canadian Blood Services and Transplant Québec.

Barriers to Optimal Extracorporeal Cardiopulmonary Resuscitation in Out-of-Hospital Cardiac Arrest

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Introduction: Extracorporeal cardiopulmonary resuscitation (ECPR) is the technique by which an extracorporeal circuit is used to restore circulation in patients with cardiac arrest refractory to conventional cardiopulmonary resuscitation (CPR).[1,2] Recent studies suggest that ECPR can improve the outcomes of out-of-hospital cardiac arrest (OHCA) patients.[3,4] However, the deployment of ECPR represents a considerable logistical challenge.[4,5] The circuit should be put in place as quickly as possible in order to reduce the time of cerebral ischemia.[4,6] Rigorous time management is essential for the success of the technique.[7]
Objectives: We aimed to establish the prehospital time in patients with OHCA transported to our center and the proportion of optimal ECPR candidates for whom the ECPR team was called. Moreover, we aimed to establish the time between patient arrival to the emergency department (ED) and ECPR team activation, the time for team arrival, the time to reach a decision concerning ECPR, as well as the time required for the initiation of extracorporeal support. The overarching goal was to help develop targeted interventions aimed at improving speed of deployment and ECPR candidacy by focusing on problematic time intervals.
Methodology: We performed a single-center retrospective cohort study. We included all consecutive patients with OHCA who were transported to Hôpital du Sacré-Coeur de Montréal, between July 1, 2018, and June 30, 2021. The data was collected from electronic medical records. We defined optimal ECPR candidates as patients (1) aged 55 years old or less with a (2) witnessed arrest and (3) no return of spontaneous circulation after 20 minutes of conventional CPR, (4) arriving at the hospital within 60 minutes of the initial arrest (5) during the day (between 8:00 and 17:00). For descriptive statistics, continuous variables were presented as medians with interquartile ranges and discrete variables were presented as counts and percentages.
Results: Over the 3-year study period, 427 patients were transported to our ED for OHCA, 15 of which met all of the above-mentioned criteria for ECPR (3.5%). The ECPR team was called for 7 of these optimal ECPR candidates (46%) and for 21 other patients. Of the 28 instances in which the ECPR team was activated, canulation was attempted in 10 cases (36%) and successful in 7 cases (70%). The median time for Basic Life Support (BLS) team to arrive on scene was 12 [8-17] minutes. BLS spent a median of 27 [20-36] minutes on scene, and transported patients to the hospital in 8 [6-10] minutes. In total, the median arrest-to-door time was 48 [38-57] minutes. Median ECPR team activation time was 2.5 [0-9] minutes. The team arrived in 2 [2-5] minutes and made the decision to cannulate in 8.5 [3.5-11] minutes. The median time to cannulate was 16 [7-23] minutes. In total, median door-to-ECLS time was 27 [21-39] minutes.
Conclusion: We found that a median of 48 minutes was required to reach our hospital after an OHCA, and a median of 27 minutes for extracorporeal support initiation. Although ideal ECPR candidates represent a very small proportion of OHCA, the ECPR team was only activated in a minority of them. The priority should be to reduce prehospital time, especially the time spent on scene by the BLS team. In-hospital, efforts should focus on improving identification of potential candidates, time spent before initiating canulation and the efficiency and success rate of cannulation.

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Table 1. Time intervals between cardiac arrest and initiation of extracorporeal life support

	Median	Percentile 25	Percentile 75
Time to call	0.00	0.00	1.00
Time to BLS on scene	12.00	8.00	17.00
Time spent on scene by BLS	27.00	20.00	36.00
Transport Time	8.00	6.00	10.00
Time for ECPR team activation	2.50	0.00	9.00
Time for ECPR team arrival	2.00	2.00	5.00
Time for Decision To Cannulate	8.50	3.50	11.00
Canulation Time	16.00	7.00	23.00
Total Arrest To Door Time	48.00	38.00	57.00
Total Door To ECLS Time	27.00	21.00	39.00

BLS = Basic Life support; ECLS = Extracorporeal Life Support; ECPR = Extracorporeal cardiopulmonary resuscitation.

Bedside Management of the Open Abdomen in the ICU: A Multi-Disciplinary Perspective

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Introduction: Management of patients with an open abdomen (OA) can be difficult and resource intensive for surgical and ICU teams alike. Patients with OA classically require regular trips to the operating theatre for dressing changes and assessment. Managing an open abdomen with bedside dressing changes in the ICU rather than the OR reduces patient transfers and cost. Though efficient, moving open abdomen management to the ICU has the potential to cause significant stress on the intensive care multidisciplinary team. We aim to better understand the experiences and opinions of team members after experiencing a bedside OA dressing change.
Objectives: To understand the perspectives of the intensive care multidisciplinary team members regarding bedside OA dressing change in the ICU and to gain perspective regarding perceived feasibility, challenges, support, and stress associated with bedside changes.
Methods: Patients were selected from individuals admitted to the ICU at the QEII Health Sciences Center, Halifax Nova Scotia who had an OA requiring management with an ABThera temporary abdominal closure device. A perioperative risk assessment was conducted and patients were deemed appropriate to undergo bedside ABThera changes within the ICU. Changes were performed as sterile procedures, in a private room, with limited traffic. Procedure carts were used to set up the sterile field immediately before the change was to occur. Once the dressing change had occurred, participants were asked to fill out a survey regarding their experience. The survey consisted of seven questions on a 5-point Likert scale (Appendix 1). Responses were recorded
Results: Response rate was 100% from all members of the ICU multidisciplinary team and surgery team asked to fill out a survey. A total of thirty surveys were returned evaluating the experiences during six ABThera changes in the ICU. Surveys were collected from eleven ICU nurses, one OR nurse, one Respiratory Therapist, nine Surgery Residents, one surgery attending, one ICU resident, five ICU attendings, and one anesthesia resident. From these surveys ninety seven percent of respondents felt ABThera change was appropriate for the ICU. Eighty three percent of respondents agreed that bedside ABThera change in the ICU was as easy or much easier than changing the ABThera in the OR. Eighty three percent disagreed or strongly disagreed that ABThera change was stressful. Ninety three percent of respondents indicated that they felt Abthera change in the ICU improved or did not hinder patient care. Ninety percent of respondents agreed that changing ABthera dressings in the ICU is convenient. All respondents agreed or strongly agreed that avoiding patient transfer was beneficial for patient care and ninety seven percent of respondents support or strongly support future ABThera changes in the ICU. Importantly, two respondents felt that bedside changes were harder or much harder; however, indicated that they felt it was safe and beneficial to reduce patient transfers.
Conclusion: Bedside OA dressing changes in the ICU are well received by the multidisciplinary team at our institution. They are viewed as beneficial, appropriate, safe, and efficient. Bedside dressing changes did not cause undue stress on members of the team and were seen as easy to facilitate.

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Clinical Evaluation of a Novel Proning Device in COVID-19 Patients with Severe Respiratory Failure

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Introduction/Background: COVID-19 patients and others with severe respiratory failure often require proning. In response to challenges with proning COVID-19 patients, the Apparatus and Method for Moving a Patient (AMMP) was developed to improve patient and provider safety.
Objectives: To evaluate use of the AMMP to prone COVID-19 patients with severe respiratory failure.
Methods: In 2021, providers including physicians, nurses, and respiratory therapists working in the ICU at the QEII Health Sciences Centre (Halifax NS) participated in a clinical trial (NCT04882865) using the AMMP to prone COVID-19 patients with severe respiratory failure. Subject selection was quasi-random and included members of the healthcare team assigned to care for ICU patients. Education on proper use of the AMMP was provided prior to movements. Paper-based surveys were administered upon completion. Providers were asked to evaluate ease of use, time, safety, and any adverse events during the proning procedure.
Results: Overall, a total of 57 ICU healthcare providers completed surveys after using the AMMP to prone COVID-19 patients. Most providers found it easy to apply the AMMP to the patient (91%; 52/57), adjust strap length (91%; 52/57), and remove after completing the movement (91%; 52/57). Compared to standard proning procedures, 88% (50/57) felt physical demands were reduced using the AMMP and 68% (39/57) agreed it took less time to complete prone positioning. Most providers believed the AMMP improved patient safety (89%; 51/57) and healthcare team safety (93%; 53/57), and that fewer providers were required to move patients into prone position (89%; 51/57). 81% (46/57) of respondents reported no adverse events while proning critically ill patients. Of the reported adverse events, the majority were related to pillows or padding after proning (6/10; 60%). Oxygenation desaturation by ≥5% was described in 3 responses (n=3), while one patient had a >20% change in heart rate or blood pressure (n=1). One incident of AMMP anchor strap malposition was reported (n=1). There were no incidents of endotracheal tube dislodgement or patient injury.
Conclusion: Critically ill patients were safely proned using the AMMP. Healthcare providers concluded the AMMP improved the ease, length of time and safety of proning patients compared to their standard proning approaches.

Code Status Documentation in Older Hospitalized Medical Patients at High Risk for Frailty: A Multi-Centre Cohort Study

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Introduction/Background: Hospitalized medical patients who clinically deteriorate face a decision of either receiving care in an Intensive Care Unit (ICU) or limiting care on the medical ward. Code status discussions and documentations for these patients help guide and communicate these decisions. Despite the importance of these discussions, studies have illustrated that documentation around patients' code statuses are inadequate (1, 2) and changes in code status during acute clinical deterioration are associated with less patient engagement (3). Prognostic tools, including the Hospital Frailty Risk Score (HFRS), can be used to screen for hospitalized patients at an increased risk of mortality and adverse outcomes (4). Identifying patients who would benefit from timely, high-quality code status discussions may facilitate the delivery of care that is consistent with their values and preferences.
Objectives: To determine the frequency of documented code statuses and code status discussions, as well as the association between prognosis and changes in code status.
Methods: We conducted a multi-centre retrospective cohort study of 200 patients admitted to medicine at one of four hospitals participating in the General Medicine Inpatient Initiative from 2015-2019. Prognosis was estimated using the HFRS, which stratifies patients into high, moderate and low frailty risk (4). Manual chart review was undertaken to collect information around code status documentation and discussions. Statistical tests included the Kruskal-Wallis and Chi-Square tests for continuous and categorical variables, respectively.
Results: Of the 200 patients, 91% of patients had a code status documented during their admission. Comfort care was the most common final code status in the chart, representing 30% of all final code statuses. Of the patients with documented code statuses, a discussion was documented in 62% of patient charts. Code status documented discussions were highest in the moderate frailty risk group (73%), followed by 63% and 49% for high and low frailty risk patients, respectively (p=0.029). Across the 4 hospital sites, there was variation in the frequency of patients with documented code status discussions, ranging from 42-80% (p=0.001). Furthermore, 48% of patients had a change in their code status at some point during their admission. The highest proportions of code status changes were seen in the moderate (60%) and high (48%) frailty risk groups, with these patients having at least one change in their code status during their admission, compared with 34% in the low frailty risk group (p=0.018). To highlight changes between first and final code statuses documented, while 5% of patients were initially comfort care, 30% of patients ended their admission as comfort care.
Conclusion: While the majority of medical patients had a code status documented in their chart, documented code status discussions varied between frailty risk categories and hospital sites. Changes in code status during admission were common, particularly in patients with an intermediate prognosis. These findings suggest that improvement is needed in establishing code status as an outpatient and further raise questions around whether gaps exist in the quality of code status discussions during admission. Patients with intermediate and poor prognoses can be identified for early, high-quality

communication concerning code status to help ensure the delivery of goal-concordant care.

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Comfort Holding in Canadian PICUs

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Introduction: The prevention and management of pain and agitation in critically ill children is a complex balance of risks and benefits within a developmentally diverse population. Uncontrolled pain and agitation, and exposure to sedatives, are associated with negative sequelae[1-5]. Despite recommendations for the use of non-pharmacological therapies, pharmacological interventions remain the foundation of pain and agitation management in pediatric critical care[6-9].
The benefits of comfort holding to children and their caregivers may include decreased pain, agitation and distress, as well as the many benefits associated with early mobilization[11-18]. However, despite its promise as potential therapeutic intervention, little is known about comfort holding in PICUs[10].
The objective of this study was to describe the prevalence of, and characteristics associated with, holding in PICUs in Canada.
Methods: As part of the PARK-PICU study, data was collected on all children admitted to 11 PICUs in Canada for > 72 hours who received any in bed or out of bed (OOB) mobility during 2 study days in 2018. Holding was defined as being held OOB for the purposes of comfort or mobility. Descriptive statistics were presented as means (95% CI), medians [IQR], and proportions; p-values were calculated using Pearson's chi^2. Logistic regression was used to estimate the odds ratios (OR) of comfort holding, controlling for possible confounders.
Results: Of 110 children, 70 (63.6%) were held. The majority of the children who were held (94.3%) were 0-2 years of age. The median time to being held was 17.5d (8-50) from PICU admission. Young age (0-2 y) and weight (<10kg), were independent predictors of being held; OR 30.64 (9.23-101.77, p<0.001) and 12.46 (4.86-21.94, p<0.001) respectively. This remained statistically significantly in multivariate analysis controlling for sex, pre-admission function and primary reason for admission. The adverse event rate (e.g. device dislodgement, change in vital signs) for holding was 3.8% as compared to 1.9% for all other OOB mobility (p=0.393). Children receiving invasive ventilation had lower odds of being held 0.25 (0.09-0.67, p=0.006) compared to children receiving little or no respiratory support, as did those who were physically restrained 0.15 (0.04-0.61, p=0.008). Nurse-patient ratios, the presence of invasive lines, vasoactive infusions and analago-sedative medications were not statistically significantly associated with being held.
Conclusions: Comfort-holding is common in PICUs in children aged 0-2 years of age, but is rare in children >2 years of age. Invasive ventilation and a need for physical restraints are associated with lower odds of being held, but other previously identified barriers such as nurse patient ratio, presence of invasive lines, vasoactive medications, and analgesic and sedative infusions were not found to be associated with children being held. The rate of adverse events was not significantly different between children

that were held and children that were not held (but still received out of bed mobility), suggesting holding is safe. This study is limited in that patients who did not receive any or patients newly admitted to the PICU (<72 hours) were excluded, therefore the rates of holding may be over reported. Comfort-holding is likely an under-utilized intervention in Canadian PICUs and further study into its benefits and safety in older children is needed to inform implementation into practice.

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Table 1. Clinical Description of Patients

Patient/Clinical Characteristic	Total n=n	Received Holding N (%); Mean (95% CI); Median [IQR]	Out Of Bed mobility, Not Holding N (%); Mean (95% CI); Median [IQR]	No Out of Bed Mobility N (%); Mean (95% CI); Median [IQR]	*p* - value
Age (years)					
0 – 2	80	66 (82.5)	5 (6.3)	9 (11.3)	<0.001
3 – 6	9	3 (33.3)	3 (33.3)	3 (33.3)	
7 – 12	12	0 (0)	5 (50.0)	6 (50.0)	
13 – 18	9	1 (11.1)	3 (33.3)	5 (55.6)	
Weight (kg)	110	6.5 (5.5 – 7.5)	25.4 (15.9 – 34.9)	25.0 (14.9 – 35.1)	<0.001
Height (cm)	99	63.6 (58.7 – 68.4)	112.4 (94.3 – 130.6)	97.2 (76.8 – 117.6)	<0.001
PICU Admission Day (on day of study)	110	17.5 [8.0 – 50.0]	14.0 [8.0 – 91.0]	7.0 [5.0 – 19.0]	0.020
Most recent sedation score					
Sedated	13	6 (10.5)	0 (0)	7 (38.9)	0.022
Awake/ Calm	62	45 (78.9)	6 (100)	11 (61.1)	
Agitated	6	6 (10.5)	0 (0)	0 (0)	
Positive delirium screen in previous 24 hours	18	11 (61.1)	1 (5.6)	6 (33.3)	0.22
Nurse: patient ratio, n (%)					
2:1 or 1:1	71	41 (57.7)	10 (14.1)	20 (28.2)	0.041
1:2 or 1:3	39	29 (74.4)	7 (17.9)	3 (7.7)	
Family member present at bedside	101	64 (63.4)	17 (16.8)	20 (19.8)	0.32
PICU Interventions, n (%)					
Respiratory support					
None or Low-flow oxygen	31	26 (37.1)	2 (11.8)	3 (13.0)	0.002
High Flow Nasal Cannula	16	14 (20.0)	2 (11.8)	0	
Non-invasive ventilation	15	8 (11.4)	5 (29.4)	2 (8.7)	
Invasive ventilation (via ETT)	43	20 (28.6)	6 (35.3)	17 (73.9)	
Tracheostomy Collar	5	2 (2.9)	2 (11.8)	1 (4.3)	
ECMO	3	2 (66.7)	0 (0)	1 (33.3)	0.15
Receiving analago-sedation					
None	52	34 (65.4)	11 (21.2)	7 (13.5)	0.96
One medication	22	13 (59.1)	3 (13.6)	6 (27.3)	
Two or more medications	36	23 (63.9)	3 (8.3)	10 (27.8)	
Vasoactive infusion(s)					
None	85	57 (67.1)	15 (17.7)	13 (15.3)	0.002
One infusion	10	2 (20.0)	0 (0)	8 (80.0)	
Two infusions	15	11 (73.3)	2 (13.3)	2 (13.3)	
Physical restraint	12	3 (25.0)	2 (16.7)	7 (58.3)	0.002
Most invasive device in situ:					
Most intensive monitoring (ECMO, VAD, Hemodialysis)	6	2 (33.3)	1 (16.7)	3 (50.0)	0.057
Moderately intensive monitoring (CVL, arterial line, chest tube, ICP monitor/ drain)	70	45 (64.3)	8 (11.4)	17 (24.3)	
Least intensive monitoring (Urinary catheter, rectal tube, surgical drain)	1	0 (0)	1 (100)	0 (0)	

Table 2. Univariate logistic regression analysis predicting being held

Baseline Patient Demographic	Total n=n	Odds of Being Held (compared to not being held)	*p* - value
Age (years)			
0 – 2	80	30.64 (9.23 – 101.77)	<0.001
≥3 years	30	baseline	
Weight (kg)			
<10kg	73	12.46 (4.86 – 31.94)	<0.001
≥10kg	37	baseline	
Height (cm)			
<65cm	49	4.59 (1.90 – 11.08)	0.001
≥65cm	61	baseline	
Sex			
Male	65		
Female	45	0.90 (0.41 – 1.98)	0.798
Pre-admission function (PCPC score)			
0 – Normal	33	baseline	
1 – Mild disability	21	1.47 (0.47 – 4.61)	0.505
2 – Moderate disability	29	1.4 (0.50 – 3.93)	0.522
3 – Severe disability	26	1.39 (0.48 – 4.03)	0.542
4 – Coma/vegetative state	1	-	-
Ambulatory prior to admission (if age ≥3)			
Yes	20	0.44 (0.05 – 3.74)	0.455
No	10	-	
Primary reason for admission:			
Surgical	48	2.47 (1.09 – 5.63)	0.031
Medical	62	baseline	

Table 3. Multivariate logistic regression analysis predicting being held

Patient Characteristic	Total n=n	Odds of Being Held (compared to not being held)	*p* - value
Age (years)			
0 – 2	80	40.85 (3.65 – 456.97)	0.003
≥3 years	30	baseline	
Weight (kg)			
<10kg	73	0.71 (0.08 – 6.69)	0.766
≥10kg	37	baseline	
Most recent sedation score			
Sedated	13	baseline	
Awake/ Calm	62	3.09 (0.91 – 10.51)	0.071
Agitated	6	-	
Positive delirium screen in previous 24 hours	18	0.30 (0.13 – 1.63)	0.228
Nurse: patient ratio, n (%)			
2:1 or 1:1	71	0.47 (0.20 – 1.11)	0.086
1:2 or 1:3	39	baseline	
PICU Interventions:			
Respiratory support			
None/ NC/ Face Mask/ Trach	36	baseline	
Collar	31	0.70 (0.23 – 2.11)	0.524
High Flow or Non-Invasive	43	0.25 (0.09 – 0.67)	0.006
Invasive Mechanical Ventilation			
ECMO	3	1.15 (0.10 – 13.06)	0.912
Receiving analago-sedation medications			
Yes	58	0.87 (0.40 – 1.89)	0.072
No	52	baseline	
Vasoactive infusion(s)			
Yes	25	0.89 (0.52 – 1.53)	0.685
No	85	baseline	-
Physical restraint	12	0.15 (0.04 – 0.61)	0.008
Most invasive device in situ:			
Most intensive monitoring (ECMO, VAD, Hemodialysis)	6	baseline	
Moderately intensive monitoring (CVL, arterial line, chest tube, ICP monitor/ drain)	70	3.6 (0.62 – 21.06)	0.155
Least intensive monitoring (Urinary catheter, rectal tube, surgical drain)	1		

Comparing the Stress Response Using Heart Rate Variability During Real and Simulated Crises – A Pilot Study

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Introduction: Medical personnel often experience stress when responding to a medical emergency. A known stress-response is a measurable reduction in heart rate variability. Heart rate variability is the beat-to-beat variation in cardiac cycle lengths (R-R interval), which is highly influenced by the autonomic nervous system. Crisis simulation is an established tool, used to expose trainees to stressful situations in a controlled and safe environment. While meant to feel realistic it is currently unknown if these simulations elicit the same stress response as real clinical emergencies.
Objective: We aim to compare stress response amongst medical providers, by measuring heart rate variability in medical trainees responding to both simulated as well as real medical emergencies.
Methods: We performed a single center prospective observational study, enrolling 19 resident physicians (PGY 1-5). Heart rate variability was measured using a 2-lead heart rate monitor (Bodyguard 2, Firstbeat Technologies Ltd) worn during 24-hour call shifts. Data was collected at baseline, during high-fidelity simulated medical emergencies, and during participants' response to real medical emergencies.
Results: 57 observations were made to compare heart rate variability throughout the participants' critical care rotation. Each heart rate variability metric (SDNN, RMSSD, PNN50, LF, LF/HF) responded in a predictable manner when comparing changes between baseline and simulation as well as changes between baseline and response to medical emergencies (Table 1). Statistically significant differences were observed between baseline and simulated medical emergencies in SDNN (9.45 $p<0.05$) (figure 1.), RMSSD (16.3 $p<0.05$), PNN50 (14.7 $p<0.05$), LF (-13.1 $p<0.05$), and LF:HF (-3.16 $p<0.05$). Similar statistically significant differences were seen between baseline and when responding to real medical emergencies: RMSSD (17.1 $p<0.05$), PNN50 (13.5 $p<0.05$), LF (-15.5 $p<0.05$), and LF:HF (-3.18 $p<0.05$). There were no statistically significant differences between simulated and real medical emergencies for any heart rate variability metrics.
Conclusion: Simulation is a valuable tool in medical education and training. We have shown that simulation can elicit the same autonomic nervous system activation in medical trainees as actual medical emergencies. Therefore, simulation may represent a reasonable way to practice essential skills in a safe environment with realistic provider-response. Multiple aspects contribute to the realism of a simulation; heart rate variability may represent one way to assess which components of simulation are essential and may help eliminate those components that may be costly and unnecessary.

Comparison of Freshly-Cultured Versus Cryopreserved Mesenchymal Stem Cells in Animal Models of Inflammation: A Pre-Clinical Systematic Review

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Introduction: Mesenchymal stem (stromal) cells (MSCs) are multipotent cells that demonstrate therapeutic potential for the treatment of acute and chronic inflammatory-mediated conditions. Especially for acute conditions, it is critical to have a readily available cryopreserved MSC product for rapid administration. Although controversial, some studies suggest that MSCs may lose their functionality with cryopreservation which could render them non-efficacious.
Objectives: In comparative pre-clinical models of inflammation, to determine if there are differences in *in-vivo* measures of pre-clinical efficacy (primary outcomes) and *in-vitro* potency (secondary outcomes) between freshly-cultured and cryopreserved MSCs.
Methods: A systematic search on OvidMEDLINE, EMBASE, BIOSIS, and Web of Science (until June 5, 2020) was conducted to identify comparative pre-clinical studies of freshly-cultured versus cryopreserved MSCs from any source in models of inflammation. Freshly-cultured MSCs were defined as cells that had been in continuous culture since extraction or cryopreserved for any duration but then cultured for more than 24 hours prior to use. The primary outcome included measures of *in-vivo* pre-clinical efficacy; secondary outcomes included measures of *in-vitro* MSC potency. Primary outcome domains were: 1) Organ dysfunction and composition of tissues (e.g. histopathological damage); and 2) Protein Expression and Secretion (e.g. cytokine levels, immunohistochemistry analysis). I*n-vitro* potency outcome domains were: 1) Co-culture assays; and 2) Protein Expression and Secretion. Risk of bias was assessed by the SYRCLE "Risk of Bias" assessment tool for pre-clinical studies.
Results: 15 studies were included. A total of 194 *in-vivo* pre-clinical efficacy experiments represented 72 distinct outcome measures. 2.6% (5/194) of these outcomes were significantly different at the 0.05 level or less; 2 favoured freshly-cultured and 3 favoured cryopreserved MSCs. A total of 63 *in-vitro* experiments represented 26 different potency measures; 11.1% (7/63) of the experiments were significantly different at the 0.05 level or less, with 5 experiments favouring freshly-cultured MSC and 2 favouring cryopreserved MSCs. Viability was assessed in 22 experiments by 10 studies and demonstrated a range of cryopreserved viability between 60-93%; 8/22 (36%) of these viability experiments demonstrated statistically significant difference, all favouring freshly-cultured MSCs.
Conclusions: The majority of preclinical *in-vivo* outcomes and *in-vitro* potency outcomes (number and percentage) did not detect significant differences ($p<0.05$) in pre-clinical efficacy between freshly-cultured and cryopreserved MSCs. With our systematic summary of the current evidence base, we hope it may provide MSC research scientists as well as regulatory bodies additional rationale and justification for considering a cryopreserved MSC product in their clinical trials.

Correlation Between Eadi and P0.1 Over a 24-Hour Period During Early Mechanical Ventilation

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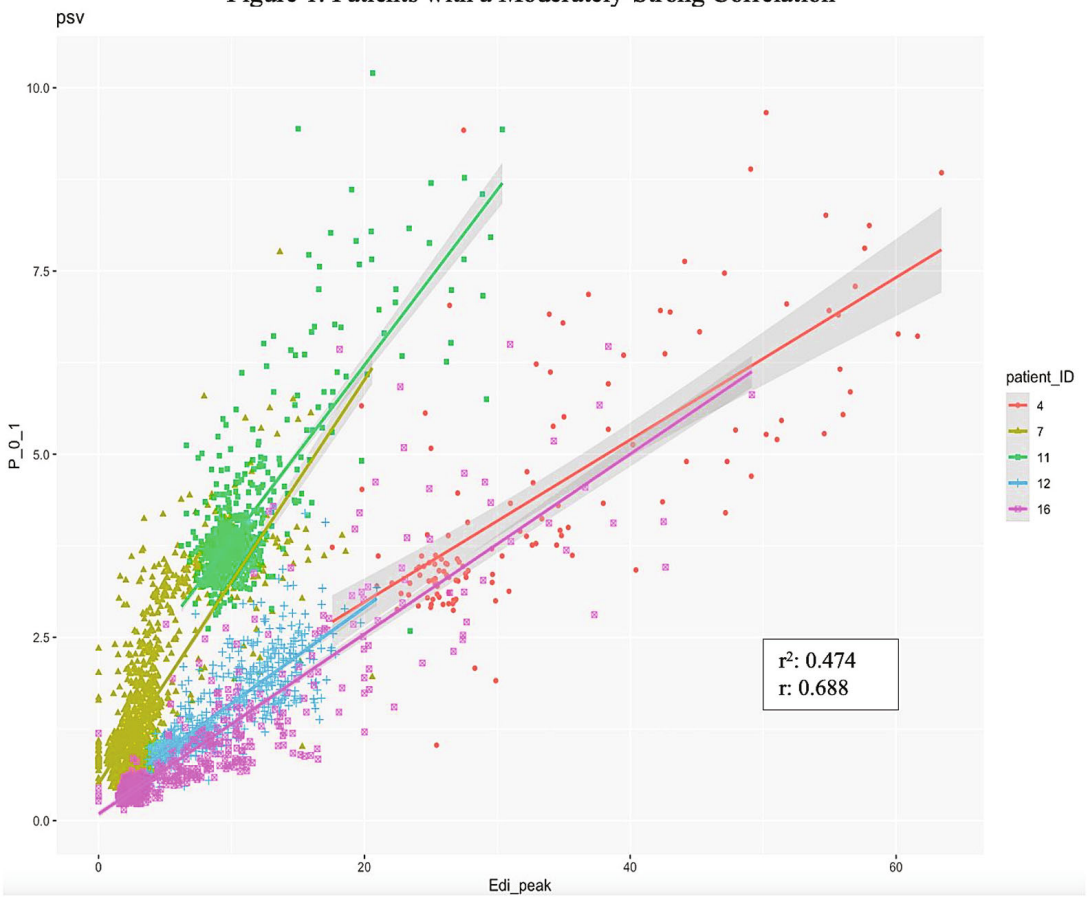
Introduction: In mechanically ventilated patients, an abnormal respiratory drive is frequently present. Derangements in respiratory drive can result in a low or high inspiratory effort, injuring the respiratory muscles (myotrauma), or the lung (P-SILI), and negatively impacting a patient's outcome. Respiratory drive cannot be directly measured, but it can be estimated based on its output with the airway occlusion pressure (P0.1) and with electrical activity of the diaphragm (Eadi). Inspiratory effort can be assessed by maximum Eadi during tidal breathing ($Eadi_{peak}$) and changes in respiratory drive and effort correlate with changes in $Eadi_{peak}$. Effective monitoring of these dynamic variables is necessary to ensure proper management of patients in the ICU, however, the relationship between P0.1 and Eadi has not been examined.
Objectives: To determine the relationship between P0.1 and Eadi during the first 24 hours of meaningful Eadi resumption (threshold of 5uV) in patients on pressure-support ventilation (PSV).
Methods: Ancillary analysis of a prospective cohort study that aimed to determine the time to resumption of meaningful Eadi in a heterogenous population of critically ill adults. Of the 75 patients included in the original study, we assessed 43 patients on PSV during the first 24 hours of meaningful Eadi activity.
Results: Analysis of the 43 patients on PSV revealed a r^2 value of 0.124 and correlation coefficient of 0.352 indicating a weak positive correlation between Eadi and P0.1. We identified subgroups of patients with vastly differing correlations between Eadi and P0.1. One group of 5 patients demonstrated an r^2 of 0.474 and correlation coefficient of 0.688 indicating a moderately-strong positive correlation between Eadi and P0.1 (Figure 1), whereas analysis of 5 additional patients showed a very weak positive correlation between Eadi and P0.1 with an r^2 of 0.033 and correlation coefficient of 0.18.
Conclusion: This preliminary analysis shows that overall, there is a weak positive correlation between Eadi and P0.1, however, there is variability in the strength of the positive correlations ranging from very weak to moderately-strong in our patient sample. Future work should investigate the individual Eadi-P.01 data to assess the difference in the slopes and coefficient of variability in order to enhance our understanding of the relationship between Eadi and P.01 over a 24-hour period. Potential factors affecting these values such as sedatives, opioids, early neuromuscular blockade and differences in ventilatory settings should be examined further to elucidate the variability of the correlations between patients. Additionally, the 24-hour variability of Eadi and P0.1 should be evaluated to learn how often they should be monitored to be representative of respiratory drive and effort.

Figure 1: Patients with a Moderately-Strong Correlation



Critical Care Fellow Perception of Early Implementation of a Competency-Based Medical Education Curriculum – A Cross-Sectional Survey

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Introduction: Adult critical care residency training programs across Canada transitioned to a competency-based medical education (CBME) model for trainees beginning fellowship after July 1, 2019. In this curriculum, critical care trainees undergo discrete observed encounters (EPAs) throughout fellowship ranging from procedural skills, resuscitation of critically ill patients, family dynamics, team management and completion of scholarly activities. Prior to this change, critical care fellows were assessed and evaluated through time based "blocks" or "rotations" after which a summative evaluation was provided.
The shift from time-based and rotation-based evaluation has changed the types, frequency and duration of evaluation. With the implementation of objectives as part of time-based medical education, attempts were made to standardize the skills required and competencies expected from graduating fellows transitioning to early career. The shift to CBME is a further extension of this process to link resident evaluation to individual objectives and reduce the reliance on time-based broad evaluations. At present there is little known about the impact of this on resident documentation, administrative workload, perception of learning or clinical outcomes. We propose to survey the current critical care trainees to determine their perception of the competency-based medical education curriculum and its impact on fellow training, education and quality of life.
Objective: We aim to characterize the experience of the first cohort to go through CBME as a way to evaluate the current status of medical education in adult critical care and identify gaps to be addressed for future cohorts.
Methods: Using an iterative process, we designed a digital survey that was administered to dult critical care trainees enrolled on or after July 1,2019. Survey questions were designed to evaluate trainees perception, experience and knowledge of the CBME process.
Results: A total of 33 trainees responded to the survey. 52% were in first year and 45% were in their second year of training and 33% had previously been enrolled in a CBME-based program. 25% of survey responders were in foundations of discipline, 41% in core and 10% had completed all requirements of the CBME curriculum. Challenges identified by responders include the large number of EPAs to complete, identifying and matching EPAs with key clinical opportunities, completing EPAs for high acuity rare events and staff availability for direct supervision. Rare procedures (cricothyroidotomy and pulmonary artery catheter) were identified as the most difficult EPAs to complete. Responders spent 14% of their clinical time completing, preparing or filling out EPAs with only 20% resulting in face-to-face feedback and 25% providing "valuable" feedback. Additional evaluations - rotation and weekly evaluations occurred for 93% and 52% of responders and led to specific and measurable feedback 50% of the time.
Conclusion: As the implementation of CBME in adult critical care training continues, there are several areas to address with respect to the perception of trainees, developing techniques to improve efficiency and improving the perceived effectiveness of physician supervisor feedback. More work is required to help characterize this further.

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Critical Care Research Response to COVID-19 Through Academic RCTs

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Introduction: Clinical research operations for critically ill patients intensified during the pandemic, underscoring the importance of interprofessional communication, coordinated informed consent encounters and co-enrolment processes. Some pre-existing non-COVID-specific randomized clinical trials (RCTs) were paused, selected RCTs were continued, and several new RCTs investigating COVID-19 treatments were initiated. The objective of this study was to analyze the consent, enrolment, and co-enrolment patterns during the 1st, 2nd, and 3rd wave (March 2020 – May 2021) of the COVID-19 pandemic in a university-affiliated ICU.
Methods: This multi-study, single-center observational analysis was conducted at St. Joseph's Healthcare Hamilton. We examined all 12 academic RCTs in the ICU, and COVID-specific RCTs on the COVID ward. COVID-specific RCTs included CATCO, CONCOR-1, CORONA, COVI-PRONE, and LOVIT-COVID. Non-COVID-specific RCTs, some of which were operational for patients with COVID-19, included BALANCE, CYCLE, FAST, FISSH, LOVIT, REVISE, and REMAP-CAP. Data sources included screening and enrolment logs, and admission registries from March 2020 to May 2021. Reasons for no consent encounters (e.g., staff or system capacity) were not captured, nor were consent decline reasons; observational studies were not considered.
Results: There were 1220 total ICU admissions in the study period, the lowest (N=55) in March 2020 at the start of the pandemic, and highest (N=94) in January 2021. The peak number of COVID-19 ICU admissions (N=42) and highest proportion of infected patients relative to total admissions (48%) occurred in April 2021. Over the 15-month study period, 5 COVID-specific RCTs were launched and 2 were completed; 2 of the 7 non-COVID-specific RCTs were paused, and 5 were continued throughout – enrolling both patients with or without COVID (BALANCE-ICU, FISSH, LOVIT, REMAP-CAP, and REVISE). Overall, 165 patients contributed to 215 enrollments into at least one RCT and peaked with 35 enrollments in March 2021. COVID-specific RCT enrollment peaked at 24 in March and April 2021. There were 215 enrolments in total, in the following RCTs: REVISE 56 (26%), CATCO 36 (17%), COVI-PRONE 33 (15%), LOVIT-COVID 27 (13%), LOVIT 22 (10%), FISSH 9 (4%), CONCOR-1 9 (4%), REMAP-CAP 7 (3%), BALANCE-ICU 6 (3%), CORONA 5 (2%), CYCLE 4 (2%), and FAST 1 (<1%). Co-enrollment in 2 or more RCTs occurred in 45 patients and was most frequent in March 2021. The overall informed consent rate for all RCTs (proportion agreed of those eligible and approached) was 64% (215 of 338); the informed consent rate was 50% for COVID-specific RCTs (110 of 221) and 90% for non-COVID-specific trials (105 of 117). CYCLE, FISSH, FAST, REMAP-CAP, and LOVIT-COVID had 100%

consent rates.
Conclusions: The importance of continuing clinical trials in the ICU was underscored during the pandemic, along with the imperative to generate new evidence to treat patients with COVID-19. Some pre-existing RCTs were paused while others were pursued during the first 3 pandemic waves; meanwhile, 5 COVID-specific trials were launched and 2 were completed. Though consent rates varied across studies, and between patients with and without COVID-19, co-enrolment was common.

Deemed Consent Legislation for Organ and Tissue Donation in Nova Scotia: Understanding the Views of Underserved and Equity-Seeking Communities

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Introduction: Deemed consent legislation for organ and tissue donation came into effect in Nova Scotia, Canada, on January 18, 2021, making it the first jurisdiction in North America to legislate a deemed consent approach. This means that all adults in Nova Scotia are considered potential organ and tissue donors and will be automatically referred to donation programs to determine candidacy, unless they opt out of the program. Recognizing that people from underserved and marginalized communities may have important and unique views on this legislation, understanding their views is critical to informing ongoing implementation.
Objectives: To explore the views of underserved and equity-seeking communities in Nova Scotia regarding organ and tissue donation and the deemed consent legislation.
Methods: We conducted interviews and focus groups with leaders of African Nova Scotian, LGBTQ2+, Faith-based (Islamic and Jewish), and immigrant communities in Nova Scotia. Leaders were persons responsible for community organizations or in other leadership roles, and were purposively recruited by the research team. Data were analyzed using a qualitative descriptive approach, which entailed coding the dataset, recording insights and reflections, sorting the data to identify similar patterns and important features, identifying major themes based on patterns, and examining themes in light of existing knowledge.
Results: Four main themes were identified. All participants were (1) highly supportive of organ and tissue donation as it aligned with their personal values. Organ donation also aligned with religious beliefs and perspectives, although tissue donation was a much more complex issue for participants from Jewish and Islamic communities. At the same time, (2) many issues related to trust and damaged relationships need to be acknowledged and addressed in the context of deemed consent legislation. These issues include longstanding systemic racism experienced by racialized communities as well as damaged relationships between men who have sex with men (MSM) and the blood donation system in Canada. Given these issues, participants noted that (3) cultural competence and safety, at all levels of the system, is essential to the roll out of the new legislation. Participants emphasized that governments and those in the health system must recognize the concerns of their communities and respond accordingly to ensure no further harm is done. Participants also emphasized there is a (4) high need for improved communication and education around the legislation to combat misconceptions and misinformation, facilitate informed decision-making, and mitigate conflict within families.
Conclusion: Leaders of underserved and equity-seeking communities in Nova Scotia are highly supportive of deemed consent legislation. However, the systemic racism experienced by members of racialized communities, longstanding perceived discrimination by MSM from the blood donation system, and the complexities around tissue donation in some Faith-based communities all exemplify the need for cultural competence at all levels: the legislation itself, institutional policies and procedures related to the legislation, and the providers who are implementing the legislation and having conversations with patients and families. These findings will inform ongoing implementation of the legislation, and should inform other jurisdictions considering a deemed consent approach to organ and tissue donation.

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Diagnosis of Delirium in Critically Ill Children: A Contemporary Review of Tools, Nuances and Gaps

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Introduction: Delirium is a neuropsychiatric syndrome that involves a fluctuating change in attention or awareness and is common in the Pediatric intensive care unit (PICU). PICU delirium might be significantly underrecognized and adversely impacts outcomes in critically ill children and lived experience of families. Many tools have been developed for the screening and monitoring of delirium in the PICU. The tools that are validated for screening for pediatric delirium in critically ill children include The Cornell Assessment of Pediatric Delirium (CAP-D), The Pediatric Confusion Assessment Method for the Intensive Care Unit (pCAM-ICU), The Preschool Confusion Assessment Method for the ICU (psCAM-ICU), The Pediatric Anesthesia Emergence Delirium Scale (PAED) and The Sophia Observation Withdrawal Symptoms-Pediatric Delirium scale (SOS-PD). However, there is a significant inter-institutional and inter-individual variation in which tools are used, how they are applied, and how accurate these are.
Objectives: The purpose of this review is to provide an in-depth review of the screening and diagnostic tools for pediatric delirium, as well as the nuances and gaps in their bedside use.
Methods: We searched PubMed and NIDUS databases systematically for abstracts related to the diagnosis of Pediatric delirium. A total of 272 articles were identified, of which 118 were relevant to the objectives of our review. Data were extracted upon full manuscript review of these articles.
Results: The CAP-D, pCAM-ICU, psCAM-ICU, PAED, and SOS-PD tools are validated screening tools for delirium in critically ill children. While each tool has advantages and drawbacks, the ***CAP-D*** appears to be the most studied. CAP-D is a rapid observational tool used to screen for delirium in children aged 0-21 years but has lower specificity when used on children with developmental delay. The ***p(s)CAM-ICU*** is a rapid bedside tool to diagnose pediatric delirium but has not been validated in children under 6 months of age and may not be practical for use in very sick patients. The ***PAED*** tool is used to identify delirium in children aged 1-17 years but does not recognize hypoactive delirium well and may be difficult to use in routine clinical practice. The ***SOS-PD*** scale is validated to detect delirium in critically ill children aged 3 months to 18 years and is easy to administer. However, age-appropriate behavior must be considered when assessing a patient with this tool. None of these tools have been validated out of the PICU setting, which is a major drawback to screening for delirium in hospitalized children.
Conclusion: Many challenges impede the accurate, objective, and timely diagnosis of delirium in critically ill children, and relate to the inherent properties of pediatric delirium, the differences in presentations among different developmental groups, and the lack of mechanistic understanding of delirium. Pediatric critical care providers should appreciate the nuances of delirium screening tools being used at the bedside to enable timely and accurate diagnosis while recognizing common pitfalls.

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Discharge Directly Home from the Pediatric Intensive Care Unit: A Retrospective Study

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Background: Patients recovering from critical illness have usually been discharged home after a period of transition on the hospital ward. Discharge directly home (DDH) has been initially described in adult patients suffering from a terminal illness and therefore were directly discharged home to facilitate palliative care and death (1,2). Nevertheless, recent adult data show that DDH is becoming a more and more common practice, due to decreasing beds availability. There are, to our knowledge, no studies describing the practice of DDH in pediatric patients.
Objective: To describe the incidence and the characteristics of pediatric patients discharged directly home from a single pediatric intensive care unit (PICU).
Methods: We conducted a retrospective descriptive study of all pediatric patients, admitted between January 1st 2014 to January 1st 2020 to the critical care unit of CHU Sainte-Justine. We included all patients < 18 years of age, who survived their PICU stay and were discharged directly home or to an inpatient ward. We excluded patients who were transferred to other hospitals or care facilities. Patients discharged directly home were compared to patients discharged to the ward using descriptive statistics, and logistic regression was used to identify factors associated with home discharge.
Results: Among the 5531 patients included in the study, 594 (10,7%) were discharged directly home from the PICU. Of these, 363 (61,6%) were males, and the median age was 36 months (IQR 15-108). The proportion of patients discharged directly to home increased from 5% (of all survivors) in 2014 to 14% in 2019. Compared to patients transferred to a pediatric ward before discharge, patients discharged directly home were older ($p<0.001$), were less severely ill ($p<0.0001$), less ventilated (<0.001), and had shorter PICU stay ($p<0.0001$). Patients discharged directly home had also significantly less total hospital stay ($p<0.0001$) . The three most frequent admission diagnoses for patients discharged directly home were respiratory acute distress (31%), acute intoxication (18,6%), and ENT postoperative care (12,5%).
Conclusions: There is an increasing trend to discharge critically ill pediatric patients directly at home in our PICU. The patients discharged directly home were older, less severely ill, were less ventilated, and had a shorter length of stay in the ICU. Tests of association between home discharge and ICU/ ward census are ongoing, as well as the evaluation of the incidence of readmission.

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Emergency Department Length of Stay and Medical Emergency Team Utilization in Children Considered for, but not Admitted to, the Pediatric Intensive Care Unit: A Retrospective Cohort Study

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Background: Although children admitted directly from the Emergency Department (ED) account for a large proportion of admissions to the Pediatric Intensive Care Unit (PICU), little is known about how many children in ED are considered for admission to the PICU and clinical trajectories after consultation that does not result in PICU admission. Disposition decisions are often difficult when patients are perceived to be "too well" to benefit from PICU despite being "too sick" for under resourced inpatient wards (1, 2). Although prior studies in adults demonstrate acceptable short-term outcomes for patients considered for, but not admitted to, medical intensive care units, clinical and process-based outcomes have not been previously studied in children (3).
Objectives: This study aimed to describe the characteristics and short-term outcomes of children who had a PICU consult in the ED that did not result in direct admission to the PICU.
Methods: This retrospective cohort study was conducted at a pediatric hospital in Canada. All children (<18 years) who had a PICU consult in the ED between January 1 and December 31, 2019 and were admitted to the PICU or general inpatient ward were eligible for inclusion. Chart reviews were conducted to determine patient characteristics, elements of ED stay, and Medical Emergency Team (MET) utilization within 24 hours of ward admission.
Results: Of 247 PICU consults requested by the ED, 86 (35%) resulted in ward admission (median age 44 months; IQR 15-130). Patients with respiratory conditions accounted for 54% of all consults, with lower respiratory tract infection the most prevalent reason for PICU admission (47% vs 22% ward admissions) and asthma the most prevalent reason for ward admission (29% vs 9% PICU admissions). Compared to PICU admissions, ward admissions had a longer total time in ED (median 800 minutes; IQR 552-975 vs. median 358 minutes; IQR 232-524) with longer times from triage to PICU consult (median 283 minutes; IQR 179-414 vs. median 191 minutes; IQR 102-288), as well as consult to admission (median 427 minutes; IQR 240-647 vs. median 130 minutes; IQR 80-221). During the first 24 hours of ward admission, 16 (19%) patients were reviewed by the MET (9 planned follow-up from ED, 7 new activations) with only 1 patient requiring transfer to PICU.
Conclusions: In our centre, a large proportion of children who had a PICU consult in the ED were denied PICU admission and remained stable on the ward during the first 24 hours of hospitalization. High rates of MET utilization indicate that there exists a cohort of patients who may benefit from an intermediate level of care for closer monitoring. Furthermore, lengthy ED times for children considered for, but not admitted to the PICU suggests that many patients require stabilization before they can be safely transferred to the ward. Future research is required to explore benefits to provision of care in intermediate care units, including safety, cost-effectiveness, and patient-oriented outcomes.

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Evaluating Potential Use of Venovenous Extracorporeal Membrane Oxygenation (VV-ECMO) Services in Patients with Severe Acute Respiratory Distress Syndrome (ARDS) at Regina General Hospital in Regina, Saskatchewan

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Introduction: Venovenous extracorporeal membrane oxygenation (VV-ECMO) is increasingly being used as a treatment modality for patients with severe acute respiratory distress syndrome (ARDS) (1). Saskatchewan's geography and distribution of 1.2 million residents over 651,900 km² create challenges for ECMO service concentration. The goal of this study was to identify local VV-ECMO volume anticipated at our tertiary centre, Regina General Hospital (RGH).
Objectives: The objectives of this study were to identify the number of severe ARDS patients who were eligible for VV-ECMO and to evaluate the clinical outcomes of ARDS patients eligible to receive VV-ECMO.
Methods: We retrospectively studied 415 consecutive intensive care unit (ICU) admissions with ARDS to RGH from October 16, 2018 to January 21, 2021. RGH is an ECMO-capable tertiary care ICU with a catchment of greater than 500,000 residents. VV-ECMO eligibility was assessed using predefined selection criteria and contraindications from the Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Syndrome trial (EOLIA), the Extracorporeal Life Support Organization (ELSO), New South Wales (NSW), and Critical Care Services Ontario (CCSO). We compared categorical data using χ^2 or Fisher's exact tests, and continuous data with T-test or Wilcoxon rank-sum test depending on normality of data when appropriate.
Results: Of 415 patients, 165 (40%) were female, 104 (25%) were admitted with bacterial pneumonia, 68 (16%) with aspiration pneumonia and 48 (12%) with COVID-19. For the cohort, the median age was 61 (interquartile range 46-71), sequential organ assessment score was 7 (5-9) and Charlson comorbidity index was 1 (1-3). Of the cohort, 72 (17%) received neuromuscular blockade, 58 (14%) received prone positioning, and 11 (2.7%) received inhaled nitric oxide (iNO). Ventilator settings demonstrated a median set tidal volume of 7.8 ml/kg of predicted body weight (7.2-8.3), positive end-expiratory pressure (PEEP) of 10 cmH_2O (8-14) and peak inspiratory pressure of 30 cmH_2O (25-36). In our study, 7/415 (1.7%), 6/415 (1.5%), 20/415 (4.8%) and 24/415 (5.8%) patients were eligible for VV-ECMO, using the EOLIA, ELSO, NSW and CCSO criteria, respectively. Of all ECMO-eligible patients, only one patient (0.2%) received VV-ECMO and had met the CCSO criteria only. Of all ECMO-eligible patients, only 1/7 (14%), 1/6 (17%), 7/20 (35%), 12/24 (50%) patients, who met the EOLIA, ELSO, NSW and CCSO criteria respectively, survived to hospital discharge. Significantly more males [34/43 (79%)] were eligible for VV-ECMO compared to females [9/43 (21%), p-value=0.01]. Low tidal volume ventilation and high PEEP strategy were only used in 44/64 (69%) and 4/64 (6%) patients with severe ARDS respectively. In terms of adjunctive therapies, 23/64 (36%) of severe ARDS cases received prone positioning, 24/64 (38%) received neuromuscular blockade, 7/64 (11%) received iNO, and 9/64 (14%) received a bicarbonate infusion.
Conclusion: This study highlights that there may be potential for expansion of VV-ECMO provision in Regina. However, the use of low tidal volume ventilation, prone positioning, and neuromuscular blockade in patients with severe ARDS in Regina were uncommon. Thus, there is potential for addressing and optimizing the use of these

ARDS management strategies through quality improvement, staff education, and protocolized care.

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Evaluating the Impact of Highly Concentrated Medication Application on Intravenous Fluid Administration in a Critical Care Setting

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Background/Objectives: Intravenous fluids (IVFs) are used ubiquitously in intensive care units (ICUs) [1]. Due to their safety profile, IVFs were long not considered “drugs” [1], however recently that view has changed and they are now viewed as drugs. Overuse of IVFs can lead to volume overload, which can impact several organs and increase mortality [1, 2]. Conversely, fluid restriction is associated with fewer complications and reduced hospital stay [3-6]. Despite significant advances made in the resuscitation of critically ill patients, the optimal dose and type of IVF to use remains unknown [7]. IVFs are delivered using infusion pump systems, controlling rate and volume. Our institution recently replaced their infusion pumps allowing for more concentrated medications to be delivered. The objectives of this cohort study was to assess IVF administration patterns and the impact of using higher concentrated medications on the amount of fluids critical ill patients received.
Methods: All critically ill patients admitted to the medical/surgical ICUs in Halifax during the study period were included. Evaluation of fluid management occurred over two three-month periods, before and after the implementation of the new infusion pumps. The primary parameters assessed included volumes of maintenance, medications, nutritional and resuscitation fluids. Fluid outputs were also assessed. Data was analysed using t-test and two-way ANOVA. Statistical significance was achieved with $p < 0.05$. Data was reported as mean ± standard error.
Results: Our results show that the mean volume of intravenous medications administered was significantly decreased after the transition to new infusion pumps, when compared to before pump implementation (340.8 ± 9.1 vs. 534.7 ± 11.3 mL; $p < 0.05$). Conversely, the mean volume of intravenous maintenance fluid delivered was significantly increased after the implementation of new infusion pumps in comparison to older infusion pumps (554 ± 16.2 vs. 427.3 ± 11.2 mL; $p < 0.05$). In assessing all forms of intravenous fluid administered, only the mean volume of crystalloid fluids delivered was significantly decreased after transitioning to the new infusion pumps when compared to before pump implementation (1181.5 ± 85.6 vs. 2642.1 ± 279.6 mL; $p < 0.05$). Nutritional fluids did not differ between the groups. Mean urine output volume was significantly decreased in patients after the implementation of new infusion pumps when compared to before pump implementation (1076.5 ± 21.7 vs. 1409.5 ± 52.8 mL; $p < 0.05$). Total fluid administration was a significantly decreased in mean volume delivered after the transition to new infusion pumps in comparison to the older pumps (1597.9 ± 34.9 vs. 1914.8 ± 53.9 mL; $p < 0.05$). Additionally, mean volumes of total fluid output were also significantly decreased after transitioning to new infusion pumps in comparison to the before pump period (1315 ± 29.6 vs. 1681.6 ± 53.4 mL; $p < 0.05$), with renal replacement rates being constant.
Conclusion: Overall, our findings show that implementation of new infusion pumps that allow for delivery of highly concentrated medications resulted in a significant decrease in overall fluid administration to critically ill patients.

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Experiences of Providers and Simulated Patients with Using a Novel Proning and Repositioning Device

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Introduction/Background: Proning critically ill patients presents risk to both patient and healthcare provider. In response to challenges with proning COVID-19 patients, the Apparatus and Method for Moving a Patient (AMMP) device was developed to facilitate the proning of patients while minimizing risk to the patient or the healthcare team.
Objectives: Using healthy participants as patient volunteers, this study sought to determine if the AMMP makes it easier, quicker, and safer to prone patients compared to using the standard approach.
Methods: In this preclinical feasibility study, healthy participants were recruited to participate as patient volunteers at 2 ICUs in Nova Scotia (QEII Health Sciences Centre, Cape Breton Regional Hospital). Education on how to use the AMMP was provided prior to performing the movements. Healthcare providers in the ICUs including physicians, nurses, and respiratory therapists used the AMMP to move participants from supine to prone and vice versa, up/down and/or to lateral position. Paper-based surveys were administered to patient volunteers and healthcare providers upon completion of the movements.
Results: In all, 10 patient volunteers and 23 healthcare providers completed surveys. The majority of volunteers were aged 18-35 years (7/10; 70%) and weighed 61-90kg (6/10; 60%). None of the volunteers reported being injured while being repositioned using the AMMP, and none of the providers reported any strain or injury to a volunteer or to a team member. Among providers, 91.3% (21/23) felt the AMMP was easy to apply to patients, 100% (23/23) found it easy to adjust strap length, and 100% (23/23) found it was easy to remove after the movement was completed. Compared to prone positioning using the standard approach, 100% (23/23) providers felt that using the AMMP was safer for the healthcare team and 96% (22/23) felt it was safer for the patient. All providers (23/23; 100%) agreed physical demands were reduced using the AMMP, and 96% (22/23) agreed it took less time to complete prone positioning and required fewer providers to prone and reposition the patient volunteers.
Conclusion: Volunteers felt comfortable and secure being proned and repositioned in the AMMP. Healthcare providers in the ICU found the AMMP easier to use and less physically demanding compared to their standard approach to proning.

Factors Associated with Mortality of Adult Patients Undergoing Mechanical Ventilation in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia

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Introduction: Mechanical ventilation is life-saving for patients with respiratory failure, but may be associated with a higher risk of adverse outcomes in low-resource settings. **Objectives:** To determine factors associated with intensive care unit (ICU) mortality in mechanically ventilated adult patients in medical and surgical ICUs of Tikur Anbessa Specialized Hospital (Addis Ababa, Ethiopia) from September 2019 to September 2020. **Methods**: A one-year retrospective cohort study was conducted using a structured and pre-tested case report form. Data was collected on demographic characters (age, sex), place of admission, source of admission, admission diagnosis, use of mechanical ventilation, the indications, the duration, complications, length of stay, ICU and hospital outcomes. Factors associated with ICU mortality were analyzed using multivariable logistic regression (SPSS 25) and reported as adjusted odds ratios (AOR).
Results: One hundred sixty mechanically ventilated patients were included in the study; 85/160 (53.1%) were female and the mean (SD) age was 38.9 (16.2) years. The commonest indication for ICU admission was respiratory diagnosis (n=97/160, 60.7%) followed by post operative state (n=94/160, 58.8%). ICU mortality was n=97/160 (60.7%) and hospital mortality was n=101/160 (63.1%). Seventy patients (43.8%) developed complications, most commonly sepsis (n=48). Factors associated with increased risk of ICU mortality included receipt of vasopressors (P<0.01), GCS < 8/7T (P<0.01), post cardiac arrest admission (P<0.01)) and priority 3 or 4 diagnosis according to society of critical care medicine(SCCM), defined as priority 3; less likely hood of recovery(priority 4; irreversible condition/with reduced benefit from ICU admission). Post-operative admission was associated with a lower risk of mortality (AOR 0.19, 95%CI 0.061-0.57) while admission MPM score (AOR 1.03, 95%CI 1.01-1.06), cardiovascular disease (AOR: 4.9, CI (1.6-15.2) P<0.01) and serum albumin level less than two (AOR 6.23, 95% CI 2.30 - 16.83) were associated with higher probability of death. **Conclusion:** ICU mortality in mechanically ventilated patients in a tertiary referral hospital in Addis Ababa was very high. Higher disease severity, low Glasgow coma score at admission on and requiring vasopressors is associated with higher mortality. The most common complication was sepsis.

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High-Flow Nasal Oxygen Cannula on the Medical Ward During the Coronavirus Pandemic: A Qualitative Implementation and Structured Interview Study of Allied Health Professionals

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Background: The World Health Organization (WHO) on March 11, 2020, declared the novel coronavirus (COVID-19) outbreak a global pandemic (1). Since then, the world has been inundated with thousands of critically ill patients, many of whom develop acute respiratory failure requiring admission to an intensive care unit (ICU).
Ontario is now in its fourth wave of COVID-19. During the first three waves, hospitals have needed to expand ICU capacity and implement novel strategies to manage growing numbers of acutely ill patients. The use of high-flow nasal cannula therapy (HFNC) is a potentially effective non-invasive oxygenation strategy to support COVID-19 patients with severe respiratory failure. In Ontario, there is no standardized approach to its use in hospitals. In our institution, we have implemented a nursing- and respiratory therapist-championed initiative to support patients on HFNC on the general medical ward in an effort to preserve capacity in ICU.
Methods: We performed a retrospective review of patients admitted to hospital with a diagnosis of COVID-19 and supported by HFNC on the medical ward from April 2020 - June 2021. We described the baseline characteristics of these patients and the hospital outcomes. We performed structured interviews of allied health professionals who were involved in championing the HFNC ward program and who actively managed these patients. A modified Delphi approach was used to develop educational materials for teaching, safety and continued quality improvement.
Results:
Patients
A total of 346 patients with COVID-19 pneumonia were managed with HFNC on the general medical ward at our institution.

Allied health professionals
4 allied health professionals were interviewed regarding their experience managing COVID-19 patients with severe respiratory failure supported by HFNC on the medical wards. Summarized themes and answers are detailed in **Table 1**. All participants identified challenges with managing acutely ill patients on a medical ward but also recognized learning opportunities. All participants felt more comfortable managing HFNC post waves 1-3 compared to pre-pandemic.

Education materials
Stakeholders identified and created the following educational materials: principles of oxygen administration, HFNC anatomy and physiology, CCRT activation process, principles of self-prone positioning, Hamilton T-1 and Phillips V6 ventilator setup and alarm guide, anatomical airway assessment (**Figure 1**).
Conclusion: Novel approaches to the delivery of care to critically-ill patients are required to maintain ICU capacity and expand clinicians' abilities to care for an increasingly large number of patients with acute care needs. Allied health professionals believe that the expansion of ICU-level care to the medical ward has important challenges but presents unique opportunities to deliver patient-centered, high-quality critical care to severely affected COVID-19 patients. Our experience with HFNC offers unique insights to other institutions and policy makers for protocols and policies for care amidst an evolving fourth wave of COVID-19.

Table 1. Summarized interview themes and answers

Theme	Summarized Answers
Interventions for implementation of program	1. Equipment - Massimo portable monitors - Increased # of HFNC delivery circuits with use of V60 BiPAP and Hamilton ventilators - Education sessions for RTs on equipment 2. Staff - Increase staffing RTs - Select/identify one RT for COVID wards - Increased MD coverage for COVID wards with a new model to provide adequate coverage 3. Patients/patient flow - HFNC patient place on designated floors to aid in providing care (geographic location, response time, team training, designated RT etc)
Barriers to optimization	1. Equipment - Comfort level mastered mainly by RTs pre-pandemic and had to be developed in RN/MDs 2. Staffing - Staffing shortage especially for volume of patients 3. Patients/patient flow - # of patients/volume/acuity (over 30 patients or 50% of the COVID ward on HFNC) - PPE needs for HFNC limiting response time to patients and flow of medical rounds - Visitation policy limited in patients with HFNC and as a consequence, the quality of the GOC conversations
Safety/Outcomes	- Hypoxic patients who were delirious present more challenges to be managed safely on the wards - DNR patients died due to pulling off O2 and not being monitored - RN perspective is that some outcomes could have been better had some patients been in ICU - RT, RN, MD perspective that transportation of HFNC patients from ward to ICU for intubation was challenging/risky
Suggestions for future	1. Equipment - Remote monitoring of O2 is important 2. Staff
	- Add another CCRT RN - Consider other model for nighttime CCRT coverage - More education for nurses re: HFNC - Additional MD coverage at night (daytime and weekend model had been stepped up but no additional nocturnal coverage) 3. Patients/patient flow: - Consider step-up unit for those HFNC/COVID patients

Figure 1. Educational materials: principles of oxygen administration, HFNC anatomy and physiology, CCRT activation process, principles of self-prone positioning, Hamilton T-1 and Phillips V6 ventilator setup and alarm guide, anatomical airway assessment

Identifying Neurocognitive Outcomes and Cerebral Oxygenation in Critically Ill Adults on Acute Kidney Replacement Therapy in the Intensive Care Unit: The Incognito-Aki Pilot Study

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Introduction: The burden of dialysis-requiring acute kidney injury (AKI) is rising, particularly among critically ill adults[1,2]. Long-term kidney replacement therapy (KRT) and critical illness have been independently linked to prolonged cognitive impairment[3] and structural brain pathology[4-7], and adults on short-term KRT in the ICU may be at risk for superimposed impairments. Delirium is one of the most consistent risk factors for cognitive impairment among critically ill adults, and has been associated with degree of brain atrophy[6]. Regional cerebral oxygenation (rSO2) predicts delirium in critically ill adults[8,9], and may provide an early marker of cognitive impairment in patients treated with KRT in the ICU. No longitudinal studies have examined the relationship between KRT, delirium, and long-term structural and cognitive outcomes in critically ill patients.
Objectives: The overall objectives for this program of research are 1) to determine the association between intradialytic rSO2 and delirium, and 2) to evaluate the long-term consequences of intradialytic rSO2 following ICU discharge. Prior to embarking on the full study, we assessed feasibility through an initial 6-month pilot. We describe here the results of the pilot study.
Methods: This was a prospective observational pilot study of patients admitted to the Kingston Health Sciences Centre ICU between Feb-Aug 2021. *Inclusion:* ≥18 years of age, admitted to ICU, severe AKI requiring KRT, within 12h of initiation of KRT. *Exclusion:* history of neurological disorders, contraindication to testing, KRT via peritoneal dialysis, life expectancy <24h, renal obstruction, rapidly progressive glomerulonephritis or interstitial nephritis, or pre-hospitalization estimated glomerular filtration rate (eGFR) <30 mL/min/1.73m^2. Participants underwent continuous rSO2 monitoring for the first 72h of continuous KRT (CKRT), and continuously during intermittent hemodialysis (iHD). Daily delirium screening was performed using the Confusion Assessment Method (CAM-ICU-7). Cognitive and neurological outcomes were assessed at 3-months post-ICU discharge using the robotic Kinarm Standard Tests™ and Repeatable Battery for the Assessment of Neuropsychological Status.
Results: Of 484 ICU patients, 16 were assessed for eligibility between Feb-Aug 2021. Two declined, four were excluded due to history of neurological illness, and three were >12h from KRT start. Seven patients (mean age 65.4 [14.9] years, 71.4% male) were enrolled. Mean [SD] eGFR at KRT start was 12.6 [5.0] mL/min/1.73m^2, and participants spent a mean of 6.9 [6.3] total days on dialysis (5.0 [5.6] days on CKRT, and 1.9 [2.9]

days on iHD). Three participants subsequently died in ICU, one died two months after discharge, and one declined follow-up. For all participants, continuous vitals, cerebral oximetry (91.3% data captured), daily delirium screening (no missing data), and medical record review (no missing data) were successfully completed. Fig. 1 shows feasibility data on the first patient. One participant has completed 3-month follow-up testing (no missing data).
Conclusion: Our initial work demonstrates the feasibility of this study for the primary aim. However, the high mortality rate in ICU is a barrier to long-term follow-up data collection. This project will ultimately provide crucial insight into the early neurological changes occurring in patients initiated on KRT in the ICU, and their potential impact on cognition and brain pathology.

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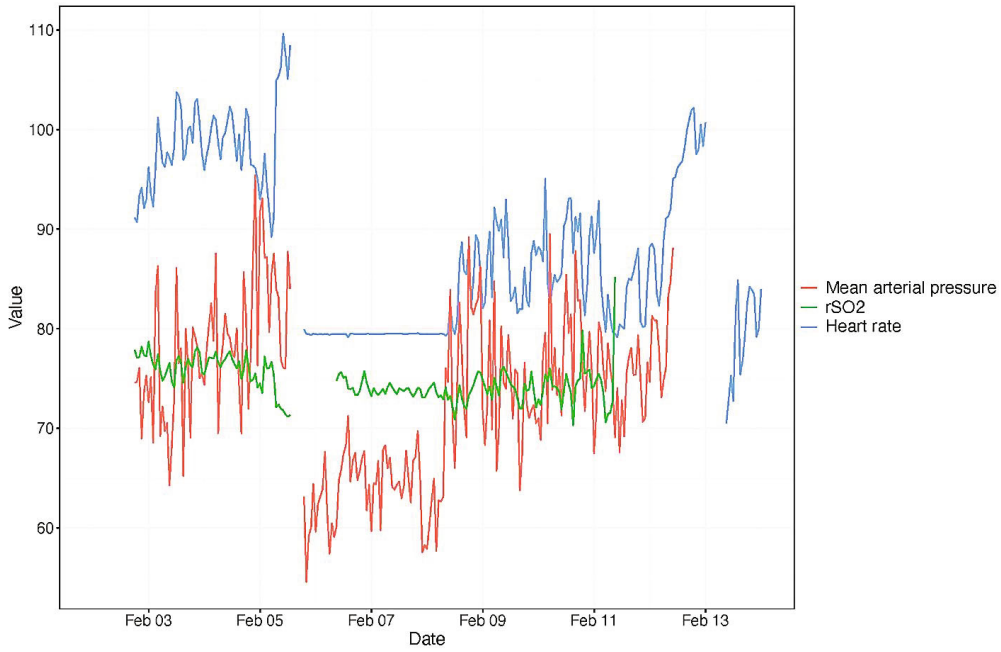
Figure 1. Feasibility data on the first patient



Impacts of Antipsychotic Medication Prescribing Practices in Critically Ill Adult Patients on Health Resource Utilization and New Psychoactive Medication Prescriptions

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Introduction: Antipsychotic medications are commonly prescribed to critically ill patients for non-psychiatric clinical indications to manage the symptoms of conditions such as delirium or insomnia.[1-4] New prescription initiations of antipsychotic medications in the intensive care unit (ICU) increases the proportion of patients discharged home on an antipsychotic medication.[1,2] Long-term use of antipsychotic medications is associated with increased risk of sudden cardiac death, falls, and worsening cognitive impairment.[5-7] The impact of ongoing antipsychotic medication prescriptions at hospital discharge on health resource utilization and new additional prescriptions of psychoactive medications such as benzodiazepines and opioids has not been evaluated in the hospital or post-hospital discharge setting.
Objectives: We aimed to estimate health resource utilization and the odds of new prescriptions of benzodiazepines and opioids up to 1-year post-hospital discharge in critically ill patients admitted to the ICU with new typical and atypical antipsychotic medication prescriptions at hospital discharge.
Methods: We completed a multi-center, propensity-score matched, population-based retrospective cohort study of adult patients admitted to one of four medical-surgical ICUs from January 1, 2014 to June 30, 2016. New antipsychotic medication prescriptions at time of hospital discharge were measured as the administration of at least one dose of antipsychotic medication during ICU or hospital admission and filled a prescription for an antipsychotic medication up to 1-year following hospital discharge. The primary outcome was a composite outcome of health resource utilization including ICU and hospital readmission, subsequent emergency room visitation, or mortality. The secondary outcome was the new prescription of benzodiazepines and/or opioids during hospitalization and up to 1-year post-hospital discharge.
Results: There were 1,388 propensity-score matched patients who received and did not receive an antipsychotic medication who survived to hospital discharge. Of the ICU patients that received an antipsychotic medication in the ICU and survived to hospital discharge, 132 (21.0%) patients were continued on an antipsychotic medication at hospital discharge. The most common antipsychotic medication continued at hospital discharge was quetiapine (91 (14.5%)) and olanzapine (32 (5.1%)). New antipsychotic medication prescriptions were not associated with increased 72-hour ICU readmission, 30-day hospital readmission, 30-day emergency room visitation, or 30-day mortality. Among critically ill patients that received an antipsychotic medication during their hospitalization, there was an increased odds of additional in-hospital prescription of benzodiazepines (OR 5.12 [95%CI 4.29 – 6.09]) and opioids (OR 3.04 [95%CI 2.49 – 3.74]). Among patients continuing an antipsychotic medication following hospital discharge, there was an increased odds of new prescriptions of benzodiazepines (OR 1.65 [95%CI 1.24 – 2.21]) and opioids (OR 1.86 [95%CI 1.44 – 2.41]) up to one year

following hospital discharge.
Conclusion: New antipsychotic medication prescriptions at hospital discharge are not associated with increased health resource utilization but are significantly associated with new additional prescriptions of benzodiazepines and opioids in-hospital and up to 1-year following hospital discharge.

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Impacts of Restricted Visitation Policies on Canadian Patients, Families, and Healthcare Professionals: A Multi-Phase Research Program

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Introduction: Patient and family-centered care (PFCC) is an essential component of high-quality critical care medicine. In response to the increasing number of people with COVID-19, hospitals enacted strict visitation policies to mitigate the potential spread of COVID-19 and preserve personal protective equipment. These strict visitation policies prohibited the presence of families for all hospitalized patients, including intensive care unit (ICU) patients, with some hospitals allowing visitation exceptions (e.g., end-of-life). However, there is no conclusive evidence that family presence increased the transmission of COVID-19 in ICU settings. The research is emerging on the impact strict visitation policies continue to have on patients, families, healthcare professionals, and PFCC, and evidence-informed policy is needed.
Objectives: We undertook a program of research to describe the extent of visitor restrictions across Canada, describe the impacts these policies had on patients, families, and healthcare professionals, and conduct a modified Delphi consensus process with a diverse panel of stakeholders to reach consensus on strategies for healthcare systems to consider regarding restricted visitation policies.
Methods: Our multi-phase research program included the following methods: 1) environmental scan of restricted visitation policies across Canada during the first wave of the COVID-19 pandemic; 2) semi-structured interviews with patients, families, and healthcare professionals to described the impact of restricted visitation policies and strategies to mitigate theses impacts; 3) scoping review to summarize the literature on the perspectives, experiences, and impacts of restricted visitation policies; and 4) modified Delphi process and National Stakeholder Meeting to prioritize evidence-informed strategies to improve restricted visitation.
Results: Evidence from the research program supports that family absence from the ICU during COVID-19 impacted patients (isolation), families (absence at end of life), healthcare professionals (moral distress), and PFCC (shared decision making). Our diverse panel of stakeholders incorporated the collective evidence to arrive at 21 consensus statements to enhance restricted visitation policies and facilitate PFCC during the current and future infectious disease outbreaks. This included strategies to improve communication of policies/policy changes, strategies for policy implementation and consistency, strategies for facilitation of in-hospital visitation, clarification around the end-of-life policy, criteria for exceptions, facilitation of out-of-hospital visitation, technological supports, and organizational (i.e., healthcare system, hospital, and unit-level) supports.
Conclusion: Family visitation is important for the support of critically ill patients and their families and is essential for PFCC. We developed evidence-informed consensus statements on how to best facilitate PFCC during a pandemic. These consensus statements include strategies to improve communication and access to patients during end-of-life (while they can communicate) and developing a more consistent approach to communicating and enacting policy changes. Adaptation of these consensus statements to the local context will be important for their uptake during the current and

future pandemics.

Grant Acknowledgement: This study was supported by a COVID-19 Rapid Response Funding Grant to Dr. Kirsten M. Fiest from the Canadian Institutes of Health Research.

Incidence of Spontaneous Hyperventilation and Its Impact on the Outcome of Severe Traumatic Brain Injury: A Single-Center Retrospective Cohort Study

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Background: Spontaneous hyperventilation (SHV) is a common pathophysiological phenomenon in acute brain injury characterized by hypocapnia and is associated with poor outcomes. However, little is known about the incidence and prognosis of SHV in severe traumatic brain injury (sTBI), especially in the Chinese population.
Objectives: This study investigates the incidence of SHV in sTBI and its impact on the prognosis at hospital discharge.
Methods: All of the sTBI patients admitted in the intensive care unit (ICU) of Beijing Tiantan Hospital between October 2018 and December 2020 were screened retrospectively. The blood gas analysis results were collected. We define the SHV as at least one blood gas analysis result fulfilling pH > 7.45 and $PaCO_2$ < 35 mmHg, while respiratory rate > 16 breaths/min, regardless of the methods and the modes of ventilatory support. Patients with no blood gas analysis results were excluded. We extracted the patient's characteristics and outcomes from the electrical medical records. A multivariate binary logistic regression model was used to examine the relationship between SHV and unfavorable outcome (defined as an extended Glasgow Outcome Scale between 1 and 4) at hospital discharge.
Results: During the 26 months, a total of 238 sTBI patients admitted in the ICU, and 162 of them fulfill the inclusion and exclusion criteria. The overall incidence of SHV was 56.8% (moderate-SHV 35.2%; severe-SHV 21.6%). There were no significant differences between SHV and non-SHV patients in terms of injury severity score (26[25-30] vs. 26[21-30]; p = 0.525), length of ICU stay (15.1[9.5-24.1] vs. 15.9[8.3-27.7]; p = 0.866), length of hospital stay (21.2[13.2-29.3] vs. 23.5[12.9-35.2]; p = 0.512), hospital mortality (23/92(25.1%) vs. 9/70(12.9%); p = 0.054) and unfavorable outcome (77/92 (83.7%) vs 50/70 (71.4%); p =0.060). After adjustment for confounders, SHV had no significant effect on the unfavorable outcome at hospital discharge (OR 0.91; 95%CI [0.82-1.01], p = 0.087).
Conclusion: There was a high prevalence of SHV in Chinese sTBI patients. However, we did not find a significant correlation between SHV and unfavorable outcomes at hospital discharge.

Internal Jugular Vein Ultrasound for Volume Status Assessment in Acutely Ill Adults: A Systematic Review and Meta-Analysis of Diagnostic Test Accuracy

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Introduction: Accurate assessment of volume status is essential in the care of acutely ill patients. Determination of hypervolemia or hypovolemia at the bedside allows physicians to rapidly implement appropriate therapeutic measures. Existing diagnostic tools are expensive and/or unreliable for assessing volume status, while bedside exam and laboratory tests have similar limitations.[1] Static hemodynamic measurements obtained via central venous or Swan-Ganz catheters are poorly correlated with improved cardiac indices following fluid resuscitation and require invasive procedures.[1] Cheap, non-invasive and reliable diagnostic modalities are needed to inform volume status assessment in acutely ill patients.
Objective: To summarize the diagnostic accuracy of internal jugular vein ultrasound (IJV-US) in assessing hypervolemia and hypovolemia in acutely ill adults.
Methods: We searched PUBMED, EMBASE, CENTRAL, and Web of Science from database inception to June 2021. We included English language studies reporting the diagnostic accuracy of IJV-US for hypovolemia and/or hypervolemia in medically unwell adults assessed in the acute care setting using any reference standard. Two reviewers independently extracted data and assessed study quality using the QUADAS-2 tool. When multiple methods of measuring IJV-US were reported, we used the method with the best reported area under the receiver operating curve. We pooled sensitivity and specificity separately for hypovolemia and hypervolemia using bivariate random-effects models. We examined the following subgroups using meta-regression: type of ultrasound measurement; reference standard; intubation status, diagnosis of sepsis (for hypervolemia); volume responsiveness testing (for hypovolemia). We assessed certainty in pooled estimates using GRADE.
Results: Of 14,537 unique citations, 34 studies were included in the qualitative synthesis, 18 of which were conducted in an intensive care unit. The most commonly used reference standards were central venous pressure (12 studies), clinical diagnosis or endpoint (5 studies), and echocardiographic parameters (5 studies). For the diagnosis of hypovolemia (19 studies; n = 956 patients), IJV-US had a sensitivity of 0.82 (95% confidence interval [CI] 0.76 to 0.87, moderate certainty), specificity of 0.82 (95% CI 0.73-0.88, moderate certainty), positive likelihood ratio [+LR] of 4.5 (95% CI 3.0 to 6.9), and negative likelihood ratio [-LR] of 0.22 (95% CI 0.16 to 0.29) (Figure 1). For the diagnosis of hypervolemia (11 studies, n = 672 patients), IJV-US had a sensitivity of 0.84 (95% CI 0.70 to 0.29, moderate certainty), specificity of 0.70 (95% CI 0.55 to 0.82, very low certainty), +LR of 2.8 (95%CI 1.9 to 4.1), and -LR of 0.23 (95%CI 0.13 to 0.41) (Figure 2). For hypovolemia, diagnostic test accuracy was better using collapsibility indices (sensitivity 0.85, 95% CI 0.80 to 0.89; specificity 0.78, 95% CI 0.64 to 0.88) compared to static measurements (sensitivity 0.73, 95% CI 0.60 to 0.82; specificity 0.70, 95% CI 0.48 to 0.86). We did not find any other subgroup effects.
Conclusion: IJV-US may be a useful bedside diagnostic tool for the diagnosis of both hypervolemia and hypovolemia. Randomized controlled trials examining the use of this tool in guiding therapeutic fluid status interventions are needed.

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Figure 1. Diagnosis of hypovolemia (19 studies; n = 956 patients)

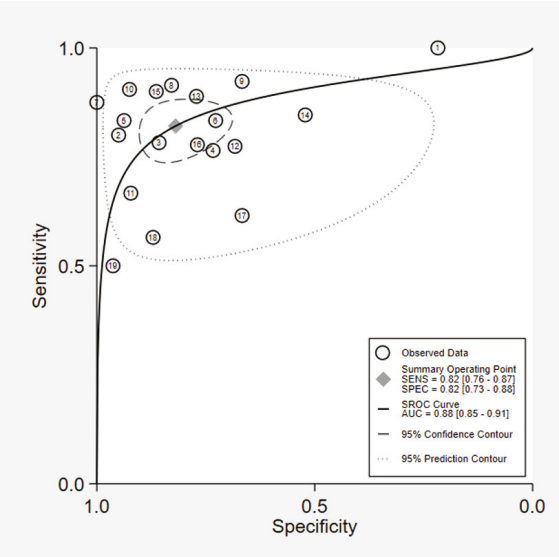
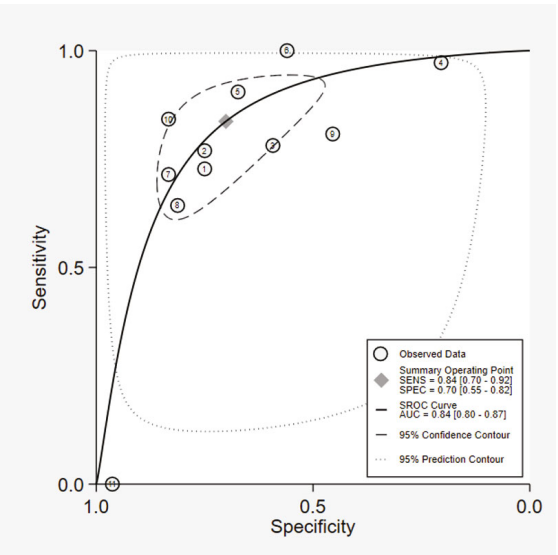


Figure 2. Diagnosis of hypervolemia (11 studies, n = 672 patients)



Is There Anything Else You Would Like to Add? Understanding the Impact of the Pandemic from the Canadian Critical Care Nurses Perspective

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Introduction: The World Health Organization (WHO) proclaimed a global pandemic in response to the rapid worldwide spread of the novel coronavirus (COVID-19) in January 2020 [1 -2]. A number of studies in the past have outlined the social, emotional and psychological impact of healthcare workers providing direct care to patients during previous infectious disease outbreaks and other natural disasters but few have focused directly on critical care nurses[3-9]. Studies conducted during this current pandemic have found high levels of stress, depression and symptoms of PTSD among healthcare workers[10-13]. This study examined the impact of the pandemic on Canadian Critical Care Nurses (CCNs) in spring 2021.
Objectives: Focusing on Canadian CCNs, the objectives of this study were to examine:
(1) what the impact of the pandemic was on their mental health;
(2) what impact the COVID-19 pandemic had on their quality of work life; and,
(3) what impact the pandemic had on their intent to stay in their current positions.
Methods: The study used a quantitative survey design utilizing four validated tools: 1) the impact of event scale – revised (IES-R)[14], 2) the depression, anxiety, and stress scale (DASS-21)[15], 3) the professional quality of life scale (PROQoL)[16], and 4) intent to turnover tool. The study also included one opened ended free text question “is there anything else you would like to add?”
Results: 425 participants responded from across Canada. 74.4% of participants reported some level of PTSD symptoms, 69.6% reported depression symptoms, 56.9% reported anxiety symptoms, and 60.7% reported stress symptoms. 100% of participants reported moderate to high burnout, and 87.1% were suffering from signs of secondary traumatic stress. When asked about their intent to leave, 44% were thinking of quitting, and 23.3% are actively searching for a new job.
When given the option of adding any further comments, an overwhelming number of participants responded. The themes that emerged from the qualitative data included: 1) failed leadership at all levels, 2) the traumatic nature of their work during the pandemic and the resulting poor mental health they were experiencing, and 3) a sense of disillusionment and defeat. These themes were woven with despair and anger at the situation and the system.
Conclusion: The overall findings of the study provide evidence of the significant negative impact the COVID-19 pandemic has had on Canadian CCN’s mental health and well-being.

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Keeping Sane in Insane Times: Psychological First Aid for Critical Care

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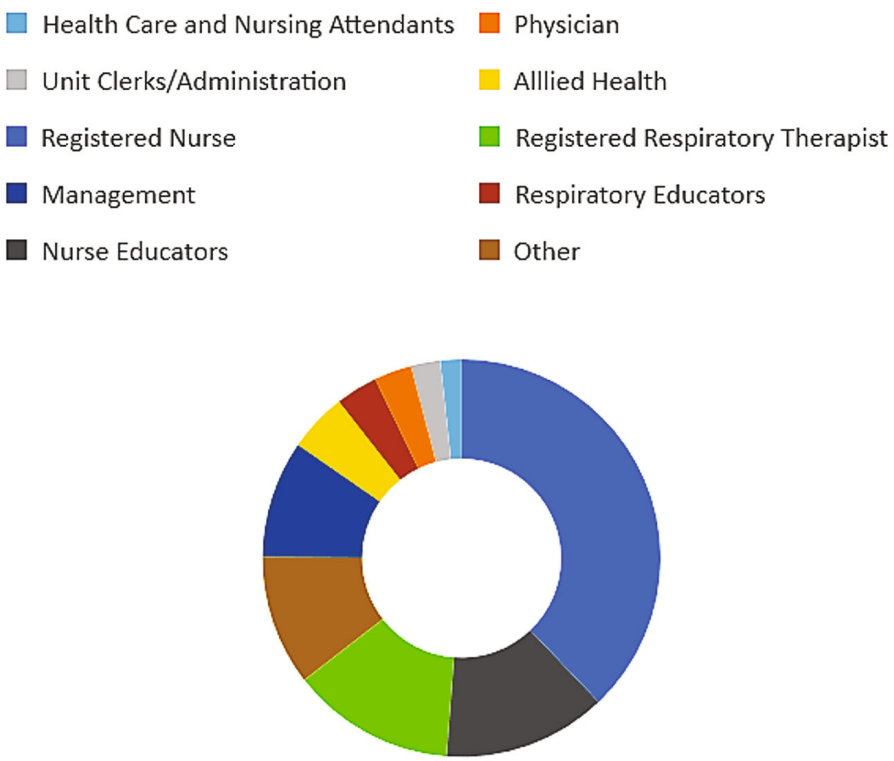
Introduction: Health care provider (HCP) burnout and moral distress are recognized issues in critical care. The
challenges faced by the COVID-19 pandemic have further heightened concern for HCP wellbeing. The pandemic has
also provided opportunity to prioritize reach out and help our community cope. Psychological First Aid (PFA) is an evidence-informed approach for psychosocial support developed in 2006 by a section
of the United States Department of Veterans Affairs. It has been widely endorsed by numerous groups, including World
Health Organization (WHO). Alberta Health Services (AHS) has adopted PFA and utilizes the WHO model.
Objectives: We aimed to adapt the WHO model for PFA for critical care, implement on a provincial scale through the
Critical Care Strategic Clinal NetworkTM (CC SCN) and provide opportunities for critical care HCP to engage in and
further strengthen naturally existing peer supports during the COVID-19 pandemic.
Methods: The CC SCN is a provincial network of 21 intensive care units (ICU) that provide population-based care for all
critically ill patients in the province of Alberta (14 adult medical-surgical ICUs, 2 cardiovascular surgical ICUs, 1 burn ICU,
1 neurosciences ICU, 3 pediatric ICUs). It has played a central role in the health system preparation and response to the
COVID-19 pandemic. Embedded within the CC SCN, practice leads provide the 'front-line' perspective through unique
background experiences in clinical critical care settings. Their intimate knowledge of 'what it's like on the ground' and how
education is received enhanced their ability to create a unique critical care specific PFA provider course readily
accessible for frontline HCP. It includes a 90-minute teaching and experience sharing session, with time for conversation,
questions and feedback. The training focuses on the 5 essential elements for effective psychosocial responses, key PFA
action principles, and a specific focus on responder self-care. Scenarios were created to reflect the lived experience of
working in critical care environments during the strain of the COVID-19 pandemic, combined with interactive sessions
that encourage conversation and reflection.
A survey was sent out to PFA attendees to gain an understanding of the current work environment, how common
stressors are impacting staff, and the effectiveness of PFA.
Results: To date, 503 members of Alberta's Critical Care community have registered in one of 15 PFA sessions. There
was engagement from all 5 zones in Alberta and broad representation of all HCP. Sessions occurred between
April 20, 2020 and April 15, 2021. Preliminary survey response rate was 20%. Respondents identified that participation in

PFA was to primarily support their teams and to further support their own wellbeing. The majority of respondents found
PFA to be a moderately to very effective strategy to support critical care HCP. Moral distress and
emotional exhaustion were identified as common themes in critical care settings during the pandemic.
Conclusion: Enabling front-line critical care HCP with support through Psychological First Aid has shown broad uptake
and perceived value within the critical care community across Alberta. PFA may represent a piece of the larger puzzle
and part of a broader strategy to support critical care HCP and address the growing issue of burnout in critical care. PFA
has created a foundation from which we can build a longer term more robust frame for supporting critical care staff.
Further evaluation of PFA beyond the COVID-19 pandemic appears justified.

Figure 1. PFA Registration by Occupation



Ketone Therapy Reduces Systemic and Organ Inflammation in Sepsis

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Introduction: Sepsis is the body's reaction to an infection that often causes lasting organ injury due to a dysregulated inflammatory response and accounts for approximately 20% of all global causes of death. Currently, there are no effective treatments to reduce inflammation during sepsis and thus assist in preventing the lasting inflammation-mediated damage[1]. As a result, many patients who recover from sepsis endure permanent damage to many organ systems which make them more susceptible to future injury that likely affects them more severely[2]. Thus, therapeutic strategies to reduce the inflammatory response in sepsis are needed to save lives and improve the quality of life of those who survive sepsis. Herein, we tested the efficacy of ketone therapy that increases circulating ketones via ketone ester supplementation. Ketones are small molecules that are normally produced by the liver and are elevated during carbohydrate-deprived states, such as prolonged fasting. While ketones are classically known to be a metabolic source of energy, they also have non-metabolic effects, such as inhibiting inflammation, which can be of therapeutic importance[3, 4]. We hypothesized that ketones have potent anti-inflammatory effects in a mouse model of lipopolysaccharide (LPS)-induced sepsis and that ketones can be used to mitigate the inflammation-mediated organ damage.
Objective: To determine if ketone supplementation can effectively reduce systemic inflammation and organ damage in a model of LPS-induced sepsis.
Methods: We treated 8week-old mice with vehicle or a clinically tested ketone ester (KE) by oral administration for 3 days. On the third day, we injected mice with saline or 10 mg/kg lipopolysaccharide (LPS) to induce systemic inflammation and organ damage, as established previously[5]. Mice were euthanized 24 hours post-injection and the effects on systemic inflammation and organs were analyzed from the 3 groups (control, LPS, LPS+KE). In other cohorts, cardiac function was assessed 24 hours post-injection.
Results: LPS-treated septic mice had a lower body weight relative to the controls, which was not altered by KE-treatment. Interestingly, LPS-treated mice had higher blood ketones compared to controls, suggesting that ketones may be important as an innate defense mechanism. Additionally, this elevation in circulating ketones was further augmented in KE-treated septic mice. While LPS-treated mice had an induction of systemic pro-inflammatory cytokines such as interferon-γ, IL-1B, IL-6, and CCL4, these cytokines were significantly lower in KE-treated septic mice. Similarly, LPS induced numerous inflammatory markers in the kidney, heart, and liver, a large majority of which were reduced in the KE-treated septic mice. LPS-induced renal fibrosis and cardiac dysfunction was also significantly lower in KE-treated septic mice. Finally, there was either no change or a reduction of ketolytic enzymes in various organs, suggesting that these protective and anti-inflammatory effects occur independent of ketone catabolism for energy production.
Conclusion: Together, these data are the first to show that ketone therapy may be a novel approach to reducing systemic and organ inflammation and subsequent organ damage in a model of LPS-induced sepsis, and that these effects are seemingly independent of ketone catabolism.

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Machine Learning Approaches to the Human Metabolome in Sepsis Identify Metabolic Links with Survival

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Introduction: Metabolic predictors and potential mediators of survival in sepsis have been incompletely characterized, potentially in part due to limitations of conventional statistical approaches in small cohorts.
Objectives: We examined whether machine learning (ML) tools applied to the human plasma metabolome could consistently identify and prioritize metabolites implicated in sepsis survivorship, and whether these methods improved upon conventional statistical approaches.
Methods: Plasma gas chromatography-liquid chromatography mass spectrometry quantified 411 metabolites measured ≤72 hours of ICU admission in 60 patients with sepsis at a single center (Brigham and Women's Hospital, Boston, USA). Seven ML approaches were trained to differentiate survivors from non-survivors. Model performance predicting 28-day mortality was assessed through internal cross-validation, and innate top feature (metabolite) selection and rankings were compared across the 7 ML approaches and with conventional statistical methods (logistic regression). Metabolites were consensus ranked by a summary, ensemble ML ranking procedure weighing their contribution to mortality risk prediction across multiple ML models.
Results: Median (IQR) patient age was 58 (47, 62) years, 45% were women, and median (IQR) SOFA score was 9 (6, 12). Mortality at 28 days was 42%. Models specificity ranged from 0.619 to 0.821. Partial least squares regression-discriminant analysis and nearest shrunken centroids prioritized the greatest number of metabolites identified by at least one other method. Penalized logistic regression demonstrated top-feature results that were consistent with many ML methods. Across the plasma metabolome, the 13 metabolites with the strongest linkage to mortality defined through an ensemble ML importance score included lactate, bilirubin, kynurenine, glycochenodeoxycholate, phenylalanine, and others. Four of these top 13 metabolites (3-hydroxyisobutyrate, indoleacetate, fucose, and glycolithocholate sulfate) have not been previously associated with sepsis survival. Many of the prioritized metabolites are constituents of the tryptophan, pyruvate, phenylalanine, pentose phosphate, and bile acid pathways.
Conclusion: We identified metabolites linked with sepsis survival, some confirming prior observations, and others representing new associations. The application of ensemble feature-ranking tools innate to ML to metabolomic data may represent a

promising statistical platform to support biologic target discovery.

Grant Acknowledgement: The metabolomics analysis was funded by an NIH/NHLBI grant (1 R01 HL112747-01).

Figure 1. Heatmap showing normalized metabolite levels grouped by superpathway among patients with sepsis

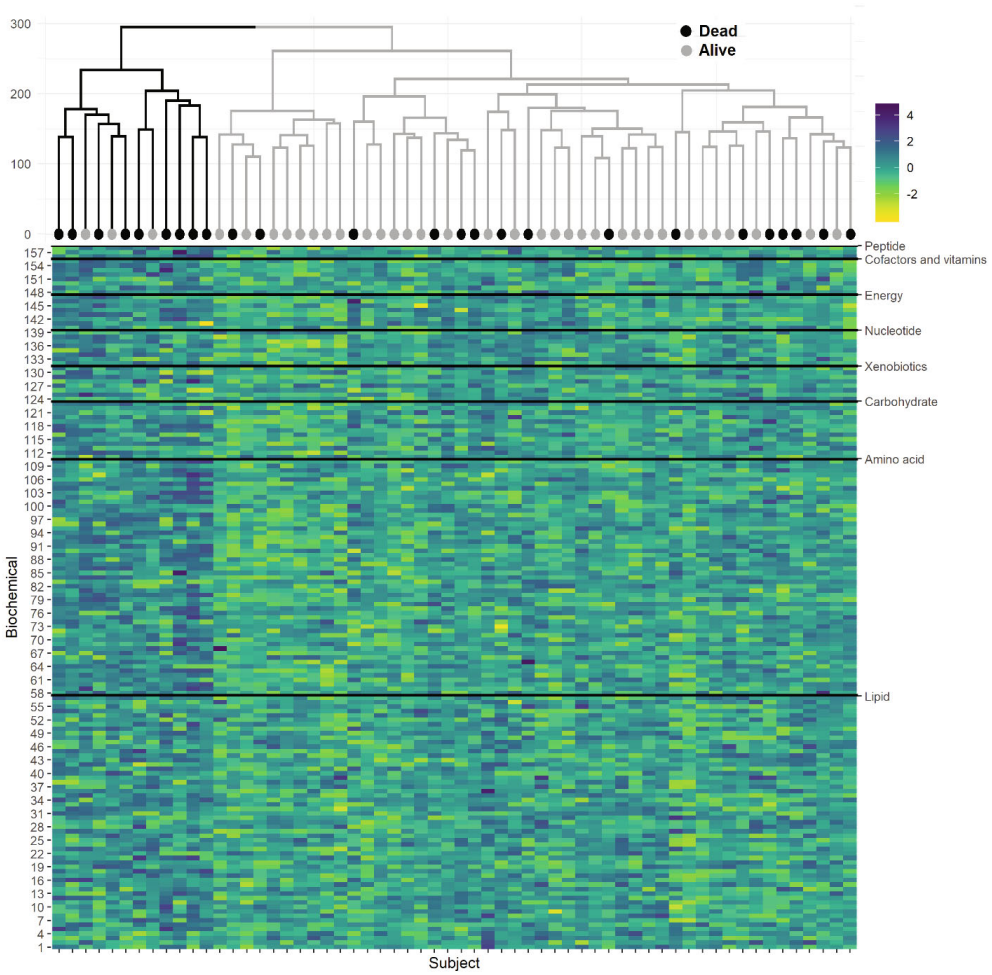
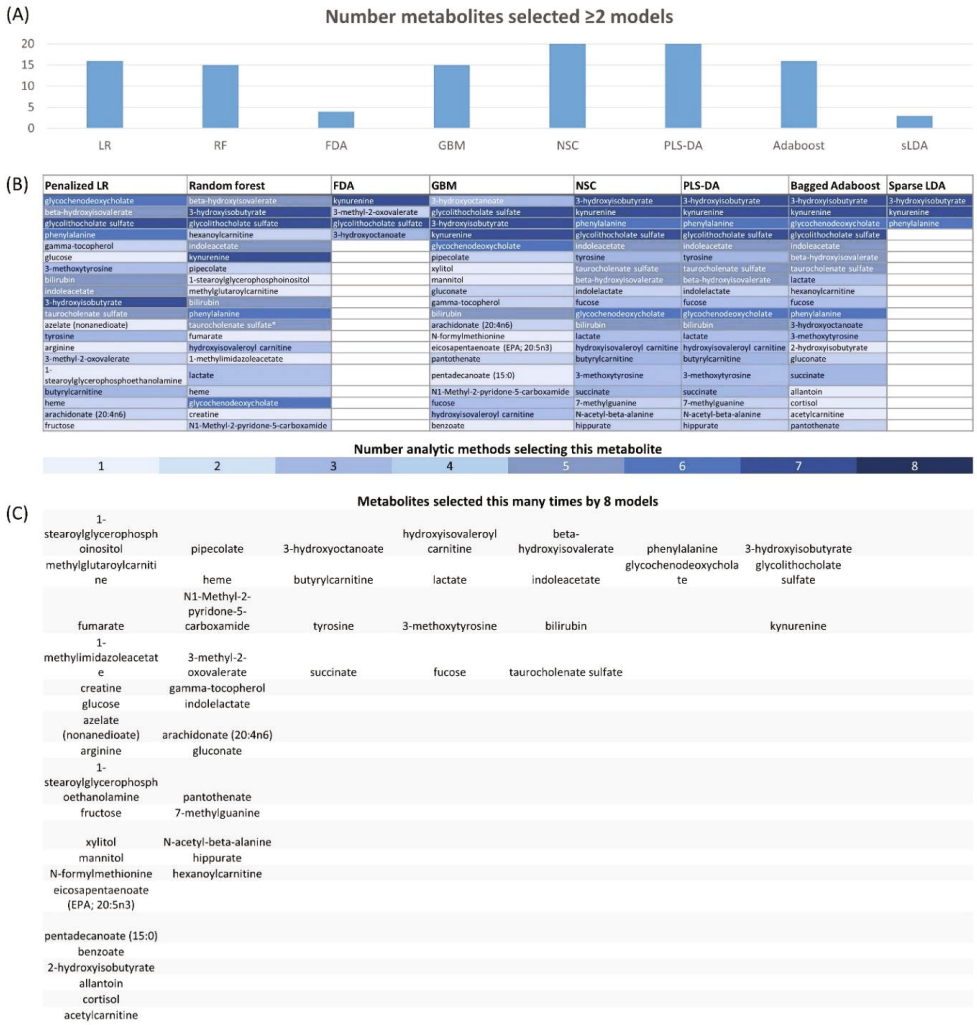


Figure 2. Comparison of top metabolites selected by each analysis method's innate feature selection algorithm



Management Practices and Outcomes Across Patients Presenting with Hyperleukocytosis

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Introduction: Approximately 10% to 20% of patients with Acute Myeloid Leukemia (AML) patients present with hyperleukocytosis. Hyperleukocytosis can result in leukostasis leading to end organ dysfunction and critical illness. Institutional practices vary on the management of patients with hyperleukocytosis and leukostasis including location of chemotherapy administration and thresholds for ICU admissions. There is paucity of data on the short- and long- term outcomes of these patients – particularly across those managed on in-patient wards vs. ICUs.
Objectives: To describe the characteristics of patients with hyperleukocytosis and factors associate with ICU admission and 60-day mortality.
Methods: We conducted a retrospective cohort study of consecutive admissions to Princess Margaret (PM) Cancer Center or Mount Sinai Hospital Intensive Care Unit (ICU for PM) between 2014-2019. Any adult patients with a white blood cell count >$50x10^9$/L and a new diagnosis of AML were included. Their clinical and laboratory data was evaluated across their first 5 days of hyperleukocytosis. Our primary outcome was ICU admission and our secondary outcome was 60 day mortality.
Results: One-hundred and sixty-nine patients were admitted with a diagnosis of AML and hyperleukocytosis. Mean age was 58 (SD 15) and 59% were male with 43% having greater than 2 comorbidities. Median WBC on the first day of hyperleukocytosis was 103 (IQR 67-152), with 55% having a WBC >100 and 15% having a WBC >200. On the first day of hyperleukocytosis, 63% had hypoxemic respiratory failure, 25% (43) had biochemical tumor lysis syndrome, and 49% were diagnosed with acute kidney injury (8% requiring dialysis) (Table 1). ICU admission was required in 44% of the cohort admitted and the median time to ICU was 1 (IQR 0-3) days. Across entire cohort, median change in from day 1 to 2 was – 17 (IQR -31 - -1), the median greatest decrease in WBC over a 24 hour period was 58 (31-88). Drop in WBC in first 5 days was higher in those not admitted to ICU and across survivors. (Table 1). Across the ICU cohort, 59% required invasive mechanical ventilation, 76% had acute kidney injury and 48% require vasopressors (Table 2). Across those admitted to the ICU, 81% were admitted within 4 days of hyperleukocytosis. Sixty-day mortality across the whole cohort was 30% (57% across the ICU cohort and 8% across the non-ICU exposed). ICU mortality was 82% across those who required invasive mechanical ventilation during the first 5 days of hyperleukocytosis. Hospital admission factors associated with ICU admission included hypoxia on day 1 of hyperleukocytosis (PaO2/FiO2 OR 0.97 (95% CI 0.96-0.98, p<0.001) and acute kidney injury (OR 12.2 95% CI 1.8-83, p 0.011) (Table 4). Factors associated with 60 day mortality included male sex, WBC >100, lower PaO2/FiO2, any invasive mechanical ventilation and a lower drop over a 24 hour period in the WBC across the first 5 days.
Conclusions: The vast majority of patients with hyperleukocytosis were managed on the inpatient wards and had a mortality rate of 8%; however, the subset admitted to ICU and particularly requiring invasive mechanical ventilation on admission did poorly.

TABLE 1	Entire Cohort (N=169)	ICU Cohort (N=75)	No ICU (N=94)	60-day Mortality (N=50)
DEMOGRAPHIC VARIABLES				
Age	58 SD 15	59 (15)	58 (14)	59 (16)
Comorbidities	1 (IQR 0-2)	2 (IQR 1-3)	1 (IQR 0-2)	2 (IQR 1-3)
Sex-Male	100 (59%)	48 (64%)	52 (55%)	38 (76%)
# Comorbidities	0 – 48 (29%) 1 – 47 (28%) ≥2 - 73 (43%)	0 – 14 (19%) 1 – 14 (19%) ≥2 – 47 (63%)	0 - 34 (37%) 1 – 33 (35%) ≥2 – 26 (28%)	0 - 11 (22%) 1 – 13 (26%) ≥2 – 26 (52%)
Days from hospital admission to ICU admission	1 (0-3)	1 (0-3)	N/A	
WBC DETAILS				
WBC >100 on presentation	92 (55%)	44 (59%)	48 (52%)	31 (65%)
WBC >200	25 (15%)	16 (21%)	9 (10%)	12 (24%)
WBC day 1	103 (67-152)	106 (61-187)	102 (69-143)	114 (71-195)
WBC day 2	85 (60-125)	87 (63-150)	76 (56—120)	98 (73-153)
WBC day 3	61 (37-110)	71 (129-46)	61 (37-109)	65 (38-100)
WBC day 4	32 (15-74)	18 (5-88)	37 (19-64)	43 (18-83)
WBC day 5	14 (3-38)	15 (2-51)	14 (5-36)	19 (9-59)
Change D2-D1	-17 (-31 - -1)	-9 (-25 – 10)	- 21 (-35- -9)	-1 (-21- 23)
Change D3-D2	-18 (-35 - -7)	-26 (-60 - -9)	-18 (-33- -6)	-23 (-35- -11)
Greatest decrease in 24 hours over first 5 days*	58 (31-88)	48 (18-91)	62 (37-87)	48 (21-80)
CLINICAL VARIABLES				
ICU admission	75 (44%)	N/A	N/A	43 (86%)
PaO2/FiO2 Day 1	280 (IQR 140-450)	168 (112-251)	452 (442-461)	145 (108-206)
Any hypoxia day 1	80 (63%)	71 (96%)	9 (11%)	
Highest oxygen support on day 1	Room Air 75 (48%) NP 27 (17%) HFNC 4 (3%) NIV 6 (4%) Inv Mech Vent 43 (28%)	4 (5%) 18 (24%) 4 (5%) 6 (8%) 43 (57%)	71 (89%) 9 (11%)	3 (6%) 8 (17%) 0 1 (2%) 36 (75%)
PTT day 1	28 (25-33)	31 (28-39)	26 (23-29)	32 (28-43)
Potassium (dialysis excluded) day 1	3.8 (3.3-4.3)	4.5 (3.9-4.9)	3.5 (3.2-3.9)	4.3 (3.8-5)
Uric Acid day 1	363 (221-540)	356 (170-640)	363 (227-539)	402 (226-742)
Biochemical TLS day 1	43 (26%)	42 (56%)	1 (1%)	30 (60%)
AKI day 1	82 (49%)	54 (72%)	28 (31%)	39 (79%)
Dialysis day 1	14 (8%)	14 (19%)	0	10 (20%)
GCS day 1	14-15: 136 (81%) <14: 31 (19%) 3: 14 (8%)	14-15: 44 (59%) <14: 31 (41%) 3: 14 (19%)	14-15: 94 (100%)	14-15: 28 (57%) <14: 22 (43%) 3: 12 (25%)
Shock day 1	33 (20%)	32 (43%)	1 (1%)	21 (43%)
WORST CLINICAL STATUS BY DAY 5				
Invasive mechanical ventilation by day 5	44 (27%)	44 (59%)	N/A	
AKI by day 5	88 (52%)	57 (76%)	35 (38%)	39 (79%)
Dialysis by day 5	14 (8%)	14 (19%)	0	
Shock by day 5	36 (22%)	36 (48%)	1 (1%)	
Time to ICU admission	Direct-25 (15% ICU) w/i 4 days-60 (37%)	25 (33%) on day 0 62 (81%) by day 4 68 (88%) by day 7		14 (32%) on day 0 36 (82%) by day 4 40 (90%) by day 7
TREATMENT IN FIRST 5 DAYS				
Hydroxyurea	140 (84%)	51 (68%)	89 (97%)	32 (65%)
Cytarabine	81 (49%)	30 (41%)	51 (55%)	23 (48%)
OUTCOMES				
60-day mortality	50 (30%)	43 (57%)	7 (8%)	N/A
Death across ICU exposed cohort	44/75 (59%)	42 (56%)	N/A	N/A
60-day mortality excluding ICU admissions	7/93 (8%)	N/A	7 (8%)	N/A
Death within 24 hours	11 (7%)	11 (15%)	0	11 (22%)
Death within 48 hours	21 (12%)	21 (28%)	0	21 (46%)

*(excluding 17 pts no decrease and 24 with missing data/death)

TABLE 2	Entire Cohort (N=169)	ICU Cohort (N=75)	ICU survivors (N=33)	ICU died (N=42)
DEMOGRAPHIC VARIABLES				
Age	58 SD 15	59 (15)	60 (16)	57 (SD 16)
Comorbidities	1 (IQR 0-2)	2 (IQR 1-3)	2 (IQR 1-4)	2 (IQR 1-3)
Sex-Male	100 (59%)	48 (64%)	16 (48%)	32 (76%)
# Comorbidities	0 – 48 (29%) 1 – 47 (28%) ≥2 - 73 (43%)	0 – 14 (19%) 1 – 14 (19%) ≥2 – 47 (63%)	0 -4 (12%) 1 – 5 (15%) ≥2 – 24 (72%)	0 – 10 (24%) 1 – 9 (21%) ≥2 – 23 (55%)
Days from hospital admission to ICU admission	1 (0-3)	1 (0-3)	1 (0-3)	1 (0-3)
WBC DETAILS				
WBC >100 on presentation	92 (55%)	44 (59%)	17 (51%)	27 (66%)
WBC >200	25 (15%)	16 (21%)	4 (12%)	12 (30%)
WBC day 1	103 (67-152)	106 (61-187)	86 (60-139)	117 (75-212)
WBC day 2	85 (60-125)	87 (63-150)	84 (50-124)	104 (74-181)
WBC day 3	61 (37-110)	71 (129-46)	73 (39-123)	71 (58-155)
WBC day 4	32 (15-74)	18 (5-88)	14 (3.9-80)	119 (89-149)
WBC day 5	14 (3-38)	15 (2-51)	6 (2-38)	89 (51-127)
Change D2-D1	-17 (-31 - -1)	-9 (-25 – 10)	- 15 (-27- -0.1)	1.7 (-17 – 26)
Change D3-D2	-18 (-35 - -7)	-26 (-60 - -9)	-26 (-60 - - 8.6)	-29 (-81 - -6)
Greatest decrease in 24 hours over first 5 days*	58 (31-88)	48 (18-91)	56 (18-100)	28 (18-77)
CLINICAL VARIABLES				
ICU admission	75 (44%)	N/A	N/A	N/A
PaO2/FiO2 Day 1	280 (IQR 140-450)	168 (112-251)	252 (157-323)	136 (105-175)
Any hypoxia day 1	80 (63%)	71 (96%)	29 (91%)	42 (100%)
Highest oxygen support on day 1	Room Air 75 (48%) NP 27 (17%) HFNC 4 (3%) NIV 6 (4%) Inv Mech Vent 43 (28%)	4 (5%) 18 (24%) 4 (5%) 6 (8%) 43 (57%)	4 (12%) 13 (39%) 4 (12%) 5 (15%) 7 (21%)	0 5 (12%) 0 1 (2%) 36 (86%)
PTT day 1	28 (25-33)	31 (28-39)	30 (26-34)	34 (29-44)
Potassium (dialysis excluded) day 1	3.8 (3.3-4.3)	4.5 (3.9-4.9)	4 (3.9-4.5)	4.5 (4.2-5.2)
Uric Acid day 1	363 (221-540)	356 (170-640)	311 (167-515)	402 (170-756)
Biochemical TLS day 1	43 (26%)	42 (56%)	13 (39%)	29 (69%)
AKI day 1	82 (49%)	54 (72%)	19 (58%)	35 (83%)
Dialysis day 1	14 (8%)	14 (19%)	4 (12%)	8 (19%)
GCS day 1	14-15: 136 (81%) <14: 31 (19%) 3: 14 (8%)	14-15: 44 (59%) <14: 31 (41%) 3: 14 (19%)	14-15: 23 (69%) <14: 10 (30%) 3: 2 (6%)	14-15: 21 (50%) <14: 21 (50%) 3: 12 (29%)
Shock day 1	33 (20%)	32 (43%)	13 (39%)	21 (50%)
WORST CLINICAL STATUS BY DAY 5				
Invasive mechanical ventilation by day 5	44 (27%)	44 (59%)	8 (24%)	36 (86%)
AKI by day 5	88 (52%)	57 (76%)	22 (58%)	35 (83%)
Dialysis by day 5	14 (8%)	14 (19%)	4 (12%)	8 (19%)
Shock by day 5	36 (22%)	36 (48%)	11 (33%)	22 (52%)
Time to ICU admission	Direct-25 (15% ICU) w/i 4 days-60 (37%)	25 (33%) on day 0 62 (81%) by day 4 68 (88%) by day 7	10 (30%) on day 0 26 (79%) by day 4 28 (85%) by day 7	13 (31%) on day 0 34 (81%) by day 4 38 (90%) by day 7
TREATMENT IN FIRST 5 DAYS				
Hydroxyurea	140 (84%)	51 (68%)	25 (76%)	26 (62%)
Cytarabine	81 (49%)	30 (41%)	11 (33%)	19 (46%)
OUTCOMES				
60-day mortality	50 (30%)	43 (57%)	1 (3%)	N/A
Death across ICU exposed cohort	44/75 (59%)	42 (56%)	0	N/A
60-day mortality excluding ICU admissions	7/93 (8%)	N/A	N/A	N/A
Death within 24 hours	11 (7%)	11 (15%)	N/A	11 (26%)
Death within 48 hours	21 (12%)	21 (28%)	N/A	21 (50%)

TABLE 3	HIGH RISK MORTALITY COHORTS
ANY INVASIVE MECHANICAL VENTILATION	82% (36 patients)
WBC >200 + ANY INVASIVE MECHANICAL VENTILATION ON DAY 1	85% (11 patients)
WBC >100 + ANY INVASIVE MECHANICAL VENTILATION AND SHOCK REQUIRING VASOPRESSORS	100% (13 patients)

TABLE 4: FACTORS ASSOCIATED WITH ICU ADMISSION			
Variable	**OR**	**95% CI**	**p**
Age	0.97	0.92-1.02	0.21
Sex	4.2	0.64-28	0.13
WBC Greater than 100 on day 1	1.7	0.33-7.6	0.58
# Comorbidities	1.21	0.67-2.19	0.54
PaO2/FiO2* on day 1	**0.97**	**0.96-0.98**	**<0.001**
AKI on day 1	**12.2**	**1.8-83.4**	**0.011**

(*SaO2/FiO2 with adjustment factor used for patients without PaO2 available)

TABLE 5: FACTORS ASSOCIATED WITH 60 DAY MORTALITY			
Variable	**OR**	**95% CI**	**p**
Age	1.03	0.98-1.08	0.31
Sex -Female	**0.03**	**0.002-0.02**	**0.003**
WBC Greater than 100 on day 1	**10.16**	**1.24-82.88**	**0.03**
# Comorbidities	0.73	0.39-1.35	0.31
PaO2/FiO2* on day 1	**0.99**	**0.98-0.997**	**0.007**
Tumor Lysis Syndrome on day 1	1.18	0.16-8.61	0.87
Any AKI	0.55	0.12-2.37	0.43
Any Invasive Mechanical ventilation	**26.85**	**1.67-434.34**	**0.02**
Greatest drop in WBC in first 5 days	**0.96**	**0.93-0.99**	**0.02**

Motivating Factors, Barriers and Facilitators of Participation in COVID-19 Clinical Research amongst Canadian Community ICUs: A Cross-Sectional Survey

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Background: Few Canadian community intensive care units (ICUs) participate in clinical research, although community hospitals hold over two-thirds of Canadian hospital beds. Study recruitment in community ICUs could accelerate the pace of knowledge acquisition, improve the generalizability of study results, research equity, and accelerate knowledge translation.
Objectives: The objective of this study was to examine the motivating factors, barriers and facilitators to research participation amongst Canadian community ICU stakeholders.
Methods: A cross-sectional online survey was distributed between May and November 2020. The survey focused on 6 domains: participant demographics, ICU characteristics, ICU research infrastructure, motivating factors, perceived barriers, and perceived facilitators. Participants were also asked to evaluate possible research funding models including (A) a partial subsidy for an in-house research coordinator (RC) with study payments going to the ICU, (B) a complete subsidy for an off-site RC for one specific study with study payments reverting to the external sponsor, (C) in-house RC hired by external sponsor for a package of studies with study payments reverting to the study sponsors.
Results: Responses were received from 73 Canadian community ICU stakeholders, representing 18 ICUs. Participants rated their interest in participating in pandemic research at 5.2 ± 1.9 (mean ± standard deviation [SD]) on a 7-point Likert scale from 'not interested' to 'very interested'. The strongest motivating factor for research participation was research improves clinical care and outcomes. The most significant facilitators of research involvement were the availability of an experienced RC and dedicated external funding to provide start-up costs for a research program, while the most significant barriers to research involvement were a lack of start-up funding for a RC and a lack of ICU research experience. With respect to research infrastructure, 7/18 ICUs had a pre-existing clinical research program and 6/18 had access to a research coordinator. Most participants preferred research funding model A, in which the ICU would receive a partial subsidy for a RC salary and retain local control over their research program.
Conclusion: Canadian Community ICU stakeholders are interested in participating in pandemic research but lack basic infrastructure, research personnel, research experience and start-up funding. Evolution of a research support model at community hospitals, where most patients receive acute care, may increase research participation and enhance the generalizability of funded research.

Non-Hepatic Hyperammonemic Encephalopathy in Young Adult Patient

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Introduction/Background: Hyperammonemia is a metabolic condition defined as an increase in the level of ammonia in the blood. As ammonia is a neurotoxin, hyperammonemia can present with cognitive symptoms and reduced level of consciousness. The most common cause of hyperammonemia is liver cirrhosis, and non-hepatic hyperammonemia in adults is rare.
Objectives: To report a unique case of non-hepatic hyperammonemia, review relevant literature, and discuss potential causes.
Methods: We report a unique case of hyperammonemia following a complicated clinical course of aplastic anemia. A literature review was conducted using the search terms “hyperammonemia”, “urea-cycle disorder”, “aplastic anemia”. A genetic analysis of the patient included the Blueprint Genetics Comprehensive Hearing Loss and Deafness Panel Plus Hyperammonemia and Urea Cycle Disorder Panel.
Results: A 17-year-old female status post-treatment with immunosuppressive therapy (IST) for severe aplastic anemia (SAA) presented with decreased level of consciousness and was found to have severe hyperammonemia with an ammonia level of 620 umol/L. Her SAA subsequently relapsed and she underwent haploidentical bone marrow transplant, which she tolerated well without complications related to hyperammonemia. Whole-exome DNA sequencing was completed and revealed no identifiable genetic cause for her hyperammonemia. An episode of acute typhlitis and subsequent appendiceal perforation and intra-abdominal sepsis may have contributed to the hyperammonemia.
Conclusion: A novel case of aplastic anemia and hyperammonemia is presented and discussed in the context of the most recent reviewed literature.

Non-Invasive Assessment of Cerebral Hemodynamics and Intracranial Compliance in Mechanically Ventilated Patients with COVID-19

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Background: Some patients with severe coronavirus disease 2019 (COVID-19) develop acute respiratory failure and requiring intubation. Hypoxia and invasive mechanical ventilation alter cerebral blood flow, increase intracranial pressure and induce an inflammatory response in the brain. These secondary brain injuries imply cerebrovascular hemodynamics disorders and intracranial compliance.
Objective: The present study aims to assess the presence of the impairment of cerebrovascular hemodynamics and intracranial compliance in patients with severe COVID-19 on mechanical ventilation.
Method: This study was conducted among patients with hypoxemic respiratory failure due COVID-19 without signs of cerebral evolviment prior intubation. We performed transcranial Doppler sonography and ocular ultrasound during first 24h of mechanical ventilation. Cerebrovascular hemodynamics was assessed using mean flow velocities in the middle cerebral arteries (MCA), resistance index (IR), autoregulation (transient hyperemic response test) and estimated cerebral perfusion pressure (eCPP) while intracranial compliance was evaluated by using the measurement of optic nerve sheath diameter (ONSD).
Results: Fourteen patients (9 male; mean age, 60,4 years; 8 died) were assessed. The average mean blood flow velocity in MCA was of 47,1 cm/s. One patient had hyperemia. eCPP below 60 mmHg was present in 13 patiens. The mean IR was of 0,62 and the mean IP was of 1,10 indicating increase of cerebral vascular resistance. Six patients (58,3%) had an abnormal transient hyperemic response test. Five patients (35,7%) showed ONSD values higher than 5 mm indicating decrease of intracranial compliance.
Conclusions: This study showed increased of indexes of cerebral vascular resistance, decreased cerebral perfusion, impaired autoregulation and decreased intracranial compliance in patients with COVID-19 during first 24 hours of mechanical ventilation.

Online User Comments Responding to Deemed Consent Organ Donor Legislation in Nova Scotia

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Introduction/Background: Nova Scotia has relatively high rates of organ donation, but internationally, Canada's and Nova Scotia's organ donation rates are lower than many other national averages. Deemed consent is seen as a tool to help increase donation rates but can generate controversy. In 2019, Nova Scotia became the first jurisdiction in North America to pass deemed consent organ donation legislation. The announcement of the legislative change generated substantial online discussion.
Objective: We analyzed the online commentary to gain insights into public perception and online discussion characteristics, which could be used to inform public outreach both in Nova Scotia and prospective jurisdictions.
Methods: We performed directed content analysis on 2663 user-generated comments appearing on two widely-shared Canadian Broadcasting Company (CBC) articles published online in April 2019. We determined levels of support and opposition in comments and described the specific rhetoric used for doing so. We also performed one-way ANOVA and Pearson chi-square tests to determine how the comments were being received and engaged by other users.
Results: There were more negative than positive comments, and negative commentary generated more replies. Positive comments were received more positively by other users, while negative comments were received more negatively. The total sum of negative comments was greatly influenced by a small number of very active participants. Those in favour saw the changes as a means of addressing organ shortages while maintaining choice. Positive comments portrayed the law as altruistic and a point of pride for the province. Those in opposition saw the law as an overreach of government authority, thereby unjustly impinging on the freedoms and autonomy of individuals. Posts expressed sentiments of condemnation on various grounds, including legal issues, ethical impropriety, and insufficient consultation. Some heated arguments took place among participants.
Conclusions: There were strong positive and negative sentiments expressed in the comments, but the total sum of negativity in the comments was significantly influenced by a small number of commentators. While not generalizable to the public, the findings suggest that a relatively small group of very loud voices might have created a false impression of broad social contention on the topic. Much of the expressed issues with deemed consent were broad, principle-based and tinged with conspiratorial sentiments, showing a general mistrust in health care systems. Suggestions for public outreach include clear explanations around the need for this legislative change, how the policy will be enacted (e.g. power of families to veto), and what is hoped can be gained from the policy. Effective communication and outreach should include participation from a range of stakeholders such as medical experts, religious leaders, as well as influential members of racialized and/or marginalized communities. Explanations of the organ donation and transplantation process as well as the legal foundation of the legislation might also prove to be useful for consensus building in some contexts. Public health officials should consider going online to participate idiscussions, using best online practices for transmitting facts, countering misinformation, clarifying procedures, and building public confidence/trust.

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Outcomes and Economics of Prolonged Mechanical Ventilation in Alberta: A 10-Year Retrospective Cohort Study

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Introduction: Approximately 33% of patients admitted to an ICU in Canada require some form of invasive mechanical ventilation (IMV) (1). The majority of these patients are successfully extubated within 7 days; however, a subset progress to prolonged mechanical ventilation (PMV). This population represents an important category of critically ill patients treated in the Intensive Care Unit (ICU). A meta-analysis of >80,000 patients on PMV found mortality rates of 59-62% on average over 1 year (2), however there is significant heterogeneity in outcomes across institutions and regions. (3-7).
Objective: To determine mortality, disposition, and health resource utilization for patients requiring PMV in the province of Alberta, Canada.
Methods: We completed a population-based retrospective cohort study of all adults ≥18 years in Alberta, Canada a province with 4.4 million individuals and a single-payer public healthcare system. We defined PMV as all patients ventilated for ≥7 days and further categorized the data into 7-13, 14-20, and ≥21 days. A search of the Alberta Health Services Enterprise Data Warehouse was performed to identify all patients with at least 7 days in an ICU with intervention code '13.62A' (Ventilatory support, in ICU) for ≥7 days in an acute care hospital in Alberta from 2009-2019. Data linkages were performed to identify mortality, 1 and 2-year disposition. Healthcare cost was estimated using resource intensity weight (RIW) score (8). Comparisons were performed using Chi-squared tests and ANOVA with a value of $p \leq 0.05$ considered statistically significant.
Results: The search identified 11739 (40.5% female) patients ventilated for ≥7 days from 2009-2019. These patients were on average 57.2 ±16.3 years old and the most common diagnosis was respiratory insufficiency. The average hospital length of stay was 72.2 ±128.7 days. In the cohort, 6929 (59%) were ventilated for 7-13 days, 2298 (20%) were ventilated for 14-20 days and 2512 (21%) were ventilated for 21 days or more. Almost a third (32%) of patients died during their index admission and one-year mortality from initiation of ventilation was similar at 38%. Patients ventilated 14-20 days and ≥21 days had a higher mortality at their index admission and at year 1 and 2 compared to patients ventilated for 7-13 days ($p<0.001$). The mean cost of the index hospitalization per patient ventilated over 7 days was estimated at $170,943 (Median (Interquartile range ((IQR)) $119,820 ($71,892-$199,700)). In the year following the index hospitalization, 62% of patients were alive. Of the patients alive, 95% were living in the community and only 5% were in a continuing care center. Of the survivors, there was a 16% mortality rate in the 2 years following initiation of mechanical ventilation. Mean healthcare costs for the year following discharge was $49,525 (Median IQR $23,964 ($7,988-$55,916)) per patient. Patients ventilated ≥21 days had greater healthcare costs in the year following discharge than patients ventilated 7-13 and 14-20 days ($p <0.001$).
Conclusion: Patients requiring PMV in Alberta represent a unique and important subset of patients treated in the ICU. PMV users require a significant duration of mechanical ventilation, a prolonged stay in the ICU and hospital, and high healthcare resource utilization. The majority of these patients are still alive and residing in the community two years after initiation of ventilation.

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Outcomes and Treatments of Critically Ill Patients with Candida spp. Colonization of the Lower Respiratory Tract in Regina, Saskatchewan

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Introduction: Critically ill intensive care unit (ICU) patients receiving mechanical ventilation are at increased risk of nosocomial infection with ventilator-associated pneumonia (VAP). While *Candida* spp. are commonly detected in the lower respiratory tract (LRT), they are generally considered colonizers rather than a pathogenic cause of infection and empiric antifungal treatment is not recommended unless the patient is experiencing shock, multi-organ failure, and more than one site isolate[1,2]. It is estimated that *Candida* spp. colonization of the respiratory tract may be present in over half of critically ill patients undergoing mechanical ventilation[3]. In a Canadian study of ICU patients with suspected VAP and *Candida* spp. found in a LRT sample, in-hospital mortality was 34.2% and 29.8% of patients received antifungal treatment during the course of the study[4]. A recent European study found an in-hospital mortality rate of 40% and 32% of patients receiving antifungal therapy[5].
Objectives: This study aims to evaluate the use of antifungals in the treatment of ICU patients with LRT isolates positive for *Candida* spp. and their clinical outcomes.
Methods: A retrospective analysis of 200 patients admitted to ICUs in Regina, SK that had positive *Candida* spp. identified on LRT isolates was performed.
Results: Patients had a median age of 64 years (interquartile range [IQR] 55-74) and 50% were female. On admission, the mean SOFA score was 10 (Standard deviation [SD] ± 3) and the median duration of intubation was 21.50 days (IRQ 5-37). ICU and hospital length of stay were a median of 12 days (IQR 4-14) and 24 days (IQR 8-29), respectively. One hundred and sixty (80%) patients died in hospital. Nearly 94% of patients received antibiotic therapy prior to a positive fungal LRT isolate. Only 51.5% of patients received an antifungal treatment. Patients were more likely to be given antifungal therapy if they had experienced shock or received parenteral nutrition. Univariable logistic regression of antifungal treatment was associated with an odds ratio (OR) of 0.44 (95% confidence interval [CI] 0.21-0.90) of death, compared to no treatment (p=0.03). Multivariable logistic regression, after adjusting for age, sex, Charlson Comorbidity Index (CCI), and SOFA score, showed antifungal treatment was associated with an OR of 0.39 (95% CI 0.17-0.87) of death, compared to no treatment (p=0.02). In a sensitivity analysis, fluconazole treatment and micafungin/caspofungin treatment was associated with OR 0.31 (95% CI 0.13-0.77, p=0.01) and OR 0.59 (95% CI 0.21-1.70, p=0.33) when compared to no treatment, respectively. Propensity score match (PSM) logistic regression demonstrates antifungal treatment is associated with OR 0.41 (95% CI 0.17-1.01) of death, compared to no treatment (p=0.05).
Conclusion: There is high mortality among patients with positive *Candida* spp. LRT cultures regardless of treatment. Although existing literature suggests antifungal treatment of *Candida* spp. LRT colonization may not confer benefit in terms of outcomes, there are a lack of high-quality studies evaluating antifungal therapy in these cases. Our results indicate a potential that antifungal therapy reduces the risk of mortality in these critically ill ICU patients and should prompt further investigation in larger studies. Our review of local practice is also hypothesis generating with the overall in-hospital mortality rate much greater than other trials reported in the literature.

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Physical Restraint Practices in a Canadian Adult Intensive Care Unit

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Background: Physical restraints are associated with adverse physical, emotional and psychological sequelae and do not prevent accidental device removal in intensive care unit (ICU) patients. For these reasons, legislation mandates, and professional society guidelines strongly recommend physical restraint minimization interventions. Nevertheless, physical restraints continue to be used extensively in ICUs both in Canada and internationally. Previously, implementation science frameworks have not been used to develop and guide the implementation of restraint minimization interventions.
Objective: To evaluate current physical restraint practice using the integrated–Promoting Action on Research Implementation in Health Services (i-PARIHS) framework as a preliminary step to designing a theoretically-informed restraint minimization intervention.
Methods: We conducted a prospective observational study of daytime restraint practices in a single,20 beds, tertiary academic ICU in Toronto, Canada. Data collection methods included hourly patient observation, medical record review, and bedside nurse informal interviews.
Results: During the 12-week study period, 102 physically restrained patients were observed. The mean patient age was 58 years (*SD* 1.92); 67 (66%) were male. Trauma was the most frequent reason for admission (*n* = 43, 42%). The median ICU length of stay was 4.6 days (IQR 4.7–9.8). The precise time of physical restraint application was ascertained for 83 (81%) patients. Almost all patients (80/83, 96.4%) were mechanically ventilated. On admission, 83 (100%) had pro re nata orders for physical restraint application, and 59 (71%) were prophylactically restrained. Sedation agitation scores at time of physical restraint application were documented for 77 patients. Of these 77 patients, 55 (71%) were heavily sedated or in a comatose state. Of the 923 hourly observed physical restraint episodes, 691 (75%) were not documented in the patient record. Of the 30 daytime interprofessional team rounds observed, physical restraint was discussed at 3 (10%). Final restraint removal was ascertained in 57 of 102 patients. In 23 (40%) of these patients, physical restraint removal was documented in the patient records. Over half of restraints (30/57, 52.6%) were removed after extubation. Of the eight patient-initiated self-extubation episodes, all were physically restrained at the time of self-extubation.
Conclusion: Our data indicate common practices of prophylactic physical restraint upon ICU admission, omission of clinical documentation, and limited interprofessional discussion on rounds, all of which may contribute to high restraint use. Further exploratory research is needed to qualitatively understand current physical restraint practice and potentially modifiable i-PARIHS domains (innovation, recipients, context, facilitation) to inform the design, implementation and evaluation of a restraint minimization intervention.

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Predictors of Adverse Outcomes and High Resource Use in Elders Hospitalized for Isolated Orthopedic Injury

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Objectives: Patients 65 years of age or older now represent more than 60% of injury hospitalizations in Canada. Geriatric patients with orthopedic injury often have long hospital stays with a high incidence of complications (nosocomial infections, delirium), functional decline, discharge to long-term care, and increased mortality. There is a knowledge gap on the characteristics of patients who could most benefit from an interdisciplinary treatment approach to improve outcomes and reduce resource overuse. We aimed to identify variables that are associated with adverse outcomes and high resource use in elders admitted to a trauma center for an isolated orthopedic injury.
Methodology: We conducted a multicenter retrospective cohort study on elders hospitalized with a primary diagnosis of isolated orthopedic injury (n=19928). Data were extracted from the provincial trauma registry (Registre des traumatismes du Québec-RTQ).). We identified potential predictors by consulting the literature and clinical experts (e.g., age, sex, comorbidities, mechanism of injury, hospitalizations in the year prior to the injury, concomitant mild traumatic brain injury). Outcomes were mortality, complications, discharge to long-term care, and extended length of stay. We used a multi-level logistic regression to estimate the association between predictors and adverse outcomes.
Results: Overall, 18.6% (n=3684) had an extended length of stay, 19.5% of patients had complications, 5.5% died in hospital, 10.8% were transferred to a long-term care facility, and 8.6% had unplanned readmission. Increasing age, male sex, certain comorbidities (malignancy under chemotherapy, dementia, cirrhosis, diabetes with chronic renal failure, heart failure, loss of independence), selected orthopedic injuries (lower limb fracture, hip fracture, pelvic ring fracture), severe orthopedic injuries (Abbreviated Injury Score- AIS ≥3), concomitant head injury, and admissions in the year before the injury was associated with an increased odds of an adverse outcome. In addition, patients admitted for surgical care had a lower odds of mortality, unplanned readmission, and adverse discharge destination.
Conclusion: We identified eight predictors of adverse outcomes in patients ≥65 years of age admitted to a trauma center for orthopedic injury. In later phases, these factors will be used to develop a clinical decision rule to identify elders who may benefit the most from interdisciplinary care.

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Prevention of Exposure Keratitis in Intensive Care Units: Case Reports, Survey, and Proposed Protocol

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Introduction: Patients within intensive care units (ICUs) are at high risk of exposure keratopathy. Ocular protection can prevent significant ocular morbidity, yet little is known about the ocular care protocols followed in ICUs.
Objectives: This study reports three cases of globe-threatening neurotrophic ulcerative keratitis arising in the ICU setting following neurosurgical procedures. The current state of ocular care across ICUs in Ontario was investigated and an algorithmic ocular care protocol for ICU patients is discussed.
Methods: This study included a retrospective chart review of patients developing exposure keratitis in the ICU setting. A telephone survey of intensive care units in major cities in Ontario was conducted. ICU charge nurses were asked about ocular care in their respective units. Questions focused on eye care protocols, assessment of eyelid closure, methods of ocular surface protection, recent complications, and ophthalmology consult practices. Data were reported in aggregate.
Results: We present the clinical course and outcomes of two female and one male patient with a mean age of 47 who developed significant exposure keratitis and corneal ulcers in the ICU following neurosurgical procedures. Despite numerous interventions, their visual outcomes remained poor: Patient 1's visual acuity was counting fingers at the face, Patient 2 underwent enucleation due to poor vision (hand motions at the face) and pain, and Patient 3's visual acuity was 20/400. Eighteen ICUs provided responses to the questionnaire. Eyelid closure was formally assessed in 56% (10) of units. Less than one third (5; 28%) of ICUs reported having an eye care protocol that is routinely implemented for unconscious patients, while 72% (13) reported a protocol for patients who are unable to close their eyes. Ointment (17; 94%) and artificial tears (16; 89%) were common components of protocols, with 15 intensive care units (83%) using both. The majority of these protocols indicated tears or ointment on an as-needed basis, with one ICU reporting tears prn as the only component of their protocol. Infection and redness/irritation were the most common reasons an ophthalmology consult would be made. Additionally, five (28%) units indicated that a consult would be made for any eye problem encountered. Corneal abrasion, ulceration, unilateral blindness, infection, stretched optic nerve, and swollen orbit were reported as complications recently encountered.
Conclusions: Prevention of exposure keratitis is inconsistent between individual ICUs, with some operating in the absence of defined protocols for ocular protection. Variability and inconsistencies within ocular care practices may be causing undue harm to patients at risk. These findings highlight the importance of implementing a simple ocular care protocol across ICUs. We propose universal precautions be initiated on admission to ICU for all unconscious patients and patients who cannot blink or close their eyes. This would require instillation of non-preserved ointment every 4 hours. Prior to instillation of ointment, an ocular surface assessment should be conducted every 4 hours for purulent discharge, conjunctival hyperemia, and opacification of any kind on the cornea. If any of these are identified, an ophthalmology assessment should be requested.

Figure 1. Photo of Patient 1's right eye showing an ulcer of the inferior third of the cornea, extending into the visual axis. Neovascularization of the inferior cornea is noted.

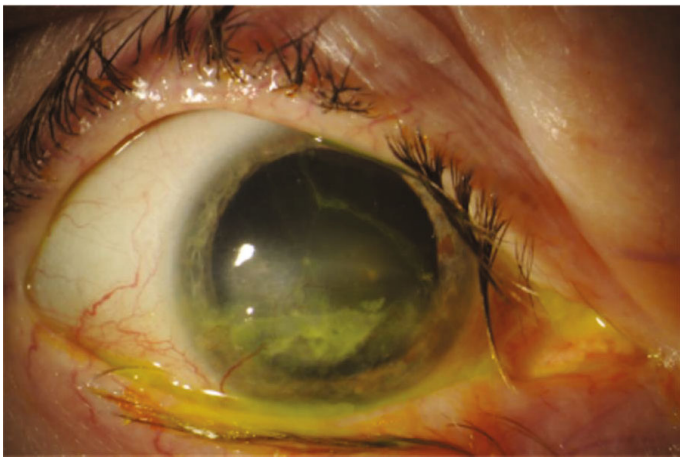


Figure 2. Photo of Case 2's right eye showing a permanent lateral tarsorrhaphy in place with coverage of the cornea. Corneal opacification is noted in the intrapalpebral fissure.

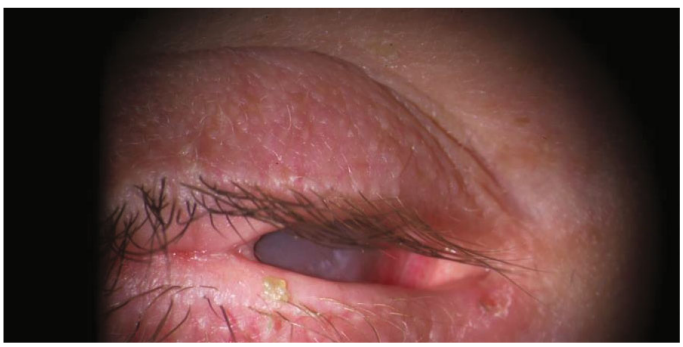
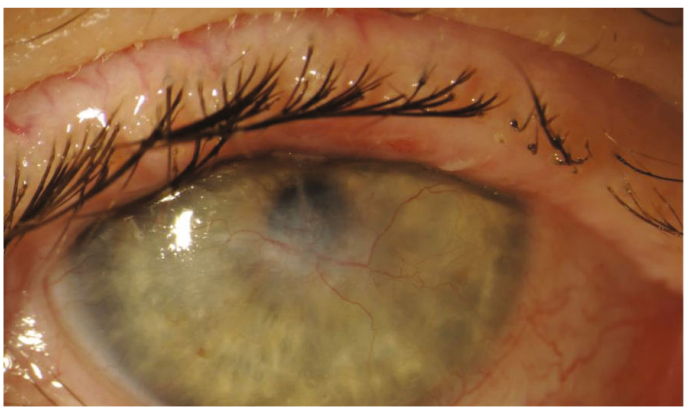


Figure 3. Photo of Case 3's right eye showing a central corneal scar with stromal haze and neovascularization.



Prioritizing Time and Accuracy Using a Digital Report: An Iterative Process to Digitize the Critical Care Response Team (CCRT) Shift Utilization Report

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Introduction: Critical Care Response Team (CCRT) nurses support the response of deteriorating patients on medical/surgical units. Caring for patients during the COVID-19 pandemic created demands on critical care resources. CCRT consults grew substantially resulting in the need to identify and prioritize patients for the Intensive Care Unit (ICU), inter-regional IMS transfers, and acute COVID-19/Optiflow cohorting throughout the organization. By automatically retrieving patient information from the electronic medical record (EMR), the CCRT Shift Utilization Report was digitized to create patient lists shared with patient flow and CCRT members. Providing a consistent list for improved accessibility, documentation accuracy and automaticity to support acute patient management and response to patient care by reducing CCRT workload.
Objective: To standardize and increase efficiency reporting patient information using the CCRT Shift Utilization Report.
Method(s): Multiple stakeholders collaborated to develop and evaluate opportunities to improve nursing workflow through digitizing the CCRT Shift Utilization Report. End-user engagement from CCRT nurses and physicians was prioritized throughout the process to ensure data accuracy and practical implementation. The CCRT Shift Utilization Report was launched in February 2021.
Result(s): Implementing the CCRT Shift Utilization Report as a resource planning strategy was timely and enabled the efficient management of increased patient volumes during the COVID-19 pandemic. End-user feedback revealed the automated report was significantly easier to use, reduced redundancy in documentation, and improved accessibility and transparency.
Conclusions: The impact of an automated CCRT utilization report is an intervention designed to alleviate time spent on reporting utilization via shift log report. This intervention will notably reduce CCRT nurse workload and support resource planning strategies in response to recent increases in CCRT demand.

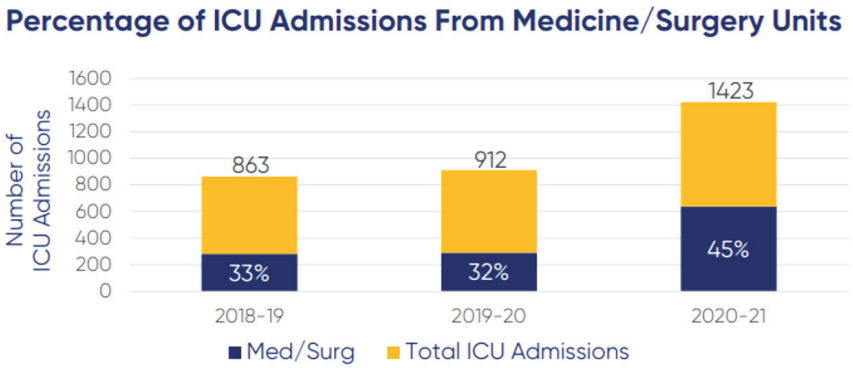


Figure 1. The total number of ICU admissions and ICU admissions from medicine/surgery units before COVID-19 pandemic (2018-2019) and during COVID-19 pandemic (2019-2020; 2020-2021). Total ICU admissions increased by up to 39% and ICU admissions from medicine/surgery units increased by 55.6% during COVID-19 pandemic in 2020-2021.

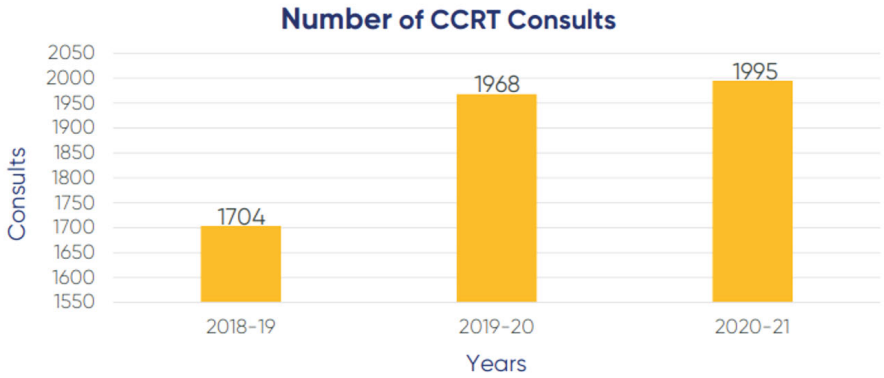
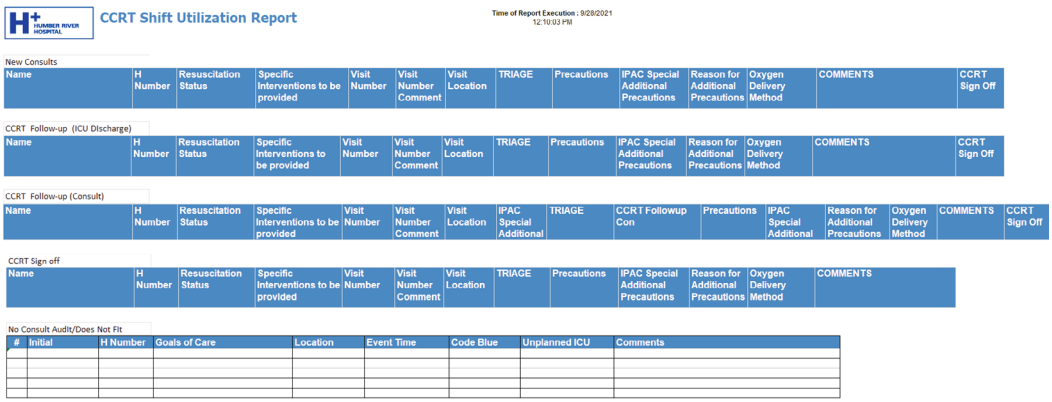


Figure 2. The total number of CCRT consults before COVID-19 pandemic (2018-2019) and during COVID-19 pandemic (2019-2020; 2020-2021). There was a 15% increase in CCRT consults in relation to increase in ICU admissions.



HUMBER RIVER HOSPITAL

CCRT Shift Utilization Report

Time of Report Execution : 9/28/2021 12:10:03 PM

New Consults

Name	H Number	Resuscitation Status	Specific Interventions to be provided	Visit Number	Visit Number Comment	Visit Location	TRIAGE	Precautions	IPAC Special Additional Precautions	Reason for Additional Precautions	Oxygen Delivery Method	COMMENTS	CCRT Sign Off

CCRT Follow-up (ICU Discharge)

Name	H Number	Resuscitation Status	Specific Interventions to be provided	Visit Number	Visit Number Comment	Visit Location	TRIAGE	Precautions	IPAC Special Additional Precautions	Reason for Additional Precautions	Oxygen Delivery Method	COMMENTS	CCRT Sign Off

CCRT Follow-up (Consult)

Name	H Number	Resuscitation Status	Specific Interventions to be provided	Visit Number	Visit Number Comment	Visit Location	IPAC Special Additional	TRIAGE	CCRT Followup Con	Precautions	IPAC Special Additional	Reason for Additional Precautions	Oxygen Delivery Method	COMMENTS	CCRT Sign Off

CCRT Sign off

Name	H Number	Resuscitation Status	Specific Interventions to be provided	Visit Number	Visit Number Comment	Visit Location	TRIAGE	Precautions	IPAC Special Additional Precautions	Reason for Additional Precautions	Oxygen Delivery Method	COMMENTS

No Consult Audit/Does Not Fit

#	Initial	H Number	Goals of Care	Location	Event Time	Code Blue	Unplanned ICU	Comments

Figure 3. CCRT Shift Utilization Report, implemented in February 2021. This automated report is stored in a centralized location in the organization's intranet. Automatically pulling data from CCRT nurse documentation on the patient's electronic medical record ensures that additions to the CCRT Shift Utilization Report are accurate. To further increase accessibility and transparency, this report can be exported and disseminated through email to all relevant stakeholders.

Prognostic Factors Associated with Extubation Failure in Acutely Brain-Injured Patients: A Systematic Review and Meta-Analysis

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Introduction: There are limited available data on factors associated with extubation failure in patients with acute brain injuries (ABI)[1]; the strength and direction of association of patient factors with extubation outcome in published studies are variable.
Objectives: To systematically review prognostic factors associated with extubation failure in adult patients with ABI, focusing on Glasgow Coma Score (GCS), cough, secretion burden, and hemodynamic and airway factors.
Methods: MEDLINE, Embase, and Cochrane Central were searched from inception through February 2021. Two reviewers independently selected English-language studies reporting prognostic factors and their association with extubation failure in adult patients (age ≥ 18) with ABI receiving mechanical ventilation for >24 hours. The primary outcome was extubation failure, defined as the need for reintubation within 72 hours of a planned extubation attempt. Meta-analysis was performed using a random effects model across five broad domains of factors: demographic factors (age, baseline co-morbidities), neurologic status (diagnosis on admission, GCS), mechanical ventilation factors on extubation day (rapid shallow breathing index (RSBI), positive end expiratory pressure (PEEP)), airway protection factors (cough, gag, swallow), and hemodynamic and gas exchange factors on extubation day (heart rate, blood pressure, P/F ratio). Results were reported as odds ratios (OR) for binary prognostic factors or as ratios of means (RoM) for continuous factors[2]. Study risk of bias was assessed using the Quality in Prognostic Factors (QUIPS) tool[3]. This systematic review followed established reporting standards for prognostic factor studies[4], the Cochrane Prognosis Methods Group, and the updated Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines[5]. The protocol was registered with PROSPERO (CRD42021253310).
Results: Of 5,998 articles screened, 101 articles were reviewed in full text and 17 studies were included in the final review. Extubation failure was less likely in the presence of a strong cough (OR 0.54; 95% CI 0.32-0.89) and swallow (OR 0.29; 95% CI 0.15-0.58), and more likely in the presence of heavy secretion burden (OR 1.78; 95% CI 1.05-3.02). Among continuous variables, extubation failure was more common with older age (RoM 1.08; 95% CI 1.03-1.13) and higher APACHE II score (RoM 1.12; 95% CI 1.05-1.18). A higher GCS on extubation day was associated with reduced extubation failure (RoM 0.91; 95%CI 0.88-0.94). There was no association between sex, baseline co-morbidities, or neurologic diagnosis (traumatic brain injury, subarachnoid hemorrhage, intracranial hemorrhage, or ischemic stroke). RSBI, PEEP, and all hemodynamic and gas exchange factors were not associated with extubation failure. Risk of bias according to QUIPS varied from low to moderate across the majority of domains.
Conclusion: In this systematic review and meta-analysis of adult patients with ABI, factors associated with increased risk of extubation failure included older age, higher APACHE score, low GCS on extubation day, and heavy secretion burden. Presence of

a strong cough and swallow were associated with reduced risk of failure. Future work could aim to integrate these factors into a clinical prediction model.

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Table 1. Meta-analysis results - Odds ratios (OR) for binary prognostic factors

	Number of Studies	No. with Factor Events	Total	No. without Factor Events	Total	Odds Ratio 95% CI	p-value
Factors							
Demographics							
Male	12	324	1687	175	888	0.89 (0.63, 1.26)	0.5
Diabetes	5	27	89	173	677	1.33 (0.8, 2.19)	0.27
Hypertension	3	19	83	39	106	1 (0.45, 2.21)	1
COPD	4	19	60	170	644	1.34 (0.75, 2.41)	0.32
Smoking	4	48	209	114	476	0.97 (0.66, 1.44)	0.89
Neurologic							
TBI	4	82	356	134	505	0.8 (0.58, 1.1)	0.17
SAH	4	55	208	161	653	1.18 (0.82, 1.7)	0.36
ICH	5	49	168	203	791	1.11 (0.76, 1.63)	0.59
Ischemic Stroke	3	42	119	136	556	1.27 (0.66, 2.43)	0.47
Airways							
Cough	3	138	743	47	145	0.54 (0.32, 0.89)	0.016
Swallow	2	57	364	73	201	0.29 (0.15, 0.58)	0.00042
Secretions	3	68	256	111	572	1.78 (1.05, 3.02)	0.032

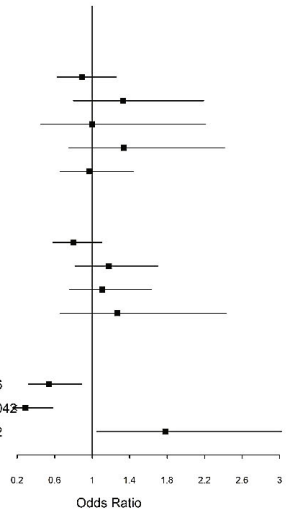
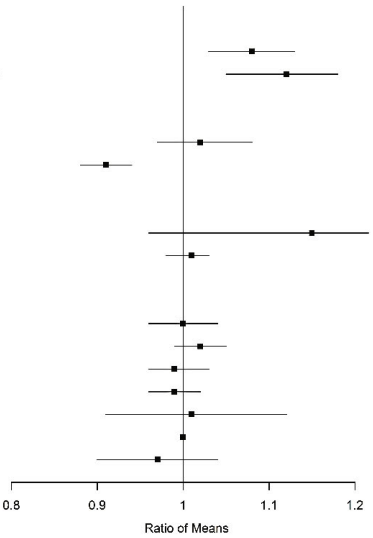


Table 2. Meta-analysis results - Ratios of means (RoM) for continuous factors

Factors	Number of Studies	Number of Failures	Number of Successes	Ratio of Means 95% CI	p-value
Demographic					
Age	10	362	1199	1.08 (1.03, 1.13)	0.0018
APACHEII	4	156	343	1.12 (1.05, 1.18)	0.00019
Neurological					
GCS Total Admission	3	155	1065	1.02 (0.97, 1.08)	0.35
GCS Total Extubation	7	278	932	0.91 (0.88, 0.94)	<0.0001
Ventilatory					
RSBI	5	169	557	1.15 (0.96, 1.37)	0.12
PEEP	2	87	180	1.01 (0.98, 1.03)	0.57
Hemodynamic/Gas Exchange					
Systolic Blood Pressure	3	96	370	1 (0.96, 1.04)	0.94
Diastolic Blood Pressure	3	96	370	1.02 (0.99, 1.05)	0.28
Heart Rate	4	127	467	0.99 (0.96, 1.03)	0.72
PaCO2	3	119	455	0.99 (0.96, 1.02)	0.36
PaO2	2	88	358	1.01 (0.91, 1.12)	0.81
ABG pH	3	119	455	1 (1, 1)	0.24
P/F Ratio	5	164	510	0.97 (0.9, 1.04)	0.33



Psychiatric Outcomes in Intensive Care Unit Patients with Family Visitation: A Population-based Retrospective Cohort Study

Moss, Stephana J.[1]; Rosgen, Brianna K.[1]; Lucini, Filipe[1]; Krewulak, Karla[1]; Soo, Andrea[1]; Patten, Scott B.[2]; Doig, Christopher J.[1]; Stelfox, Henry T.[1]; Fiest, Kirsten M.[1]

1 Department of Critical Care Medicine, University of Calgary, Calgary, AB, Canada
2 Department of Psychiatry, University of Calgary, Calgary, AB, Canada

Background: Intensive care unit (ICU) survivors are at risk for physical, cognitive, and psychiatric problems following ICU discharge.[1] Guidelines recommend in-person visitation between ICU patients and family members; family presence in the ICU is essential to ensure the well-being of critically ill patients during their ICU stay and post-discharge.[2] The effect of family visitation in the ICU on patients' post-hospital discharge psychiatric outcomes is unknown.
Objective: The objective of this study was to estimate the association between family visitation in the ICU and incidence of psychiatric outcomes in ICU patients 1-year post-hospital discharge.
Methods: Population-based retrospective cohort of adult patients admitted to one of 14 medical-surgical ICUs from January 1, 2014 to May 30, 2017 surviving to hospital discharge with an ICU length of stay ³3 days. To be eligible patients needed to have at least 5-years of administrative health data prior to ICU admission (to exclude pre-existing psychiatric disorder) and at least 1-year of follow-up data post-hospital discharge. An internally validated algorithm that interpreted natural language in the health record determined patients with or without in-person family (i.e., relatives, friends) visitation during their ICU stay.[3] The primary outcome was risk of an incidence of psychiatric disorder (composite outcome) including anxiety,[4] depressive,[5] trauma- and stressor-related,[6] psychotic,[7] and substance use disorders[7] that were identified using coding algorithms for administrative health databases. A validated coding algorithm identified people who experienced a suicide attempt or event of self-harm.[8] Propensity scores[9] were used in inverse probability weighted logistic regression models and average treatment effects were converted to risk ratios (RR) with 95% confidence intervals (95%CIs).[10] Secondary outcomes were incidences of diagnoses by type of psychiatric disorder.
Results: We included 14,344 patients with and without in-person family visitation who survived to hospital discharge. Over one-third of patients were diagnosed with incidence of any psychiatric disorder within 1-year post-discharge (34.9, 95%CI: 34.1%-35.6%). Patients were most often diagnosed with incidence of anxiety disorders (17.5%, 95%CI: 16.9%-18.1%) and incidence of depressive disorders (17.2%, 95%CI: 16.6%-17.9%); 216 patients experienced a suicide attempt or event of self-harm (1.5%, 95%CI: 1.3%-1.7%). After inverse probability weighting of 13,731 patients, in-person family visitation was associated with lower risk of being diagnosed with any incident psychiatric disorder within 1-year post-discharge (RR 0.87, 95%CI: 0.79-0.97), and mostly lower risk of a trauma- and stressor-related disorder (RR 0.66, 95%CI: 0.38-0.87).
Conclusion: Critically ill patients with in-person family visitation had decreased risk for psychiatric disorders up to 1-year after hospital discharge. Critically ill patients with family visitation also had decreased risk for trauma- and stressor-related disorders. Given the high incidence all patients, family members, and primary care physicians should be made aware of the risk and those without visitation should perhaps be identified as being at higher risk.

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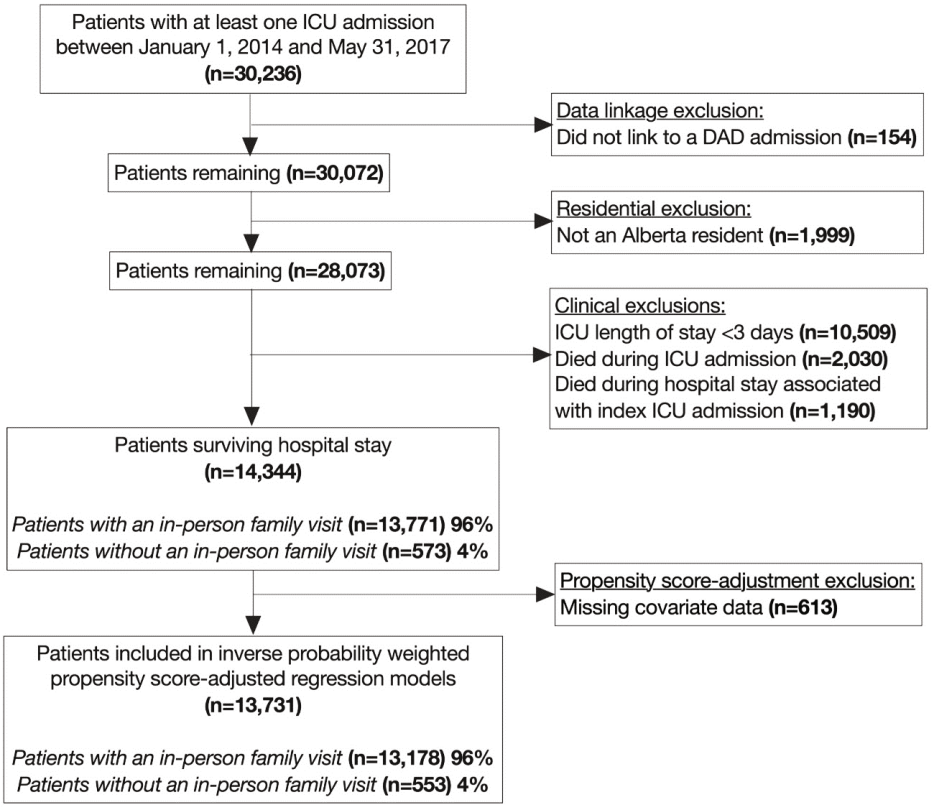

Figure 1. Study flow diagram of included participants

Abbreviations: *DAD*, discharge abstract database; *ICU*, intensive care unit; *n*, number; *LOS*, length of stay

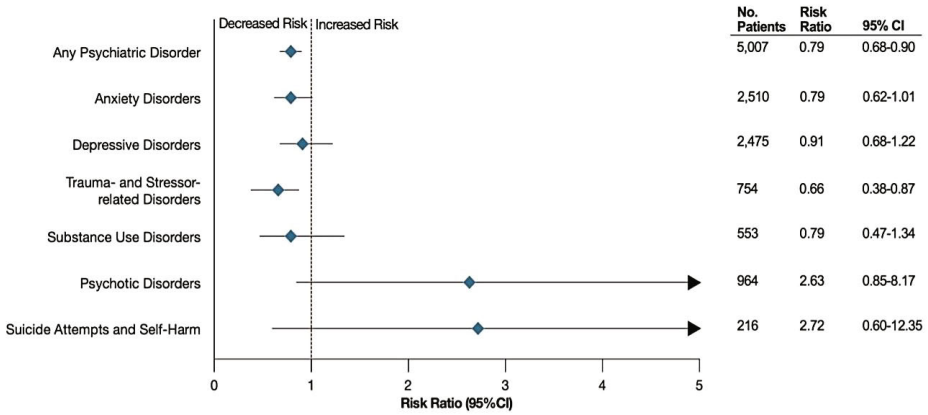

Figure 2. Risk of psychiatric disorders with in-person family visitation at any point during admission to the intensive care unit

Any psychiatric disorder denotes anxiety, depressive, trauma- and stressor-related, substance use, and psychotic disorders.

Propensity scores were based on patient age, sex, admission type (no surgery, elective surgery, emergency surgery), admission Charlson index score, admission APACHE-II and APACHE-III score, use of invasive mechanical ventilation (yes/no), use of non-invasive mechanical ventilation (yes/no), use of vasoactive medications (yes/no), use of continuous renal replacement therapy (yes/no), ICU length of stay (days), hospital type (tertiary, community, regional), and teaching hospital status (yes/no).

Propensity scores were used in inverse probability weighted logistic regression models (that reweights patients based on the propensity score to make them more representative of the population.

Abbreviations: *No.*, Number, *CI*, Confidence Interval

Quality Improvement Interventions to Prevent Unplanned Extubations in Pediatric Critical Care: A Systematic Review

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Introduction: An unplanned extubation is the uncontrolled and accidental removal of a breathing tube. The health impact of an unplanned extubation ranges from minimal to life-threatening, and is an important quality indicator in pediatric critical care.[1–3]
Objective: The objective of this review is to comprehensively synthesize literature published on quality improvement (QI) practices implemented to reduce the rate of unplanned extubations in critically ill children.
Methods: This systematic review was conducted and reported according to the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) 2020 reporting guidelines[4] and was registered on PROSPERO (CRD42021252233) prior to data extraction. A search was conducted in MEDLINE, Embase, and CINHAL from inception through April 29, 2021, and two reviewers independently screened citations in duplicate using pre-determined eligibility criteria. Data from included studies were abstracted using a tool created by the authors, and QI interventions were categorized using the Behavior Change Wheel.[5] Study quality was assessed using the Quality Improvement Minimum Quality Criteria Set (QI-MQCS).[6] Results were presented as descriptive statistics and narrative syntheses.
Results: Twelve studies were included in the final review. Ten described primary QI projects; two were sustainability studies that followed up on previously described QI interventions. Half of the included studies were rated as high-quality. The median number of QI interventions described by each study was 4.5 [IQR 4-5], with a focus on guidelines, environmental restructuring, education, training, and communication. Nine studies reported decreased unplanned extubation rates after the QI intervention; of these, six were significant ($p<0.05$). Both sustainability studies observed increased rates that were not statistically significant.
Conclusion: This review provides a comprehensive synthesis of QI interventions to reduce unplanned extubation rates. With only half the studies achieving a high-quality rating, there is room for improvement when reporting research in this area. Findings from this review can be used to support clinical recommendations to prevent unplanned extubations, positively support patient safety in pediatric critical care.

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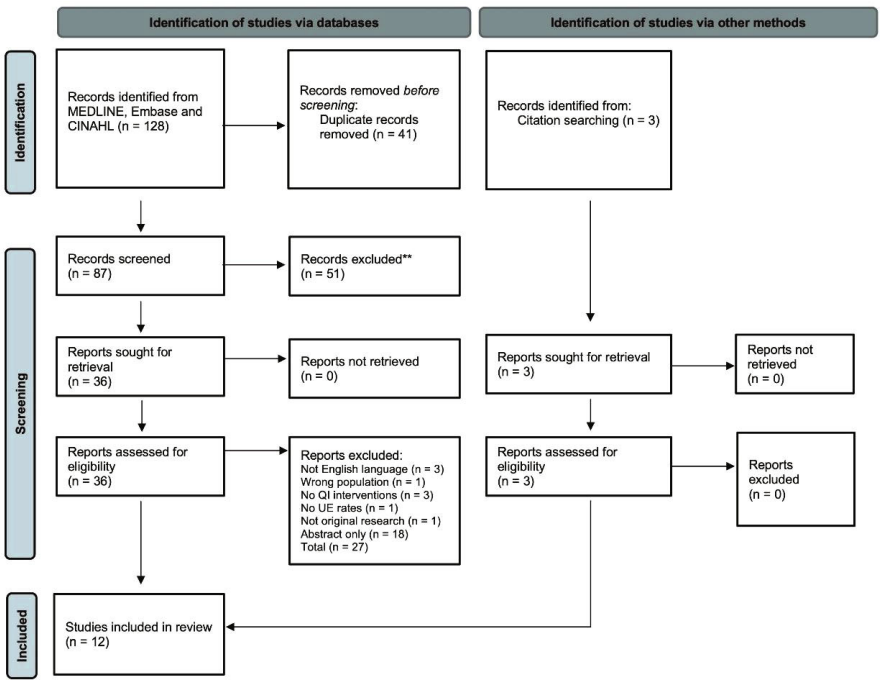
Figure 1. PRISMA 2020 Flow Diagram



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Table 1. Study Characteristics

Author	Year	Country	Unit Type(s)	Single vs. Multi-Centre	Unit Size (Bed N=)	Study Design	SQUIRE guidelines	Sustainability Study
Dechert et al.	2004	United States	PICU	Single	16	Prospective		
Popernack et al.	2004	United States	PICU	Single	NR	Prospective		
da Silva et al.	2008	Brazil	PICU	Single	5	Prospective		
Rachman et al.	2009	USA	PICU	Single	10	Prospective		
Kaufman et al.	2012	USA	PICU CICU	Single	PICU=26 CICU=16	Prospective		
Rachman et al.	2013	USA	PICU	Single	10	Prospective	✓	✓
Menon et al.	2015	Canada	PICU	Single	NR	MM		
Tripathi et al.	2015	USA	PICU	Single	20	Prospective		
Al-Abdwani et al.	2018	Canada	PICU CICU	Single	NR	Retrospective		
Kandil et al.	2018	USA	PICU	Single	19	Prospective		
Censoplano et al.	2020	USA	CICU	Single	16	Retrospective		✓
Klugman et al.	2020	USA	PICU CICU	Multi	NR	Prospective		

Table 2. QI Interventions Categorized Using the Behaviour Change Wheel

	Intervention Functions						Policy Categories					
Author (Year)	Education	Persuasion	Training	Enablement	Modeling	Environmental Restructuring	Guidelines (and description)	Environmental/ Social Planning	Communication/ Marketing	Regulation	Total (N=)	Change to UE Rate
Dechert et al. (2004)	✓					✓	✓ Vent weaning Sedation Protocol		✓		4	⇓ *
Popernack et al. (2004)						✓	✓ Sedation Algorithm				2	⇓ *
da Silva et al. (2008)	✓					✓	✓ Standardization (care) Sedation Protocol		✓		4	⇓ *
Rachman et al. (2009)	✓		✓			✓	✓ Tube fixation policy				4	⇓ *
Kaufman et al. (2012)		✓				✓	✓ Standardized handover Sedation Protocol		✓	✓	5	⇓ (PICU) ⇓ * (CICU)
Menon et al. (2015)	✓	✓	✓			✓	✓ Standardization (care) Tube fixation policy		✓		6	=
Tripathi et al. (2015)	✓		✓	✓		✓	✓ Standardization (care) Sedation				5	⇓
Al-Abdwani et al. (2018)	✓	✓	✓	✓	✓				✓		6	⇓
Kandil et al. (2018)						✓	✓ Tube fixation policy Protocol for high-risk situations	✓	✓		4	⇓
Klugman et al. (2020)	✓		✓			✓	✓ Tube fixation policy Protocol for high-risk situations		✓		5	⇓ * (PICU) = (CICU)

⇓ Decrease; = No change; * Statistically Significant at p<0.05; PICU: Pediatric Intensive Care Unit; CICU: Cardiac Intensive Care Unit
No intervention was categorized as incentivization, coercion, restrictions, legislation, service provision or fiscal measures, so these categories were left out of this table.

Readmission to the Intensive Care Unit in Nova Scotia: A Descriptive Study and Generation of a Model to Predict Patients at High Risk for Readmission

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Introduction: Readmission to the Intensive Care Unit (ICU) is defined as a return to ICU during the same hospitalization.(1) According to the Canadian Institute for Health Information, Canada's overall 48-hour ICU readmission rate was 1% in 2016(2). Canada's readmission rates are comparable internationally, with rates ranging from 1.3-13.7% in countries such as Brazil, France, Taiwan, Netherlands and Australia(1) . ICU readmission is associated with a variety of adverse outcomes including increased mortality rates, length of stay, and healthcare costs.(3-7) Determining predictors of ICU readmission may help identify patients most at risk of readmission, support protocols intended to reduce ICU readmission, thereby contributing potentially to a reduction of associated adverse outcomes.(8) In Nova Scotia (NS), there has been no research to date on predictors of ICU readmission or characteristics of patients readmitted to ICU. Closer study of ICU readmission in NS will help to inform work to reduce ICU readmissions and potentially improve outcomes.
Objectives: 1) To describe the rate of ICU readmissions in Nova Scotia. 2) To determine the impact of ICU readmission on patient outcomes. 3) To determine which variables are predictive of ICU readmission, and to generate a model to help predict which patients have the highest probability of readmission.
Methods: We conducted a retrospective review of data collected in the Nova Scotia (NS) provincial ICU database. We included all patients admitted to one of twelve adult ICUs in NS between April 1, 2018 and March 31, 2021. All data were analyzed using the statistical programming language R (R Core Team 2020).(9) Descriptive statistics on ICU readmission were generated. A linear mixed effects model was fit to examine differences in mortality based on ICU readmission. A generalized linear mixed effects model was used to predict ICU readmission from the following predictor variables identified a priori: APACHE IV predicted mortality, age, diagnosis, need for ventilation in the first 24 hours, ICU admission location, location prior to ICU admission, occurrence of delirium during ICU stay, and mobility level.
Results: A total of 12,395 patients were admitted to ICU in NS between April 2018 and March 2021, with 217 (1.75%) of these patients readmitted to ICU during their hospitalization. Readmission rates in the 12 ICUs in NS ranged from 0.40-3.94%. ICU readmission was associated with a 63.8% increase in odds of mortality (p<0.004). Higher APACHE IV predicted mortality and occurrence of delirium during ICU stay were significant predictors of ICU readmission ($p < 0.05$).
Conclusion: The current study is significant as it provides the first examination of ICU readmission in Nova Scotia. ICU readmission rates in NS are comparable to the Canadian average. ICU readmission is associated with a large increase in risk of mortality. This data strengthens the need for further study on reducing ICU readmissions and the potential effect this may have on outcomes. Our work has shown that higher APACHE IV predicted mortality as well as occurrence of delirium during ICU stay are predictors of readmission. These findings can help target future interventions to those most at risk of readmission. Future work on reducing ICU readmission should closely examine how any reduction in readmissions affects outcomes.

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Reducing Central Line Bloodstream Associated Infections in the Intensive Care Unit

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Introduction: Catheter-related blood stream infection (CR-BSI) has an average mortality rate between 4% and 20%. Central line infections (CLI) prolong hospital stay by approximately seven days, increasing cost by $3,700 to $29,000 USD. Humber River Hospital experienced an increased incidence of CLI in Intensive Care Unit (ICU) between November 2020 and February 2021. A total of five CLI cases were confirmed, with three from internal jugular central lines, and two from Peripherally Inserted Central Catheters (PICC). Practice gaps identified include noncompliance with best practices.
Objective: To reduce incidence of central line infections in the ICU patient population
Methods:

- Educational huddles conducted on central line care and maintenance
- Practice tip sheet developed
- Implemented Safer Health Now's Central Line Care and Maintenance Bundle
- Audits were conducted to monitor compliance with central line dressing and IV tubing change date
- PICC insertion observed by Infection Prevention and Control coordinator and feedback provided

Results: Through discussion, case studies, collaborative learning and the reinforcement of preventive strategies on central line care and maintenance, the ICU was able to eliminate CLI in admitted patients. Since March 2021 to September 2021, zero incidence of CLI was reported. Continuous education and support were provided to maintain best practice.

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Figure 1. Spot Audit Results

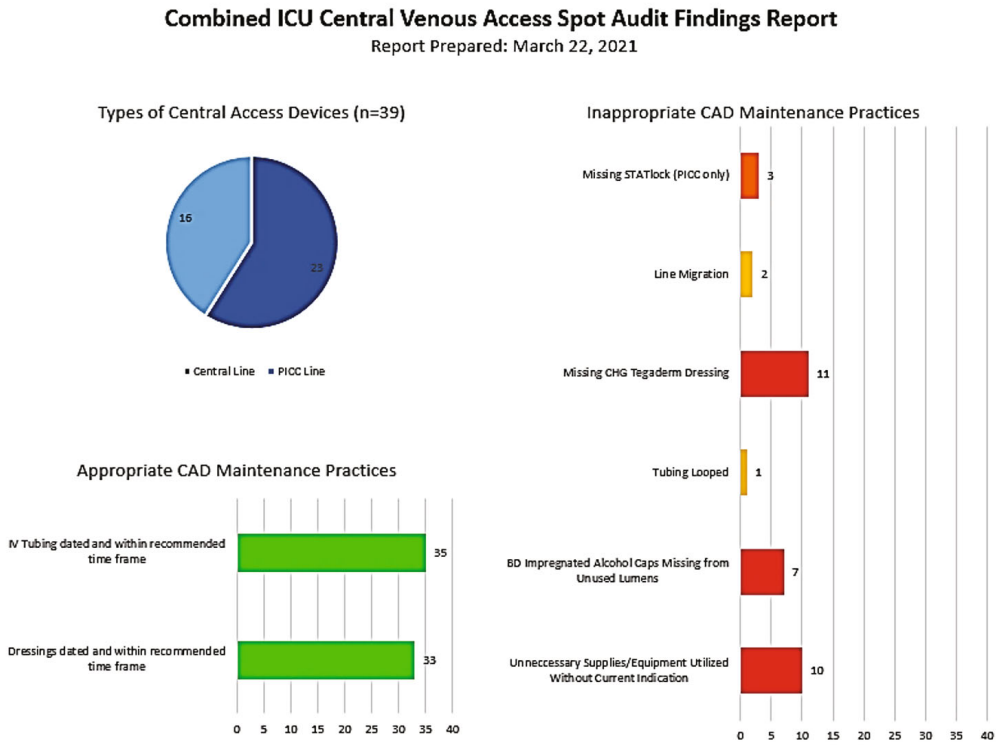

Table 1. CLI Rate

	Central Line Infection Incidents (Diagnosed after 48 hours of Critical Care Admissions)	Central Line Days	CLI Rate*	# of CLI Incidents Diagnosed within 48 hours of Admission to Critical Care Unit	# of Patients admitted with Existing CLI (Excludes same site Level 3 & Level 2 Admission Sources)	Total # of CLI Incidents
2021/Mar	0	1142	0	0	2	2
2021/Apr	0	1117	0	0	2	2
2021/May	0	1300	0	0	2	2
2021/Jun	0	929	0	0	1	1
2021/Jul	0	946	0	0	0	0
2021/Aug	0	436	0	0	1	1

*CLI Rate: (Number of CLI Incidents Diagnosed after 48 hours of Critical Care Admissions / Number of Central Line Days) x 1000
Note: Incidents diagnosed within the first 48 hours of admission to a Critical Care Unit are not included in the calculated rates.

Table 2. Central Line Bundle

Central Line Bundle	
Insertion Bundle	**Care Bundle**
1. Hand Hygiene 2. Maximal Barrier Precautions 3. Chlorhexidine Skin Antisepsis 4. Optimal Catheter Type and Site Selection Avoid the femoral vein in adults; subclavian preferred to minimize infection risk	1. Daily review of line necessity, with prompt removal of unnecessary lines 2. Aseptic lumen access 3. Catheter site and tubing care

Relationship Between Followership Type and Burnout Amongst Followers Within the Critical Care Setting - A Pilot Study

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Introduction: Healthcare teams are made up of both leaders and followers. Followers make up the majority of the healthcare team and greatly influence the quality of care each patient receives. There are five followership styles which have been described by Kelly based on critical thinking and active engagement. Followership type may prove to be correlated with burnout syndrome, which occurs when an imbalance is created between personal characteristics of the health care worker and the work-related issues and organizational factors.
Objective: We aim to explore if a relationship exists between followership style and burnout as well as followership style and job satisfaction of followers within the critical care setting. Additionally, we aim to quantify the distribution of followership types amongst followers within the critical care setting.
Methods: A total of 64 participants (27 residents and 37 critical care nurses) participated in a single centered, cross sectional survey. A four-part survey was completed by each participant to classify the participant's followership type (Kelly followership type), burnout (Maslach Burnout Inventory) and job satisfaction (Brayfiled-Rothe Survey and Work and Meaning Inventory). Correlations between followership type and burnout as well as followership type and job satisfaction were then determined.
Results: There was a weak to moderate correlation between independent critical thinking and personal accomplishment (R=0.297), and moderate correlation to meaningful work (R=0.390), and job satisfaction (R=-0.300). Active engagement was moderately correlated with personal accomplishment (R=0.302), meaningful work (R=0.448) and job satisfaction (R=-0.418). Neither independent critical thinking nor active engagement showed significant correlation with depersonalization and emotional exhaustion subscales (Tables 1,2). The majority of both residents and nurses were characterized into effective/exemplary followership type with no statistically significant differences between these groups (Tables 1,3).
Conclusion: Understanding the followership type of healthcare providers is an important first step in fostering enhanced team dynamics. This research shows that by creating an environment which promotes critical thinking and active engagement, nurses and residents may display less burnout, and enhanced job satisfaction.

Table 1. Survey results regarding fellowship style, job satisfaction and burnout

	Overall		Nurses (n=37)		Residents (n=27)		Nurse vs Resident
	Mean Score	Standard deviation	Mean Score	Standard deviation	Mean Score	Standard deviation	T-test
Followership style							
Active engagement	39.21	10.02	40.59	7.19	40.30	7.57	0.875
Critical thinking	37.12	9.78	39.15	6.92	37.65	7.59	0.421
Job Satisfaction							
Brayfield-Rothe Score	77.03	5.98	78.07	6.13	76.27	5.83	0.236
WMI[A]	36.31	5.09	36.33	5.49	36.30	4.85	0.978
Burnout							
Depersonalization	1.52	1.03	1.84	1.07	1.28	0.94	**0.029***
Personal Accomplishment	4.69	0.66	4.78	0.68	4.63	0.64	0.383
Emotional Exhaustion	2.10	1.15	2.28	1.18	1.97	1.13	0.285

[A]WMI=Work and meaning inventory
*Reaches statistical significance

Table 2. Correlational data between fellowship type components and subscales of burnout and meaningful work

Variables	Correlation	Significance
Critical thinking x Brayfield-Rothe Score	0.418	*p=0.001*
Critical thinking x WMI[A]	0.390	*p=0.001*
Critical thinking x Depersonalization	-0.053	*p=0.676*
Critical thinking x Personal accomplishment	0.297	*p=0.017*
Critical thinking x emotional exhaustion	-0.092	*p=0.470*
Active engagement x Brayfield-Rothe Score	0.300	*p=0.006*
Active engagement x WMI[A]	0.448	*p=0.000*
Active engagement x Depersonalization	-0.162	*p=0.201*
Active engagement x Personal accomplishment	0.302	*p=0.015*
Active engagement x emotional exhaustion	-0.037	*p=0.769*

[A]WMI= Work and Meaning Inventory

Table 3. Distribution of fellowship type across each participant subgroup represented as percentage of participants within each subgroup

	Pragmatic	Alienated	Passive	Conformists	Effective/exemplary
Junior residents (n=19)	31.7%	0%	5.2%	5.3%	57.8%
Senior Residents (n=8)	37.54%	0%	0%	0%	62.5%
Nurses (n=37)	35.1%	0%	2.7%	2.7%	59.5%

* T-test shows no significant difference between participant groups

Renal Perfusion Evaluation with Doppler Ultrasonography in Patients with Severe COVID-19

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Introduction: Significant proportion of patients with severe coronavirus disease 2019 (COVID-19) developed hypoxemic respiratory failure and requiring invasive mechanical ventilation. Both hypoxia and mechanical ventilation affect renal perfusion.
Aim: To assess renal perfusion by means Doppler ultrasonography in patients with severe COVID-19 on mechanical ventilation.
Methods: This study was conducted among patients with hypoxemic respiratory failure due COVID-19 without kidney disease prior ICU admission in a Brazilian intensive care unit. We assessed renal perfusion by using resistive index and color-Doppler semi-quantitative evaluation during first 24h of mechanical ventilation. Renal resistive index is normally lower than 0.70. Semiquantitative color-Doppler scale for evaluating intrarenal perfusion: 0, absence of renal perfusion; 1, few vessels visible in the vicinity of the hilum; 2, hilar and interlobar vessels visible in most of the renal parenchyma; 3, renal vessels identifiable until the arcuate arteries in the entire field of view.
Results: Fifteen patients (10 male; mean age, 62,2 years; 8 were died) with severe COVID-19 were assessed during first 24h of mechanical ventilation which mean PaO2 / FiO2 ratio was 183,3. All patients received tidal volume < 6 mL/kg predicted body weight and mean driving pressure was 11,06. Five patients had AKI stage 1 and no one had AKI stage 2 or 3. Seven patients had renal resistive index higher than 0.7 and eight patients had grade 1 of semiquantitative color-Doppler scale.
Conclusions: This study showed impairment of renal perfusion in critically ill patients with COVID-19 during first 24h of mechanical ventilation.

Representation of Black People in Critical Care Randomized Control Trials – A Systematic Review

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Introduction/Background: Randomized Controlled trials (RCTs) are the gold standard when it comes to examining the efficacy and safety of ICU interventions. The underrepresentation of certain populations within RCTs limits the generalizability of findings. In Canada and the US, Black people disproportionately require intensive care and rates of stroke and sepsis are higher in Black populations than in non-Black populations. Thus, it is crucial to ensure adequate representation of Black participants in critical care RCTs.
Objectives: The objective of this systematic review is to investigate the proportionate representation of Black people enrolled at Canadian and US study sites from major critical care RCTs published in the last 5 years.
Methods: We performed a search of critical care RCTs published in 3 major general medicine journals (JAMA, NEJM, Lancet) and 4 ICU journals (Critical Care Medicine, Intensive Care Medicine, American Journal of Respiratory and CHEST) between January 1, 2016 and December 31, 2020. We included RCTs that enrolled critically ill adults (>16 years) at US or Canadian sites, and provided a breakdown of racial demographic data by study site. For studies with multiple international sites, we only included the Canadian and US sites in the analysis. We contacted study authors of potentially eligible studies if the necessary race-based was unavailable. Two reviewers screened all citations in two stages and extracted data independently and in duplicate. We describe results narratively and compare study-based demographics to publicly available city-based demographics (using US Census and StatsCan). We pooled representation of Black people across studies, cities and centers using a random effect model and used meta-regression to explore the impact of certain variables (country, drug intervention, consent model, multicentre vs single centre, industry funding and year of publication) on Black representation.
Results: Of 737 citations, we included 21 RCTs that examined a number of different ICU interventions. Of the included studies, 9.5% (2/21) consisted of solely Canadian sites, 81.0% (17/21) consisted of solely American sites, and 9.5% consisted of both; 42.9% (9/21) of the studies were single centre while 57.1% (12/21) of the studies were multicentre trials. Pooled across all studies, Black people were underrepresented in critical care RCTs by 6% compared to population-based city demographics (95% confidence interval [CI]: 1 to 11%) and underrepresented in 17 of the 21 included studies. Meta-regression showed that US-based sites underrepresented Black people more than Canadian sites (6% in US studies, 4% in Canadian studies, subgroup effect p=0.02). There were no other subgroup effects demonstrated.
Conclusion: The findings of this systematic review suggest that Black people are

underrepresented in critical care RCTs compared to city-based demographics. The lack of adequate representation in these RCTs may be a crucial factor contributing to the disproportionate adverse health outcomes among Black people. Ultimately, the results of this study illustrate the need for action from both Canadian and American researchers to ensure more equal representation to maximize the quality and generalizability of healthcare delivery. Further research is needed to investigate the full extent of Black underrepresentation in critical care trials and to identify other contributing factors.

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Sacrifice and Solidarity: Family Experiences of Death and Bereavement During the Pandemic

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Introduction: Pandemic-related restrictions are expected to continue to shape end-of-life care and impact the experiences of dying hospitalized patients and their families.
Objective: To understand families' experiences of loss and bereavement during and after the death of their loved one amidst the SARS-CoV-2 (COVID-19) pandemic.
Methods: In this qualitative study, family members of 28 hospitalized patients who died between March and July 2020 were interviewed. Patients and families were enrolled from three acute care units in a Canadian tertiary care hospital. Qualitative semi-structured interviews inquired about family experiences before and beyond the death of their loved one, and garnered suggestions to improve end-of-life care. Data collection and analysis used a qualitative descriptive approach to conventional content analysis.
Results: Pandemic restrictions had consequences for families of dying hospitalized patients. Most family members described an attitude of acquiescence, some framing their experience as a sacrifice made for the public good. Families appreciated how clinicians engendered trust in the name of social solidarity as they attempted to mitigate the negative impact of family separation. However, fears about the patient's experience of isolation and changes to post-mortem rituals also created despair and contributed to long-lasting grief.
Conclusion: Profound loss and enduring grief were described by family members whose final connections to their loved one were constrained by pandemic-related restrictions. Families observed solidarity among clinical staff, and sense of unity with staff, which alleviated some distress. Improvements to end-of-life care under these circumstances may include frequent communications, exceptions for family presence when safe, and targeted efforts to connect patients whose isolation is intensified by functional impairment or limited technologic access.

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Serum Sodium Behaviour During the Recovery of Renal Function in Critically Ill Adult Patients: Multicenter Prospective Cohort Study

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Introduction: An increase in plasma sodium (Na) during the recovery of acute kidney injury (AKI) has been described among critically ill patients. Both hypernatremia (HPNa, defined as Na ≥145 mEq/L) and a positive fluid balance, which may result from free water used to treat HPNa, are associated with increased morbidity and mortality.
Objectives: The objective of this study was to evaluate the association between daily fluid balance and daily PNa during the recovery phase of AKI among critically ill patients. As secondary objectives, we described the incidence and risk factors for Na increases and HPNa.
Methods: Eligible patients (>18 years old with AKI at or following intensive care unit [ICU] admission) were consecutively enrolled from four mixed medical-surgical ICUs from Buenos Aires, Argentina (March 2019-February 2020). AKI was defined according to KDIGO guidelines. Exclusion criteria comprised conditions associated with specific objectives for fluid or sodium management: chronic kidney disease (CKD), pregnancy, burns, open abdomen, central nervous system pathology, and acute or chronic treatment with antidiuretic hormone or analogues. Day zero was defined as the peak day of creatinine; patients were followed up for 4 days or until ICU discharge or initiation of renal replacement therapy, whichever came first. The main outcome was daily Na, and the main exposure was daily fluid balance (fluid intake-urine output). Demographic characteristics, baseline severity of illness, and daily creatinine, urea, and potassium were recorded. To estimate the effect of daily fluid balance on daily Na, we fitted a general estimating equations (GEE) model with an autoregressive correlation structure and robust standard errors; this model generated beta-coefficients with 95% confidence intervals (CIs). Multivariable logistic regression was used to identify risk factors associated with HPNa, expressed as odds ratios (ORs) with 95%CI.
Results: 93 patients were included, with median age 66 years (IQR 54.5–78); 63 (67.8%) were male. 73 patients (78.5%) completed the 4-day follow-up period. Among 20 patients who did not complete follow-up, 18 (19.4%) were discharged from ICU, 1 (1.1%) died and 1 (1.1%) required renal replacement therapy. The mean APACHEII score at ICU admission was 17.7 (SD 7.3) and ICU mortality was 11/93 (12.5%; Table 1). 81 patients (87.1%) had an elevation of Na during AKI recovery, and 50 patients (53.7%) had a Na ≥145 mEq/L. Over the follow-up period, the mean daily fluid balance was +0.70 L (SD 1.65), the median daily fluid intake was 2.80 L (IQR 2.15–3.78), the median daily diuresis was 2.00 L (IQR 1.40-2.90). We found no significant effect of daily fluid balance, fluid intake, or urine output on daily Na (Table 2). The development of HPNa was independently associated with Na at day zero (OR 1.36, 95%CI 1.17 – 1.57; p <0.001) and urea at day zero (OR 1.02, 95%CI 1.01 – 1.03; p=0.045), but was

not associated with cumulative fluid balance (over 4 days), APACHEII, age or sex.
Conclusions: Na increase, including to ≥145 mEq/L, is common during recovery of AKI. Fluid and sodium intake seem to have no impact on Na during this phase. Although we did not directly measure free wáter administration, the lack of association between fluid intake and Na suggests that free water may have no effect on Na during AKI recovery.

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Table 1. Study population baseline characteristics.

Baseline characteristics	**N = 93**
Age – years (median, IQR)	66 (54.5–78)
Male – n (%)	63 (67.7)
APACHEII at admission (mean, SD)	17.7 (7.3)
Mortality – n (%)	11/93 (12.5)
Creatinine, day 0 – mmol/L (mean, SD)	196 (86)
Urea, day 0 – mmol/L (mean, SD)	35 (18)
Sodium, day 0 – mEq/L (mean, SD)	139 (6)
AKI etiology – n (%): Sepsis Shock Post surgical Nephrotoxic agents Trauma IV contrast Obstructive Others	 44 (47.3) 22 (23.6) 8 (8.6) 8 (8.6) 5 (5.4) 1 (1.1) 0 4 (4.4)

Table 2. Univariate analyse of predictors of daily sodium (beta-coefficients) and of hypernatremia (odds ratios).

Predictor	Mean change in daily sodium	*p* value
Daily fluid balance (per 1 L)	-0.19 (-0.45 – +0.07)	0.156
Daily fluid intake (per 1 L)	0.06 (-0.39 – 0.27)	0.714
Daily urine output (per 1 L)	0.16 (-0.06 – 0.39)	0.151
Time (per day)	1.60 (1.15 – 2.06)	<0.001
	Hypernatremia	
Sodium, day 0 (per 1 mEq/L)	1.36 (1.17 – 1.57)	<0.001
Urea, day 0 (per mmol/L)	1.04 (1.01 – 1.09)	0.045

Strengthening a Commitment to Support Learners: A Critical Care Workforce Strategy During COVID-19 Pandemic

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Introduction: While the Intensive Care Unit (ICU) often experiences staffing challenges, the COVID-19 pandemic exacerbated the situation when occupancy rates skyrocketed to 95%. A workforce planning strategy focused on deploying alternative care providers (ACPs) was implemented to optimize staffing ratios and meet capacity demands. ACPs consisted of redeployed medicine nurses or student learners, who were provided educational support and supervision to ensure safe patient care and role clarity. In parallel, participant engagement centered around maximizing the learning potential of the ACPs to build competency, while ICU staff served as preceptors to support the integration of ACPs into the ICU.
Objective: To engage alternate care providers through educational opportunities to support the ICU workforce
Methods:

- Collaborated with Professional Practice to ensure role clarity for ACPs by considering their unique knowledge, skill, and competency levels
- Provided individualized learning packages to ACPs and ICU preceptors to facilitate learning and transition into the ICU team
- Surveyed ACPs on the effectiveness of this integrative workforce strategy

Results: By focusing on education and engagement in the ICU workforce, the burden exerted on the ICU was reduced. Survey results revealed that 82.75% of ACPs reported positive experiences, with an additional 75.86% of ACPs indicating an interest in pursuing a career in Critical Care Nursing.

Figure 1. Distribution of ACP Roles

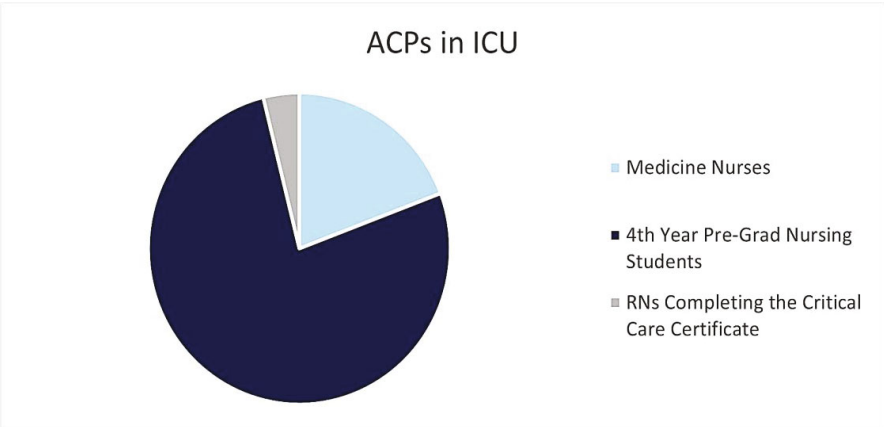
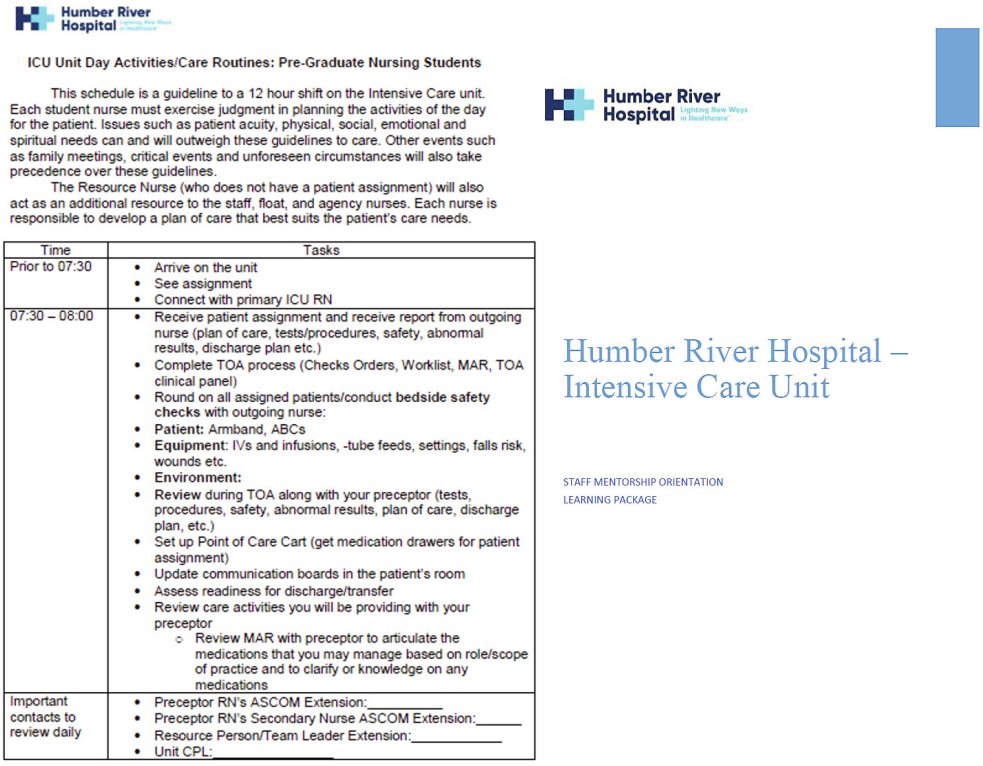


Figure 2. A consolidative resource package was designed for ACPs to standardize their role in the ICU workforce (left). Similarly, an ICU Staff Mentorship Orientation Learning Package was developed to guide ICU preceptors when facilitating learning for ACPs (right).



Humber River Hospital

ICU Unit Day Activities/Care Routines: Pre-Graduate Nursing Students

This schedule is a guideline to a 12 hour shift on the Intensive Care unit. Each student nurse must exercise judgment in planning the activities of the day for the patient. Issues such as patient acuity, physical, social, emotional and spiritual needs can and will outweigh these guidelines to care. Other events such as family meetings, critical events and unforeseen circumstances will also take precedence over these guidelines.

The Resource Nurse (who does not have a patient assignment) will also act as an additional resource to the staff, float, and agency nurses. Each nurse is responsible to develop a plan of care that best suits the patient's care needs.

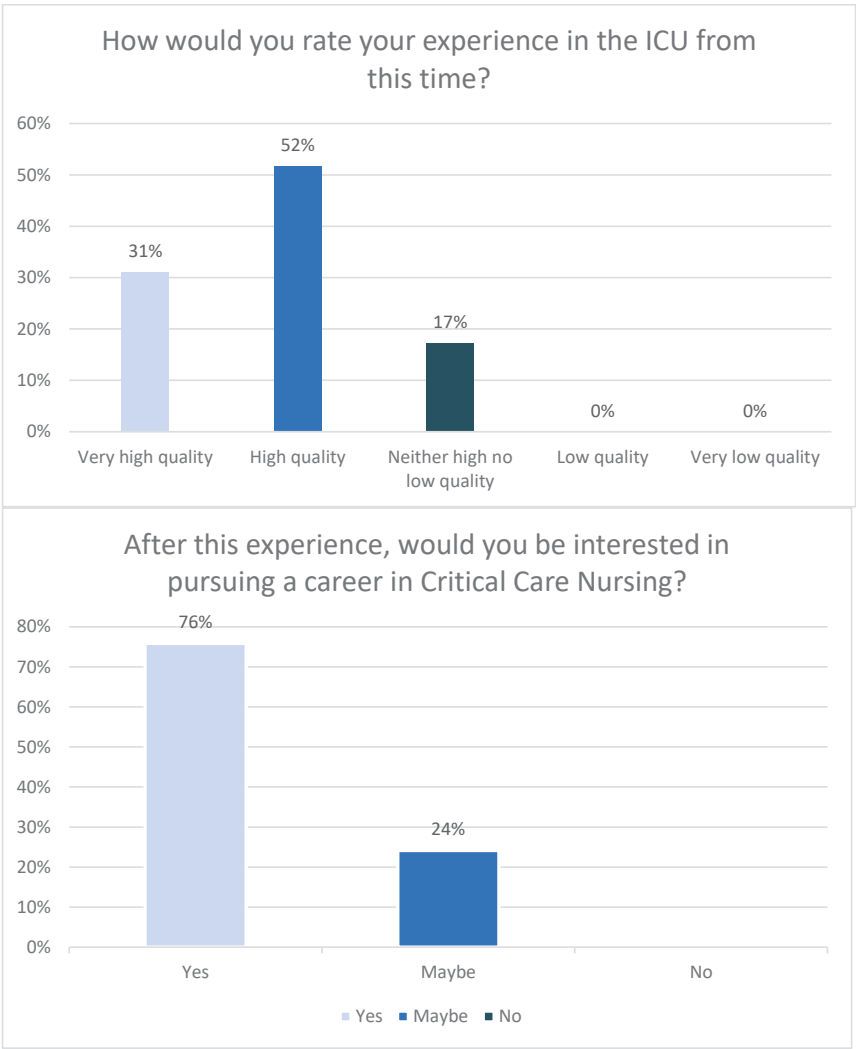
Time	Tasks
Prior to 07:30	• Arrive on the unit • See assignment • Connect with primary ICU RN
07:30 – 08:00	• Receive patient assignment and receive report from outgoing nurse (plan of care, tests/procedures, safety, abnormal results, discharge plan etc.) • Complete TOA process (Checks Orders, Worklist, MAR, TOA clinical panel) • Round on all assigned patients/conduct **bedside safety checks** with outgoing nurse: • **Patient:** Armband, ABCs • **Equipment:** IVs and infusions, -tube feeds, settings, falls risk, wounds etc. • **Environment:** • **Review** during TOA along with your preceptor (tests, procedures, safety, abnormal results, plan of care, discharge plan, etc.) • Set up Point of Care Cart (get medication drawers for patient assignment) • Update communication boards in the patient's room • Assess readiness for discharge/transfer • Review care activities you will be providing with your preceptor ○ Review MAR with preceptor to articulate the medications that you may manage based on role/scope of practice and to clarify or knowledge on any medications
Important contacts to review daily	• Preceptor RN's ASCOM Extension:_____ • Preceptor RN's Secondary Nurse ASCOM Extension:_____ • Resource Person/Team Leader Extension:_____ • Unit CPL:_____

Humber River Hospital

Humber River Hospital – Intensive Care Unit

STAFF MENTORSHIP ORIENTATION
LEARNING PACKAGE

Figure 3. Evaluation Survey Results



The "CanoPPE" as a Novel Barrier Enclosure for Individual Airborne Isolation: From Prototyping to Clinical Applications

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Background and Objective: Different aerosol barrier enclosure systems to protect healthcare workers from airborne contaminants have been recently designed but their efficacy and safety have been questioned. The CanoPPE is a novel system with improved ergonomics and a negative pressure suctioning system to minimize dispersion risks. We tested the efficacy of retaining aerosolized particles and the safety of this device in bench, healthy volunteer, and initial clinical studies.
Methods: A manikin with an airway connected to a breathing simulator was placed inside the CanoPPE. Negative pressure inside the device was applied using vacuum wall suction. With this configuration, we simulated active breathing, cough, fluorescent microparticle aerosolization (Glo Germ Oil - 0.1 to 20μm), and carbon dioxide (CO_2) production (6L/min, 5% CO_2). High-flow nasal cannula (HFNC) therapy was applied inside the CanoPPE at flow rates of 30 and 60L/min. Furthermore, CanoPPE was assessed for leakage in an airtight aerosol chamber. Latex aerosol microparticles (0.12μm) were introduced into CanoPPE while HFNC at 60L/min and a suction of 80L/min was applied; particle counts were measured at regular intervals from air sampled inside and around the CanoPPE. CanoPPE was also tested on healthy volunteers breathing spontaneously. Last, we tested the feasibility of five intubation procedures in elective surgical cases.
Results: The design of the CanoPPE was originally adjusted until no fluorescent particles were visualized in the surrounding area illuminated by ultraviolet light. The efficacy of the device in retaining microparticles was confirmed quantitatively in a controlled environment by the absence of leakage from the CanoPPE. CO_2 accumulation inside the CanoPPE showed an inverse correlation with the suction flow rate in all conditions tested (normal breathing and HFNC 30 or 60L/min) in both the bench and the healthy volunteer studies. Particle removal efficacy and safety environmental conditions in terms of CO_2, temperature and humidity were achieved when the suction flow rate was set at a minimum of 60L/min or at least 20L/min above the HFNC set flow. Five patients were successfully intubated in the operating room without ergonomic difficulty.
Conclusion: Unlike other enclosure barrier devices, the efficacy and safety of the CanoPPE were confirmed by several tests from prototyping to initial clinical application.

Our results support its reliability for clinical use and demonstrate its dependency on the negative pressure system. The suction flow rate must be set at a minimum of 60L/min or 20L/min higher than the HFNC flow rate to ensure healthcare workers and patient safety. Our promising results suggest that the CanoPPE is an additional barrier against airborne transmission.

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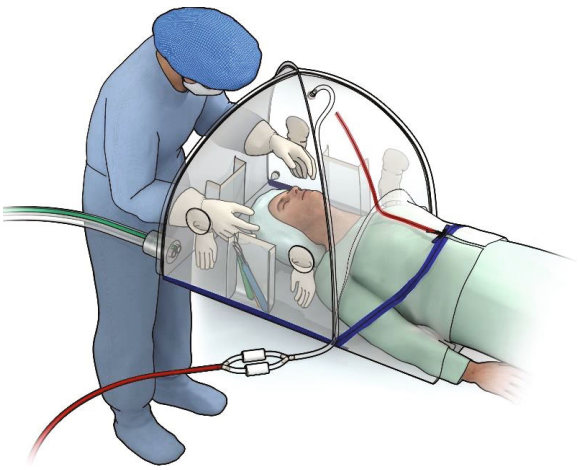
Figure 1. The “CanoPPE”



The Association of Corticosteroids and PERSEVERE II Biomarker Risk Stratification with Mortality in Pediatric Septic Shock

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Introduction: Sepsis remains a leading cause of worldwide morbidity and mortality in children. Corticosteroids are a controversial treatment of septic shock with unclear efficacy in children and sigificant side effects. Mortality risk stratification may identify a subset of patients who benefit from or be harmed by corticosteroid administration. We have previously developed and validated the PERSEVERE-II score, a biomarker-based mortality risk stratification tool for pediatric sepsis.
Objectives: To determine the effect of corticosteroid administration on 28-day mortality within level of baseline mortality risk score (PERSEVERE II) in a cohort of children with septic shock.
Methods: We performed a secondary analysis using prospectively collected data (December 2014-March 2019) of an observational cohort of children with septic shock from 13 centres in the United States of America. All healthcare providers and caregivers were blinded to PERSEVERE-II scores. Our analysis included logistic regression (outcomes 28-day mortality, complicated course), inverse-probability treatment weighting (outcome 28-day mortality), survival analysis (outcome ICU-free days) and linear regression (outcome maximum failed organs). We defined complicated course as a death by 28 days or at least two failing organs on day 7 of septic shock.
Results: A total of 461 patients were included in analysis (215 corticosteroids exposure, 246 no corticosteroid exposure) with an average age of 7.1 years (IQR 2.2, 13.6). In the subgroup of patients with a high PERSEVERE II score, corticosteroid administration was associated with an increased adjusted risk of 28-day mortality (OR 4.28 (1.77-10.33), p=0.001), but not in the low risk group (OR 0.14 (0.01-1.37), p = 0.09). A significant interaction between PERSEVERE II score and corticosteroids was seen for both secondary outcomes complicated course (p=0.01) and maximum failed organs (p<0.001). Corticosteroid exposure was associated with less ICU-free days (p<0.0001).
Conclusions:
In our multicentre observational study, corticosteroid administration was associated with increased mortality in a subgroup of children with a high PERSEVERE-II score.

The Diagnostic and Prognostic Utility of Protein C as a Biomarker for Adult Sepsis: A Systematic Review and Meta-Analysis

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Introduction: Sepsis diagnosis and mortality risk-assessment remains challenging due to the heterogenous presentation of the disease. Identification of a biomarker involved in multiple sepsis physiological pathways can improve diagnostic or prognostic evaluation. Protein C's activity as an anticoagulant and anti-inflammatory molecule makes it an appealing target for sepsis biomarker studies. To date, no study has synthesized sepsis biomarker literature on Protein C (PC).
Objectives: Our study had two main objectives:

1. Evaluate the diagnostic accuracy of PC for adult sepsis
    a. Evaluate the diagnostic accuracy of PC for sepsis-induced disseminated intravascular coagulation (DIC)
2. Assess the prognostic strength of PC for sepsis-related mortality

Methods: We searched, from inception to January 12th, 2020, Ovid MEDLINE, EMBASE, PubMed, Cochrane Library and CINAHL. Two reviewers, independently and in duplicate, screened articles to identify eligible studies. Our patient population consisted of adults with sepsis as defined by the sepsis international consensus definitions, or suspicion of sepsis. Prospective observational studies measuring PC levels within 24 hours of sepsis presentation were included. Independently and in duplicate, we performed data abstraction, risk of bias (RoB) assessment using the QUADAS-2 and QUIPS tools, and certainty assessment using GRADE. We performed meta-analyses using fixed or random effects models depending on between-study heterogeneity. Sensitivity analysis was conducted for our prognostic outcome by removing high RoB studies, and sub-group analysis was used to evaluate 28-day sepsis-related mortality.
Results: We identified 12 studies that met the inclusion criteria for the systematic review, and 8 were synthesized for meta-analysis (see references and Figure 1 & 2). Three studies examined the diagnostic outcome, 3 examined the prognostic outcome, and 6 examined both outcomes. Data could not be synthesized on our primary diagnostic outcome due to the heterogeneity of the control groups in each study. Pooled analysis (**Figure 1)** demonstrates moderate certainty evidence of difference in PC levels between sepsis survivors and non-survivors (SMD 0.53, 95% CI 0.25-0.81, p=0.0002, I^2=55%). Heterogeneity was reduced in our subgroup (SMD 0.44, 95% CI 0.26-0.61, p<.00001, I^2= 0%) and sensitivity (SMD 0.44 95% CI 0.25-0.62, p<0.0001, I^2=0%) analyses. Pooled analysis (**Figure 2)** also demonstrated low certainty evidence of difference in PC levels between septic patients with and without DIC (SMD 0.83, 95% CI 0.66-1.00, p<0.00001, I^2=20%). Our findings are limited by high RoB in studies due to missing information on patient selection, insufficient data reporting, and unexplained missing patient biomarker samples.
Conclusions: We demonstrate that PC can be used as a tool to distinguish patients with worsening severity of sepsis and those at risk for mortality. However, we were unable to assess PC as an early diagnostic tool due to limited available literature. We

were also limited by a lack of the quality reporting in the included studies and a lack of sensitivity & specificity data to explain PC utility in clinical practice. Overall, our results provide a rationale for future robust biomarker studies evaluating PC's use as a biomarker for early sepsis detection and routine use in sepsis prognosis.

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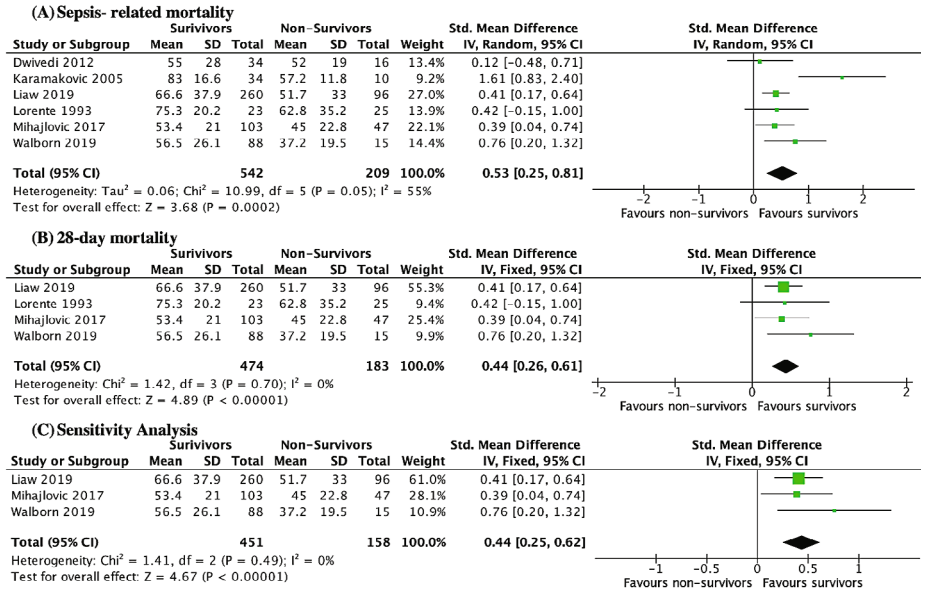

Figure 1: Forest plots of standardized mean difference (SMD) in PC biomarker measurements in survivors vs. non-survivors. Standardized mean difference (SMD) estimate favouring survivors indicates that normal PC levels favour survival in sepsis patients. (A) SMD of PC levels in septic survivors vs. non-survivors. (B) SMD of PC in survivors vs. non-survivors for 28-day mortality. (C) Sensitivity analysis conducted by removing high RoB studies.

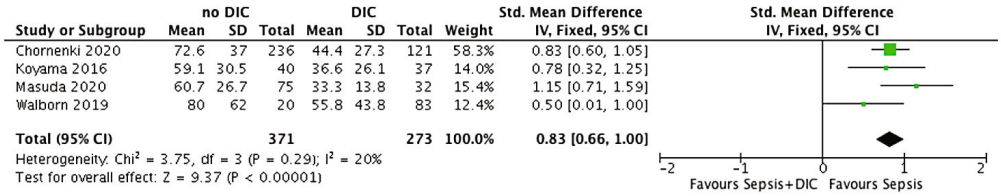

Figure 2: Forest plots of standardized mean difference (SMD) in PC biomarker measurements in septic patients with and without DIC. SMD estimate favouring septic patients indicates that normal PC levels favour patients without sepsis induced DIC.

The Effectiveness of Inferior Vena Cava Filters among Patients with Femur Fractures

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Introduction: The patients with femur fractures are vulnerable for thrombosis such as deep venous thrombosis (DVT) and pulmonary embolism (PE). The evidence supported that using IVC filters reduce these risks.
Objective: This study aims to assess the effectiveness of IVC filters in preventing PE.
Methods: This is a descriptive comparative study. The included patients were followed for development of pulmonary embolism and death among patients with IVC filters inserted 45 (64.3%) and those without IVC filters 25 (35.7%). The study was conducted in Althora Hospital, Taiz in Yemen between January 2020 and November 2020 among 70 patients with femur fractures. All patients were admitted to intensive care unit (ICU) with femur fractures. The convenience sampling technique was used. Data was analyzed by SPSS.
Results: The 70 admitted patients to the ICU during study period. The mean patients' age was 41±21 years old and they were both males (64.3%) females (35.7%). The cause of trauma was varied: Motorcycle accidents 42.8%, Occupational injuries 28.6%, Fall from height 14.3%, and Gunshot 14.3%. The type of fractures was only femur fracture among all patients. Among first group with IVC filters 45 (64.3%) were with only two reported pulmonary embolisms (4.4%), (p=0.001). Among another group 25 (35.7%) without IVF, patients the PE was reported in 4 (16%), (p=0.08).
Conclusion: The insertion of IVC filter among patients with femur fractures significantly decrease the risks of developing PE.

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The Optimal PEEP Study: Lung Collapse Versus Lung Overdistension – Preliminary Results

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Introduction: Selecting the level of Positive End-Expiratory Pressure (PEEP) in patients with Acute Respiratory Distress Syndrome (ARDS) is a challenge in clinical practice, and numerous approaches have been proposed. An individualized approach is to set the PEEP in the crossing point between the relative lung collapse and relative overdistension, assuming an association with the best transpulmonary pressure. However, we still do not know if both phenomena are equally harmful, since some studies have suggested that to prevent overdistention is more important than to prevent collapse.
Objective: To address the impact of setting PEEP based on the crossing point of collapse and overdistension, compared to PEEP set at low collapse (high PEEP) and PEEP set at low overdistension (low PEEP), on the lung inflammation, respiratory function and hemodynamics, during long-term mechanical ventilation in ARDS.
Methods: This was an experimental randomized controlled study in a porcine ARDS model. We used Electrical Impedance Tomography (EIT) to measure relative lung collapse and overdistension. After lung injury, the pigs were randomized in one of three intervention groups: low overdistension group, the pig is ventilated with PEEP set at 0-3% of overdistension; the crossing point group, PEEP set at the crossing point of collapse and overdistension; or low collapse group, PEEP set at 0-3% of collapse. The pigs were ventilated for 12 hours with the randomized PEEP. We collect blood samples and respiratory and hemodynamics variables, including esophageal pressure, EIT measurements, cardiac output and pulmonary arterial pressure, every three hours. At the end of the protocol, we also do biological and histological analysis. For comparisons between groups, we used One-way ANOVA, and for comparisons between group with repeated measures, we used Mixed ANOVA. We used Bonferroni correction for post hoc analysis.
Preliminary results: Thirty-six pigs were included in this study, 12 per group. All pigs had severe lung injury, with a mean PaO_2/FiO_2 of 113±68 and a mean respiratory system compliance of 13±2 mL/cmH_2O at the baseline. Median and Interquartile Range (IQR) PEEP were 7 (6-8) for the low overdistension group, 11 (10-11) for the crossing point group, and 15 (12-16) for the low collapse group, $p<0.001$. Six pigs died in the low overdistention group (50%), before 12 hours of MV. Tidal volume per weight was not different between groups, median 6 (6-8) ml/kg ($p=0.113$), but the driving pressure was higher during the entire protocol in the low overdistension group, mean of 20±7cmH_2O, compared to the crossing point group, 17±6 cmH_2O, and to the low collapse group, 16±5 cmH_2O ($p<0.001$). PaO_2/FiO_2 increased over time in all groups, but it was lower after 12h in the low overdistention group (238±63), compared to the other two groups (318±132 and 354±52), $p<0.001$. Cardiac output decreased over time in all groups, but there was no difference between groups, $p=0.07$.
Conclusion: In this highly recruitable lung injury model, the preliminary analysis suggests that a low PEEP is associated with worsening of respiratory mechanics and higher mortality. We are going now to analyze the biological and histological data to understand better the effects of lung collapse and overdistension.

Time Required to Initiate a Pandemic focused Clinical Trial in Canada

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Background/Introduction: Randomized control trials (RCTs) provide essential evidence to inform treatments. However, there are many necessary and time-consuming steps from idea generation to enrollment of patients. Lengthy times to initiate RCTs are particularly problematic for treatment RCTs for emerging infections causing large outbreaks and pandemics, such as COVID-19.
Purpose: We aimed to determine the duration the time to complete various steps of a CIHR-funded Health Canada regulated multi-centre drug treatment RCT in Canada (Canadian Treatments for COVID-19, CATCO), to identify areas for improved efficiency in the trial initiation process.
Materials and Methods: All participating CATCO hospital sites were surveyed using a structured data abstraction form. We measured the durations from protocol receipt to site activation and initiation of patient enrollment, and also durations of administrative processes including research ethics board (REB) approval, contract execution, and the lead-time between contract execution to initiation of site activation and patient enrollment.
Results: Among 52 (academic hospitals (N=27), community hospitals (N=21) and central submission sites (N=4)) Canadian institutions surveyed, all sites responded, across 7 Canadian provinces (AB, BC, MN, SK, ON, QC, NS). 15 sites (academic hospitals (N=8), community hospitals (N=7)) provided the requested data completely. The median (interquartile range) time from receipt of the protocol receipt to initiation of patient enrollment was 169 (49, 227) days. The durations for REB approval and full contract execution were 5 (1, 12) and 25 (16, 63) days respectively. The lead time from REB approval to enrollment of first patient was 114 (27, 170) days and 63 (10, 135) days from full contract execution to enrollment of first patient. In a stratified analysis, academic hospitals required less time for site activation and initiation of patient enrollment after REB approval and contract execution compared to community hospitals.
Conclusions: Even with broad-based motivation to expedite research, there was considerable variation in the time required to initiate a large multi-centre pandemic-focused clinical trial RCT in Canada. While REB approvals generally happened quickly, contract executions were typically prolonged, and start-up activities post contract execution variable. Having standardized contract templates and greater pre-existing site-level research infrastructure might shorten the time to initiate pandemic focused clinical trials in Canada, especially in community hospitals.

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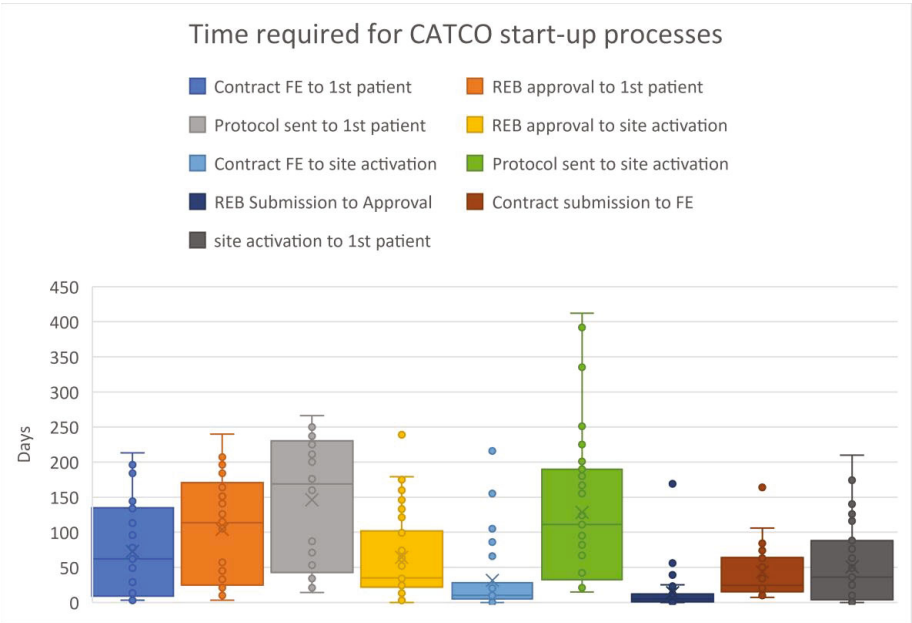
Figure 1. Time required for CATCO start-up processes



Validation and Optimization of Adding Antimicrobial Data to ICD-10-CA Coded Case Definitions for Sepsis and Septic Shock: A Work in Progress

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Introduction: Sepsis and septic shock are a leading cause of mortality, morbidity and increased healthcare expenditure in Canada and worldwide[1,2]. Capturing sepsis patients using ICD-10 codes from health administrative data is challenging because it is highly undercoded[3]. Although ICD codes were specific (median: 98.5%, range: 78.3% to 100%), these codes were not sensitive (median: 42.4%, range: 5.9% to 82.3%)[4]. The addition of antimicrobial data has been proposed to further improve the performance of ICD-10 sepsis identification algorithms[3,5]. However, this strategy has not been applied in sepsis validation studies.
Objectives: To determine whether antimicrobial data improves the diagnostic accuracy of the existing Canadian sepsis identification algorithms.
Methods: We are conducting a review of medical charts of 850 adult patients admitted to The Ottawa Hospital General and Civic campus ICUs between April 2014 and March 2019. Patients are classified as infected or non-infected based on a modified Sepsis-3 criteria. Chart review data will be linked with health administrative data (for ICD-10 codes and antimicrobial data) housed at the Ottawa Hospital Data Warehouse. Our primary outcomes include the performance characteristics (Sensitivity(Sn), Specificity(Sp), Positive Predictive Value(PPV), Negative Predictive Value(NPV)) of the modified algorithm including antimicrobial data, with corresponding 95% CI when compared to the existing Canadian algorithms[3,7].
Preliminary Results: We have reviewed a total of 475 charts (55.8%) of which 458 were included. Of the included charts, 210 (45.9%) were classified as infected and 248 (54.1%) as non-infected. The median patient age was 65 (52,74) years. Of the 458 included patients, the majority was male (62.0%). 30% (N=63) and 18.1% (N=45) of infected and non-infected patients died during their admission. Diabetes (24.6-44.8%) and cancer (18.1-31.4%) were major co-morbidities of patients in both infected and non-infected cohorts. Among the infected group, most infections were respiratory in origin (46.4%) and most patients had at least 2 antimicrobials initiated within 24 hours of documented infection (29.5%). Both cohorts had varying degrees of organ dysfunction, which was overall more pronounced in the infected group, particularly that of respiratory and renal dysfunction (37.1% and 32.9%, respectively).
Conclusion: Our preliminary results reveal that it is feasible to apply a modified Sepsis-3 criteria to identify patients with sepsis from medical charts. Our presentation will report the impact of adding various types of antimicrobial data on the diagnostic accuracy of algorithms used to identify sepsis cases from routinely collected data.

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