Alberta Health Services

Department of Critical Care Medicine Calgary

1st Colleen and Brent Winston Critical Care RESEARCH DAY

Featuring:

"The Miriam and Arnold Winston Lectureship"

Endowment Facilitated By:
Alberta Lung Association

alberta lung
for every breath

Friday, November 21, 2025
8:00 AM – 4:00 PM
ACCC Auditorium

UNIVERSITY OF CALGARY

Message from Dr. Braedon McDonald

MD, PhD, FRCPC

Dear Colleagues,

Welcome to our annual showcase and celebration of research in the Department of Critical Care Medicine. This year is particularly significant as it marks the inaugural rebranding of our annual Research Day as the **Colleen and Brent Winston Critical Care Research Day**. We are tremendously grateful to Colleen and Brent for their generous support of this event and their commitment to advancing critical care research.

This year, we are excited to highlight and celebrate the breadth of scholarly activity in the Department by members at every stage of training and career, with impactful research contributions spanning all CIHR pillars, as well as education and quality improvement.

A highlight of our annual Research Day is the **Miriam and Arnold Winston Lectureship**, made possible by the generosity of the Winston Family (Brenda Winston, Brent Winston, Belinda Meller, Bruce Winston). This year, we are honoured to welcome **Dr. Eddy Fan** from the University of Toronto to deliver the 2025 Miriam and Arnold Winston Keynote Lecture. Dr. Fan is a global leader in advanced life support, including extracorporeal life support, and we look forward to learning from his inspiring lecture and hopefully sparking new cross-Canada collaborations with researchers here in Calgary.

On behalf of DCCM, we thank Dr. Fan for joining us here in Calgary, as well as the Winston Family for making this exciting event possible.

Sincerely,

Braedon McDonald, MD, PhD, FRCPC
Associate Professor and Snyder Chair of Critical Care Research
Director of Research and Innovation
Department of Critical Care Medicine
Cumming School of Medicine, University of Calgary

Alberta Health Services | UNIVERSITY OF CALGARY CUMMING SCHOOL OF MEDICINE

Guest Speaker: Dr. Eddy Fan

MD, PhD, FRCPC

Dr. Eddy Fan is a Professor of Medicine in the Interdepartmental Division of Critical Care Medicine and the Institute of Health Policy, Management and Evaluation at the University of Toronto. He serves as a Staff Intensivist at the University Health Network and Mount Sinai Hospital. Dr. Fan completed his undergraduate studies at the University of Toronto, earned his medical degree from the University of Western Ontario, and holds a PhD in Clinical Investigation from Johns Hopkins University.

Currently, Dr. Fan is the Medical Director of the Extracorporeal Life Support Program at Toronto General Hospital and the Director of Critical Care Research at the University Health Network and Sinai Health System. He is also an Executive and Steering Committee Member of the Practical Platform Trial Program.

His research focuses on advanced life support strategies for patients with acute respiratory failure and improving outcomes for critically ill individuals. His work includes studies on mechanical ventilation and extracorporeal life support in ARDS, as well as investigations into ICU-acquired weakness, early rehabilitation, and long-term recovery following critical illness.

Event Schedule

Department of Critical Care Medicine Research Day November 21, 2025	
8:00am –8:20am	**Registration / Breakfast (in ACCCC Auditorium)**
8:20am –8:30am	Welcome / Opening Remarks Miriam and Arnold Winston Lectureship Introduction – Braedon McDonald
8:30am –9:30am	**Keynote Address –** "Healing Lungs Together - Through Observational Studies, International Collaboration, and Finding Joy" - **Dr. Eddy Fan** *[introduced & moderated by Dr. Braedon McDonald]*
9:30am - 9:35am	Introduction to Presentations *[Braedon McDonald]*
Session 1 – Critical care innovation (Moderator: Dr. Ann Zalucky)	
9:35am –9:50am	*Kirsten M. Fiest, Professor, Department of Critical Care Medicine* - Identifying Research Priorities in Canadian Adult and Pediatric Critical Care: Results from a James Lind Alliance Priority Setting Partnership
9:50am -10:05am	*Andreas Kramer, MD MSc FRCPC and Intensivist, *Atul Phillips[1] MD, MSc, Neurocritical Care Fellow, Department of Critical Care Medicine* -Relationship Between Cerebral Oximetry and Outcomes in Patients Resuscitated from Cardiac Arrest: A Systematic Review and Meta-analysis
10:05am -10:20am	** Gwen E. Knight*, MSc Student*, Department of Critical Care Medicine* - Impact of intermittent versus continuous neuromuscular blockade on VFDs in ARDS: A retrospective cohort study
10:20am -10:35am	**Qadeem Salehmohamed and Alex Wyma – ICU Fellows, Department of Critical Care Medicine*- Methods To Estimate Mechanical Power And Their Association With Outcomes In Mechanically Ventilation Patients; A Systematic Review And Meta-Analysis Protocol.
10:35am -10:50am	**Amanda Y. Leong*, *PhD Student and Clinical Pharmacist, Department of Critical Care Medicine* - An Intravenous Sodium Bicarbonate Shortage In The Critically Ill: An Interrupted Time-Series Analysis
10:50am -11:10am	**Break – Snacks (in ACCCC Auditorium)**
Session 2 – Precision critical care (Moderator: Dr. Kirsten Fiest)	
11:10am –11:25am	**Colin Mackenzie, Postdoctoral fellow, Department of Critical Care Medicine* – Personalized VAP prophylaxis with microbiome-directed therapy.
11:25am –11:40am	**Luke Brown, PhD graduate, Department of Critical Care Medicine* - Visualizing a neutrophil-platelet immunothrombosis cascade during sepsis
11:40am –11:55pm	**Rebecca Quaijah*, *MSc Student in Biostatistics, University of Calgary* - Precision SOFA Analytics in Critically Ill Patients
11:55am-12:10pm	**Agyei Osei Duodu[1] MSc Data Science and Analytics, University of Calgary* - Explainable AI-Based Clinical Decision Support System for Diagnosing Pneumonia Using Chest X-ray
12:10 –12:25pm	*Ann Zalucky, Assistant Professor and Intensivist, Department of Critical Care Medicine* – Elastance Does Not Determine the Effect of Prone Positioning on Mortality in Patients with Acute Respiratory Distress Syndrome: A Post-Hoc Analysis of the PROSEVA Trial

12:25pm -1:25pm	**Lunch (in ACCCC rooms YC021131, YC021136, YC021141)**
Session 3 – Critical Care Neurosciences (Moderator: Dr. Dan Zuege)	
1:25pm - 1:40pm	*Karla D. Krewulak, Research Associate, Department of Critical Care Medicine* - Development and validation of the Family ICU Delirium Detection Instrument
1:40pm -1:55pm	**Amanda Y. Leong*, PhD Student and Clinical Pharmacist - Prevalence and incidence of ICU delirium and pain: A systematic review and meta-analysis
1:55pm –2:10pm	*Kerry Holliday, MSW[2]; Rachel Wilkins, BA, Give Life Alberta, Department of Critical Care Medicine*- Donation Physician Specialist and Missed Donation Opportunities
2:10pm –2:25pm	**Mohammad M Banoei, Postdoctoral fellow, Department of Critical Care Medicine*- Multiplex Point-of-Care MIP Biosensor for Severe Traumatic Brain Injury Diagnosis and Prognosis
2:25pm -2:40pm	**Break – Snacks (in ACCCC Auditorium)**
Session 4 – Optimization of critical care delivery (Moderator: Dr. Ken Parhar)	
2:40pm -2:55pm	**Sampson Law, PhD Student, Department of Critical Care Medicine* - Effectiveness of quality improvement interventions in reducing low-value laboratory test utilization in adult intensive care units: a systematic review and meta-analysis
2:55pm -3:10pm	*Jessica Jenkins MN ACNP,* [1,2] Understanding Nurse Practitioner works in Multisystem Intensive Care Units: A focus group study
3:10pm –3:25pm	*Jessica Jenkins MN NP[1,2]* - Supporting Child Visitors in the Intensive Care Unit: A Multisite, Cross-Sectional Survey of Healthcare Provider Perspectives
3:25pm –3:40pm	**Stefan Edginton, MSc student, Clinical Scholar, and Intensivist, Department of Critical Care Medicine* - Association Between Spinal Anesthesia and Postoperative Outcomes in Cardiac Surgery: A Retrospective Cohort Study
3:40pm - 3:55pm	*Amanda Roze des Ordons[1]*,- An environmental scan of resident-focused trauma-informed medical education policy in Canada
3:55 pm - 4:00 pm	Wrap up and thank you – Dan Zuege

Note:* = Trainee

We extend our heartfelt appreciation to **Dr. Eddy Fan** for generously joining us as a speaker at the **inaugural Colleen and Brent Winston 2025 Research Day**.

This meaningful event is made possible through the **Winston family's generous contribution**, honoring the memory of **Miriam and Arnold**, and establishing an endowment with the **Canadian Intensive Care Foundation** to support ongoing research and innovation in critical care. We are pleased to note that this event qualifies as a **Section 1 Accredited Rounds activity** under the **Maintenance of Certification program of the College of Physicians and Surgeons of Canada**.

Abstract Presentations

Identifying Research Priorities in Canadian Adult and Pediatric Critical Care: Results from a James Lind Alliance Priority Setting Partnership

Kirsten M. Fiest[1-3], Karla D. Krewulak[1], Tamara Rader[4], Hailey Bain[1], Karen E. A. Burns[5], Marie-Maxime Bergeron[1], Michelle E. Kho[6], François Lamontagne[7], Laurie A. Lee[8], Shannon McKenney[1], Kusum Menon[9], Marcia Reid[1], Kristine Russell[1], Holden Sheffield[10], Jennifer LY Tsang[11,12], Srinivas Murthy[13], and on behalf of the Canadian Critical Care Trials Group (CCCTG)

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10. Qikiqtani General Hospital, Iqaluit, Nunavut, Canada
11. Niagara Health Knowledge Institute, Niagara Health, St. Catharines, Ontario, Canada
12. Department of Medicine, McMaster University, Hamilton, Ontario, Canada
13. Department of Pediatrics, Faculty of Medicine, University of British Columbia
14. Vancouver, Canada; Pediatric Critical Care, BC Children's Hospital, Vancouver, Canada

Background and Rationale:
Despite advances in the provision of critical care medicine, many uncertainties remain, and existing guidelines are often based on low-quality evidence. The James Lind Alliance (JLA) methodology provides a structured approach to identify research priorities based on input from patients, families, and healthcare providers. This Priority Setting Partnership (PSP) aimed to identify the Top 10 research priorities for critical care medicine across adult and pediatric ICUs in Canada.

Study Design:
This national JLA PSP was conducted in three phases from April 2024 to May 2025. The PSP focused on ICU admission, care processes and delivery, and post-ICU outcomes, while considering sociocultural, personal, and geographic factors. Participants included patients with lived experience of critical illness, family members, and healthcare providers. In Phase 1, participants submitted uncertainties via an open survey. In Phase 2, participants prioritized refined questions using a national ranking survey. In Phase 3, participants discussed and reached consensus on the Top 10 research priorities during a virtual workshop.

Results:
In Phase 1, 154 participants (44 patients/family members, 110 healthcare providers) submitted 539 questions, of which 509 (94%) were in scope. Overlapping questions were combined and refined into 64 unique questions. In Phase 2, 244 participants (63 patients/family members, 191 healthcare providers) prioritized 20 questions for the final workshop. In Phase 3, 24 individuals (12 patients/family members, 12 healthcare providers) participated in a virtual consensus workshop. Structured discussion and ranking produced the Top 10 research priorities. Briefly, the top three priorities were: (1) improving physical, cognitive, and mental health outcomes post-ICU/PICU; (2) supporting goals-of-care conversations with families; (3) characterizing short- and long-term post-ICU outcomes.

Conclusion: This national JLA PSP identified the top 10 patient-, family-, and healthcare provider-**driven** research priorities for critical care medicine in Canada, providing a foundation for meaningful, inclusive, and evidence-informed future research.

Relationship Between Cerebral Oximetry and Outcomes in Patients Resuscitated from Cardiac Arrest: A Systematic Review and Meta-analysis

Phillips A[1], Bencsik C[2-3], Bains I[2-3], McKenzie E[2], Wong A[4], Couillard P[2-3,5-6], Kromm JA[2-3,5-6], Kramer AH[2-3,5-6].

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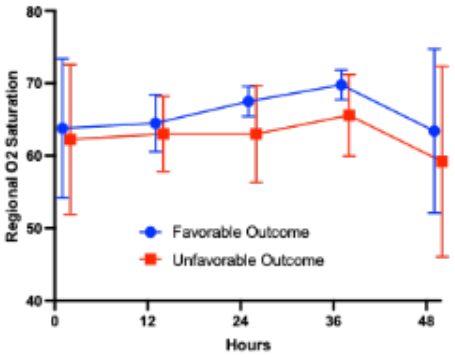
3. Alberta Health Services
4. Intensive Care Unit, Reginal General Hospital
5. Department of Clinical Neurosciences, University of Calgary
6. Hotchkiss Brain Institute

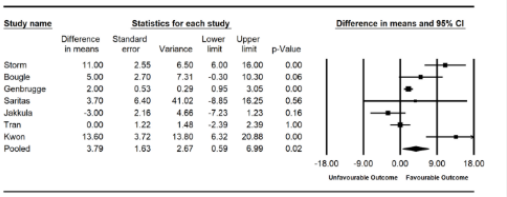
Background:
Following return of spontaneous circulation, cerebral hypoperfusion may perpetuate hypoxic-ischemic brain injury (HIBI) in post-cardiac arrest patients. Cerebral oximetry is a non-invasive method of assessing brain oxygenation. We performed a systematic review to assess whether higher regional oxygen saturation (RSO_2) is associated with improved outcomes.

Methods:
We searched the literature for studies reporting outcomes in comatose post-cardiac arrest patients who immediately underwent continuous cerebral oximetry for at least 6 hours. RSO_2 over the initial 48 hours post-arrest was compared between patients with favourable (CPC 1-2) versus unfavourable (CPC 3-5) outcomes. Random effects models were used to combine studies and generalized estimating equation models to assess changes over time.

Results: 9227 records were identified, of which 12, with a total of 670 patients, met inclusion criteria. RSO_2 was similar at baseline, but significantly higher at 24 hours post-arrest among patients with favourable outcomes (3.8%, 0.5% to 7.0%; p=0.02), although there was marked heterogeneity (Figure). Average RSO_2 was non-significantly higher over the initial 24 hours (2.4%, -0.4%-5.1%; p=0.09) and significantly higher between 24-48 hours (5.2%, 95% CI 1.6%-8.8%; p=0.005) in patients with favourable outcomes. RSO_2 was consistently higher in studies where cardiac arrest duration was relatively shorter (6.3%, 95% CI 0.8% to 11.7%; p<0.001). RSO_2 was affected by body temperature, with lower RSO_2 during the 24 hours post-arrest, and a greater increment over time in studies with routine use of therapeutic hypothermia. Although very low RSO_2 had high specificity for poor outcome in some studies, no consistent threshold could be identified for use in neuroprognostication.

Conclusion: Higher cerebral oximetry values are associated with a greater chance of favourable outcome in post-cardiac arrest patients. Lower RSO_2 is likely indicative of more severe HIBI. Further research is needed to determine whether treatment of low RSO_2 can modify outcomes.





Impact of intermittent versus continuous neuromuscular blockade on VFDs in ARDS: A retrospective cohort study

Gwen E. Knight[1, 2], Andrea Soo[1], Danny J. Zeuge[1,3,4], Damon C. Scales[5,6], Gordon Rubenfeld[5,6], Daniel J. Niven[1, 2, 3], Christopher J. Doig[1,2], Sean M. Bagshaw[7,8], Matthew T. James[2, 3, 4, 9], Henry T. Stelfox[1,2,7], Kirsten M. Fiest[1,2,3], Ken Kuljit Singh Parhar[1,3,4]

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7 Department of Critical Care Medicine, Faculty of Medicine and Dentistry, College of Health Sciences, University of Alberta and Alberta Health Services
8 School of Public Health, College of Health Sciences, University of Alberta
9 Department of Medicine, Cumming School of Medicine, University of Calgary

Background and rationale:
Patients with ARDS have high rates of morbidity and mortality. Neuromuscular blockade agents (NMBAs) may improve the outcomes of patients with moderate to severe disease. Guidelines support continuous intravenous infusion of NMBAs; however, this is associated with risks. Intermittent bolus dosing of NMBAs might offer similar benefits but with less harm. To address this question, we evaluated the association between NMBA administration method and outcomes in adults with moderate-severe ARDS.

Study Design:
Secondary analysis of the Venting Wisely study cohort. The exposure is the use of continuous vs bolus neuromuscular blockade among invasively ventilated adult patients with moderate to severe ARDS. The primary outcome is 28-day ventilator free days. To adjust for measured confounders, we generated a propensity score (PS) for each patient. The primary outcome will be assessed using an inverse probability of treatment weighting with mixed effects linear regression. Sensitivity analysis will be conducted using PS matching and PS regression.

Results:
In 20,964 mechanically ventilated patients admitted to 17 adult ICUs across Alberta (June 1, 2020 to October 31, 2022), 5009 met criteria for ARDS. We classified 2679(53.5%) patients with moderate to severe ARDS (PF ratio≤150). Among patient with moderate-severe ARDS, 2096(78.2%) patients received NMBA at some point during their ICU stay; 1519 of these patients receiving cisatracurium or rocuronium within 48 hours of their qualifying ABG (PF ratio≤150). Bolus dosing was used in 522(34.4%) versus infusion in 997(65.6%) patients. Among patients receiving bolus NMBA, the median number of boluses was 4(IQR 2,11). Among patients receiving infusions, the median duration of infusions was 84.8(IQR 42.9,157.5) hours. Analysis of the primary outcome is underway.

Conclusion:
Among patients with moderate-severe ARDS who are invasively ventilated, the use of NMB was common. Analysis of differences in outcome between patients who received bolus dosing vs infusions are currently ongoing.

Methods to estimate mechanical power and their association with outcomes in mechanically ventilation patients; A systematic review and meta-analysis

Alexander Wyma[1], Qadeem Salehmohammed[1], Emery Boadi-Gumbs, Ken Kuljit S Parhar[1]

1 Department of Critical Care Medicine, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada

Background and rationale:
Mechanical power (MP) estimates the energy delivered to lungs over time delivered by invasive mechanical ventilation. Previous studies suggest an excess MP may be associated with ventilator induced lung injury (VILI) and higher morbidity and mortality. Various methods for estimating MP exist leading to inconsistent comparisons of MP between studies. Understanding which MP estimate is most closely associated with patient outcomes may help its implementation and use in future studies as an outcome.

Study Design:
This study will use systematic review and meta-analysis methodology. A search strategy was created in conjunction with a librarian to search PubMed-MEDLINE, EMBASE, SCOPUS, and CENTRAL databases were searched. The population and setting of interest is adult mechanically ventilated patients in the intensive care unit. The intervention of interest is the estimation or measurement of mechanical power. The patient related outcomes that will be assessed include ICU mortality (primary), hospital mortality and ventilator free days. The meta-analysis using a random-effects model. Where possible calibration and discrimination as well as primary and secondary outcomes will be pooled for meta-analysis. Two reviewers will independently screen titles and abstracts for inclusion. Studies that are included will then undergo a full text review for inclusion by both reviewers before being included in the final included studies. The review will be conducted according to the PRISMA guidelines for publications investigating the impact of mechanical power on clinical outcomes in mechanically ventilated adult patients in the ICU. Risk of bias will be assessed by ROB-2 Cochrane tool.

Results:
We plan to complete an analysis of pooled effect of mechanical power on mortality, ICU length of stay and ventilator free days across MP equations. Initial analysis of included studies reveals numerous strategies for calculation of MP.

Conclusion:
This review aims to identify the MP equation most closely related to patient outcomes and define a threshold above which MP may be harmful. The findings of this review will inform ventilator management with the aim of reducing VILI and improving ICU survival.

An intravenous sodium bicarbonate shortage in the critically ill: an interrupted time-series analysis

Amanda Y. Leong. BSc.Pharm., ACPR[1,2,3], Soo, Andrea, PhD[1], Bond, Andrew, MD[4], Wunsch, Hannah, MD, MSc[5], Zuege, Danny J, MD, MSc[1,7], Sean M. Bagshaw, MD, MSc[6], Stelfox, Henry T., MD, PhD[6], Daniel J. Niven, MD, MSc, PhD[1,2,7]

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Background and rationale:
We examined the effects of the 2017 worldwide shortage of IV sodium bicarbonate on outcomes of critically ill adults with acidemia using an interrupted time series analysis.

Study Design:
Among seventeen adult ICUs in Alberta, Canada, we examined adults (≥ 18 yr) with blood pH <7.3, admitted between June 1, 2015, and 31 December 2019. The sodium bicarbonate shortage occurred between 8 June and October 4, 2017, during which time our health authority enacted emergency conservation measures. The main data source was eCritical Alberta. The primary outcome was the proportion of patients treated with IV sodium bicarbonate. Outcomes were examined via segmented regression.

Results:
Among 18,865 admissions, median age was 62 years (IQR 50-71), median APACHE II was 23 (IQR 18-30), and 39.6% were female. Immediately after start of the shortage, patients treated with bicarbonate decreased from 29.3% to 21.5% (absolute -7.8%; 95% CI, -12.8 to -2.8%). During the shortage, bicarbonate recipients more likely had pH ≤7.20 (78.8% vs. 69.0%, p<0.01). Subgroup analysis among those with pH ≤7.20 who did not receive bicarbonate during the shortage suggested increased proportion treated with vasopressors (9.9%; 95% CI, 2.4-17.4%) and continuous renal replacement therapy (8.6%; 95% CI, 0.6-16.6%). Similar trends were observed among those with renal SOFA greater than or equal to 3 who did not receive bicarbonate during the shortage. There was no change in ICU length of stay or mortality in overall population or subgroups.

Conclusion:
Emergency conservation measures that accompanied a worldwide shortage of IV sodium bicarbonate were associated with a reduction in IV sodium bicarbonate use among critically ill patients with acidemia. This was not linked to changes in survival or length of stay outcomes. Future bicarbonate research should focus on subgroups such as those with severe acidemia and/or advanced renal insufficiency.

Personalized VAP prophylaxis with microbiome-directed therapy – development of rapid microbiome sequencing technology and clinical trial protocol

Colin Mackenzie[1], Ish Bains[1], MD Mohon Nasser[1], Breadon McDonald[1]

1Deaprtment of Critical Care Medicine, Cumming School of Medicine, University of Caglary

Background and rationale:

Ventilator associated pneumonia (VAP) is the most common nosocomial infection in intensive care units. VAP increases patients' risk of death, prolongs the duration of life support, and the length of ICU admission. VAP is caused by bacterial infection in the lower airways, arising from pathogens that inhabit the airway microbiome. Antimicrobial administration to prevent VAP (prophylaxis) is aimed at suppressing pathogen growth in the airway microbiome, but its efficacy in prior clinical trials has been limited by a "one size fits all" approach to this heterogeneous infection. We seek to develop new technology for rapid airway microbiome analysis to guide personalized antimicrobial prophylaxis to reduce VAP.

Study Design: Development and optimization of rapid long-read DNA sequencing for microbiome analysis was undertaken utilizing a cohort of 98 ventilated patients at FMC ICU. Endotracheal aspirate samples were collected on days 1, 3, 7 of admission for microbiome analysis, as well as patient outcomes of VAP, hospital-acquired pneumonia, ICU length of stay, hospital length of stay, and mortality to 30 days post admission.

Results: Using Oxford Nanopore Minion-based long-read sequencing, coupled with bespoke data processing and analysis pipeline, we found that airway microbiome analysis was feasible within 4 hours from sample-to-data (compared to >7 days for conventional DNA sequencing). Rapid airway microbiome sequencing identified VAP pathogens in the airways of ~40% of patients on the day of ICU admission, prior to the development of VAP.

Conclusion: We have developed a rapid microbiome sequencing workflow and demonstrated its feasibility for identification of VAP pathogen colonization in the airways upon admission to ICU. A pilot clinical trial protocol will be presented utilizing this novel technology for personalized microbiome-directed VAP prophylaxis.

Visualizing a neutrophil-platelet immunothrombosis cascade during sepsis

Luke Brown[1,2,3], Bryan G. Yipp[1,2,3]

[1]Department of Critical Care Medicine
[2]Calvin, Phoebe and Joan Snyder Institute for Chronic Diseases
[3]Hotchkiss Brain Institute

Background and rationale:
Sepsis demands host defence yet incurs collateral injury. Neutrophils mediate both by collaborating with platelets to form intravascular “immunothrombi,” but disentangling defence from damage in vivo remains difficult.

Study design:
Using an *Escherichia coli* bloodstream sepsis model with lung intravital microscopy, we directly visualized and quantified the immunothrombosis cascade in vivo.

Results:
The neutrophil-derived antimicrobial peptide cathelicidin localized neutrophils to *E. coli* and seeded founder immunothrombi via formyl-peptide receptors (FPRs). These structures trapped circulating bacteria, and cathelicidin promoted platelet antimicrobial activity. Cathelicidin blockade prevented cascade initiation and reduced early sepsis mortality but led to delayed death from uncontrolled infection. In contrast, neutrophil leukotriene B_4 (LTB4) amplified late-stage immunothrombosis into occlusive microvascular plugs; LTB4 inhibition curtailed pathological occlusion while preserving bacterial control, revealing a discrete inflection point in sepsis progression.

Conclusion:
In vivo imaging defines a staged neutrophil–platelet immunothrombosis cascade in sepsis: cathelicidin–FPR signalling initiates host-protective founder clots, whereas LTB4 drives occlusive progression. Selectively targeting LTB4 mitigates immunopathology without compromising host defence.

Precision SOFA Analytics in Critically Ill Patients

Rebecca Quaijah[1], Chip Doig[2], Jingjing Wu[1], Chel Hee Lee[1,2]

[1]Biostatistics, Mathematics and Statistics, University of Calgary
[2]Critical Care Medicine, Alberta Health Services & University of Calgary

Background and rationale:
In the ICU, patients' conditions can change rapidly, and predictions made at admission may soon become outdated. We observed that survivors' SOFA scores generally declined over time, whereas non-survivors' scores remained high or worsened. This highlighted the need for a modeling approach that continuously updates risk as new information becomes available. We aimed to evaluate whether models incorporating daily SOFA scores and key clinical markers, Creatinine, Mean Arterial Pressure (MAP), and Platelets could provide accurate, patient-specific, and dynamically updated predictions of ICU mortality

Study Design:
We analyzed data from patients with sepsis admitted to four Calgary ICUs between 2014 and 2018. We first examined survival patterns by comparing the duration of patients' ICU stays and the changes in their SOFA scores over time. We then applied models that followed each patient's daily SOFA trajectory and linked it to survival outcomes. Finally, we expanded the models to include additional biomarkers. Model performance was evaluated by assessing how well predictions aligned with observed outcomes at various time points.

Results:
Models based on SOFA scores alone produced stable and accurate predictions of survival. When additional clinical markers were included, prediction improved further, providing clearer separation between survivors and non-survivors. Survival curves generated by the models reflected clinical reality, with steep declines for non-survivors and gradual improvement for survivors.

Conclusion:
Models that track daily changes in patient condition offer a practical way to generate individualized, real-time survival predictions in the ICU. By focusing on trends rather than one-time measurements, they mirror the way clinicians make decisions. This approach may support earlier interventions, guide treatment strategies, improve communication with families, and ultimately contribute to better ICU outcomes.

Explainable AI-Based Clinical Decision Support System for Diagnosing Pneumonia Using Chest X-ray

Agyei Osei Duodu[1], Christopher Grant[2], Christopher Doig[2], Chel Hee Lee[2,3]

[1]Master of Data Science and Analytics, University of Calgary
[2]Critical Care Medicine, Cumming School of Medicine, University of Calgary
[3]Mathematics and Statistics, Faculty of Sciences, University of Calgary

Background and rationale:
The development of clinical decision support (CDS) is crucial for diagnosing pneumonia (PNA) in the ICU because patients often have multiple health issues that have similar signs and symptoms of pneumonia, such as ARDS or heart failure. In addition, a shortage of staff can slow down the interpretation of medical images and ultimately delay patient care.

Study Design:
We used the pre-processed RSNA Pneumonia Detection Challenge dataset in Kaggle. The associated bounding box annotations have been preserved and saved as mask images. Preprocessing includes normalization, resizing, augmentation, and fine-tuned labels. We implemented transfer learning using a CNN pre-trained Xception architecture, fine-tuned on labeled chest X-ray datasets. Grad-CAM was employed to enhance interpretability.

Results:
The model achieved approximately 97% training and 88% test accuracy with F1-scores > 0.8 for two pneumonia subcategories. The heatmaps highlighting regions in the chest X-ray aligned with known pathological features and contributed most to the model's predictions for clinicians to understand and validate AI-driven outputs.

Conclusion: This study allows us to examine the feasibility of adopting an explainable AI algorithm in our AHS clinical environment and explore potential study designs comparing the accuracy and speed of human reading vs AI models, and expect 40% faster than manual reading as reported in a recent literature.

Elastance Does Not Determine the Effect of Prone Positioning on Mortality in Patients with Acute Respiratory Distress Syndrome: A Post-Hoc Analysis of the PROSEVA Trial

Ann. A. Zalucky[1], Ewan C. Goligher[2,3,4], Jose Dianti[2], Andrew Willmore[5], Claude Guerin[6,7,8] and Carolyn S. Calfee[5].

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Abstract

Background and Rationale: There is evidence for mortality benefit with prone positioning in patients with acute respiratory distress syndrome (ARDS). However, patient factors determining the benefit of proning remain uncertain, resulting in the maneuver being applied indiscriminately among those with moderate to severe ARDS. We aimed to assess if baseline respiratory system elastance (Ers), or “stiffness”, determines the treatment effect of prone positioning on mortality.

Study Design: We conducted a secondary Bayesian analysis of the PROSEVA Trial. Bayesian logistic regression modeling was used to estimate the posterior probability of prone positioning effect moderation by baseline Ers on 90-day mortality in patients with moderate to severe ARDS. As a secondary aim, we tested whether the absolute change in driving pressure of the respiratory system (ΔPaw) in response to prone positioning predicted 90-day mortality, using logistic regression.

Results: The treatment effect of prone positioning on mortality did not meaningfully vary with baseline Ers (posterior probability of benefit OR<0.95=52%; interaction OR 0.94, 90% credible interval, CrI, 0.74-1.20). Although, on average, higher baseline Ers was associated with greater improvements in ΔPaw at the end of the first prone session (β= -3.3, 95% CI (-4.09,-2.49) p=<0.001); this response was not associated with mortality benefit in models adjusted for age, PaO2/FiO2, SOFA score, and baseline ΔPaw (OR 1.14 (95% CI 0.96-1.37), p=0.14).

Conclusion: In this secondary analysis of the PROSEVA trial, the effect of prone positioning on mortality did not vary with Ers, nor was the prone positioning-induced improvement in ΔPaw predictive of mortality in passively ventilated patients with ARDS. This interaction requires further study in the spontaneously breathing patient.

Development and validation of the Family ICU Delirium Detection Instrument

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Background and Rationale:
Delirium is a common and harmful complication for ICU patients, yet it is often underrecognized. Families are well-positioned to notice subtle changes in a patient's behavior and cognition; any family role in delirium detection must be supported with valid tools. While family-administered delirium detection tools exist, none have been adapted for the ICU environment. The purpose of this study was to adapt the Sour Seven to develop the Family ICU Delirium Detection Instrument (FIDDI) and assess its usability, reliability, and construct validity.

Study Design: The Sour Seven was adapted using data from previous research and input from a multidisciplinary working group. This cross-sectional study was conducted at Foothills Medical Centre ICU. Patient-family dyads were included if patients had no primary brain injury, a Richmond Agitation-Sedation Scale score ≥ -3, and were expected to remain in the ICU for >24 hours. Internal consistency was assessed with Cronbach's alpha, and construct validity was evaluated using confirmatory factor analysis (CFA). Family members completed surveys regarding usability and their experience detecting delirium using the FIDDI.

Results: Fifty-one patient-family dyads were enrolled. Most family members were women (75%) and were spouses (33%), adult children (31%), or siblings (20%). The FIDDI demonstrated strong internal consistency (Cronbach's alpha=0.858) and acceptable construct validity (TLI=1.015, CFI=1.000, RMSEA=0.000, SRMSR=0.044). Family members generally found the tool easy to use and helpful for understanding delirium. Some attributed behavioral changes to medical treatments or underlying conditions, indicating the need for additional education to support accurate delirium detection.

Conclusion: The FIDDI is a reliable and valid family-administered delirium detection tool adapted for the ICU setting. Evaluation of comparative effectiveness with standard delirium detection strategies is needed.

Prevalence and incidence of ICU delirium and pain: A systematic review and meta-analysis

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Background and rationale:
We performed a secondary analysis of a prior systematic review and meta-analysis to examine the prevalence and incidence of ICU delirium and pain.

Study Design:
The original search examined MEDLINE, EMBASE, CINAHL, and the Cochrane Central Register of Controlled trials from inception to May 15, 2023 (PROSPERO ID: CRD42022367715). Articles eligible for the current study derived from those previously reviewed at full text review. Included in the current study were randomised or observational studies among critically ill adults, that reported delirium or pain incidence or prevalence. Delirium or pain were dichotomized as present or absent. Clinically significant pain was defined as moderate-to-severe pain (NRS ≥5, BPS ≥5, VAS ≥5 or CPOT ≥3). Proportion data was transformed using the Freeman-Tukey double arcsine method prior to pooling using a random effects meta-analysis model. Joanna Briggs' Institute prevalence checklist was used for risk of bias.

Results:
From 517 full-text articles, 213 original studies, 226 publications (183,285 patients) were included. The pooled delirium prevalence (173 studies) was 35.7%(95%CI 32.4–39.0%). The most common delirium subtype was hypoactive (16.5%, 95%CI 12.1–21.4%). The pooled delirium incidence (41 studies) was 28.8% (95%CI 23.2–34.8%). The pooled pain prevalence (11 studies) was 43.5% (95%CI 28.6–58.9%). Prevalence of clinically significant pain was 40.6% (95%CI 20.1–63.0%).
Delirium prevalence but not incidence decreased following publication of pain, agitation and delirium guidelines in 2013 (before: 39.9%, 95%CI 34.7–45.3% vs. after: 32.3%, 95%CI 28.2–36.5%, p=0.02). Delirium prevalence significantly differed among ICU types and severity of illness. Pain prevalence decreased significantly since following guideline publication in 2013 (before: 64.6%, 95%CI 41.6– 84.6% vs. after: 35.8%, 95%CI 20.5– 52.6%, p=0.046).

Conclusion: Delirium and pain prevalence among adults admitted to ICUs have decreased since publication of pain, agitation and delirium guidelines. However, both remain common, occurring in up to one-half of patients.

Donation Physician Specialist and Missed Donation Opportunities

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Background:
Organ and tissue donation is an important component of end-of-life care for critically ill patients and their families. It also reduces the need for hospitalization and costly organ replacement therapy, making it a cost-effective option. Given the benefits to donors, recipients, and society, failure by healthcare teams to offer donation when appropriate is increasingly seen as a medical error, a “never event.” Retrospective studies show that missed donation opportunities are common worldwide. This quality improvement study examined deaths among critically ill patients in Alberta over 42 months to determine the incidence and risk factors for missed donation opportunities.

Study Design:
This cohort study used interrupted time series analysis to compare baseline data from Alberta intensive care units and emergency departments with data from the first 3 years of a Donation Physician (DP) program. It included consecutive deceased, critically ill patients with brain injuries who received mechanical ventilation within 12 hours of death.

Results:
There were 1072 eligible donors, including 635 (59%) following death by neurologic criteria and 437 (41%) following death by circulatory criteria. During the initial 36 months of the DP program, 129 of 942 (14%) eligible potential donors were missed, compared with 43 of 123 (33%) during 6 months of baseline data ($P < .001$). Monthly missed cases decreased by 10.9% (95%CI, −22.0% to 0.3%; $P = .06$) following the start of the program and then declined −0.7% (95%CI, −0.9%to −0.5%; $P < .001$). Notification of the donation organization increased 0.9%. The donation rate increased from 14.0 to 23.7 donors per million. Missed opportunities occurred in 3% of eligible donors with a DP physician versus 17% without ($P < .001$).

Conclusion:
In consecutive eligible organ donors, implementing a DP program was associated with sustained reductions in missed donation opportunities, increased referrals, and higher deceased donation rates.

Multiplex Point-of-Care MIP Biosensor for Severe Traumatic Brain Injury Diagnosis and Prognosis

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Background:
Severe traumatic brain injury (sTBI) is a leading cause of death and disability, and current imaging and clinical assessments often fail to predict outcomes in the acute phase. Metabolomic analyses have previously identified several metabolites and protein biomarkers associated with sTBI severity and mortality. The present study focuses on the validation phase, integrating these biomarkers into a multiplex molecularly imprinted polymer (MIP) biosensor for point-of-care applications.

Method:
Extensive statistical modeling of plasma metabolomics data (LC-MS/MS and NMR) from sTBI patients refined hundreds of analytes to 3–6 key metabolites with strong diagnostic and prognostic potential. Electrochemical MIP biosensors have already been developed for selected metabolites, including lactate, and for glial fibrillary acidic protein (GFAP), a well-established astroglia injury marker. The next step integrates 3–4 informative metabolites with GFAP into a multiplex microfluidic biosensor for near bedside small-volume blood analysis. Validation will be conducted in three phases using two multicenter cohorts—CanTBI (Canada) and TRACK-TBI (USA)—to assess analytical performance, reproducibility, and clinical validity.

Results:
Identified metabolites demonstrated strong discriminative and prognostic performance (AUC > 0.85). Prototype MIP sensors for lactate and GFAP achieved nanomolar sensitivity, excellent selectivity, and rapid response times (<10 minutes), confirming feasibility for real-time testing.

Conclusion:
This validation-phase study bridges metabolomic biomarker discovery and biosensor engineering to deliver a multiplex MIP-based diagnostic platform. The technology aims to enable bedside biochemical assessment of sTBI, improving early diagnosis, prognostic accuracy, and personalized clinical decision-making.

Effectiveness of quality improvement interventions in reducing low-value laboratory test utilization in adult intensive care units: a systematic review and meta-analysis

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Background:
Patients admitted to intensive care units (ICUs) undergo routine blood testing where up to 48% of tests yield normal results. Unnecessary tests increase patient discomfort, can lead to overdiagnosis, iatrogenic anemia, need for blood transfusions, and waste resources. This study explored the effectiveness of quality improvement interventions to reduce low-value blood testing (e.g. no valid indication) in adult ICUs.

Study Design:
A systematic review and meta-analysis were conducted by searching four databases from inception to October 2024. Randomized or quasi-experimental studies on patients admitted to adult ICUs were included, while observational studies and those on pediatric populations excluded. Eligibility assessments were conducted independently and in duplicate. The primary outcome was the number of low-value blood tests ordered per patient-day. Risk of bias was assessed using the ROBINS-I tool. Data were pooled in a meta-analysis using a random-effects model.

Results:
Our search identified 15,400 studies; here we report results from 4,350 Medline citations. We completed full-text reviews of 116 articles and extracted data from 20. Studies captured 87,723 patients and 1,286,338 blood tests. Ninety percent of studies (n=18) used multi-component quality improvement interventions or education, and 70% (n=14) used guidelines or protocols. Eight articles were included in a meta-analysis that suggested a pooled relative reduction (RR) of 0.72 low-value blood tests per patient-day (95%CI 0.60–0.85). Subgroup analyses suggested that interventions focused on arterial blood gases (RR=0.62, 95%CI 0.55–0.69) were more effective than those targeting a broader number of blood tests (RR=0.80, 95%CI 0.72–0.88). Studies had moderate to high risk of bias due to weaker study designs.

Conclusion:
Quality improvement interventions focused on low-value blood tests successfully reduced low-value blood tests by 28% per patient day relative to baseline. Greater reductions were observed among interventions focused on arterial blood gases compared a broad group of blood test types.

Understanding Nurse Practitioner work in Multisystem Intensive Care Units: A focus group study

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Background:
Nurse practitioners (NPs) in Canada have been integrated into intensive care units (ICU) as part of a team-based model of care. Previous studies have compared outcomes of NP teams demonstrating overall non-inferiority compared to physician trainees with similar mortality, ventilation days, and length of stay. The use of these measures to evaluate the NP role is severely inadequate, as these outcomes are impacted by multiple factors and better reflect high functioning teams and healthcare delivery systems. With the growth of the NP workforce in Canadian ICUs, a better understanding of NP practice is needed to ensure workforce optimization and sustainability. To date, there have been no studies exploring NPs' perception of their impact in ICU. To address this gap and explore possible quality metrics that best reflect NP practice, we sought to understand the perceived impact and barriers for ICU NPs working in Alberta.

Study Design
We conducted two province-wide, online focus groups with NPs who work in adult ICUs. Analysis was guided by a multi-level, socio-institutional lens of macro-, meso- and micro-perspectives to differentiate personal, institutional, and societal impacts on practice. The focus group transcripts were independently coded by the researchers.

Results
Seven ICU NPs (response rate 58%) participated. Participants described areas of impact for NPs in 3 main themes: continuity of care, clinical expertise, and leadership. Barriers to NP practice were identified as the lack of role clarity, underrepresentation in formal leadership, and lack of workforce sustainability.

Conclusions
This focus group study further substantiates the comprehensive practice of ICU NPs. The themes identified in this study can be used as scaffolding for role creation and evaluation while addressing barriers NPS face in practice. Further exploration is needed to improve NP leadership in ICU structures and address the burden of attrition that threatens our practice.

Supporting Child Visitors in the Intensive Care Unit: A Multisite, Cross-Sectional Survey of Healthcare Provider Perspectives

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Background:
HCPs in ICU are often faced with supporting child visitors in crisis situations. Visiting family is crucial to the psychological well-being of children. Additionally, healthcare for Indigenous people in Canada is blanketed by racism, exemplified by families expressing concern that children will be apprehended by child services, further contributing to children not being present in ICU. The absence of studies exploring the experience of child visitors in ICU perpetuates the assumption that ICU is an unsafe place for children. Without the proper tools to support child visitors there may be unaccounted for impacts on children, including fear, anxiety, and adjustment issues.To provide safe, developmentally appropriate patient and family centered care (PFCC), we aim to understand healthcare provider's (HCP) perspective on the barriers and facilitators to supporting child visitors in ICU.

Study Design
We have developed a survey with interdisciplinary HCP, Indigenous community members, PFCC representatives, and adults who experienced ICU as children to explore facilitators and barriers to child visitors in ICU. The survey was distributed electronically to HCP in ICU who provide direct support to families and data was analyzed using descriptive statistics.

Results:
The survey explored HCPs' perception of operational barriers (restricted visiting hours, infection prevention policies, or general restriction of child visitors) and non-operational barriers (lack of healthcare provider education to support children or discomfort communicating based the developmental understanding of the child) to better understand barriers that may prevent meaningful visits. Facilitators explored in the survey include staff education, child-friendly resources, and dedicated staff to support child visitors.

Conclusion:
Through the understanding of barriers and facilitators of child visitors in ICU we hope to create lasting interdisciplinary collaborations to support families facing critical illness.

Association Between Spinal Anesthesia and Postoperative Outcomes in Cardiac Surgery: A Retrospective Cohort Study

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Background and Rationale:
Cardiac surgery patients experience significant postoperative pain, which can impair recovery and prolong hospital stay. Spinal anesthesia, by providing both analgesia and attenuation of the sympathetic stress response, may improve outcomes. Although routinely used in Calgary for decades, this practice has not been rigorously evaluated.

Study Design:
We conducted a retrospective cohort study of adults admitted to the Calgary Cardiovascular ICU over 18 months. The primary outcome was ICU length of stay (LOS), assessed as median (IQR) and extended Cox regression to explore time-varying effects. Secondary outcomes were hospital LOS, time to extubation, and 24-hour postoperative opioid use (oral morphine equivalent). Data were extracted from provincial databases. Patients were grouped based on receipt of pre-induction single-shot spinal. Propensity scores were used to match spinal patients with controls 1:1 to balance baseline characteristics.

Results:
1,648 patients met inclusion criteria, of whom 235 (14%) received spinals. 208 spinal patients were matched with controls. The primary outcome ICU LOS was similar in the spinal (median 0.90, IQR 0.79 to 1.79 days) vs control groups (median 0.91, IQR 0.76 to 1.84) days; $p = 0.64$). However, extended Cox regression demonstrated a time-varying effect in that the initial hazard of ICU discharge was higher among spinal vs control patients (HR 3.33, 95% CI 2.12 to 5.26; $p < 0.001$), but was attenuated over time (treatment-time interaction HR 0.64, 95% CI 0.50 to 0.81; $p < 0.001$). Hospital LOS (5.8 vs 5.8 days; $p = 0.47$) and time to extubation (5.6 vs 7.3 hours; $p = 0.074$) were similar in the spinal vs control groups, respectively. Initial opioid use was lower in the spinal group (mean difference -13mg, 95% CI -20mg to -6 mg; $p <0.001$).

Conclusion:
Spinal anesthesia was not associated with shorter ICU or hospital stays but was associated with a transient early discharge effect and reduced postoperative opioid requirements.

An environmental scan of resident-focused trauma-informed medical education policy in Canada

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Background:
Many resident physicians experience psychological trauma, with impacts on learning, patient care, relationships, mental health, and well-being. Trauma-informed approaches to medical education have been recommended in the literature although it is not clear whether such approaches have been adopted. The purpose of this study was to identify institutional policies on resident-focused trauma-informed medical education (RF-TIME) in Canada.

Study design:
An environmental scan of public-facing websites of Canadian medical schools (n=18) and partner organizations involved in the governance of resident training, licensure and support (n=42) was performed (December 2024 – June 2025). The initial focus on policy was expanded to include strategic planning, standards, guidelines, reports, educational documents and support resources.

Results:
We found no RF-TIME specific policies at any Canadian medical school or partner organization. Thirteen schools briefly mentioned RF-TIME approaches within strategic planning (*n* = 3 schools), policies not focused on trauma (*n* = 9), guidelines (*n* = 1), reports (*n* = 3), educational resources (*n* = 3), and/or support resources (*n* = 8). Seventeen partner organizations included RF-TIME content in a limited way within strategic planning (*n* = 2 organizations), standards (*n* = *2*), guidelines (*n* = *1*), reports (*n* = 9), educational resources (*n* = 2), and/or support resources (*n* = 4).

Conclusion: Canadian institutions involved in resident training demonstrate limited engagement with psychological trauma among residents. Policies and procedures are needed to address both the needs of residents with psychological traumatic injury and the many factors in residency education that can contribute to and exacerbate psychological trauma.