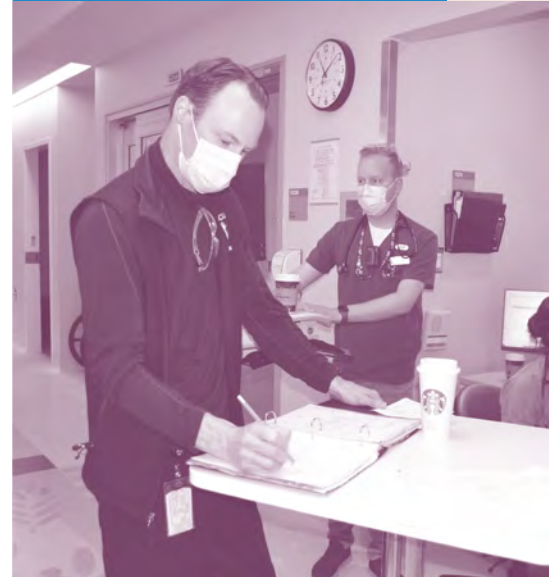


## Department of Critical Care Medicine

### Calgary Zone



# 2021 Annual Report



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# Message from Department Head



I'm thrilled to present, on behalf of my colleagues throughout our department, the 2021 annual report for the Department of Critical Care Medicine.

Herein we report on important work and accomplishments in addition to challenges we faced during another extraordinary pandemic year. As a clinical and academic department, we integrate clinical programs, education and research to deliver exceptional patient and family centred-care to critically ill patients in the Calgary Zone and associated referral area. Our greatest resources are always our people who are dedicated to the service of others.

#### Some notable events from 2021 include:

- Continuing to learn, manage and adapt to the changing COVID-19 pandemic, including expanding critical care capacity in the Calgary Zone to over 200% of baseline
- Adaptation of our family resources and guidelines over the course of the pandemic to better support safe but inclusive patient and family centred care
- Achieving significant research success in the setting of an unprecedented pandemic, leading and contributing to important local, national and international scholarship related to both COVID-19 related and other critical care clinical and basic science
- Getting ready for Connect Care - helping shape the content, system design and optimization for use in critical care in Calgary and throughout the province
- Accomplishing substantial quality improvement and knowledge translation work despite pandemic restrictions – contributing to care pathways to optimize the care of patients with pandemic relevant diseases and continuing the journey to deliver value based care
- Successfully actioned a departmental clinical ARP for critical care service at three sites

Despite a continually evolving pandemic, our departmental members continue to lead critical care through their commitment to clinical care, education and research producing exceptional patient-and-family-centered care and continually advancing both the art and science of critical care.

Respetfully,

A handwritten signature in black ink, appearing to read 'Dan Zuege'.

**Dan Zuege MD, MSc, FRCPC**

## Department of Critical Care Mission & Vision

- Alberta Health Services
- DCCM Calgary Zone
- Cumming School of Medicine



## Mission & Vision

## Our Values

**compassion**

We show kindness and empathy for all in our care, and for each other.

**accountability**

We are honest, principled and transparent.

**respect**

We treat others with respect and dignity.

**excellence**

We strive to be our best and give our best.

**safety**

We place safety and quality improvement at the centre of all our decisions.



### VISION

Healthy Albertans.  
Healthy Communities.  
**Together.**

### MISSION

To provide a patient-focused, quality health system that is accessible and sustainable for all Albertans.

## Department of Critical Care Medicine

### VISION

Exceptional patient-and-family-centered critical care.

### MISSION

We lead critical care medicine through our commitment to clinical care, education and research. Our definition of critical care excellence is: best clinical outcomes, exceptional patient and family experience and zero preventable patient and staff harm.

### VALUES

1. Multidisciplinary teamwork is evident in our clinical care, education and research
2. Clear expectations and regular feedback.
3. DCCM is regarded by members to be a great place to work. We model professionalism.
4. Nationally recognized for clinical care, education and research.
5. We report near misses and adverse events and focus on system improvement.

## Cumming School of Medicine University of Calgary



### VISION

Creating the future of health.

### MISSION

The Cumming School of Medicine (CSM) is driven to create the future of health. We are a proud leader with seven world-class research institutes and more than 2,700 students, as well as faculty and staff, working to advance education and research in precision medicine and precision public health (PM/PPH), improving lives in our community and around the world.

The CSM's strategic plan focuses on three key areas — people, platforms and partnerships. By continuing to strategically focus on and invest our resources in these three priority areas, we're creating the ability to focus on PM/PPH; an individualized approach to patient diagnosis, treatment and disease prevention, and the use of emerging technologies to better enhance precision in healthcare. The school is named in honour of UCalgary alumnus Geoffrey Cumming, who provided the largest single philanthropic gift in the university's history in 2014. The CSM marked its golden anniversary in 2017, celebrating 50 years since our doors opened.



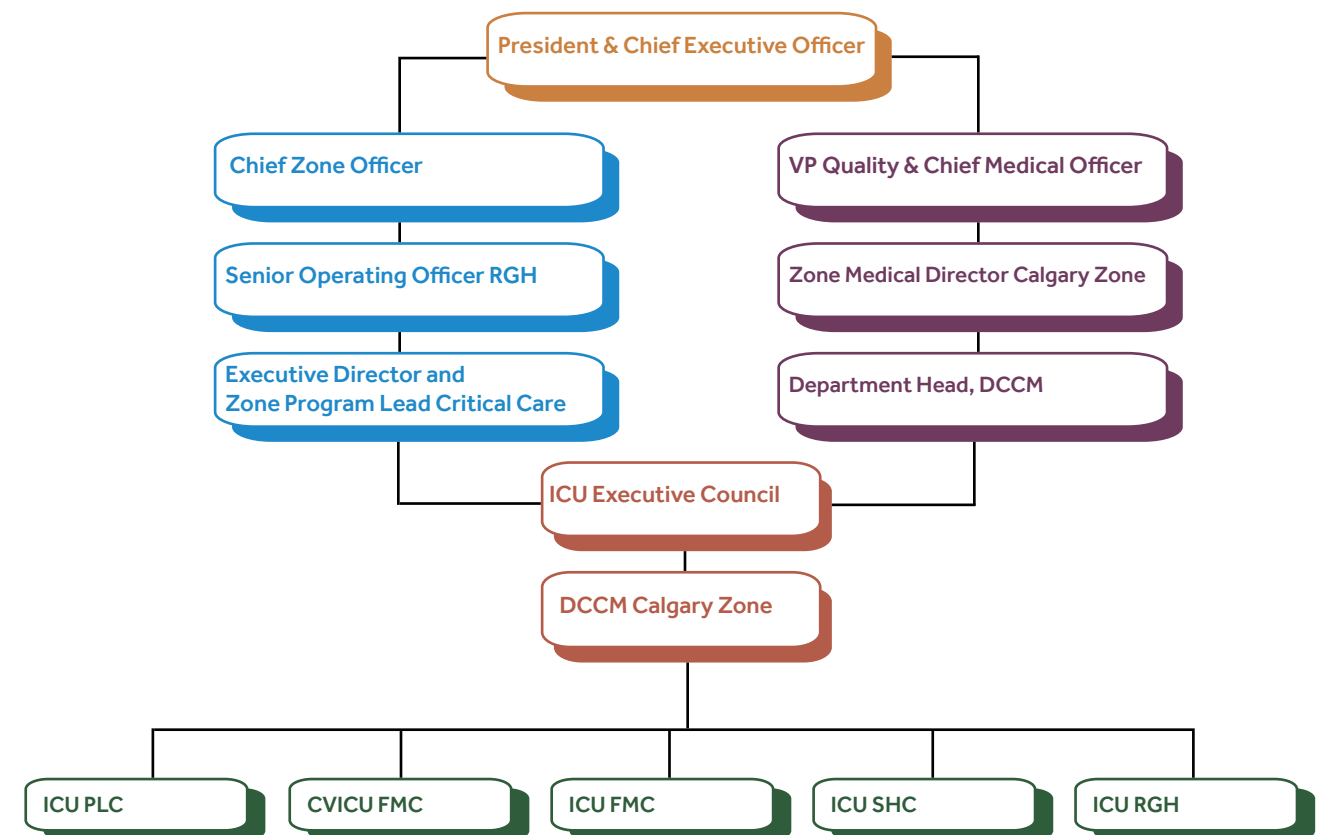
# Department Organization, Strategic Planning & Teams

The Departmental functions are principally located at the four acute care sites, with the Peter Lougheed Medical Centre (PLC), Rockyview General Hospital (RGH) and South Health Campus Hospital (SHC) providing general intensive care services while the Foothills Medical Centre (FMC), in addition, provides tertiary services for Trauma and Neurosciences patients. Cardiovascular Surgery Intensive Care Services (CVICU) are provided at the Foothills Medical Centre in a distinct ICU under the supervision of Intensivists from the Department of Critical Care Medicine.

## Organizational Charts Critical Care Calgary Zone

# GOVERNANCE

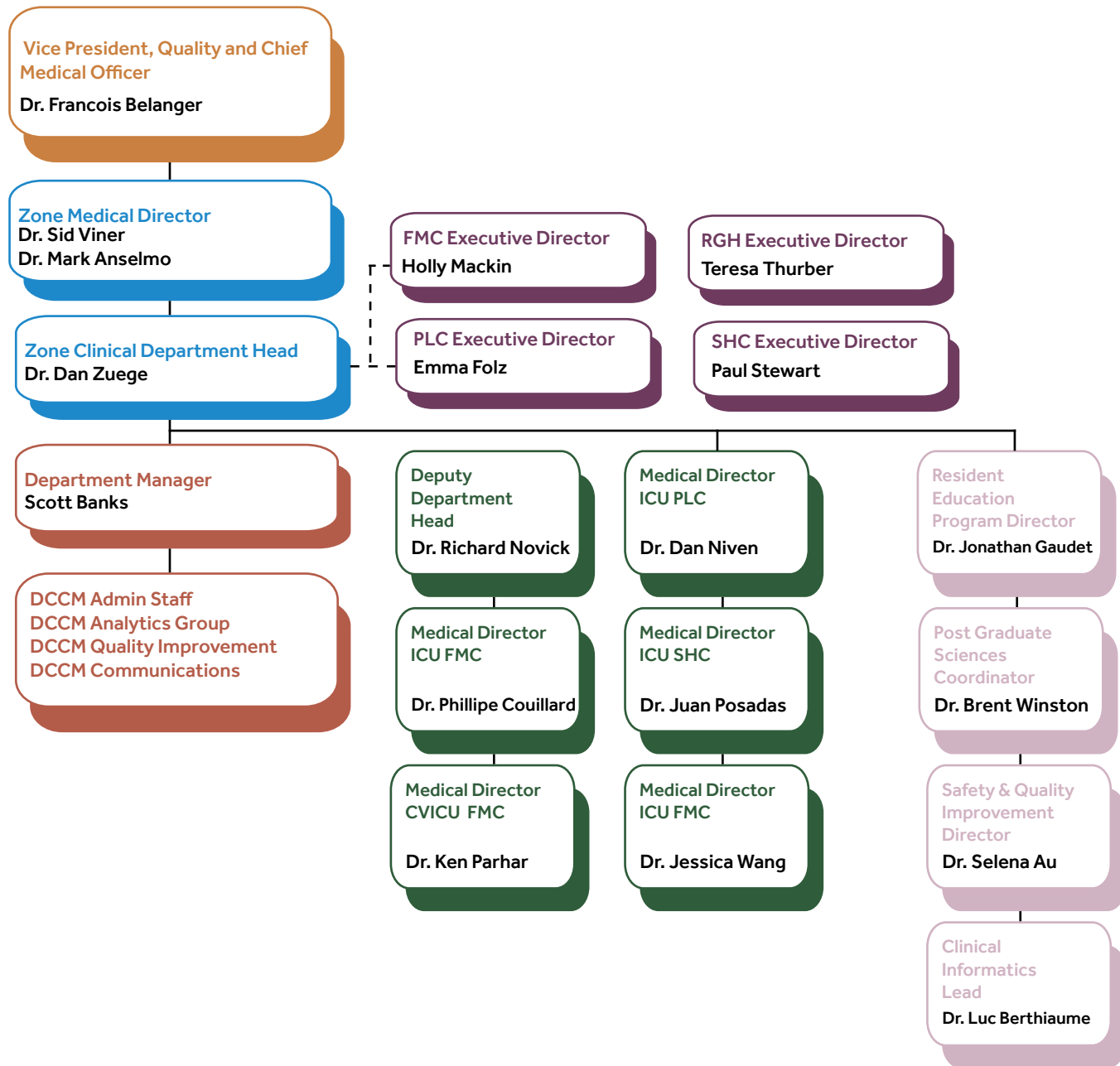
The Calgary Zone reporting relationships and governance of DCCM are provided in the schema outlined below. The DCCM Head is a member of the Zonal Medical Advisory Committee. All DCCM members share responsibility for the vision, goals and advancement of all facets of the Department: exceptional patient-and-family centered critical care. We lead critical care through our commitment to clinical care, education and research. The Department head meets with the members of the Department, Medical Executive Committee and also with the Zonal ICU Executive Council for operational issues on a regular basis. Participation by medical and non-medical ICU practitioners in our weekly Grand Rounds, our annual Research Day, our site based & Zonal Morbidity and Mortality working group review processes with direct links to our Departmental Quality Assurance Committee and finally social programs foster our strong Zonal and inter-disciplinary cooperation.



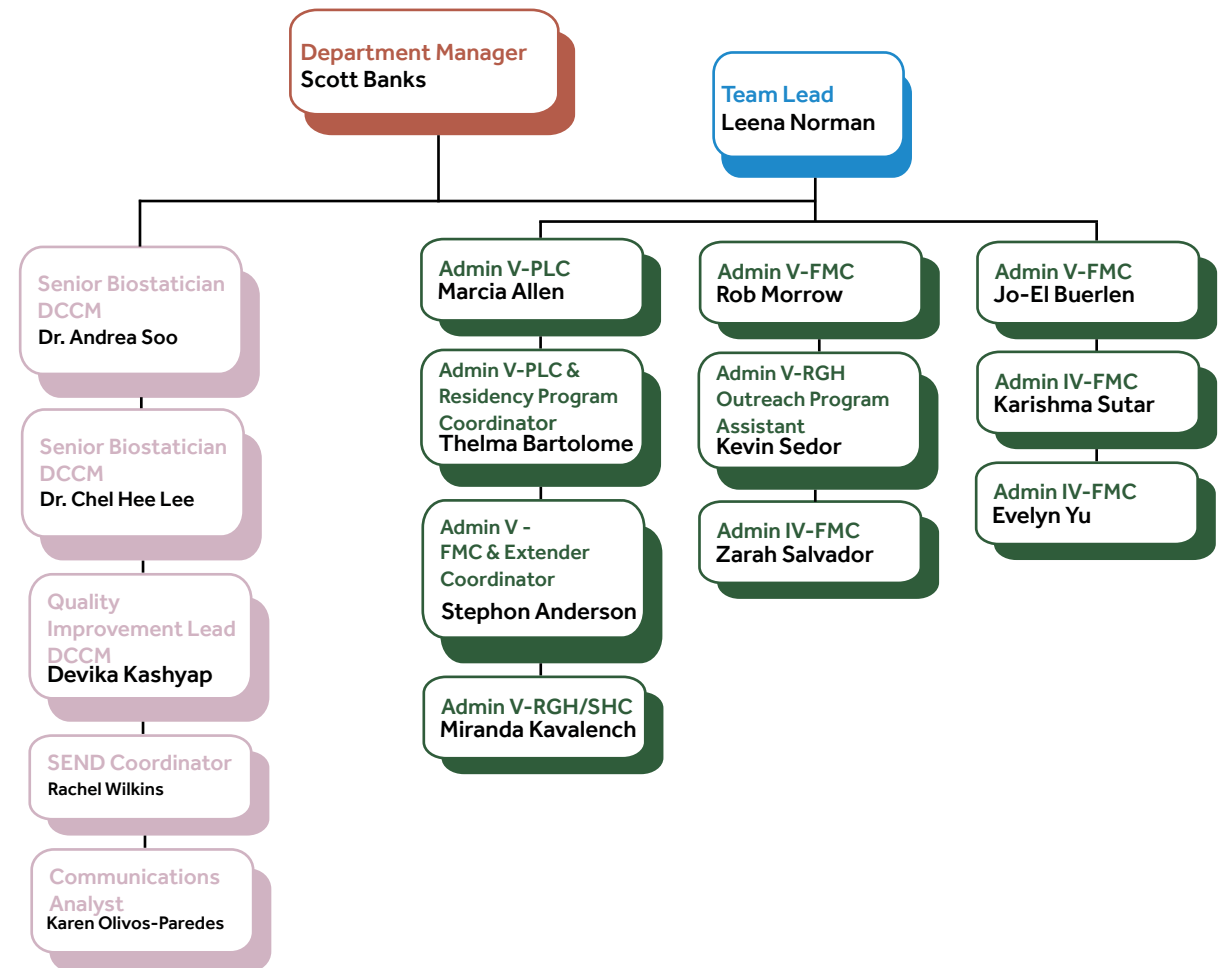
# Organizational Charts

## Critical Care Calgary Zone

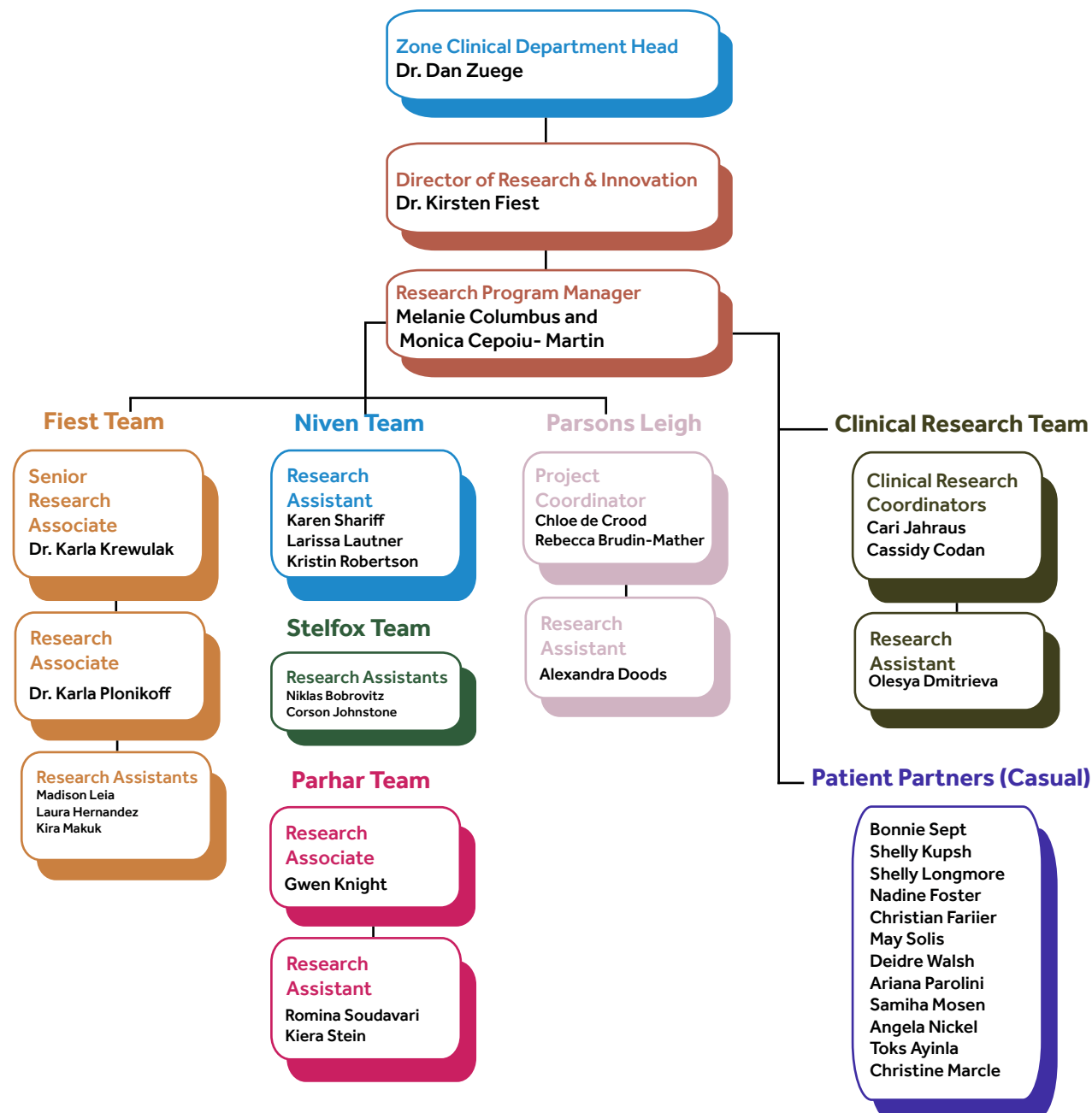
### Medical Leadership & Administration



### Administration & Support Staff



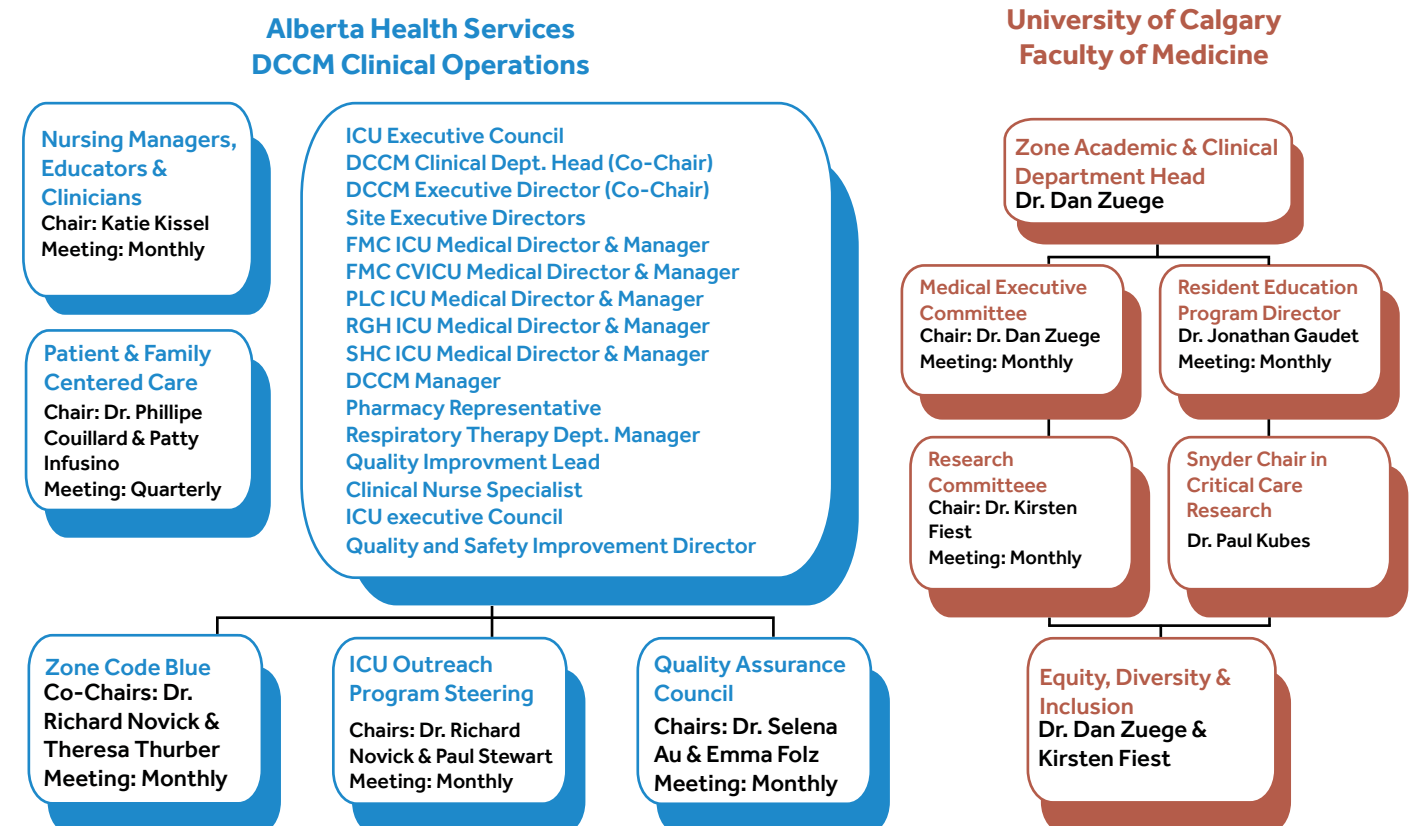
## Clinical Research AHS & University of Calgary



## Councils and Committees

The following Departmental Councils and Committees meets on a regular basis based on the Terms of Reference for each group. Councils more often have a zone mandate and a broader inter-professional representation than committees.

- Equity, Diversity, & Inclusion Committee
- DCCM Business Meeting
- DCCM Clinical Research Meeting
- ICU Executive Council
- ICU Medical Executive Committee
- Mortality Working Group
- Quality Assurance Committee
- Zonal ICU Outreach Steering Committee
- Zonal Code Blue Committee Meeting



## Focus Area: Clinical Care

### Goal

Exceptional patient care that uses practices to optimize patient health outcomes

### Objectives

Develop a framework for quality management

### Activities

1. Identify the needs of patients and the critical care team to optimize patient care and co-develop metrics to measure performance
2. Develop a strategy to align clinical guidelines, pathways and performance metrics with current and future clinical information systems

## Focus Area: Leadership

### Goal

Develop a Just Culture

### Objectives

Provide leadership and support for a Just Culture

### Activities

1. Leadership communication to all members that patient & staff safety is a departmental priority.
2. Discuss quality of care at every ICU executive meeting and at unit meetings

### Objectives

Align all quality assurance activities with Just Culture principles

### Activities

1. Educate all members on the principles of Just Culture & their application to the department
2. Task the Quality Assurance Committee to champion Just Culture principles that included patient and team perspectives

## Focus Area: Education

### Goal #1

Successful transition of critical care medicine residency program (Competence by Design)

### Objectives

Successful implementation of CBD transition plan

### Activities

1. Train all physicians on the fundamental of CBD and support them during the transition
2. Evaluate the effectiveness of the CBD program

### Goal #2

Professional development to support DCCM member's pursuit of excellence

### Objectives

Continuous growth and development of members

### Activities

1. Solicit feedback to inform professional development opportunities
2. Establish expectations for participation in professional development activities
3. Foster a culture of growth
4. Incorporate educational activities in the accountabilities of all physicians and CSM faculty



## Focus Area: Research

**Goal #1**  
Increase interdisciplinary research infrastructure

**Objectives**  
Maximize impact of departmental investment in research

### Activities

1. Complete implementations of existing DCCM Clinical Research Strategic Plan
2. Develop and implement a framework for prioritizing investments in research that leverages existing departmental strengths
3. Establish research fund development strategy
4. Support inter-professional research collaborations across departmental sites

**Goal #2**  
Increase member capacity for research

**Objectives**  
Capacitate members to engage in research

### Activities

1. Incorporate research activities into the accountabilities of all physicians and CSM faculty
2. Encourage development of interdisciplinary research teams with synergistic interest and expertise
3. Develop an interdisciplinary research training strategy

## Members of the Department

Member profiles have been moved to the website. This allows us to provide the most up-to-date list of department members.

There are six categories that members are categorized into:

- Leadership
- Medical Professionals
- Education
- Research
- Student / Trainee
- Support Staff



[view profiles here](#)

## Workforce Planning

### Summary of Recruitment

- Dr. Kevin Solverson, DCCM Intensivist
- Dr. Selena Au, Interim Medical Director, Rockyview Hospital
- Dr. Dan Niven, Medical Director, Peter Lougheed Hospital
- Dr. Jonathan Gaudet, CME Coordinator

### University of Calgary Academic Promotions

- Dr. Andreas Kramer - promotion to Clinical Professor effective July 1, 2021
- Dr. Kirsten Fiest – tenure and promotion to Associate Professor effective July 1, 2021
- Dr. Phillippe Couillard – promotion to Clinical Associate Professor effective July 1, 2021
- Dr. Ken Parhar - promotion to Clinical Associate Professor effective July 1, 2021

# DCCM Awards & Accomplishments



## DCCM Awards/Recognition/Promotions

<b>Michael Dunham</b>	Surgery - Honor Roll
<b>Julie Kromm</b>	Course 5 Gold Star
<b>Jason Waechter</b>	Course 3 Gold Star ECGs for Dummies Award
<b>Natalia Jaworska</b>	Behind-the-Scene Award - pre-clerkship
<b>Jason Waechter</b>	Certificate of Appreciation, Dentistry Program
<b>Kirsten Fiest</b>	Promoted to Associate Professor OADR Grant Development Webinar series appreciation Killam Emerging Research Leader Award
<b>Andreas Kramer</b>	Promoted to Clinical Professor
<b>Ken Parhar</b>	Promoted to Clinical Associate Professor
<b>Philippe Couillard</b>	Promoted to Clinical Associate Professor
<b>Bryan Yipp</b>	OADR Grant Development Webinar series appreciation
<b>Jonathan Gaudet</b>	Royal College Program Director of the Year
<b>Brent Winston</b>	The Michael Ward Award from the Canadian Critical Care Forum for the best basic or translational science study.
<b>Tom Stelfox</b>	2021 CIHR-ICRH/CCCS Distinguished Lecturer Award in Critical Care Sciences. Canadian Institutes of Health Research at the 2021 Critical Care Canada Forum.
<b>Michael Dunham</b>	Gold Star teaching award, UofC Off Service Preceptor of the Year Award, Emergency Medicine
<b>Karla Krewulak</b>	Garner King Award for best clinical or quality improvement study

# Communications

DCCM is a joint clinical and academic department, Alberta Health Services – Calgary Zone and Cumming School of Medicine University of Calgary. It is comprised of members spanning multiple disciplines dedicated to improving the care and health of critically ill patients and their families. DCCM leads critical care through our commitment to clinical care, education and research.

As a department our vision is to provide exceptional patient-and-family-centered critical care and our mission is to lead critical care through our commitment to clinical care, education and research. Communications plays a crucial role in our organization's success, our communications tactics ensure all administrative, operational & educational aspects of our department run smoothly and are up to date.

## SMART Goals

- S: Our communication goal is to establish an effective and transparent channel for us to disseminate information to our team and stakeholders
- M: How we measure our success- satisfaction with our team and our stakeholders. We can hold bi-annual survey that measures how transparent, effective and relevant our content and distribution channels are.
- A: Our communications plan is concrete and straightforward, at the core of what our role is to be a tool and resource to our department.
- R: Clear and straightforward communications is part of the core of the department, for DCCM a communications plan is relevant not only for the organizational aspects (Insite web publishing) but also to celebrate our team and our department's accomplishments.
- T: Our communications strategy and tactics can be continuously assessed through our bi-annual survey and a full audit can be conducted with every department annual review.

## Our Audience

DCCM'S primary audience are our staff and physicians. Out of the 4 communications channel 3 of them are directly targeted and can only be accessed as an AHS employee. A key distinction within the DCCM communications scope is that our audience often times are also our content creators. The synergy between our audience and our communications materials presents a unique entity for DCCM. As result, a key goal in our strategy is to maintain an effective and transparent communications channel.

Our secondary audience is our community. Because, DCCM is a joint clinical and academic department our public platform exists on the UCalgary Cumming School of Medicine Website. The UCalgary Critical Care platform is a part of The School of Medicine's portfolio. In this site, the information available encompasses our team, education and research. In addition, UCalgary site serves a resource to attract medical talent.

## Current Communications Channels & Materials:

### InSite Website (Internal)

Our InSite website is our main point of contact for our staff and team. We host both clinical and education resources on this site. In this site, each page has an owner and they are responsible submitting updates and keeping their content up to date.

### U of C Website (External)

The Critical Care Medicine platform on the University of Calgary website is DCCM's public platform. On this site we include a description of our department, the scope of our work and our team members. In addition, we have resources related to our academic program for prospecting talent and we do post and advertise professional opportunities on this site.

### Newsletters

The DCCM Newsletter is a monthly or bi-monthly reoccurring issue. One of the main features of this communications material is the intro address. This opening section of the newsletter includes a thank you message dedicated towards DCCM staff on behalf of the DCCM executive council and a "Department at a Glance" infographic which captures clinical statistics and bed capacity. The main objective of our department newsletter is to celebrate our talented staff, we include patient success stories, department research and other news worthy DCCM items.

### Grand Rounds

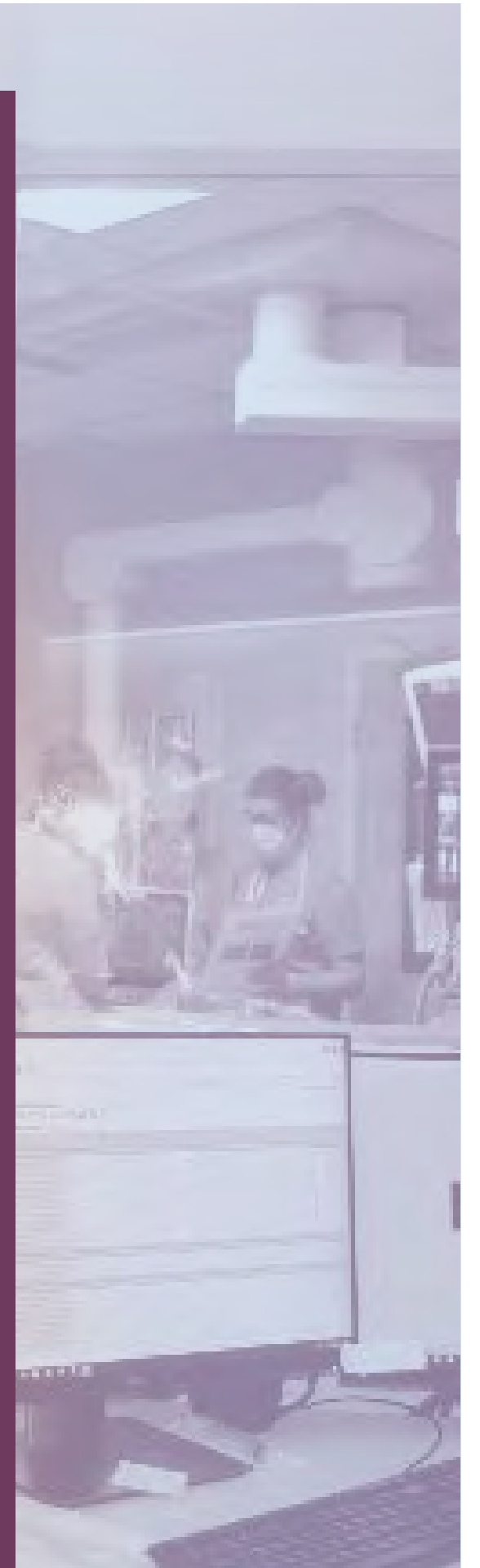
Within our Insite website, DCCM has a designated page for the education's program Grand Rounds. DCCM's Grand Rounds model, includes a video presentation which we update weekly on our website. DCCM Grand Rounds (presentation and video) are posted for easy access on our website.

## Summary

Our communications goal is to maintain an effective and transparent channel for DCCM. Along with keeping our stakeholders in mind we will conduct a bi-annual assessment of our communication channels and materials to ensure our platforms up to date and the workflow is efficient.

## Another Year of COVID-19

DCCM began 2021 in the midst of a second wave of COVID-19 in the province. Just as the year before, COVID-19 created significant challenges to our department from a clinical and organizational perspective. However, in the midst of adversity we are proud to share that our DCCM staff rose to the occasion time and time again.



## Wave Three (March 22nd - July 1st 2021)

At the peak of Wave 3, we added 52 additional surge beds beyond our usual 66 bed capacity; an increase of 175%. As far as we know, throughout this time, our patients were cared for safely and efficiently with no significant changes in adverse events despite the amount of intra-zonal load leveling required and significant adjustments of our usual team models of care which were required to manage an extraordinary increase in patient load. As our province moved into a new phase of relaunching, DCCM was proud to report that in addition to the thousands of patients we have cared for, another outstanding achievement by our ICU teams is that there were no outbreaks in our ICU's. Moreover, as far as we know, no physicians or staff contracted COVID from the workplace.

## Wave Four (July 18th to September 30th, 2021)

During Wave 4 our team was incredibly adaptable and innovative in ensuring our operations continued to run as smoothly as possible while remaining committed to the highest standard of care for our patients. This has not been an easy feat in the face of COVID-19.

From August 2021 to September 2021 our team achieved the following together:

- A massive and timely bed expansion of +72 surge beds; an unprecedented increase to operating over 200% of our usual baseline capacity
- Adoption of efficient care standards
- Offloaded a total of 45 patients from other overwhelmed zones as part of our provincial Critical Care community ( from the South, Central and North Zones collectively)

What our department achieved could not have been done without the flexibility, dedication and diligence of the 347 nurses mobilized and through reassignment & redeployment, the addition 121 pandemic surge physicians, 39 respiratory therapists and of course the admins and behind-the-scenes staff who keep the trains running on time.

## Wave Five (Dec 1st 2021- March 15th, 2022)

We closed 2021 in the midst of another COVID-19 wave, although the Omicron variant impacted our critical care resources and ICU services significantly less in comparison to previous waves, DCCM experienced a substantial effect on our units and staffing. All our hard-working ICU staff have been impacted by the virus through sickness in either friends or family, and of course by having to cover hours and work to make up for colleagues who unable to work because of illness. A silver lining: Critical Care having been in the limelight over the last year of the pandemic had garnered the attention and support of executive leadership in Alberta Health Services and Alberta Health, leading to new investments in our department. This included funding to expand our ICU teams with additional ICU nursing staff, respiratory therapists and additional Nurse Practitioners to expand support at FMC and PLC. These are welcome additions to our already mighty medical and operational teams.

## Summary

DCCM would like to acknowledge the immense amount of courage displayed by each and every one of our DCCM team members throughout the past year. The word "courage" as defined by the Oxford Language Dictionary is "strength in the face of pain or grief"- that being said it takes an incredible amount of courage and resilience for us to do indispensable work to care for patients requiring Critical Care through the waves of COVID-19. Among some of the amazing feats we accomplished over the past year; our team learned to adapt and pivot to remain committed to the highest standard of care. Indeed, difficult times make for resilient people and resilient people make for successful teams.

DCCM would like to take a moment to give a big thanks to every single one of our Critical Care staff for always stepping up to the plate to not only adapt but also finding innovative ways to fill the gaps and meet the demand that COVID has thrown at our department. We know this isn't possible without a great deal of personal sacrifice. Our sincere hope is that as 2022 unfolds there is less COVID related demand and that we can we can allocate ICU resources to put more focus on ourselves and our loved ones; maintaining a mighty and resilient team for years to come.

COVID-19 4th Wave

# Redeployment

**\* Insights**

What we have accomplished so far

**72**  
Surge beds added to zone capacity

**45**  
Patients offloaded from South, Central & North Zones

**1,083**  
Patients admitted into our care in this 4th COVID-19 wave

**347**  
Nurses mobilized and through reassignment & redeployment

**39**  
Respiratory Therapist Mobilized through reassignment & redeployment

**121**  
surge physicians & anesthesiologists added to our team

**10%**  
efficiency

**21%**  
efficiency

**60%**  
efficiency

**11%**  
decrease in patients versus Wave 1 for ICU

**21%**  
decrease in patients versus Wave 2 for ICU

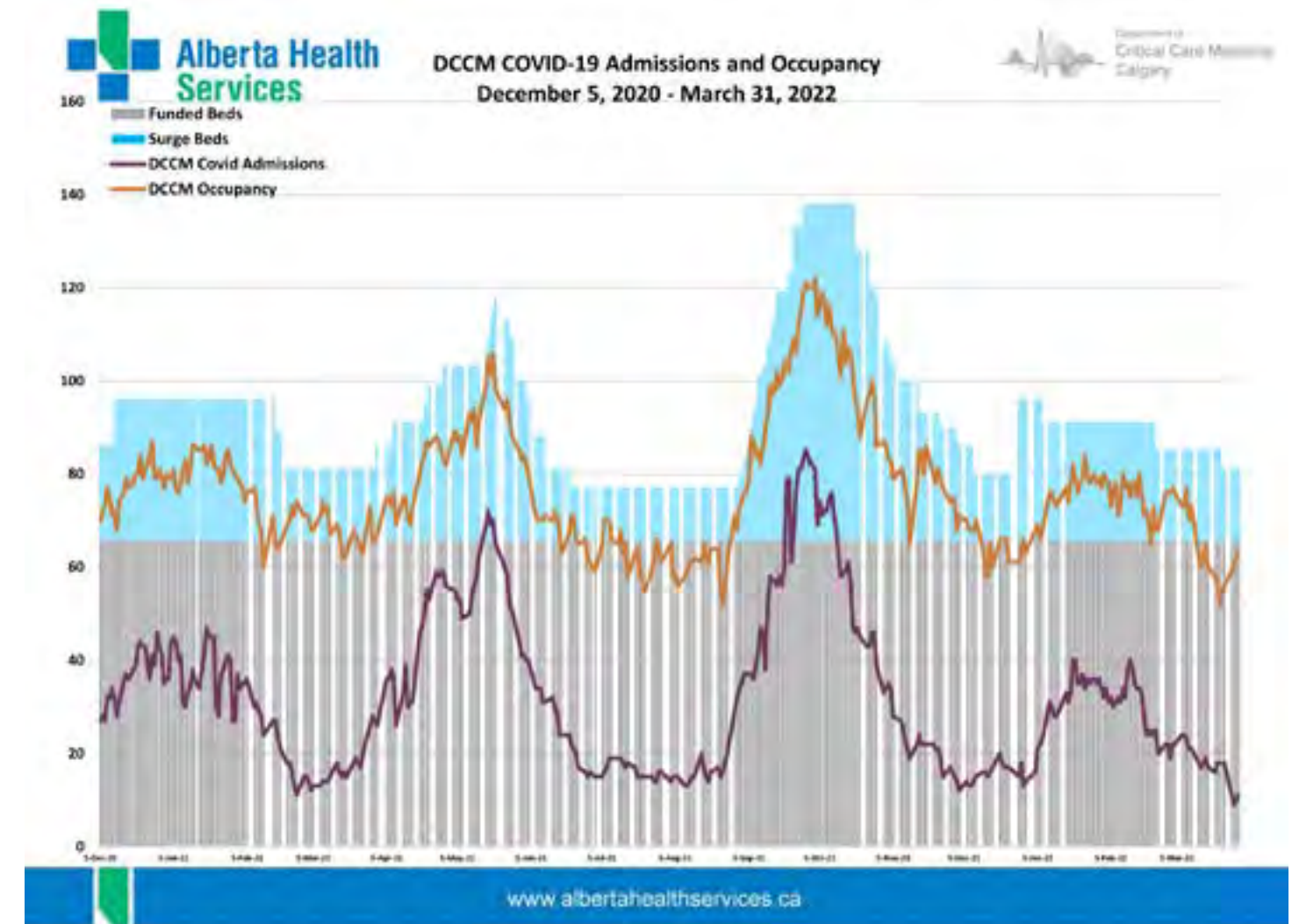
**60%**  
decrease in occupancy versus Wave 2 for ICU



What we have accomplished we could not have done without our team members' individual and collective support and sacrifice.

On behalf of the Calgary Zone Critical Care community – thank you.

## DCCM Occupancy & COVID-19 Admissions (December 5, 2021 – March 31, 2022)





## Site Updates

The Department of Critical Care Medicine (DCCM) is a joint clinical and academic department, Alberta Health Services – Calgary Zone and Cumming School of Medicine (CSM), University of Calgary. It is comprised of members spanning multiple disciplines dedicated to improving the care and health of critically ill patients and their families. We lead critical care through our commitment to clinical care, education and research.

A team of 33 intensivists, 1 physiatrist and 1 epidemiologist work alongside a multidisciplinary team of Registered Nurses, Respiratory Therapists, Pharmacists, Physiotherapists, Occupational Therapists, Speech Language Pathologists, Dieticians, Social Workers, Spiritual Care Specialists, Unit Clerks, Health Care Aides, Volunteers, Research Coordinators, QI Staff, Research Analysts and Administrative professionals between 5 adult intensive care units located in 4 hospitals across the Calgary Zone. We have a large complement of residents, medical students and fellows.

## Foothills Medical Centre (FMC)

The Foothills Medical Centre (FMC) ICU continues to support the largest hospital in Calgary by providing intensive care, code blue and outreach services to over 1100 inpatients and support many key programs for the zone; neurosurgery, stroke, hepatobiliary surgery, head and neck cancer reconstructive surgery, burn care, thoracic surgery, and the bone marrow transplant programs, to name a few.

The unit is physically organized into three separate pods with a funded capacity of 28 patients. Neurotrauma patients and medical-surgical patients are clustered.

In 2021, all efforts were focused on the COVID-19 Pandemic response and increasing ICU capacity. Frequent challenges and changes in our usual operations around Infection Prevention, & Control, cohorting of patients, family presence and human resources were met with adaptability and a focus on patient safety.

Our 28 bed unit treated 52 concurrent patients in Oct 2021 at the height of the pandemic. Recruitment of approximately 170 redeployed nursing staff from throughout the site and zone supported the capacity increase with RN's with and without previous ICU nursing experience joining the team after just in time education and worked to provide quality patient care in a team nursing model. Physician support from Residents and physicians from the Departments of Anesthesia and Emergency Medicine was crucial for the pandemic response.

FMC ICU embraces patients and families as partners in care and we encourage their presence at the bedside and involvement in care. One of the greatest challenges of the COVID-19 response were significant changes to family's access to our unit.



## Foothills Medical Centre (FMC Continued...)

When in- person attendance was not possible, implementation of virtual patient visits, virtual family attendance during daily multidisciplinary rounds, and virtual family conferences with the ICU team supported families in staying connected to their loved ones.

The ICU Outreach Team, with a ramp up RN & RRT model, continues to support the site. The team responded to over 825 Code 66 calls and 1100 follow up visits this past year. The team was instrumental in ongoing assessment and safe transfer of COVID-19 patients to ICU as well as providing support to inpatient unit teams during this time of high capacity and acuity.

Education and Research are essential components of the ICU and our specialty services offer unique and valuable learning experiences. FMC ICU hosts many learners, and continued to do so during the COVID-19 response, throughout the year including undergraduate nursing, Advanced Critical Care Nursing, Respiratory Therapy & Allied Health students along with Medical trainees and Fellows.

**Kelly Coutts, FMC Patient Care Manager**  
**Dr. Philippe Couillard, FMC ICU Medical Director**



## Foothills Medical Centre Cardiovascular Intensive Care Unit (FMC CVICU)

### Overview

The Cardiovascular Intensive Care (CVICU) provides high quality care for the post cardiac surgery patients. This can only happen with the amazing dedication, teamwork, and collaboration of all the departments and multidisciplinary teams involved throughout the cardiac surgery patients' journey. The unit has a total of 22 beds on two separate units (Units 94 and 104) with 16 of these beds currently funded.

The Cardiovascular Intensive Care Unit (CVICU) at the Foothills Medical Centre, is the only CVICU serving Southern Alberta with over 1400 cardiac surgery cases in 2021. The CVICU specializes in post-operative open heart surgery with the majority of cases being Coronary Artery Bypass Graft (CABG) and valve repair or replacement. Other post-operative surgeries cared for in the CVICU include complex thoracic aortic surgery, minimally invasive valve surgery including alternate approaches to femoral based Transcatheter Aortic Valve Replacement (TAVR), as well as Extracorporeal Life Support (ECLS) for both temporary heart and lung support (VV/VA ECMO) as well as Ventricular Assist Devices (VAD) which provide short term and more durable heart support.

### Patient Care

The CVICU multidisciplinary team, in particular the nursing team, has remained busy. In addition to taking care of post-cardiac surgical patients the team has played an essential role in the care of the COVID-19 patients during the pandemic. In addition to co-managing the COVID-19 patients supported by ECLS in the general systems ICU at FMC, CVICU nurses were deployed to assist with the additional nursing of patients in the general systems ICU or to take care of general systems patients transferred to CVICU. Team members are commended for their hard work, courage and dedication to provide care in many different ways during the pandemic.

The CVICU consists of a large multidisciplinary team:

- 110 Registered Nurses
- CVICU has the highest number of advanced certifications in critical care including IABP, CRRT, three VAD devices, Pulmonary Artery catheters, advanced pacing, Lumbar drains as well as other ICU advanced certifications

## Foothills Medical Centre Cardiovascular Intensive Care Unit (FMC CVICU) (Continued...)

- 1 Clinical Nurse Educator
- 10 Cardiovascular Intensivists MD's
- Seven intensivists have obtained advanced Echocardiography training
- Two Intensivists have additional training in ECLS
- 11 Cardiac Surgeons
- 19 Registered Respiratory Therapists
- 2 Physiotherapists
- 1 Clinical Pharmacist
- Many allied health care providers including Unit Clerks, Health Care Aids, housekeeping staff, social workers

### Quality & Improvement

Our dynamic multidisciplinary CVICU team continues work on Quality Improvement and re-search projects including:

- Relaunch of the Patient Flow Project – Optimizing patient flow from CVICU to cardiac surgery ward Unit 91. The goal is to improve the flow of patients from the CVICU to unit 91.
- Preparation for the SMART-BP study which is going to examine the use of wireless non-invasive real time blood pressure monitoring and compare it to invasive blood pressure monitoring.
- Participation in the Venting Wisely initiative which is a pan-provincial initiative to optimize the care provided to patients who are mechanically ventilated with hypoxemic respiratory failure and ARDS using a multidisciplinary evidence informed care pathway.
- Creation of a high-resolution quality improvement database for patients who are postoperative Cardiac Surgery to try and eliminate unnecessary variability in care.

### Education

The CVICU has a very robust, clinically engaged process of educating our nurses. The extensive advanced certifications require initial certification as well as annual recertification provided by the CVICU clinical nurse educator Chris Coltman. All new ICU nurses are part of the Department of Critical Care mentorship program. This program has been customized for CVICU and provides a supportive learning environment to allow nurses to become independent and highly skilled.

## Foothills Medical Centre Cardiovascular Intensive Care Unit (FMC CVICU) (Continued...)

The CVICU is heavily involved in a simulation program. The purchase of a specialized mannequin has enhanced the learning experience for emergent post-operative procedures. In addition with the COVID-19 pandemic, extensive simulation of the safe ECLS cannulation of COVID-19 patients using PPE and a new cannulation protocol was undertaken. The simulation involved members of the entire team, including Cardiac surgeons, Cardiac Anesthetists, CV-intensivists, operating room nurses and, anesthesia and non-anesthesia respiratory therapists as well as our multidisciplinary colleagues from the general systems ICU. Simulation in 2022 will be expanded to accidental hypothermia, cardiac catheterization lab, and CVICU ECLS emergencies.

**Barb Jones, FMC CVICU Patient Care Manager**  
**Dr. Ken Parhar, FMC CVICU Medical Director**

## Peter Lougheed Centre (PLC)

2021 COVID-19 response: expanded our 18 bed unit to 36 beds, having 1 ICU located in 2 separate areas. A change in the model of care was required during waves 3 and 4 to more of a team based focus with 1 ICU RN caring for 2 or 3 critically ill patients with the assistance of redeployed staff to the ICU. The surge was medically supported by redeployed residents as well as attending physicians from adult and pediatric emergency medicine, anesthesia and pediatric intensive care. Attending ICU physicians worked additional weeks on service to function as an additional team. ICU also had a team of staff from outside the ICU developed to assist with the significant number of proning required assisting twice a shift in the ICU 7 days a week composed of allied health, staff from other units and PLC leadership team.



Attempts to try to have Connect Care launched at the PLC, were once again delayed due to the impact of the pandemic. Plan for Go live is May 28,2022.

**Patty Infusino, PLC Patient Care Manager**  
**Dr. Dan Niven, PLC ICU Medical Director**

## Rockyview General Hospital (RGH)

This year, RGH ICU received capital project funding to move ahead with construction of a new combined and expanded ICU/CCU, slated for completion in 2024. We are grateful for this long awaited opportunity to update our space to better support patients, their families, and the dedicated healthcare providers that care for them.

We are pleased to welcome the addition of Nurse Practitioners to the ICU as of December 2021. These advanced providers work alongside our intensivists and medical trainees in a hybrid team model unique to the ICUs in the city.

We continue to support our hospital and ICUs across the city through the pandemic, frequently operating at overcapacity to ensure all critically ill patients receive the care they require.

Our Inter-professional projects remain active, including Enhancing Inter-professional patient care rounds and Arterial line insertions by RTs. We are a high performing site in a number of province wide quality initiatives (such as the ICU Delirium Management and Venting Wisely projects).

**Melissa Redlich, RGH Patient Care Manager**

**Dr. Jessica C. Wang , RGH ICU Medical Director**

## South Health Campus (SHC)

This past year has been very challenging for the SHC ICU in navigating the COVID-19 pandemic. Twice the unit was required to add more beds outside of the normal bed map requiring overflowing to other care spaces. Once to the PACU when capacity was topped at 22 beds and again in the fall to Day Surgery for the same number of bed spaces. Staff from the hospital and beyond were reassigned or redeployed to assist with patient care. This included for all disciplines; Medical, Nursing, Respiratory, Nursing Attendants, Service Workers, Physiotherapists, Pharmacists and Unit Clerks. Alternative care models were instituted to assist in the care of so many critically ill patients.

The ICU remains a very collaborative team working toward achieving patient care goals. The nursing staff is comprised of all RNs along with Nurse Practitioners, Respiratory Therapists, Nursing Attendants, Service Workers, Unit Clerks, Physiotherapists, Dieticians, Pharmacists, Social Workers and Occupational Therapists. The ICU supports the site with an Outreach Team as well as a Code Blue Team.

### Unit Accomplishments

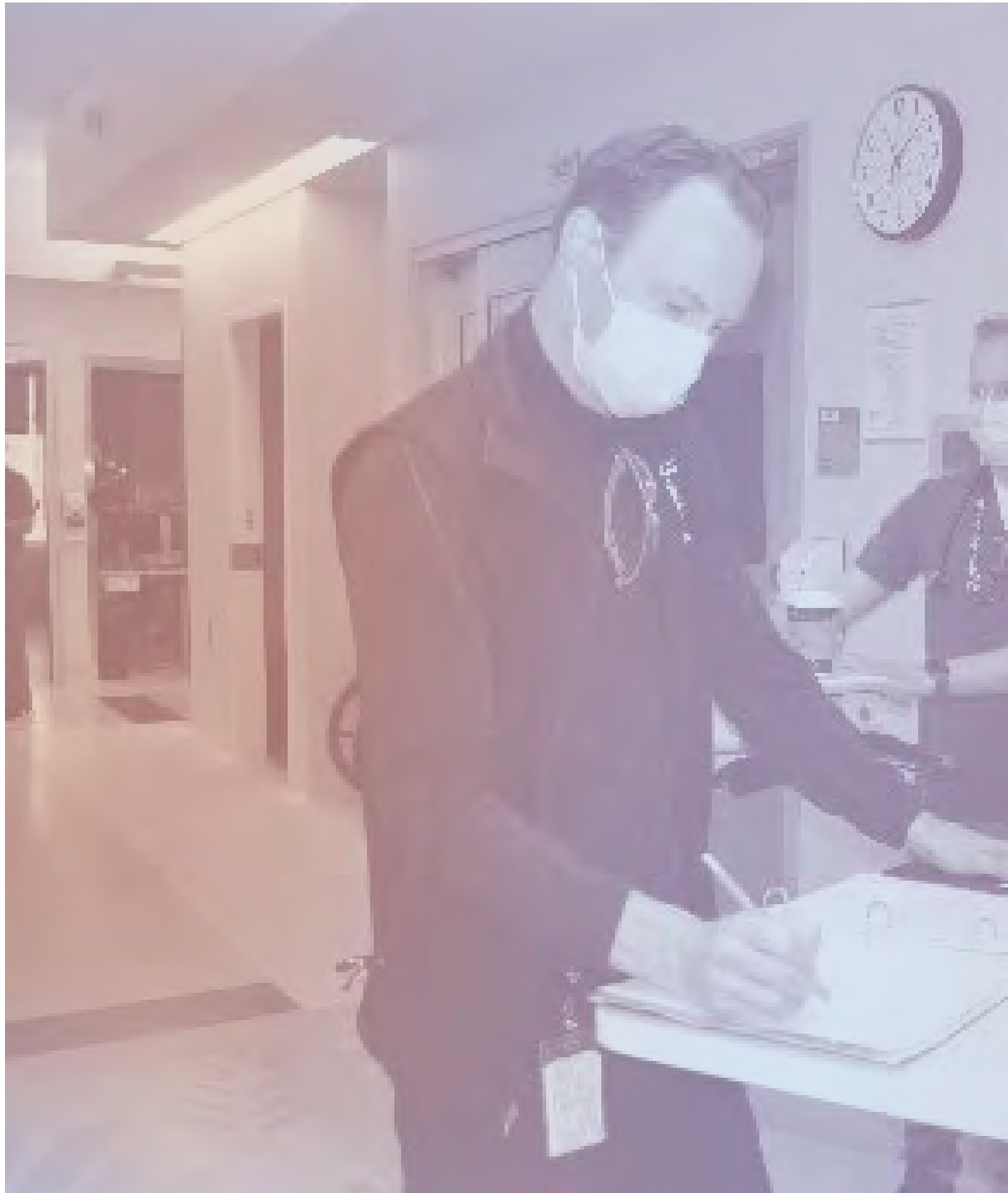
- Planning and implementing care for COVID-19 pandemic patients as well as expected ICU patient populations.
- Providing education to reassigned and redeployed staff members

### Future Goals

- Supporting staff to lessen stress and burnout
- Begin work on Connect Care

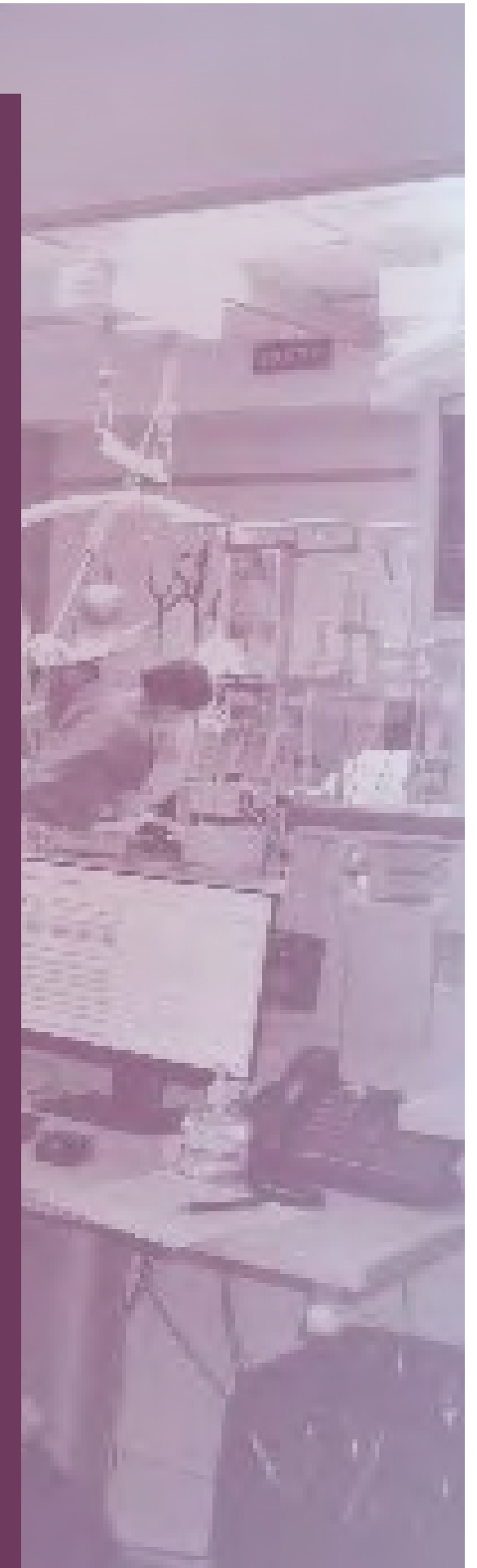
**Rachel Taylor, SHC Patient Manager**

**Dr. Juan Posadas, SHC ICU Medical Director**



## Clinical Program Updates

1. Critical Care Network
2. Extracorporeal Life Support Program
3. HRF & ARDS
4. Neurocritical Care
5. Organ & Tissue Donation
6. Outreach Program
7. Nurse Practitioner Program
8. Critical Care Rehab
9. Albumin Project



## Critical Care Network

The Department of Critical Care Medicine is a vital part of the Critical Care SCN (CCSCN). Several members of our department provide leadership or vital participation within the CCSCN (Dan Zuege – Senior Medical Director; Dan Niven, Ken Parhar, Kirsten Fiest – provincial project leads; Jeanna Morrissey – CCSCN Manager; Kirsten Robertson, Karen Shariff, Dan Jewers – provincial practice leads; Emma Folz, Dan Niven – Core Team membership; many of our research support staff and trainees). Provincial collaboration benefits our department in many ways, in particular during our COVID-19 pandemic. Some of the key outputs and collaborations of the CCSCN related to COVID in 2021 are illustrated in this image:



## Critical Care Network (Continued...)

Many other key CCSCN provincial initiatives are underway, many led by individuals from DCCM:

**RATIONALE** – a program aiming to optimize the use of Albumin in the critically ill. Project Lead - Dan Niven. Funding – CIHR; MSI Foundation. This program, despite the limitations of the pandemic, has completed its full implementation stage and is entering a sustainment phase. This program has demonstrated significant trends to reduced and more appropriate use of Albumin in ICUs in Alberta.

**Venting Wisely** – a program aiming to optimize the care of ventilated patients with hypoxemic respiratory failure in Alberta ICUs. Project Lead – Ken Parhar. Funding – HHS (awarded in 2020); CIHR. This program, despite the significant stresses of a pandemic, is nearing the completion of its implementation phase. This program optimizes the care patients with hypoxemic respiratory failure receive through rigorous measurement, audit and feedback, education supported by practice leads, and clinical decision support embedded in our information systems, ultimately saving lives, reducing ICU length of stay and healthcare costs.

**Don't Misuse My Blood** – a program aiming to optimize use of blood products (other than albumin) in Alberta ICUs. Project Lead - Dan Niven. Funding – PRIHS (awarded in 2020); Choosing Wisely Alberta. This program, in its early phase, aims to influence practices of transfusion and the ordering of blood tests to reduce the exposure of patients to blood products, contribute to conservation of our scarce blood supply, and reduce healthcare costs.

**Delirium** – a well established quality improvement program aiming to optimally prevent, detect and manage delirium in critically ill patients. This program is in its sustainability phase. Ongoing important investigations related to the roles families can play in the detection and prevention of delirium continue, led by Dr. Kirsten Fiest and her team.

**Dr. Dan Zuege, Senior Medical Director, Critical Care SCN**

## Extracorporeal Life Support Program

Extracorporeal Life Support (ECLS) is a method of life support used in patients with catastrophic cardiac and respiratory failure. It is primarily used to oxygenate and remove carbon dioxide from the blood as well as provide hemodynamic support. ECLS includes veno-venous extracorporeal membrane oxygenation (VV-ECMO), which is used to treat refractory respiratory failure, as well as veno-arterial extracorporeal membrane oxygenation (VA-ECMO), which is used to treat refractory cardiac failure.

ECLS has been provided at the Foothills Medical Center CVICU for several years. During the 2008/2009 H1N1 influenza epidemic there was a renewed interest in expanding the use of ECLS worldwide and also locally. Since then, it has been used increasingly for refractory respiratory and cardiac failure.

In 2015 a multidisciplinary ECLS committee was created to oversee and improve the delivery of ECLS within Calgary. The objectives of the ECLS committee have been to prioritize the provision of this resource intensive modality to those patients most likely to benefit, whilst improving safety and reducing morbidity during ECLS runs. 2016 was the first full year of the formalized ECLS program.

In 2021, almost 30 runs of in ECLS were performed in total (including both VA and VV). In addition, several notable accomplishments were made. We are actively using our new CardioHelp system. These units have improved our monitoring and ease of transport while minimizing risks to the patients such as air emboli and clotting.

In 2022, we look to continue our momentum by expanding our training and simulation exercises for the use of ECLS. We are building on our experience with high fidelity simulation during the COVID-19 pandemic and expand that to include cannulation, and ECLS emergencies for non-COVID patients. We will continue to work together with the ECLS programs at the Mazankowski Heart Institute in Edmonton as well as Alberta Children's Hospital to work on areas of mutual interest such as policy, education and simulation.

Finally, we will continue to put the pieces in place to move towards being accredited by the international Extracorporeal Life Support Organization as a "Center of Excellence" further demonstrating our commitment to providing the highest quality of care for patients requiring ECLS.

## Extracorporeal Life Support Program (Continued...)

Being able to provide ECLS is a team sport. This could not happen without the hard work and dedication of our multidisciplinary team including all the nurses (CVICU, ICU, general ICU, and OR), the Perfusion team, respiratory therapists, physician colleagues (including intensivists, cardiologists, cardiac surgeons, and cardiac anesthesiologists), allied health care workers, as well as senior administrative support locally and provincially.

### Dr. Ken Parhar, ECLS Committee Chair and CVICU Medical Director

## HRF & ARDS

Acute Respiratory Distress Syndrome (ARDS) is an inflammatory syndrome of the lungs that results in impaired oxygenation due to non-cardiogenic pulmonary edema. ARDS is associated with a significant morbidity and mortality, and thus prompt recognition and treatment is crucial. Treatments for ARDS that have been shown to reduce mortality include minimizing pressure and volume during mechanical ventilation to prevent ventilator induced lung injury, as well as muscle relaxants and prone positioning.

Previous work by our project team (funded by a QI grant Calgary Zone CMO/Medical Affairs, MSI foundation, and 2017 Critical Care Strategic Clinical Network Seed Grant) demonstrated that ARDS is prevalent within the Calgary Zone and associated with significant morbidity and mortality. We estimate that approximately 10% of all Calgary Zone ICU patients meet full ARDS criteria by the Berlin Definition. This is important because patients with ARDS have a two-fold increase in ICU mortality, with patients in the severe ARDS category demonstrating a mortality rate of 56%. Application of evidence based care interventions is quite variable, particularly in the severe ARDS category. If we extrapolate our Calgary area incidence of ARDS to the province of Alberta we estimate approximately 951 cases of ARDS per year in Alberta, with an average hospital length of stay of 22 days. Given a significant variation in care across the province, this presented an opportunity to reduce unnecessary variability and ensure all patients in Alberta were receiving the right care at the right time.

Using existing ARDS guidelines and most recent evidence, we conducted an expert-panel modified-Delphi Consensus process to determine the optimal evidence-informed management of ARDS. We also externally validated the pathway through a survey that was conducted with enthusiastic response from over 700 clinicians from tertiary, community, and regional ICUs across the province. Finally, we pilot tested the pathway for one year at the Foothills Medical Center ICU (2020) and successfully demonstrated its feasibility and acceptability. Based on this work we were funded by CIHR (through a project grant) and also Alberta Health Services (through a HHS grant) to scale and spread this pathway across the province. This initiative is called “Venting Wisely” and is a partnership with the Critical Care Strategic Clinical Network. Currently we have implemented in 12 of the 16 remaining ICUs with improvement in use of key practices such as lung protective ventilation and prone positioning. This work is being conducted in a pragmatic cluster randomized stepped wedge trial. Formal clinical outcomes will be assessed at the end of this trial. Focus groups and surveys are being used to conduct a process evaluation. A cost-effectiveness analysis will be conducted at the end.

## HRF & ARDS

Many members of the DCCM have a key role in Calgary based project and also the broader provincial based work and include:

- Gwen Knight, Research Assistant, Dr. Andrea Soo, Senior Biostatistician DCCM
- Katie Kissel RN MN CNS, Vanessa Doiron CNE, Michelle Cyca RRT
- Dr Tom Stelfox, Dr Dan Zuege, Dr Dan Niven, Dr Chip Doig, Dr Kirsten Fiest
- Devika Kashyap, DCCM Quality Improvement Consultant

### Dr. Ken Parhar, HRF and Venting Wisely Project Team lead

## Neurocritical Care

The Neurocritical Care Service consists of three fellowship-trained and board-certified (United Council of Neurological Sciences) neurointensivists – Dr. Andreas Kramer, Dr. Philippe Couillard and Dr. Julie Kromm – who work alongside a multidisciplinary team. Our vision is exceptional, comprehensive patient and family centered neurocritical care (NCC). Our mission is to advance neurocritical care through clinical, education and research excellence.

Between 15-20% of annual ICU admissions comprise patients with life-threatening neurological disorders. In Calgary and Central/Southern Alberta, this translates into approximately 900 patients per year who are admitted to various ICUs. These patients suffer from a variety of disorders. The average age of all NCC patients is ≈50 years (IQR 33-65). The rate of devastating outcomes (death, coma/vegetative state, or severe disability) varies widely, between ≈20-70% depending on the diagnosis. This high morbidity and mortality, combined with relatively young patients being impacted, results in a large proportion of disability-adjusted life years.

For patients with life-threatening neurological disorders, high quality NCC is a crucial link in their chain of survival and recovery. Our service aims to assist clinical teams with diagnostic workups, preventing and managing secondary neurologic injury and systemic complications of neurologic disorders, providing evidence-based neuro-prognostication and, when appropriate, supporting organ and tissue donation. We offer both in-person and telephone consultations to members of the Departments of Critical Care Medicine, Clinical Neurosciences and Cardiac Sciences. We also provide telephone support when requested for Red Deer Regional Hospital, Chinook Regional Hospital and Medicine Hat Regional Hospital ICUs. We hope to grow our team, develop clinical protocols, and update our equipment in the future, which will further help support NCC patients and the teams providing care for them.



## Neurocritical Care (Continued...)

We continue to conduct local research and are collaborating with several other Hotchkiss Brain Institute members to launch a NCC research group. With great support from the DCCM research team, we have continued our involvement in several CIHR-sponsored international research trials, including HEMOTION, SaHaRA, INDEX, and PROTEST trials. We are currently working on launching the NeuPaRT (Neurologic Physiology after Removal of Therapy) study at Foothills Medical Centre. Members of our group are co-investigators for each of these studies. We continue to be involved in several national and international research and guideline committees including the Canadian NCC Society and Canadian Cardiovascular Society position statement on neurologic prognostication post cardiac arrest; the Canadian Critical Care Society, Canadian Blood Services and Canadian Medical Associations Brain-Based Definition of Death Guidelines; and the National Institute of Neurologic Disorders and Stroke Curing Coma Campaign.



We successfully launched our NCC fellowship program this past July 2021 and have welcomed Dr. Ian Schoonbaert as our inaugural fellow. We remain involved in NCC education at both PME and CME levels including past and planned presentations at the annual Neurocritical Care Society meeting and Canadian Neurological Science Federation Congress.

We look forward to ongoing collaborations in the coming year aimed at improving NCC for all those in need.

**Dr. Phillippe Couillard, FMC ICU Medical Director**  
**Dr. Julie Kromm, Neurointensivist/Intensivist**  
**Dr. Andreas Kramer, Neurointensivist/Intensivist**



## Organ & Tissue Donation Program

Organ and tissue donation are an important component of end-of-life care in the intensive care unit (ICU). Many families of critically ill patients find comfort in knowing that something positive occurred despite their tragic circumstances. A growing number of Albertans have expressed their intent to donate organs and tissues at the end of life via the Alberta Organ and Tissue Donation Registry.

In 2021, we had our highest number of deceased organ donors ever (42 or approximately 19 donors per million population). This included 28 (67%) donors following neurological determination of death (NDD), 6 (14%) following circulatory determination of death (DCD), and 8 (19%) that began as DCD organ donors but then progressed to NDD.

Another development in 2021 was that Alberta Health funded a provincial “Specialist in End-of-Life Care, Neuroprognostication, and Donation” (SEND) program. Most other Canadian provinces have had “Donation Specialist Physician” (DSP) programs for some years. The Alberta SEND program was developed with the recognition that excellence in deceased donation is highly interdependent with excellence in other domains of critical care practice. For example, our DCD program routinely requires a second independent opinion about prognosis before a patient can be considered eligible. As such, the scope of practice needed to provide excellence extends beyond just immediate donation-related concerns.

More than 20 SEND physicians have now been recruited across the province in Calgary, Edmonton, Grand Prairie, Red Deer, and Lethbridge. Within Calgary, there is always a SEND physician “on call” to provide second opinions regarding prognosis, assist with neurological or circulatory death determination, and support donation processes. The SEND program has also initiated a continuous audit of missed donation opportunities and other donation-related metrics, such as consent rate, compliance with donor management guidelines, and use of the provincial registry. The goal is to regularly provide feedback to front line providers for the purpose of continuous quality improvement. Educational seminars and case reviews for physicians and donation coordinators have been occurring approximately every 3-4 weeks. A provincial SEND conference is planned for later 2022 or early 2023.

## Organ & Tissue Donation Program

The Death Prediction and Physiology after Removal of Therapy (DePPaRT) study was published in the New England Journal of Medicine in 2021. Drs. Chip Doig and Andreas Kramer were co-investigators in this seminal work and DCCM enrolled more patients than any other Canadian program. Based on the results showing no resumption of circulation following a maximum of 4 minutes and 20 seconds without pulse pressure, our DCD policy was modified such that death is declared after 5 minutes of circulatory arrest rather than necessarily requiring electrical asystole. This is expected to increase the number of DCD organ donors and the quality of grafts that are transplanted. A follow-up project, the Neurologic Physiology after Removal of Therapy (NeuPaRT) study, has been funded by CIHR, and Drs. Julie Kromm and Andreas Kramer are co-investigators.

Additional important donation research was completed in 2021. The INDeX-CTP study evaluated the use of CT perfusion in the diagnosis of NDD. Over 40 out of approximately 300 patients were enrolled in Calgary under the leadership of Dr. Philippe Couillard. Preliminary results were presented at the Canadian Critical Care Forum and multiple publications are expected later in 2022 and 2023.

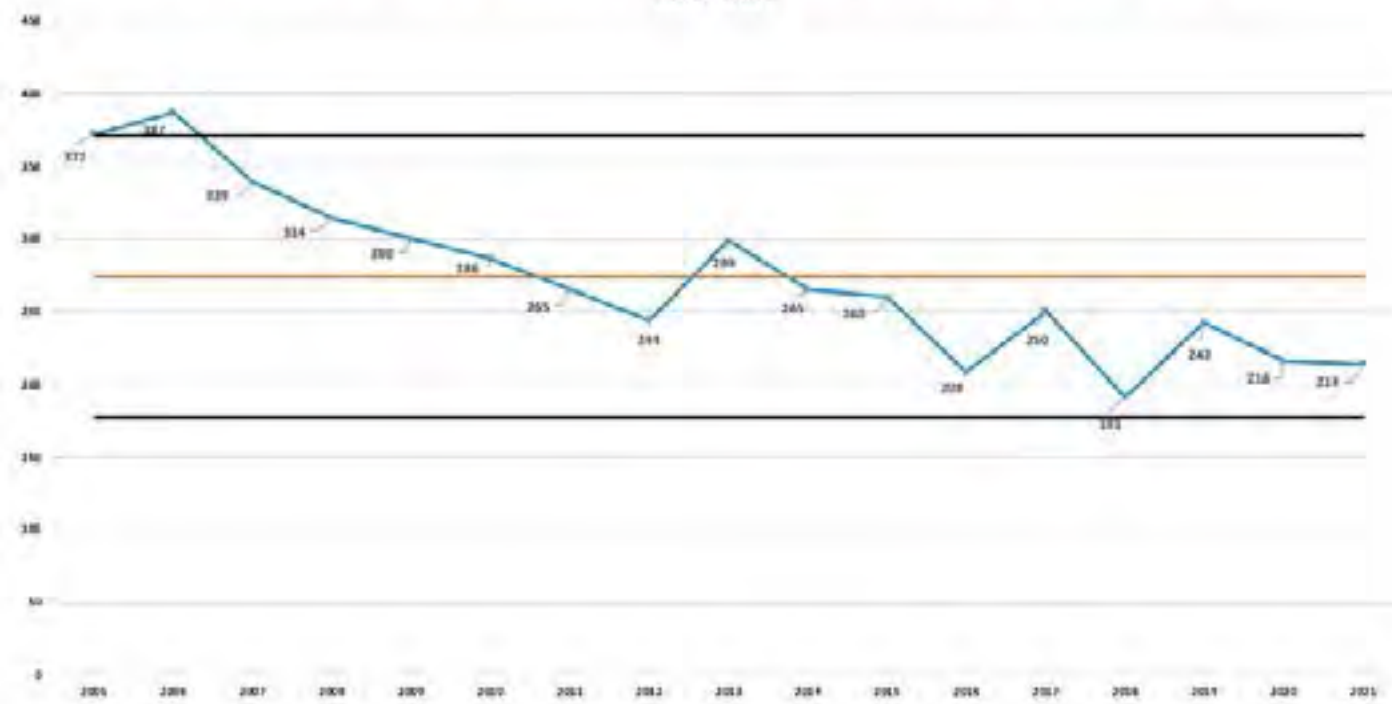
There were 86 patients referred for ocular and tissue donation in 2021 from Calgary adult ICUs. Because the contraindication list for ocular/tissue donation is much longer than for organ donation, only 13 of these cases resulted in transplantation. We continue to recommend that clinicians call SAOTDP about every death in patients under the age of 80 years to assess whether they might be eligible for tissue donation.

### **Dr. Andreas Kramer, Medical Director - Southern Alberta Organ and Tissue Donation Program**

## Outreach Program

The provision of high quality critical care within our 5 busy ICUs in the Calgary Zone requires 24/7 on site presence of providers who continuously oversee the complex care needs of this patient population, including responding to rapid changes in physiology which happen frequently and over short time spans. In addition to the care provided to those already admitted to the ICU, an integral component of our program is a multidisciplinary rapid response (“outreach”) team, comprised of an experienced ICU nurse, respiratory therapist and physician, who respond to urgent medical activation and code blue calls and consult on clinically deteriorating patients on inpatient units. The overriding goal of this team is to improve patient outcomes – either by preventing the need for intensive care (via rapid assessment and appropriate ward-based treatment and decision-making) or by the rapid institution of critical care. ICU outreach physicians are the core physician providers for the ICU outreach teams and are also key tier one providers in all five ICUs from 17:00 to 8:00 hours every night, thus providing mission-critical staffing of our adult ICUs.

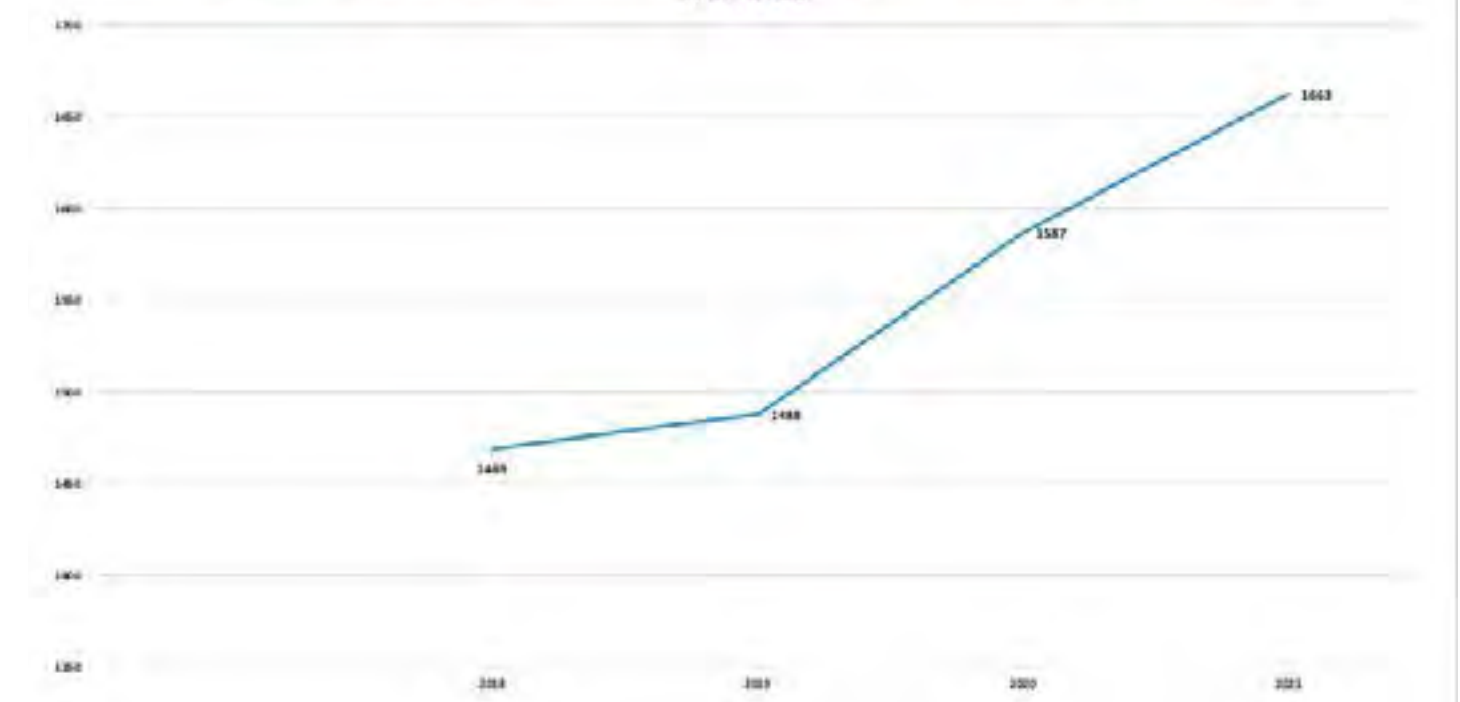
**Figure 1 - Code Blue Team Activations outside of ICU - Calgary Zone Adult Acute Care Hospitals 2005 - 2021**



## Outreach Program (Continued...)

Our ICU outreach program was implemented in 2006 in all adult Calgary hospitals at the request of the former Calgary Health Region, to address concerns about the safety of care provided to hospitalized patients whose health deteriorates during their hospital stay, in particular during off-hours when fewer medical resources are available on-site. Recently published systematic reviews have shown that implementation of ICU outreach/rapid response programs results in clinically significant reductions in cardiac arrests and deaths in hospitalized patients. The ready availability and advanced skill set of multidisciplinary ICU outreach teams have been pivotal in our and other centres’ care protocols during the Covid-19 pandemic, when hospitalizations and inpatient acuity have dramatically increased.

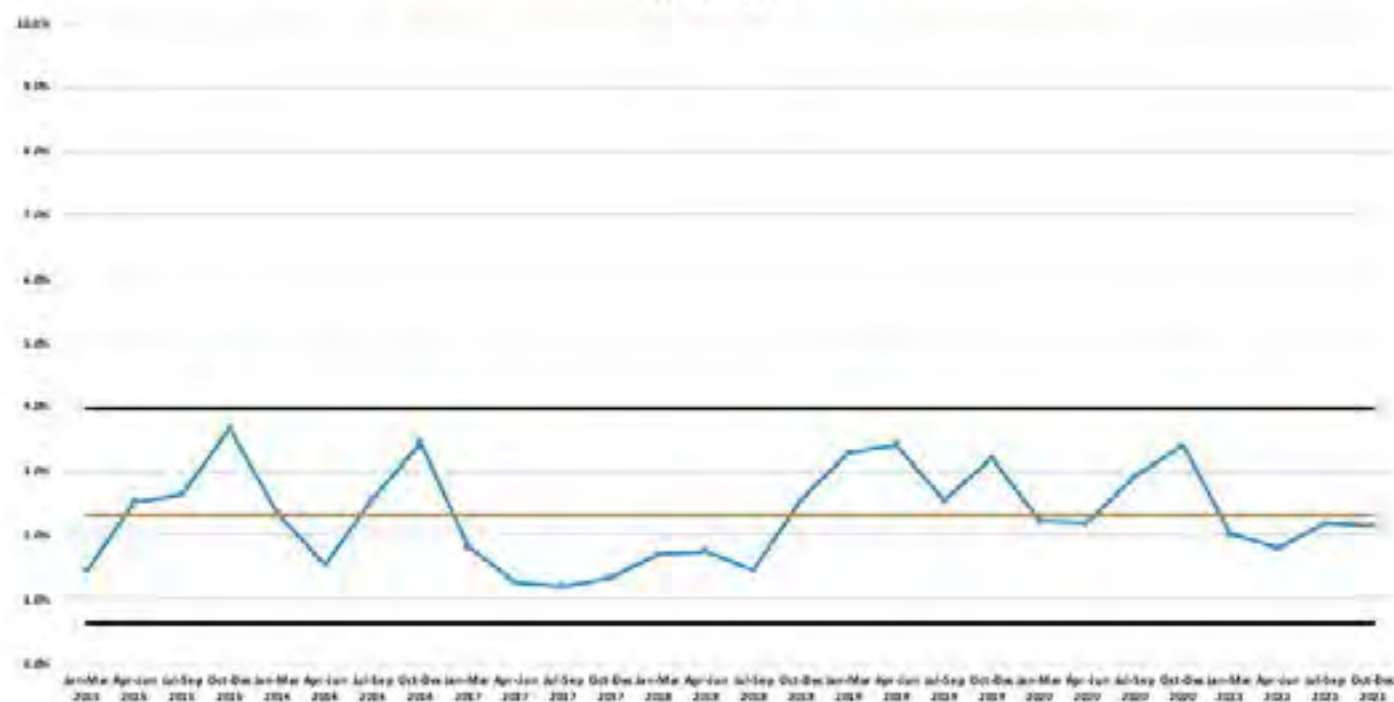
**Figure 2 - Rapid Response System Activations - Calgary Zone Adult Acute Care Hospitals 2017-2021**



As shown in **Figure 1**, the number of code blue team activations in hospitalized patients outside of our adult ICUs decreased from 387 in 2006 to 242 in 2019, with further decreases during the past two years, despite the dramatically increased number of hospital admissions during the Covid-19 pandemic.

## Outreach Program (Continued...)

Figure 3 - Readmission Rate to ICU within 72 hours of index hospitalization 2015-2021



These data highlight the positive impact that our ICU outreach/rapid response team has had in reducing the incidence of inpatient cardiac arrests, despite increasing patient numbers. In addition, as shown in **Figure 3**, our ICU readmission rate within 72 hours of discharge from the unit has remained below 2.5% during the past year, despite enhanced patient acuity during successive waves of the pandemic.

The specific metrics related to multidisciplinary rapid response calls in calendar year 2021 are highlighted for each of our four non-cardiac ICUs in **Table 1**. Despite increased patient acuity and volume during successive waves, the time spent at the patient’s bedside has averaged 61 minutes, highlighting the complex care needs of this patient cohort.

## Outreach Program (Continued...)

This has occurred despite a significant (13.2%) increase in the number of overall rapid response team activations since 2018, as demonstrated in **Figure 2**.

2021	FMC			PLC			RGH			SHC			Total		
# calls	685			256			377			194			1512		
Level of Call	I 55%	II 37%	III 7%	I 38%	II 54%	III 8%	I 32%	II 63%	III 6%	I 42%	II 44%	III 13%	I 45%	II 47%	III 8%
Time on a call	71 minutes			52 minutes			54 minutes			50 minutes			61 minutes		
% admitted to ICU	30%			20%			14%			18%			23%		
MRP responded	67%			68%			86%			54%			70%		
MRHP directed care	52%			61%			83%			44%			60%		
GOC	R 79% M 20% C 0% U 1%	R 75% M 23% C 0% U 1%	R 64% M 33% C 0% U 3%	R 72% M 26% C 1% U 2%	R 74% M 25% C 0% U 2%	R 72% M 26% C 1% U 2%	R 74% M 25% C 0% U 2%	R 74% M 25% C 0% U 2%	R 74% M 25% C 0% U 2%	R 74% M 25% C 0% U 2%	R 74% M 25% C 0% U 2%	R 74% M 25% C 0% U 2%	R 74% M 25% C 0% U 2%	R 74% M 25% C 0% U 2%	R 74% M 25% C 0% U 2%
Change in GOC	R-M 2%	R-C 0%	M-C 4%	R-M 1%	R-C 0%	M-C 3%	R-M 2%	R-C 1%	M-C 6%	R-M 1%	R-C 1%	M-C 2%	R-M 2%	R-C 0%	M-C 4%

At present there are 33 outreach physicians on our rota, who are credentialed family physicians, anesthesiologists, emergency medicine physicians, internal medicine physicians or cardiologists, with additional Critical Care training and experience. We are continuing to recruit highly skilled and motivated practitioners to this mission-critical role.

- Dr. Richard J. Novick, Deputy Head (DCCM)**
- Devika Kashyap, Quality Improvement (DCCM)**
- Kevin Sedor, Outreach Program Assistant (DCCM)**

## Nurse Practitioner Program

2021 was another clinically challenging year due to the demands of the global COVID-19 Pandemic. The Nurse Practitioners of the DCCM rose to the task of providing direct clinical care for an increasing and challenging patient population, coordinated for surge planning, assisted in supporting and collaborating with volunteer non-ICU physician/learners, and supported the increasing workload and acuity on wards with outreach follow up. The DCCM NPs have also developed and implemented a Critical Care Nurse Practitioner (CCNP) orientation program as well as supported new NP orientees to the department.

Clinically, they have continued to strengthen their abilities with point of care ultrasound competence as augments to the physical exam, have worked to mitigate complications and incidents of central line associated blood stream infections, and have focused heavily on integrating evidence-based practice for treating critical care patients such as with the appropriate use of albumin implementation of the Venting Wisely program. In addition to their clinical responsibilities, the DCCM NPs have continued to focus on research and program development. Highlights include the effectiveness of early cognitive stimulation in the prevention of delirium, exploring integration of advanced care planning in complex congenital heart disease with a patient led focus, and protocol development for integration of NPs in outpatient coarctation clinics. They have also collaborated on projects including a national survey on neuroprognostication practices post cardiac arrest, the impact of rapid redeployment of nurses during pandemic surges, mentorship for newly graduated and student NPs, and ongoing involvement with the ICU follow up clinic.

As the DCCM expands the NP role to all adult ICUs this year, we expect to utilize the CCNP orientation program to support our new team members through mentorship, excellence in procedural competence, ongoing quality improvement, and research. We look forward to further expand the program in the years to come and to establish long lasting collaboration with our interdisciplinary colleagues.



**Emma Folz, PLC Executive Director (DCCM)**

**Charissa Elton-Lacasse, Nurse Practitioner (DCCM)**

## Critical Care Rehab

### Outpatients

The Critical Care Recovery Clinic continues to function through the pandemic. The focus of the clinic has shifted primarily to COVID recovery for our patients in the ICU. We continued to run two outpatient clinics each week, but resources have shifted somewhat. Physiatry continues to work in the clinic but Nurse Practitioner resources were pulled back into the units due to the pressure from the various waves. We continue to use existing rehab resources within the city and have established informal working relationships with the respiratory covid recovery clinic at RGH (Dr. Kate Skolnik, Respiriology).

### Inpatients

We have expanded the music therapy program to include two sites in the city (South Health Campus and Foothills Medical Centre ICUs).

Occupational Therapy and Physiotherapy routinely use the RT-300 FES ergometer in the Foothills ICUs. We continue to develop training and best approaches to best support the use of this advanced therapy equipment with our patients in the units.

### Research

On the research front, a recent feasibility and acceptability study on music therapy within the unit has been submitted for publication (Dr. Stephanie Plamondon, Physiatry). We recruited patients from the Recovery Clinic to participate in the Canadian COVID-19 Prospective Cohort Study (CANCov) (Local PI: Dr. Sarah Manske, Kinesiology). The ICU Peer Support Group study has closed (Dr. Tanya Mudry, Psychology).

**Dr. Chris Grant, Physical Medicine & Rehabilitation (DCCM)**

**Joanna Everson, Nurse Practitioner (DCCM)**

## De-implementation of Low-value Albumin Fluid Resuscitation in Critical Care – Customized KT during a Pandemic

Overuse of low-value care remains a major threat to providing high quality healthcare. Fluid resuscitation using human albumin is an exemplar low-value care practice. Albumin is a blood product used intravenously to treat patients whose intravascular volume is severely reduced. Evidence has identified a small number of patient populations that derive benefit from use of intravenous albumin, however the vast majority of albumin is commonly prescribed for patients where rigorous science indicates no benefit. The objective of the current study was to reduce low-value albumin use among adults admitted to ICUs in Alberta, Canada.

The RATIONALE (cRitical cAre opTimIzatiON of ALbumin ordEring in Alberta) study was a registry-based stepped wedge quality improvement intervention trial implemented in all 16 adult ICUs in Alberta. Implementation was driven by a team of Calgary investigators and facilitated by collaboration with the Alberta Critical Care Strategic Clinical Network as well as the Physician Learning Program. Clusters of two ICUs began using the intervention every two months until all 16 ICUs were using the intervention. The quality improvement intervention targeted established barriers and facilitators and was co-developed by a multi-disciplinary working group and consisted of: 1) identifying clinical champions in each ICU; 2) targeted and tailored education to prescribers and bedside nurses; 3) changes to the way in which albumin was ordered; and 4) bi-monthly unit-level audit and feedback. Data was obtained from eCritical, the provincial electronic medical record and data registry for all ICUs. The primary outcome was the proportion of patients without an evidence-based indication for albumin who received at least one unit of albumin during ICU admission. Secondary outcomes included the number of albumin units prescribed per patient that received any albumin, and the amount of avoided biomedical waste.

Intervention implementation began with the first cluster of ICUs in November 2019. The final ICUs were brought onboard January 2021. COVID-19 interrupted implementation by six months between March and August 2020, and delayed audit and feedback by another 6 months in 2021. Among the 16 participating ICUs, the proportion of patients without an evidence-based indication for albumin who received at least one unit of albumin during ICU admission decreased from 12.9% at baseline to 8.7% as of October 2021 (relative decrease 32.7%). This resulted in 649 patients avoiding unnecessary exposure to a blood product.

## De-implementation of Low-value Albumin Fluid Resuscitation in Critical Care – Customized KT during a Pandemic (Continued...)

The number of albumin prescriptions per patient did not change considerably compared to baseline (4.0 versus 3.9), however owing to a reduction in use of the glass bottles used to store albumin, 1416kg has been prevented from entering biomedical waste. Among the 5 ICUs from Calgary, a low baseline utilization of 7.5% of admissions decreased to 6.0%, a relative decrease of 19.2%.

A targeted and tailored, multifaceted quality improvement intervention resulted in considerable reduction in low-value albumin use among patients admitted to adult ICUs in Alberta. Pandemic-related strain significantly hampered timelines associated with planned non-pandemic quality improvement work. Additional work to sustain the observed change in practice is ongoing.

**Dr. Dan Niven, PLC ICU Medical Director**

# Clinical Informatics

Informatics plays a vital role in the delivery of and planning for excellent critical care in Calgary. We are fortunate to have in Alberta in general, and in Calgary in particular, robust clinical information systems, data repositories and clinical analytics resources and teams to support us in our daily work.

## Clinical Informatics

Informatics plays a vital role in the delivery of and planning for excellent critical care in Calgary. We are fortunate to have robust clinical information systems, data repositories and clinical analytics resources and teams to support us in our daily work. These include: Connect Care – planned implementation to Calgary critical care in May 2022 at PLC, November 2022 at FMC, RGH and SHC in 2023. Numerous planning activities are underway with active unit engagement. Device and wifi upgrades are complete as is the installation of tap and go computer access. Area trainers and superusers are busy training end users for the PLC ICU implementation. Fortunately, many of these individuals can support Launch 5 at FMC. The Connect Care Critical Care Area Council and its adult subgroup have significant Calgary leadership (Emma Folz, Dan Zuege) and representation.

The eCritical Alberta Program – supports the MetaVision bedside Critical Care Information System in all ICUs in Alberta since 2012 (now being replaced by Connect Care) and the TRACER data repository and clinical analytics system. As our core CIS in our ICUs, MetaVision provides detailed electronic clinical, device and laboratory data to support daily care of critically ill patients. This data, supplemented with other data sources, allows the TRACER analytics system and team to provide near real-time summary operational, quality and performance data to support optimal care delivery and planning. Adaptations to MetaVision and several new analytics tools were quickly made available to understand the evolution of COVID in ICUs from a utilization and outcome perspective. The vital importance of a critical care focused informatics team, with knowledge and skill with both the clinical and informatics aspects of critical care in Alberta, independent of the information systems in use, cannot be overstated.

Looking forward, the importance of excellent informatics resources will only be growing to support the drive for quality, appropriate, cost effective care. Our department looks forward to the continued evolution of our informatics assets to enhance our measurement of quality of care at department, unit and provider levels.

**Dr. Luc Berthiaume, Medical Informatics Lead for Critical Care, Calgary Zone**



# Quality Assurance & Patient Safety

Patient safety culture starts with awareness and readiness to review safety events in a timely and just manner. The DCCM Patient Safety Roadmap summarizes how we learn about safety events in our department, as well as how we respond when serious safety events occur. The Reporting and Learning System (RLS) reports and the zonal Mortality Working Group (MWG) reviews are important forums for how we learn about and discuss safety events.

## Quality Assurance & Patient Safety

Here are some cases and outcomes from the 2021 year driven by RLS and MWG:

### 1. Best Practices for Multidisciplinary ICU Rounds

With many active points of communication with team members, a medication was ordered on the wrong patient during ICU rounds. This resulted in a Quality Assurance Review (QAR) that led to an ongoing QI project to standardize communication flow and improve role clarity for best rounding practices

RLS by Facility



### 2. Advanced Temperature Monitoring for at Risk Patients

In 2020, several cases submitted via RLS highlighted a discrepancy between external temperature versus internal temperature monitoring devices and was shared at the zonal MWG. After an extensive review by a working group comprised of our CNS/CNE teams, Dr. Niven and the ICU executive, a critical care standard of practice was developed by way of an algorithm for temperature management and manipulation using core temperature monitoring.

### 3. Partnership with Cardiology for High-Risk Transfers

The transfer of sick patients for off-site procedures requires clear communication between multiple providers so the most responsible physician and care team have the relevant information. ICU and cardiology QI leadership have partnered to facilitate these complex transfers with assistance from RAAPID.

### 4. Contact Lens Screening

The presence of contact lenses can be difficult to detect in critically ill patients and information about visual aids is often not known at the time of ICU admission. A practice support document is soon to be released that summarizes work that was completed on defining and implementing standardized timing for contact lens screening, assessment and documentation by the ICU care teams.

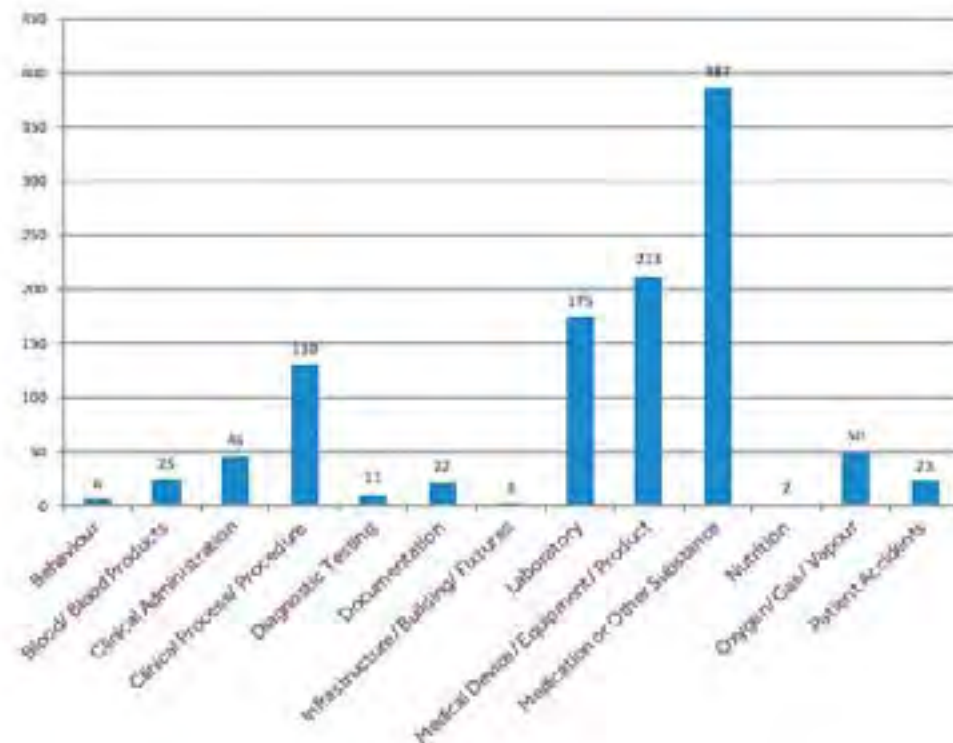
## Quality Assurance & Patient Safety (Continued...)

### 5. Foley Trauma Prevention

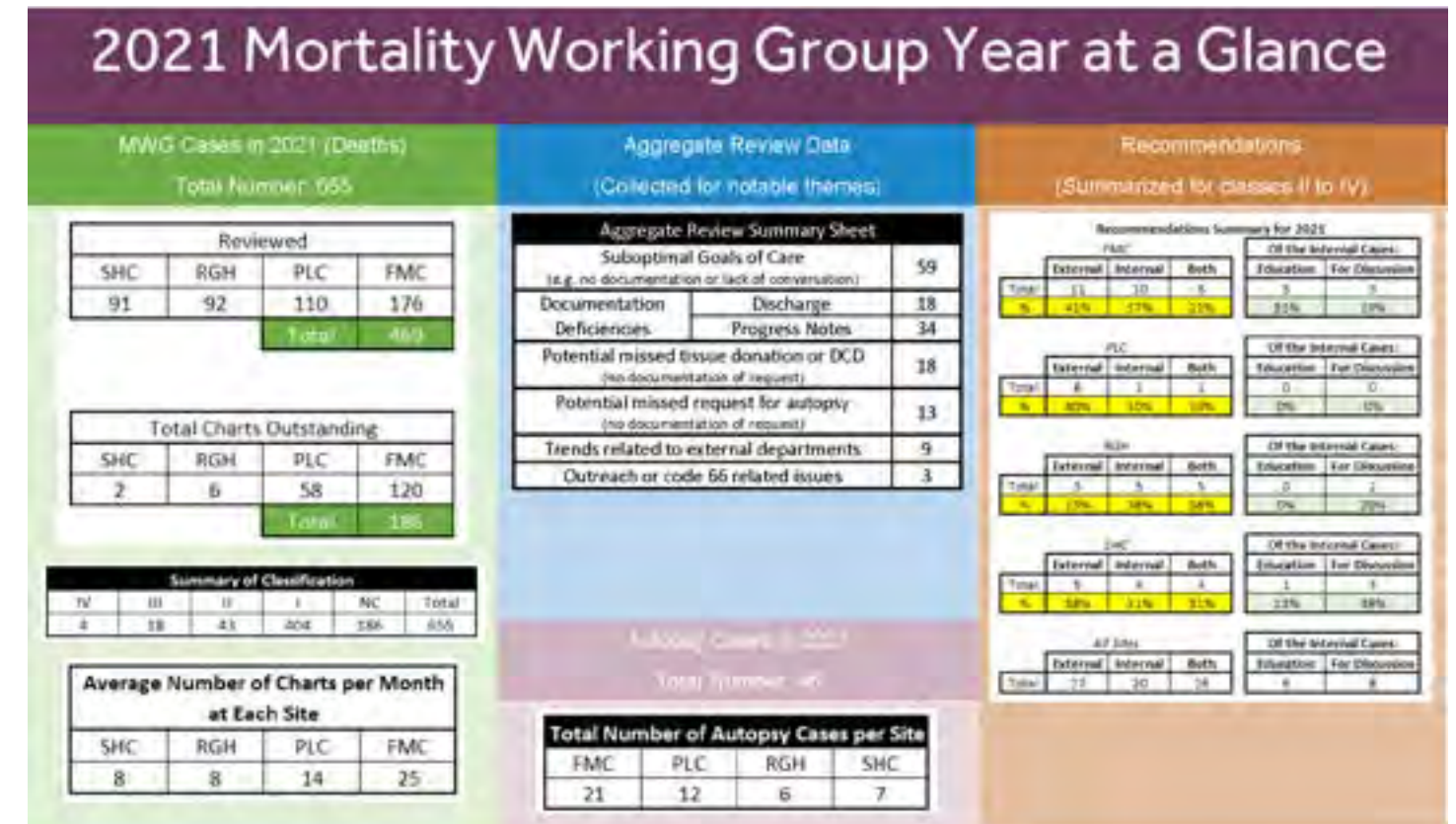
Multiple RLS reports have demonstrated that Foley Trauma is a common injury. An environmental survey of incidence showed that incomplete Foley insertion prior to inflating the balloon as the preventable component of the injury pattern. This important reminder was shared with our ICU teams via our Patient Safety Memos.

### 6. Neuromonitoring Education

A 2020 meningitis case highlighted opportunities to increase staff education on caring for patients admitted with neurologic diagnosis. In 2021 a neuro assessment video was disseminated to highlight basic best practices neurological assessment for critical care nurses, and how to differentiate between normal and abnormal findings, including emergent assessment findings for immediate intervention. Thank you to Emily and Laura, FMC ICU CNEs, and Katie, CNS, for contributing to this education effort!



## Quality Assurance & Patient Safety (Continued...)



### 7. Collaborated with Other Quality Assurance Committees (QACs)

Much of our QAC's safety work involves contribution and collaboration with other QACs and departments across the zone. Examples include but are not limited to: Identification of a difficult airway patient and communicating this information in future encounters (Medicine QAR), documentation of wound packing in collaboration with the surgery, wound care, and electronic health records (DCCM QAR), and optimizing paramedic use of needle decompression (EMS Consult).



## Quality Assurance & Patient Safety (Continued...)

### 8. Safety work to come

Despite the demands COVID has placed on our system and department, the DCCM continues to identify and engage in extensive patient safety work. In the upcoming months we will see completion of QARs for a food allergy, mental health, environmental safety, and updates to practice guidelines for tracheostomy change.

These practice changes are all generated by frontline communication. Thank you for your contribution to safer care!

**Dr. Selena Au, QAC Co-Chair & QI Medical Director**

**Emma Folz, QAC Co-Chair & Executive Director**

**Dr. Dan Zuege, Department Head DCCM**

**Tracey Receveur, Patient Safety Lead**

**Katie Kissel, Clinical Nurse Specialist**

**Alan Sutton, Respiratory Therapy Lead**

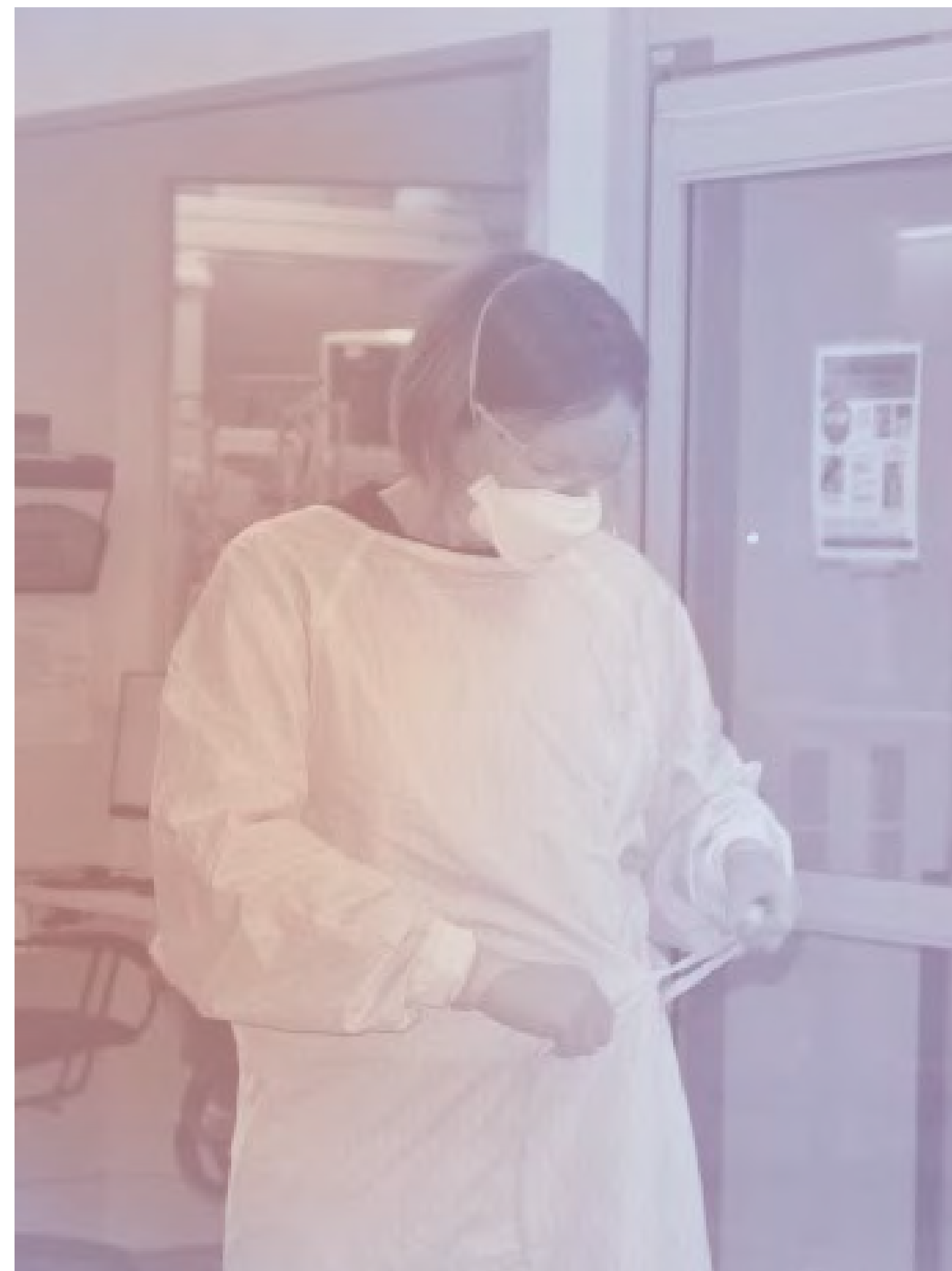
**Kelly Coutt & Dr. Paul Boiteau, FMC Representatives**

**Patty Infusino, Dr. Luc Berthiaume, Dr. Kevin Solverson, PLC Representatives**

**Melissa Redlich & Dr. Frank Warshawski, RGH Representatives**

**Rachel Taylor & Dr. Selena Au, SHC Representatives**

**Miranda Kavalench, Administrative Support**



# Quality Improvement

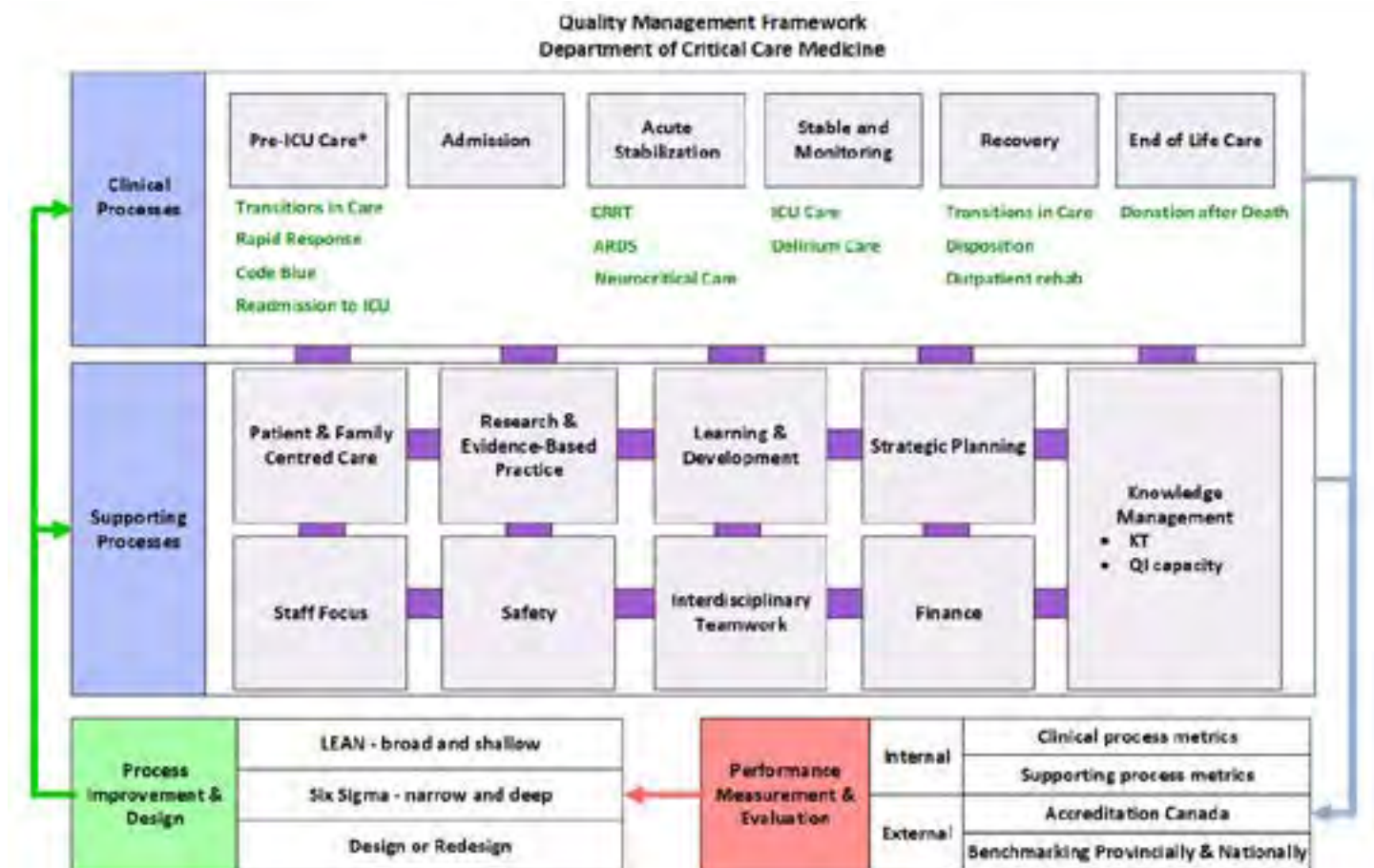
The culture of Quality Improvement (QI) is integral to the strategic direction, planning and operations for the Department of Critical Care Medicine (DCCM). In the last year, there were two main areas of focus for the QI Portfolio; preparing for the Accreditation Canada survey and putting the final pieces on the Quality Management Framework and Performance Metrics.

## Quality Improvement

### Quality of Culture

Quality Improvement (QI) is integrated and considered in all aspects of Critical Care clinical operations and supporting processes. The QI portfolio is one small component of the broad scope of QI work that occurs across the department; QI methodology essentially touches all aspects of care and operations - a guiding principle towards the mission of continuous improvement in patient care.

In the last year, there were three main areas of focus for the QI Portfolio: planning and reporting for ICU-related pandemic operations; road testing the appropriateness of updated performance metrics for department operations; and completing a safety project related to contact lens screening, detection and removal in the ICU setting.



## Quality Improvement (Continued...)

### Pandemic Reporting

Over the last year, our regular ICU operations pivoted quickly and deftly to support our critical care teams with the pandemic response. A small but mighty role included sharing daily data with our critical care teams and health system as a whole in order to make short-term adjustments and longer term plans to manage acuity and capacity. The DCCM leveraged its robust data and reporting infrastructure to adapt to providing our teams with timely and up to date information in a rapidly changing environment.



## Quality Improvement (Continued...)

### DCCM Performance Metrics

The DCCM has a long history of using data as a foundation to discuss and drive improvement work for our ICU teams.

E-critical provides us with an extensive dashboard of metrics which has detailed and timely access to numerous data points. A curated list of performance metrics were chosen to review over time and identify possible areas for improvement for ICU Executive and beyond.

This list of metrics was shared regularly this past year to determine appropriateness and plan for broader dissemination. The ultimate hope is these metrics will be the foundation upon which our ICU teams can focus QI priorities that benefit our patients most.

Quality Dimension	Performance Measure
<b>Safety</b>	% Mortality in Critical Care
	% Mortality in Hospital
<b>Effectiveness</b>	% Re-admission to ICU within 72 Hours
	% Goals of Care documented daily
<b>Acceptability</b>	% 1st Family Contact w/in 30 minutes of patient arrival
	% Avoidable Days
<b>Accessibility</b>	Length of Stay in the ICU
<b>Appropriateness</b>	Delerium ever delirium
	Organ Donation- % Family Approached
<b>End of Life Care</b>	Tissue Donation % Family Approached

### Contact Lenses in the ICU

In critical care, there are challenges in knowing the contact lens status for patients due to patient status and eyes being closed for extended periods of time. To address this and prevent potential serious adverse events, the DCCM developed a process with supporting practice support document and education for the screening, assessment, detection and removal of contact lenses for ICU patients.

**Devika Kashyap, Quality Improvement (DCCM)**



## Education

The Department of Critical Care Medicine (DCCM) at the University of Calgary has been lucky to have trained adult Critical Care Medicine (CCM) physicians for 33 years. The Royal College of Physicians and Surgeons fully accredited our CCM Training Program for seven years in February 2015. In 2019 we also underwent a successful mid-point internal accreditation process through Postgraduate Medical Education (PGME) at the University of Calgary. Physicians who have graduated from our Training Program have gone on to practice in a variety of both tertiary and secondary centers across Canada and the United States and have helped to shape the modern practice of CCM, not just as clinical leaders but as administrators, researchers and educators in their respective centers.

## Critical Care Medicine Residency Program

Presently, there are eight trainees in our CCM Training Program from a variety of base specialty backgrounds (e.g., Internal Medicine, Nephrology, Respiriology, Cardiology and Emergency Medicine). We continue to provide entry positions for four trainees each year with a guarantee of two years of funding. Recruitment was once again highly successful this year with four applicants from across Canada choosing to pursue CCM training at the University of Calgary. Over the years the Training Program has built a solid national reputation, if one trusts the fact that we have witnessed increasing numbers of external applicants and that we consistently match into all our offered training positions. The quality of our program is underscored by the results of our graduating trainees on their national licensing exams—all 4 graduating trainees were once again successful in attaining their FRCPC designation in CCM this past fall.

In July 2019 we implemented a once-in-a-generation change in our educational paradigm by transitioning to a competency-based medical education (CBME) model. This Royal College initiative called “Competence by Design” (CBD) has been the biggest change in postgraduate medical education in Canada in more than three decades! CBD is an outcomes focused physician education model to better support continuous learning and assessment in professional development.

Over the past years several of our faculty members have been engaged in meetings at the Royal College in Ottawa and served in a leadership capacity in this regard within the University. The product of these workshops was delineation of required training experiences, development of new training requirements organized around a framework of enabling competencies, as well as the incorporation of new workplace-based assessment methods that have informed the education and professional development for our current cohort of CCM trainees. Experience to date with the new paradigm has been positive and has afforded our trainees and clinical faculty greater hands-on experience with workplace-based observation, feedback, and coaching in the moment. We remain excited about this transformational educational change and are actively furthering education scholarship exploring our experience with the transition to, and lived-experience of, this new educational paradigm.

## Education Curriculum

In addition to outstanding clinical patient care opportunities afforded at the University of Calgary, we continue to strive to improve and grow our formal educational curriculum for CCM trainees. Notable aspects include: a weekly core content curriculum, monthly journal club, monthly morbidity and mortality working group, monthly clinicopathological correlation, multi-professional high-fidelity simulation as well as weekly city-wide grand rounds.

Our core content curriculum covers the foundational expertise required of a CCM specialist across all CanMEDS domains. Educational sessions as part of the core content curriculum are provided by a combination of Departmental attending physicians and local experts and are designed in a small-group, interactive format to maximize participation. Our residents also continue to participate in a variety of PGME-sponsored workshops, including sessions on Teaching Techniques and Provision of Feedback as well as Biomedical Ethics and Medico-Legal aspects of practice.

## Continuing Professional Development

High caliber citywide CCM Grand rounds continue to be a weekly staple as part of our continuing professional development. A variety of local and national experts continue to offer state of the art topic reviews and cutting edge talks on the science of CCM as part of our CME offerings. These are recorded and archived along with the presentation slides. Both are available for review on our website.

## MDSC Program

Believing that we needed to continuously “raise the bar” in critical care education, a Critical Care MSc/PhD graduate training program was developed nearly two decades ago within the University of Calgary Department of Medical Sciences to better support departmental academic activities. It offers MSc/PhD graduate students and CCM residents a structured education environment to further their academic pursuits.

The program offers a tremendous amount of flexibility to allow training in diverse areas related to Critical care. The program currently offers 3 graduate courses: The Fundamental Basis of Critical Illness (MDSC 623.02) and Basic Pulmonary and Ventilator Physiology (MDSC 623.03) and Advanced Pulmonary Physiology (MDSC 623.04). Many graduate students have successfully trained in this MDSC subspecialty training program pursuing advanced graduate MSc and PhD degrees.

Students enrolled in the program are expected to present their basic science and clinical research at local, national and international conferences and many students have published their research in well-respected, peer-reviewed scientific journals. The program requires students to have a supervisor who is a member of the Department of Critical Care as well as a supervisory committee that may be made up of diverse members within the University. For further information about the Critical Care Medicine Graduate Program please contact Aggie Chan, MDSC Graduate Program Administrator, Graduate Sciences Education in the Cumming School of Medicine at [medgrad@ucalgary.ca](mailto:medgrad@ucalgary.ca) or Dr. Brent Winston, Graduate Coordinator, Critical Care Graduate Program at [bwinston@ucalgary.ca](mailto:bwinston@ucalgary.ca).

## Curriculum Innovations

Several curriculum innovations have been implemented in recent years as well. Our didactic and hands-on curriculum on application of ultrasound and echocardiography in the ICU continues to mature. State of the art on-line educational modules to augment the didactic and practical experiences as part of the curriculum have been implemented since 2016. Since then, a novel IT solution enabling image archiving of ultrasounds acquired at each of the various sites in the city is being implemented to facilitate expert feedback on image acquisition and image quality. Four hand-held ultrasound platforms continue to be accessible to our trainees to allow them to more easily be able to develop their echocardiography skills at the point of care.

More recently, clinicopathological case rounds (CPC) rounds have been developed as a new curriculum innovation to have a forum to improve clinical reasoning skills. These monthly rounds are a joint educational activity between the DCCM and the Division of Anatomic Pathology / Department of Pathology & Laboratory Medicine to provide multidisciplinary teaching around interesting presentations of common diseases, common presentations of uncommon diseases, or otherwise diagnostically and therapeutically challenging disease presentations in critically ill patients. These rounds have been extremely well received by participants and will continue for the foreseeable future due to the high-quality teaching and learning opportunity they afford us.

Two additional important curricula continue to grow, serving to nicely round out our educational offerings. A novel communication skills curriculum that explores fundamental aspects of effective communication including goals of care discussions, addressing conflict and disclosure of unanticipated medical events has been implemented relying on simulated patients to allow CCM residents to grow their skills. Recognizing the increasing importance for physicians to develop comfort and fluency with Quality Improvement and patient safety (QIPS), we have also developed a QIPS curriculum to familiarize our trainees with foundational concepts and to help them develop skills necessary to lead QIPS projects in their future careers.

## Community ICU

To further enhance our clinical and academic collaboration with our referring rural centers, the Training Program continues to integrate a one-month community-based rotation at the Red Deer Regional Hospital intensive care unit. This year several of our fellows participated in this rotation supported by the Distributed Learning and Rural Initiative (DLRI) Program offered by the University of Calgary.

The educational experience and professional development afforded by this rotation has been universally highly regarded and immensely valued by our trainees. We're appreciative of our Red Deer colleagues for fostering such a great experience for our trainees as well as the supports put in place by DLRI to make these learning experiences possible.

## Undergraduate & Post-Graduate Medical Education

In addition to the CCM Training Program, the DCCM continues to support undergraduate and post-graduate medical education at the University of Calgary. The DCCM supervised approximately 150 months of CCM training for rotating residents this past academic year.

Rotating residents came from the following core programs: Internal Medicine, Respiriology, Cardiology, Neurology, Emergency Medicine, Anesthesia, General Surgery, Orthopedic Surgery, Plastic Surgery, Otolaryngology, Cardiac Surgery and Urban and Rural Family Medicine. There is no national requirement for CCM rotations in Family Medicine but given that many trainees subsequently practice in rural Alberta, a one-month rotation is offered for all trainees in order to develop skills in caring for the critically ill.

We are pleased to report that our clinical rotation continues to be highly desired by undergraduate medical students at the University of Calgary. The number of medical students who have chosen CCM remained high in 2021. Based on requests for the upcoming academic year, interest in CCM rotations from medical students remains strong.

## Clinical Scholar Program

2021 witnessed the reinvigoration of a Clinical Scholar Program for the DCCM and a renewed commitment by the Department to sustaining it long term. A scholarship opportunity has been made available to Canadian-trained Critical Care Medicine (CCM) physicians who desire additional specialized training in anticipation of an academic CCM career.

This academic opportunity allows for 12 to 48 months of protected time to complete academic pursuits relevant to the field of CCM. The program allows for the Clinical Scholar to pursue a higher degree (M.Sc. or Ph.D.) as part of the academic component of the Clinical Scholar role or additional sub-specialized fellowship training relevant to the practice of CCM. To support additional academic training, Clinical Scholars are provided the opportunity to work a limited number of locum physician weeks within the Calgary Zone of Alberta Health Services.

The successful completion of the Program is an important pathway of individual professional development and career advancement for Canadian trained CCM specialists after their base training. It's also an important way that the DCCM contributes to the development of subspecialized national CCM expertise and advances the science of caring for the critically ill.

## Neurocritical Fellowship Program

The DCCM was thrilled to develop and launch a neurocritical care fellowship program this past year at the University of Calgary. Recognizing the paucity of opportunity within Canada to obtain subspecialized training in caring for neurologically injured patients, the DCCM has responded by developing a structured, competency-based fellowship opportunity.

Spearheaded by Dr. Julie Kromm and neuro-intensive care colleagues Drs. Andreas Kramer and Philippe Couillard this comprehensive training opportunity has come to life welcoming our first fellow in July 2021. We anticipate one position available on a yearly or biannual basis going forward. This will help grow both local and national expertise in neurocritical care and meaningfully impact patient care in centers across Canada.

## COVID-19 Pandemic

Finally, the COVID-19 pandemic has once again made 2021 an indelible year with far reaching impacts experienced across all facets of the Education Office's endeavors. Many of our trainees have experienced the disappointment of having to cancel their outbound electives due to necessary PGME restrictions on travel outside our institution. Conversely, we've not been able to welcome as many visiting trainees as we might like to Calgary. Many of our ICU fellows were once again recalled to home service in the ICU to meet surging patient care needs because of the pandemic.

Simultaneously, the DCCM also benefitted from the "can-do" attitude of other Departments whose trainees volunteered to redeploy to help out during several waves of COVID-19 pandemic surges impacting the ICU. For this assistance we are extremely grateful.

Given the requirement to socially distance our educational offerings have necessarily also had to adapt and have been reimaged in new ways. Our curriculum has had to move to an online format leveraging Zoom. We successfully hosted our second virtual CaRMS interviews as well. We're hopeful to see the pandemic subside to resume our usual standard of in-person learning opportunities in the months ahead.

In closing, we would like to recognize and celebrate all our trainees who have risen to the occasion time and time again in providing high quality care amidst a very busy, once-in-a generation, public health emergency. It is an absolute privilege to work shoulder to shoulder with them. Their resolve and commitment have not gone unnoticed and are hugely appreciated during a time of immense challenge.

We're all looking forward to brighter days that lie ahead!

**Dr. Jonathan Gaudet, Critical Care Medicine Education Program  
Director**

## Clinical Research

The goal of our Department is to lead and partner in research initiatives to develop and implement new knowledge to provide the best care for critically ill patients. Our Department has much to celebrate and notable research highlights are summarized as follows.



### Critical Care Clinical Research

Despite the tremendous challenges of the COVID-19 pandemic, clinical research continued to thrive and achieve new heights in the DCCM in 2021. Pandemic-related limitations required non-COVID research studies to be paused during the first 2 months 2021, but through remarkable efforts and collaborations, clinical research remained fully operational for the remainder of the year including through the 4th and 5th waves of COVID surges. A remarkable total of 469 patients were enrolled in 16 different studies in ICUs across the Calgary zone in 2021.

2021 saw a continued focus on COVID-19 research in DCCM. Highlights of DCCM COVID research included the completion of enrollment for the COVI-PRONE trial, a large CIHR-funded randomized controlled trial led by Dr. Ken Parhar, as well as 2 major COVID-19 pathogenesis/biomedical research studies led by Drs. Yipp and McDonald. Dr. Yipp's study of single cell transcriptomics of neutrophils in COVID-19 patients was published in the prestigious journal Nature Medicine.

In addition, non-COVID clinical research also continued to thrive in 2021. Recruitment was completed for the clinical trials RE-ENERGIZE (site PI Dr. Stelfox) and INDEX (site PI Dr. Couillard), for which Calgary was a major contributor to total recruitment. A number of new trials were initiated in 2021 including REMAP-CAP and REVIVAL (PI Dr. Doig) which will continue recruitment in the coming years.

DCCM members achieved ongoing success in obtaining significant research funding in 2021 (NPA/PI >\$3M, CO-I >\$11M), including CIHR project/operating grants (Fiest (3), Stelfox (3), Kubes/McDonald (1)) and CFI infrastructure grant (McDonald). In addition, CCRN funding was secured that will allow the DCCM to hire 2 additional clinical research assistants in 2022 to help expand the ICU research portfolio at RGH and SHC.

**Dr. Braedon McDonald, Interim Director of Research and Innovation (DCCM)**



## Critical Care Graduate Program - MDSC Program

Several years ago, a Critical Care MSc/PhD graduate training program was developed within the University of Calgary Department of Medical Sciences to better support departmental academic activities. It offers MSc/PhD graduate students and CCM residents a structured education environment to further their academic pursuits.

The program offers a tremendous amount of flexibility to allow training in diverse areas related to Critical Care. The program currently offers 3 graduate courses: The Fundamental Basis of Critical Illness (MDSC 623.02) and Basic Pulmonary and Ventilator Physiology (MDSC 623.03) and Advanced Pulmonary Physiology (MDSC 623.04). Many graduate students have successfully trained in this MDSC subspecialty training program pursuing advanced graduate MSc and PhD degrees. Many Critical Care trainees have augmented their training by getting an advanced degree in the MDSC Critical Care program. Students enrolled in the program are expected to present their basic science and clinical research at local, national and international conferences and students are expected to publish their research in well-respected, peer-reviewed scientific journals.

The program requires students to have a supervisor who is a member of the Department of Critical Care Medicine as well as a supervisory committee that may be made up of diverse members within the University.

For further information about the Critical Care Graduate Program please contact Aggie Chan, MDSC Graduate Program Administrator, Graduate Sciences Education in the Cumming School of Medicine at [medgrad@ucalgary.ca](mailto:medgrad@ucalgary.ca) or Dr. Brent Winston, Graduate Coordinator, Critical Care Graduate Program at [bwinston@ucalgary.ca](mailto:bwinston@ucalgary.ca).

## Winston Lab Highlights

Dr. Winston continues to be active in research administration in the DCCM as the Coordinator of the Critical Care Graduate Program (a subspecialty within the Medical Sciences Graduate Program) and sits on the Graduate Educational Committee of the Medical Sciences Graduate Program. Dr. Winston also coordinates 2 of the three graduate courses in the Critical Care Graduate Program and is on the GEC of the DCCM.

The Winston lab has been actively involved in examining how metabolomics can be used for diagnosis, prognosis and determining mechanisms of disease in acute respiratory disease syndrome (ARDS) and in traumatic brain injury (TBI), with the goal of applying precision medicine in these disease processes. Currently, Dr. Winston is examining metabolomics of Covid-19 pneumonia and ARDS and is planning to examine the Covid-19 Variants of Concern. As part of Dr. Winston's research team, Dr. Winston is working with Mohammad Banoei (who just finished his PhD and is doing metabolomics in Dr. Ian Lewis' lab. He has had 2 summer students and has a new graduate student starting in his lab). He works closely with Dr. Chel Hee Lee in biostatistics in the DCCM.

Dr. Winston has been working closely with the ARBs Corona Group over the last year on Covid-19. The Winston team has published 8 publications over the year and has received 5 grants – two as PI (ALA and VPR Catalyst Grant) and 3 CIHR grants as co-I or collaborator. His team has been involved in Clinical trials involving sepsis, Covid-19 and ARDS. Dr. Winston was an invited presenter to the Aspen Lung Conference in September 2021. His presentation was entitled "ARDS heterogeneity from a metabolomics perspective.

Dr. Winston filed a new patent in 2021: US Patent application 111218P-2. Filed July 2021. Metabolomic profiles in serum predict global functional neurological outcome and death at 3 and 12 months following severe traumatic brain injury by Mohammad Banoei, David Wishart and Brent W. Winston.

## Winston Lab 2021 Highlights (Continued...)

### Three noteworthy publications are:

1. Sayed Metwaly, Sarah J. Donnelly, Mohammad M. Banoei, Ahmed I. Mourad, Hans J. Vogel, Oliver Fiehn, Brent W. Winston on behalf of the Canadian Critical Care Translational Biology Group (CCCTBG). "ARDS Metabolic Fingerprints: Characterization, Benchmarking and Potential Mechanistic Interpretation." *Am J Physiol Lung Cell Mol Physiol*. 2021 May 5, 321: L79–L90. doi, 10.1152/ajplung.00077.2021.
2. Kevin Burns, Matthew Cheng, Todd Lee, Allison McGeer, David Sweet, Karen Tran, Terry Lee, Srinivas Murthy, John Boyd, Joel Singer, Keith Walley, David Patrick, Francois Lamontagne, John C. Marshall, Gregory Haljan, Robert Fowler, Brent Winston, and James Russell. Sustained Dysregulation of the Plasma Renin-Angiotensin System in Acute COVID-19. *Research Square*, 2021. Preprint before publication. doi, 10.21203/rs.3.rs-125380/v1.
3. Mohammed, Yassene; Goodlett, David; Cheng, Matthew; Vinh, Donald; Lee, Todd; Mcgeer, Allison; Sweet, David; Tran, Karen; Lee, Terry; Murthy, Srinivas; Boyd, John; Singer, Joel; Walley, Keith; Patrick, David; Quan, Curtis; Ismail, Sara; Amar, Laetitia; Pal, Aditya; Bassawon, Rayhaan; Fesdekjian, Lara; Gou, Karine; Lamontagne, Francois; Marshall, John; Haljan, Greg; Fowler, Robert; Winston, Brent; Russell, James for ARBs Corona I. "Longitudinal Plasma Proteomics Analysis Reveals Novel Candidate Biomarkers in Acute COVID-19". *The Journal of Proteome Research*, 2021. DOI 10.1021/acs.jproteome.1c00863. <https://doi.org/10.1021/acs.jproteome.1c00863>

## McDonald Lab 2021 Highlights

In response to the COVID-19 pandemic, Dr. McDonald's research team expanded their interest in immunity, microbiology, and systems biology to investigate COVID-19 pathogenesis in the ICU, in addition to their ongoing work on microbiome-immune interactions in sepsis and critical illness. Selected 2021 highlights include:

1. The McDonald, Yipp, and Kubes labs conducted a collaborative study on the immunopathogenesis of COVID-19 ARDS, with a focus on the impact of neutrophil dysfunction. With the support of 2 CIHR COVID-19 operating team grants, this study identified a pathological shift in the immune system driven by hyperactivated neutrophils in patients with COVID-19. Furthermore, this signature of neutrophil hyperactivation escaped conventional treatments, revealing a new target for further therapeutic development. Their findings were recently published in *JCI Insights* (Panda et al. *JCI Insights* 2022).
2. In collaboration with Dr. Justin Chun (Department of Medicine, Division of Nephrology) Dr. McDonald and colleague published a report on post-mortem molecular diagnostics to identify SARS-CoV-2 infection in a renal transplant recipient. Their publication described the first case of fatal COVID-19 in Calgary (FMC ICU), and is also presumed to be one of the first in Canada (Simms EL et al. *Am J Transplant* 2021)
3. Recognizing the high rates of blood clotting complications in patients with severe COVID-19, Dr. McDonald teamed-up with Dr. Prism Schneider (Department of Surgery, McCaig Institute) and Dr. Ben Gershkovitch (ICU Fellow) to conduct a prospective and longitudinal study of blood coagulation function in COVID-19 ARDS. Using point-of-care testing (thrombelastography) to track coagulation function over the course of each patient's ICU stay, it was discovered that ICU patients had profound, and sustained hypercoagulability driven by platelet dysfunction. Dr. Gershkovitch presented the study findings at the 2022 ASCIP trainee symposium and was awarded the prize for best oral presentation, and is currently preparing a manuscript for publication.
4. In a study led by Dr. Michael Chiu (ICU fellow) and supervised by Dr. McDonald, the immunological impact of heat shock proteins and HSP auto-antibodies was investigated in patients with COVID-19 ARDS compared to ARDS caused by bacterial pneumonia. Striking differences in the levels of pro-inflammatory HSP and anti-HSP autoantibodies were identified in patients with COVID-19 ARDS, and were associated with the systemic inflammatory response ('cytokine storm') in these patients. Drs. Chiu and McDonald are currently preparing a manuscript for publication.

## McDonald Lab 2021 Highlights (Continued...)

5. In addition to new COVID-19 research, the McDonald lab had a productive year of re-research in their main areas of interest of immunology and microbiome in sepsis and critical illness (Changirwa, et al. Cancers 2021; Zucoloto AZ et al. STAR Protocols 2021; Zhang M et al. Crit Care Explor 2021; Mendelson AA et al. Intensive Care Med Exp 2021).
6. New graduate students Jared Schlechte, Diana Changirwa, and Breenna Dobson joined the McDonald lab
7. Zdenka Slavikova (clinical research coordinator) joined the McDonald team to support these (and other) clinical-translational research studies in the ICU.

## Parhar Lab 2021 Highlights

### Actively Funded MAJOR Projects

- Implementation Science and Cluster Randomized Stepped Wedge Trial. (TheraPPP study implementing the “Venting Wisely” pathway in all adult Critical Care studies. In this study, Ken in partnership with the Critical Care Strategic Clinical Network is implementing a care pathway for patients who are mechanically ventilated. This project uses an implementation science based strategy to adopt this pathway. The pathway was piloted successfully in 1 ICU and currently actively implementing in all 17 adult ICUs in the provinces as a stepped wedge cluster randomized study. This work has been funded by CIHR (KP-NPA) and Alberta HHS funding (KP – NPA)
- Awake Prone Positioning for COVID respiratory failure. Ken has co-led (with Jason Weatherald Edmonton and Waleed Alhazzani McMaster) an international multicenter RCT looking at the role of awake prone positioning for patients with COVID-19. As supportive work, Ken was the senior author on a Calgary based case series, as well as Rapid Review on this topic. Ken was also one of the principal applicants on successful CIHR funding for this trial. In total 92 patients of the total 400 were recruited from Calgary ICUs and Covid wards. This work is currently under revision at a top tier general medical journal. He is currently leading a systematic review and has also been invited to help write a Rapid Practice Guideline from the Journal Intensive Care.

### Collaborative Projects

Ken is a co-applicant and co-investigator on several CIHR based project grants from within the Department of Critical Care (Stelfox – Accelerate and Fiest – COVID family), as well as outside DCCM (Muruve – Inflammation). In addition, he has an expanding role in multiple national and international collaborations including being a steering group/CIHR co-applicant on several respiratory failure projects including the use of helmets and non-invasive ventilation (HONOUR, Scales Sunnybrook), and Dual Lumen catheters for ECMO (Fan, TGH). Most recently he has been invited to be on the steering group for a large international platform trial (PRACTICAL) for respiratory failure interventions being led by the University of Toronto. This will provide Calgary the opportunity to play a key role in likely future landmark Critical Care trials which will include re-examining the role of steroid in ARDS and also the role of Driving Pressure.

## Parhar Lab 2021 Highlights (Continued...)

### Notable Presentations

In 2021, Ken was invited present both at the Canadian Critical Care Forum as a speaker to provide a presentation on Mechanical Power and was faculty at the Canadian Critical Care Review Course and gave a lecture on ARDS.

### Team Members

He currently works with a team of 7 (3 hired research assistants as well as 4 KT practice leads) in addition to multiple multidisciplinary team members. Most recently Ken has taken on his first Graduate Student Committee membership for a MSc student in Community Health Sciences.

### Notable Publications

1. Parhar KKS, Zuege DJ, Shariff K, Knight G, Bagshaw SM. Prone positioning for ARDS patients-tips for preparation and use during the COVID-19 pandemic. *Can J Anaesth.* 2020 Dec 24:1–5. doi: 10.1007/s12630-020-01885-0. Epub ahead of print. PMID: 33367994; PMCID: PMC7759020.

## Biomedical - Craig Jenne

The Jenne Lab had 10 papers published in 2021 including 2 reviews, 6 collaborations and 2 primary research papers. Collectively these works focus on the role of inflammation in the host response to both infectious and non-infectious disease conditions and include multiple clinical studies assessing the efficacy of vaccination, the measurement of biomarkers after brain injury and mapping biomarker profiles during appendicitis in a pediatric population. In addition, we received two CIHR priority announcements to use intravital microscopy to study animal models of viral infection and were successful in a team application to build a Canadian Hepatitis B Virtual Centre of Excellence. The Jenne lab has also been engaged in public outreach with regards the ongoing COVID-19 pandemic, participating in more than 400 local, national, and international media interviews in 2021 and contributing to numerous public lectures and panels on viral spread and vaccines.

## Paul Kubes

Dr. Paul Kubes has helped the Vice President of Research of the University of Calgary write a Biosciences Research Infrastructure Fund CFI for \$13 million to expand the level 3 facility so that we can do more than just COVID research but also study TB and other pathogens. We obtained 3 additional CIHR grants: one looking at COVID variants of concern together with Dr. Braedon McDonald and two examining liver injury and lung infections. We have published with Dr. McDonald a study examining neutrophils from COVID patients and, in addition, a study in the cancer field. Most exciting is that L-SALT, an inhibitor of neutrophil recruitment into lungs discovered in Calgary, has now made it to Phase 3 clinical trials in COVID-19 patients.

## Departmental Research Report - Q3

## Book Chapters 2021 / Patents 2021

Departmental Research Report - Quarter 3

### Current DCCM Clinical Studies

Clinical Studies				Department Member Participation (n=)	
Industry Trial	Non-Industry Trial	Local Initiated Trial	Not Funded	PI	Co-I
1	15	3	1	10	23

### On-going Enrolment - Calgary Zone

Study Name	# Active Enrolment Sites	Patient Enrolment		Start Date
		Most Recent Quarter	Total	
ARBS Corona	2	0	365	Jul-20
Balance	2	2	41	Jan-16
COVI-PRONE	4	0	92	Oct-20
CATCO	1	0	9	Jun-20
Corona I	4	0	11	Nov-20
CCEPTR	2	0	14	Jan-20
Co-Pilot	1	0	45	Nov-19
ECMOCARD	1	0	89	Jan-20
HALO	1	0	4	Nov-18
HEMOTION	1	1	28	Nov-18
INDEX	1	0	47	Feb-18
MICRO ICU	1	0	55	Aug-19
Protest	1	2	9	Nov-19
RE-ENERGIZE	1	0	14	May-16
REVISE	2	6	61	Jan-20
REMAP-Cap	2	1	2	Apr-21
REVIVAL	4	3	8	Jun-21
SAHARA RCT	1	1	21	May-18
Sprint-Sari	1	61	150	Jan-20

### Patient Enrolment (YTD)

2021	Foothills Medical Centre (n=610)		Rockyview General Hospital (n=235)		Peter Lougheed Centre (n=341)		South Health Campus (n=122)		Calgary Region (n=1,368)	
	Total	N <sup>o</sup> per 100	Total	N <sup>o</sup> per 100	Total	N <sup>o</sup> per 100	Total	N <sup>o</sup> per 100	Total	N <sup>o</sup> per 100
Screened	1,261	80	93	19	549	60	119	21	2,022	57
Missed*	0	0	0	0	0	0	0	0	0	0
Enrolled	100	6	6	1	31	3	0	0	137	4
Admitted	1,572		488		912		340		3,532	

### Patents 2021

1. US Patent application 111218P-2. Filed July 2021. Metabolomic profiles in serum predict global functional neurological outcome and death at 3 and 12 months following severe traumatic brain injury by Mohammad Banoei, David Wishart and Brent W. Winston.

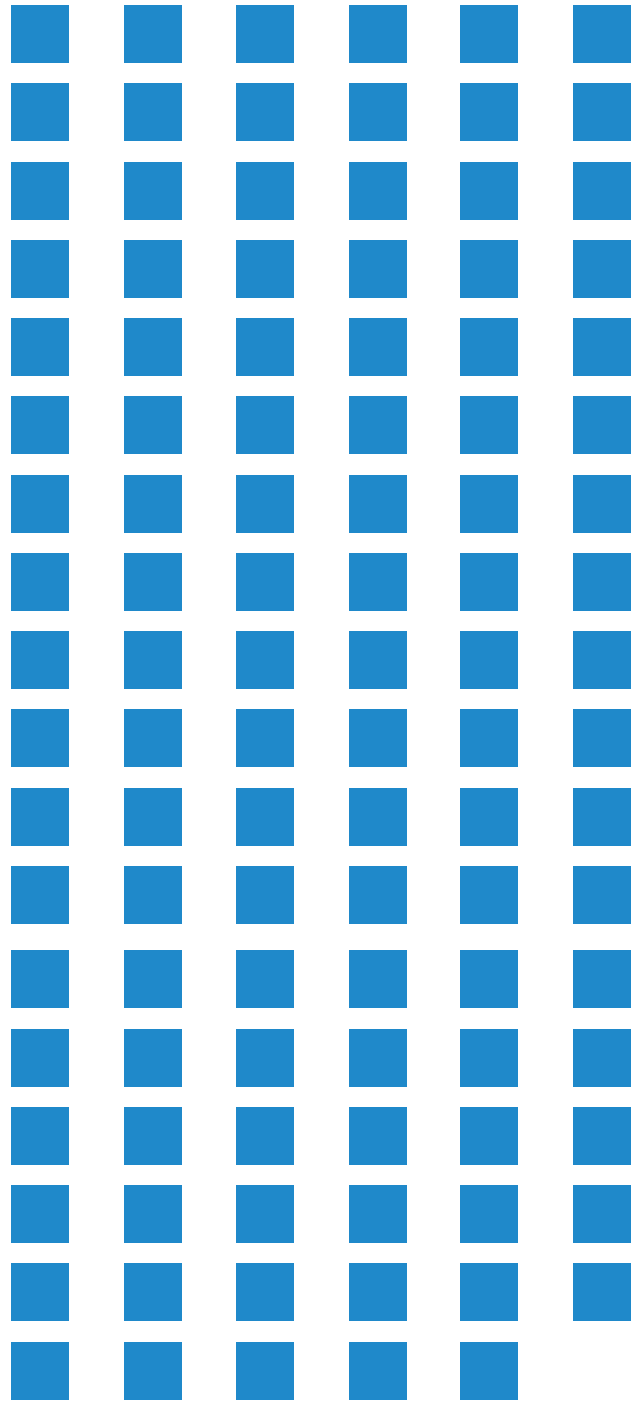
## 2021 Supervised Research Trainees

Trainee Name	PI
1. Tanner Fahlman, Undergraduate Project Student 2. Kathryn Strayer, Undergraduate Project Student 3. Amanda Zucoloto, PhD Student 4. Jared Schlechte, MSc Student 5. Diana Changirwa, MSc Student 6. Breenna Dobson, MSc Student 7. Gabriela Quiroz-Olguin, PhD 8. Chris Connors, PhD Student 9. Benjamin Gershkovich, MD, FRCPC 10. Michael Chiu, MD, MSc, FRCPC	Dr. Braedon McDonald
11. Simon Guienguere (Doctoral candidate) 12. Amanda Leong, MSc candidate 13. Laurie Lee, Doctoral Candidate	Dr. Chip Doig
14. Ian Schoonbaert 15. Erica McKenzie 16. Natalia Jaworska	Dr. Julie Kromm
17. Muhammad Saahim Salman, Critical Care SCN Studentship 18. Mariam Ansari, MSc, Medical Sciences Program	Dr. Brent Winston
19. Inara Lalani, BSc Student, University of Calgary 20. Janelle Boram Lee, PhD Epidemiology 21. Laurie Lee, PhD Epidemiology 22. Amanda Leong, MSc in Epidemiology 23. Abigail Thomas, MSc in Epidemiology 24. Hina Qureshi, MSc in Epidemiology 25. Dr. Natalia Jaworska, MSc in Health Services Research 26. Em Schalm, MSc in Epidemiology 27. Stephana Moss, PhD Candidate in Epidemiology 28. Brianna Rosgen, MSc in Epidemiology 29. Samiha Mohsen, MSc in Epidemiology 30. Victoria Owen, MSc in Health Services Research	Dr. Kirsten Fiest

## 2021 Supervised Research Trainees (Continued...)

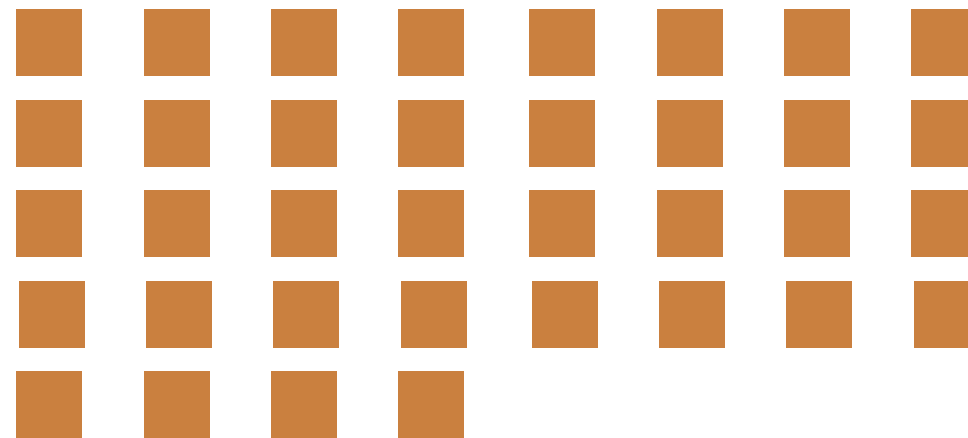
Trainee Name	PI
31. Stephana Moss, PhD., Dept. Community Health Sciences 32. Filipe Lucini, Postdoctoral Fellow, Department of Critical Care Medicine Eyes High Postdoctoral Fellow 33. Camillo Valderrama Cuadros, Postdoctoral Fellow, Department of Critical Care Medicine (Joon Lee co-supervisor) 34. Anmol Shahid, Postdoctoral Fellow, Department of Critical Care Medicine 35. Derek Roberts, Assistant Professor, Department of Surgery, University of Ottawa 36. Abdel-Aziz Shaheen, Assistant Professor, Department of Medicine and Community Health Science, University of Calgary	Dr. Thomas Stelfox
37. Amanda Leong, MSc Student 38. Erin Gionet, MSc Student 39. Victoria (Tori) Owen, MSc student 40. Dr. Andrew Bond, Internal Medicine Resident, Department of Medicine, University of Calgary 41. Dr. Josh Ng Kamstra, Critical Care Resident, Department of Critical Care Medicine, University of Calgary	Dr. Daniel Niven
42. Dr. Simon Demers – Barriers to Prone Positioning 43. Dr. Lawrence Gutman – Critical Care Fellowship – Academic Advisor	Dr. Ken Parhar
44. Ms. Angelica Nguyen- Summer Student 45. Ms. Eliana Pyon- Summer Student 46. Mr. Fletcher Liu 47. Dr. Elise Granton. MD/PhD PhD 48. Mr. Carlos Hiroki. PhD Immunology program 49. Dr. Raquel Farias MD/PhD Eye's High PDF awardee	Dr. Bryan Yipp

## 109 Manuscripts

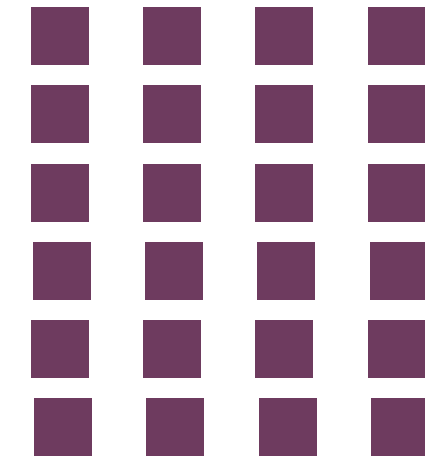


# Research at a Glance

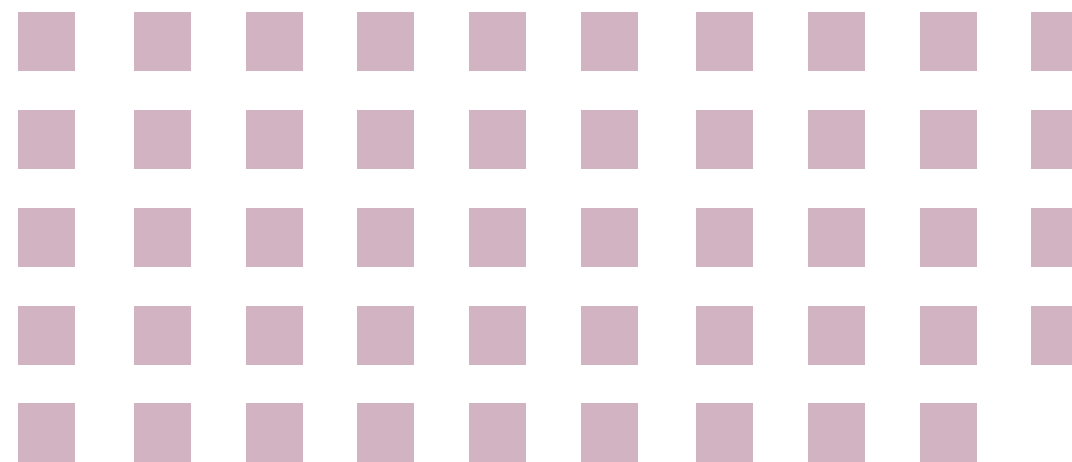
## 28 Abstracts



## 24 Grants



## 49 Trainees



## 1 Patents



## Department of Critical Care Medicine Research Grants

Year	Sponsor	PO/CO Investigator	Title	Amount
2021-2022	CHIR	PI: Dr. Fiest & Dr. Stelfox	Examining Drivers of Vaccine Hesitancy and Approaches to Improve Vaccine Confidence in Canada	\$251,232
2021-2024	CHIR	PI: Dr. Fiest, Dr. Stelfox, COI: Dr. Zuege	ACCELERATE: Partnering with ICU patients and family caregivers toward early transitions in care	\$355,725
2021-2023	CHIR	PI: Dr. Fiest	Restricted family presence in the PICU during the COVID-19 pandemic: Understanding impact, experience, and stakeholder priorities	\$332,775
2021-2022	CHIR	PI: Dr. Stelfox	Engage, Educate, Empower: Partnering with Canadian Families to Understand and Mitigate the Multifaceted Impacts of the COVID-19 Pandemic on Child and Youth Wellbeing	\$144,756
2021-2022	CHIR	PI: Dr. McDonald	Intravital imaging of COVID19 lungs to visualize pathogenic differences between SARS-CoV-2 variants of concern	\$500,000
2021-2024	Sepsis Canada	PI: Dr. McDonald	National Preclinical Sepsis Platform: the role of biological sex on sepsis pathogenesis and outcomes	\$544,318
2021-2026	CFI (JR Evans Leaders Fund, and Gov't of Alberta ETDD)	NPI: Dr. McDonald	Microbiota-immune interactions and host defense against infections and sepsis	\$922,125
2021-2022	VPR Catalyst Grant, University of Calgary	PI: Dr. Winston	Using metabolomics for early detection and prognosis of patients with COVID-19 ARDS	\$13,500
2021-2021	CHIR	COI: Dr. Kromm	The Neurologic Physiology after Removal of Therapy (NeuPaRT) Study	\$684,676

Year	Sponsor	PO/CO Investigator	Title	Amount
2021-2024	CHIR	COI: Dr. Fiest	Adverse Drug Events and Medication Errors in adult Intensive Care Units	\$474,622
2021-2023	CHIR	COI: Dr. Fiest	New Frontiers in Research Fund: Breaking the Cycle of Intimate Partner Violence: Education, Identification, and Intervention	\$250,000
2021-2024	CHIR	COI: Dr. Fiest, Dr. Parhar, Dr. McDonald	Preparation to Trial in Inflammation for Chronic Conditions Team Grant: Therapeutic Targeting a Shared Inflammation Pathway in the Lung and Kidney	\$750,000
2021-2024	CIHR	COI: Dr. Fiest, Dr. Stelfox	Project Scheme: REVIVE: Frailty, Rehabilitation, and Hospitalization Outcomes in Adult and Pediatric Survivors of COVID-19	\$738,224
2021-2023	Kidney Foundation of Canada	COI: Dr. Stelfox	Follow-up and Outcomes of Critically Ill Patients with Acute Kidney Injury	\$99,320
2021-2023	CHIR	COI: Dr. Stelfox	The right care, for the right patient, at the right time, by the right provider: A value-based comparison of the management of ambulatory respiratory diseases in walk-in clinics, primary care physician practices and emergency departments	\$879,751
2021-2024	CIHR	COI: Dr. Stelfox	Improving the quality of Canadian pediatric injury care: identifying priorities based on evidence, practice variations and stakeholder needs and preferences	\$608,176
2021-2022	CIHR	COI: Dr. Stelfox	Pulmonary vascular disease in patients with Long COVID	\$292,092
2021-2026	CIHR Project Grant	COI: Dr. Yipp	A novel mouse model for human 'STING-associated vasculopathy with onset in infancy' (SAVI), a genetic auto-inflammatory disease	\$921,825
2021-2023	CIHR Project Grant	COI: Dr. Parhar	High-Flow Nasal Oxygen with or without Helmet Non-invasive Ventilation for Oxygenation Support in Acute Respiratory Failure (HONOUR) Pilot RCT	\$347,500
2021-2022	SSHRC (Insight Development Grant)	COI: Dr. Zuege	Critical care work during and after COVID-19: Exploring changing identities and Practices associated with recovery from burnout	\$62,990
2021-2024	Alberta Innovates - PRIHS	COI: Dr. Zuege	Dialyzing Wisely – Improving the delivery of acute renal replacement therapy to Albertans	\$830,225



## Research Publications/ Presentations

### Peer Reviewed Manuscripts

1. Fiest KM, Krewulak KD, Makuk K, Jaworska N, Hernández L, Bagshaw SM, Burns KE, Cook DJ, Doig CJ, Fox-Robichaud A, Fowler RA, Kho ME, Parhar KKS, Rewa O, Rochweg B, Sept BG, Soo A, Spence S, West A, Stelfox HT, Parsons Leigh J, for the Canadian Critical Care Trails Group. A modified Delphi process to prioritize experiences and guidance related to ICU restricted visitation policies during the COVID-19 pandemic. *Crit Care Explor* 2021; 3(10): e0562.
2. Kramer AH, Kromm JA, Doig CJ, Chasse M, Couillard PL. Neurological determination of death following intratentorial stroke: a population-based cohort study. *Can J Neurol Sci* 2021; doi:10.1017/cjn.2021.177
3. Blanchard IE\*, Williamson TS, Ronksley P, Hagel B, Niven D, Dean S, Shah MN, Lang ES, Doig CJ. Linkage of emergency medical services and hospital data: a necessary precursor to improve understanding of outcomes of pre-hospital care. *Prehospital Emergency Care* 2021; doi: 10.1080/10903127.2021.1977438
4. Moss SJ, Krewulak KD, Stelfox HT, Ahmed SB, Anglin MC, Bagshaw SM, Burns KEA, Cook DJ, Doig CJ, Fox-Robichaud A, Fowler R, Hernández L, Kho ME, Kredentser M, Makuk K, Murthy S, Niven DJ, Olafson K, Parhar KKS, Patten SB, Rewa OG, Rochweg B, Sept B, Soo A, Spence K, Spence S, Straus S, West A, Parsons Leigh J, Fiest KM. Restricted visitation policies in acute care settings during the COVID-19 pandemic: a scoping review. *Crit Care*. 2021 Sep 25;25(1):347. doi: 10.1186/s13054-021-03763-7. PMID: 34563234; PMCID: PMC8465762.
5. Moss SJ, Stelfox HT, Krewulak KD, Ahmed S, Anglin MC, Bagshaw SM, Barnes T, Burns KEA, Cook DJ, Crowe S, Doig CJ, Foster N, Fox-Robichaud A, Fowler R, Kredentser M, Murthy S, Niven D, Olafson K, Parhar KKS, Patten SB, Rewa O, Rochweg B, Sept BG, Soo A, Spence K, Spence S, Straus SE, West A, Parsons Leigh J, Fiest KM. Impact of restricted visitation policies in hospitals on patients, family members and healthcare providers during the COVID-19 pandemic: a scoping review protocol. *BMJ Open*. 2021 Sep 23;11(9):e048227. doi: 10.1136/bmjopen-2020-048227. PMID: 34556510; PMCID: PMC8461363.
6. Ng-Kamstra JS, Soo A, McBeth P, Rotistein O, Zuege DJ, Gregson D, Doig CJ, Stelfox HT, Niven DJ. STOP signs: A population-based interrupted time series analysis of antimicrobial duration for complicated intra-abdominal infection before and after the publication of a landmark RCT. *Annals of Surgery* 2021. doi: 10.1097/SLA.0000000000005231
7. Fiest KM, Soo A, Lee CH, Niven DJ, Ely EW, Doig CJ, Stelfox HT. Long-term outcomes in intensive care unit patients with delirium: a population-based cohort study. *American Journal of Respiratory and Critical Care Medicine* 2021; 204: 412-20.
8. Scott NV, Kramer AH, Nguyen R, Wong CHY, Jenne CN, Ruddell S, Wong J, Tse M, Winston BW, Soo A, Doig CJ, Zygun DA, Kubes P. The relationship between iNKT cells, Th1 and Th2 cytokine profiles, and the development of infection among critically ill patients with neurological injury. *Neurocritical Care* 2021; 35: 617-30.
9. Boehm C#, Doig C, Chen JZ, Sligl WI, Bagshaw SM, Conly J. Procalcitonin measurement in West Nile virus neuroinvasive disease: a first case series. *JAMMI* 2021. doi: 10.3138/jammi.5.s1.02.abst.
10. Dhanani S, Hornby L, van Beinum A, Scales NB, Hogue M, Baker A, Beed S, Boyd JG, Chandler JA, Chasse M, D'Aragon F, Dezfulian C, Doig CJ, et al. Resumption of cardiac activity after withdrawal of life-sustaining measures. *New Engl J Med* 2021; 384: 345-52.
11. Farrah K, McIntyre L, Doig CJ, et al. Sepsis-associate mortality resource use and healthcare costs: a propensity matched cohort study. *Crit Care Med* 2021; 49: 215-27.
12. Moss SJ, Stelfox HT, Krewulak KD, et al. Impact of restricted visitation policies in hospitals on patients, family members, and healthcare providers during the COVID-10 pandemic: a scoping review protocol. *BMJ Open* 2021; 11(9): e048227.
13. Kromm J, Alkhachroum A, Genesan SL, Koren JP, Massad N, Reyes RA, Miller MR, Roh D, Agarwal D, Park S, Claassen J. Quantitative EEG based Seizure Diagnosis and Seizure Burden Estimation in Super- Refractory Status Epilepticus. *Neurocritical Care*. 2021 DOI: 10.1007/s12028-021-01395-x.
14. Kramer AH, Couillard PL, Kromm J, Ruddell S, Demers-Marcil S, Mitha A, Sutherland G, Wong A. Clinical Findings with High Specificity for Poor Outcome Following WFNS Grade 5 Aneurysmal Subarachnoid Hemorrhage: A Cohort Study. *CJNS*. 2021; Jan 21:1-10. DOI: 10.1017/cjn.2021.13.
15. Kromm J, Fiest KM, Alkhachroum A, Josephson C, Kramer A, Jette N. Structure and outcomes of educational programs for training non-electroencephalographers in performing and screening adult EEG: a systematic review. *Neurocrit Care*. 2021;35(3): 894-912. DOI: 10.1007/s12028-020-01172-2
16. Ganesh A, Ospel J, Kromm J, Goyal M. Ignorance is not bliss: Managing uncertainty in acute stroke treatment in the COVID-19 era. *Neuroradiology*. 2021; 63:3-6. DOI: 10.1007/s00234-020-02592-9
17. Goyal M, Kromm J, Ganesh A, et. al. Integrating New Staff into Stoke Teams During the COVID-19 Pandemic. *AJNR*. 2021;42(1):22-27. DOI: 10.3174/ajnr. A6854
18. Zochios V, Lau G, Conway H, Parhar KKS. Protecting the Right Ventricle Network (PRORVNet): Time to Defend the "Forgotten Ventricle"? *J Cardiothorac Vasc Anesth*. 2021 Jan 8: S1053-0770(21)00002-1. doi: 10.1053/j.jvca.2021.01.002. PMID: 33478881.
19. Weatherald J, Norrie J, Parhar KKS. Awake prone positioning in COVID-19: is tummy time ready for prime time? *Lancet Respir Med*. 2021 Aug 20: S2213-2600(21)00368-4. doi: 10.1016/S2213-2600(21)00368-4. PMID: 34425072; PMCID: PMC8378831.

## Research Publications/ Presentations Peer Reviewed Manuscripts (Continued...)

20. Parhar KKS, Fedak PWM. Commentary: The 4AT score-Reducing confusion about delirium diagnosis after cardiac surgery. *J Thorac Cardiovasc Surg.* 2021 Jun 18: S0022-5223(21)00977-6. doi: 10.1016/j.jtcvs.2021.06.023. PMID: 34217535.
21. Fiest KM, Krewulak KD, Hiploylee C, Bagshaw SM, Burns KEA, Cook DJ, Fowler RA, Kredentser MS, Niven DJ, Olafson K, Parhar KKS, Patten SB, Fox-Robichaud AE, Rewa OG, Rochweg B, Spence KL, Straus SE, Spence S, West A, Stelfox HT, Parsons Leigh J; Canadian Critical Care Trials Group. An environmental scan of visitation policies in Canadian intensive care units during the first wave of the COVID-19 pandemic. *Can J Anaesth.* 2021 Oct;68(10):1474-1484. doi: 10.1007/s12630-021-02049-4.
22. Parhar KKS, Zjadewicz K, Knight GE, Soo A, Boyd JM, Zuege DJ, Niven DJ, Doig CJ, Stelfox HT. Development and Content Validation of a Multidisciplinary Standardized Management Pathway for Hypoxemic Respiratory Failure and Acute Respiratory Distress Syndrome. *Crit Care Explor.* 2021 May 17;3(5):e0428. doi: 10.1097/CCE.0000000000000428.
23. McGinn R, Stewart DJ, Fergusson D, Kristof A, Barron CC, McIntyre L, Stacey D, Thebaud B, Liepmann M, Dodelet-Devillers A, Zhang H, Renlund R, Lilley E, Downey G, Brown E, Cote L, Dos Santos C, Fox-Robichaud A, Hussain S, Laffey J, Liu M, MacNeil J, Orlando H, Qureshi S, Turner P, Winston BW and Manoj M. Lalu, on behalf of the Canadian Critical Care Translational Biology Group. "Surrogate humane endpoints in small animal models of acute lung injury: A Modified Delphi Consensus Study of Researchers and Laboratory Animal Veterinarians". *Critical Care Medicine*, 2021, 49(2):311-23. DOI: 10.1097/CCM.00000000000004734
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25. Lee T, Cau A, Cheng MP, Levin A, Lee TC, Vinh DC, Lamontagne F, Singer J, Walley KR, Murthy S, Patrick, D, Rewa O, Winston BW, Marshall, J, Boyd, J, Tran K Luther, JM Opal, S Kalil A, McCuloh R, Russell, JA on behalf of ARBs Corona. Angiotensin receptor blockers and angiotensin converting enzyme inhibitors in covid-19— meta-analysis/meta-regression adjusted for confounding factors. Submitted to *The Canadian J Cardiology Open*, 2021 in press. 2021 Apr 6.doi: 10.1016/j.cjco.2021.03.001. Online ahead of print.
26. Scott B, Kramer A, Rita Nguyen, Wong C, Jenne C, Ruddell S, Wong J, Mandy Tse M, Winston BW, Soo A, Doig CJ, Zygun D, Kubes P. "Evaluation of the relationship between iNKT cells and systemic cytokine profiles of critically ill patients with neurological injury". *Neurocritical Care*, 2021, *Neurocrit Care* (2021). <https://doi.org/10.1007/s12028-021-01234-z>.
27. Metwaly S, Donnelly S, Banoei M, Mourad A, Vogel H, Fiehn O, Winston BW on behalf of the Canadian Critical Care Translational Biology Group (CCCTBG). "ARDS Metabolic Fingerprints: Characterization, Benchmarking and Potential Mechanistic Interpretation." *Am J Physiol Lung Cell Mol Physiol.* 2021 May 5, 321: L79–L90. doi, 10.1152/ajplung.00077.2021.
28. Alessandro C, Matthew C, Terry L, Adeera L, Todd L, Donald V, François L, Joel S, Keith W, Srinivas M, David P, Oleksa R, Brent BW, John M, John B, James R. "Acute Kidney Injury and Renal Replacement Therapy in COVID-19 Versus Other Respiratory Viruses – A Systematic Review and Meta-Analysis." Accepted for publication in the *Canadian Journal of Kidney Health and Disease*, 2021.
29. Burns K, Cheng M, Lee T, McGeer A, Sweet D, Tran K, Lee T, Murthy S, Boyd J, Singer J, Walley K, Patrick D, Lamontagne F, Marshall J, Haljan G, Fowler R, Winston BW and Russell J. Sustained Dysregulation of the Plasma Renin-Angiotensin System in Acute COVID-19. *Research Square*, 2021. Preprint before publication. doi, 10.21203/rs.3.rs-125380/v1.
30. Mohammed Y, Goodlett D, Cheng M, Vinh D, Lee T, Mcgeer, A, Sweet D, Tran K, Lee T, Murthy S, Boyd J, Singer J, Walley K, Patrick D, Quan C, Ismail S, Amar L, Pal A, Rayhaan B; Fesdekjian, L, Gou, K, Francois L, Marshall J, Haljan G, Fowler R, Winston, BW, Russell, J for ARBs Corona I. "Longitudinal Plasma Proteomics Analysis Reveals Novel Candidate Biomarkers in Acute COVID-19". Accepted for publication in *The Journal of Proteome Research*, 2021.
31. Plotnikoff KM, Krewulak KD, Hernandez L, Spence K, Foster N, Longmore S, Straus SE, Niven DJ, Parsons Leigh J, Stelfox HT, & Fiest KM. Patient discharge from intensive care- an updated scoping review to identify tools and practices to inform high-quality care. *Crit Care.* 2021 Dec 17;25(1):438. doi: 10.1186/s13054-021-03857-2.
32. Weatherald J, Solverson K, Zuege DJ, Loroff N, Fiest KM, Parhar KKS. Awake prone positioning for COVID-19 hypoxemic respiratory failure: A rapid review. *J Crit Care.* 2021 Feb; 61:63-70. doi: 10.1016/j.jcrrc.2020.08.018.
33. Fiest KM, Soo A, Lee CH, Niven DJ, Ely W, Doig CJ, Stelfox HT. Long-Term Outcomes in ICU Patients with Delirium: A Population-based Cohort Study. *Am J Respir Crit Care Med.* 2021 ;204(4):412-420. doi: 10.1164/rccm.202002-0320OC.

## Research Publications/ Presentations Peer Reviewed Manuscripts (Continued...)

34. Moss SJ, Krewulak KD, Stelfox HT, Ahmed S, Anglin MC, Bagshaw S, Barnes T, Burns KEA, Cook DJ, Crowe S, Doig CJ, Fox-Robichaud A, Fowler R, Hernandez L, Kho M, Kredenster M, Makuk K, Murthy S, Niven D, Olafson K, Parhar KKS, Patten SB, Rewa O, Rochweg B, Sept B, Soo A, Spence K, Spence S, Straus S, West A, Parsons Leigh J & Fiest KM. Restricted visitation policies in acute care settings during the COVID-19 pandemic: a scoping review. *Crit Care* 2021; 25, 347. <https://doi.org/10.1186/s13054-021-03763-7>
35. Shahid A, Rosgen BK, Krewulak KD, Lorenzetti DL, Foster N, Sept BG, Parsons Leigh J, Stelfox HT, & Fiest KM. Incorporating and evaluating citizen engagement in health research: a scoping review protocol. *BMC Systematic Reviews*. 2021; 10, 260. <https://doi.org/10.1186/s13643-021-01812-4>.
36. Cherak SJ, Stelfox HT, Krewulak KD, Ahmed S, Anglin MC, Bagshaw S, Barnes T, Burns KEA, Cook DJ, Crowe S, Foster N, Fox-Robichaud A, Fowler R, Kredenster M, Murthy S, Niven D, Olafson K, Parhar KKS, Patten SB, Rewa O, Rochweg B, Sareen J, Sept B, Soo A, Spence K, Spence S, Straus S, West A, Parsons Leigh J\* & Fiest KM\*. The impact of restricted visitation policies in hospitals on patients, family members and healthcare providers during the COVID-19 pandemic: a scoping review protocol. *BMJ Open*. 2021;11: e048227. doi:10.1136/bmjopen-2020-048227. \*Indicates co-senior authors
37. Fiest KM, Krewulak KD, Makuk K, Jaworska N, Hernández L, Bagshaw SM, Burns KE, Cook DJ, Doig CJ, Fox-Robichaud A, Fowler RA, Kho ME, Parhar KKS, Rewa O, Rochweg B, Sept BG, Soo A, Spence S, West A, Stelfox HT, Parsons Leigh J, for the Canadian Critical Care Trails Group. A modified Delphi process to prioritize experiences and guidance related to ICU restricted visitation policies during the COVID-19 pandemic. *Crit Care Explor*. 2021. 3(10) p e0562. doi: 10.1097/CCE.0000000000000562
38. Rosgen B, Cherak SJ, Soo A, Stelfox HT, Patten SB, & Fiest KM. Healthcare utilization and mortality outcomes in patients with pre-existing psychiatric disorders after intensive care unit discharge: A population-based retrospective cohort study. *J Crit Care*. 2021; 66:67-74. doi: 10.1016/j.jcrc.2021.08.009
39. Casault C, Lee CH, Soo A, Couillard P, Niven DJ, Stelfox HT, & Fiest KM. Sedation strategy and ICU delirium: a multi-centre, population-based retrospective cohort study. *BMJ Open* 2021;11: e045087. doi: 10.1136/bmjopen-2020-045087.
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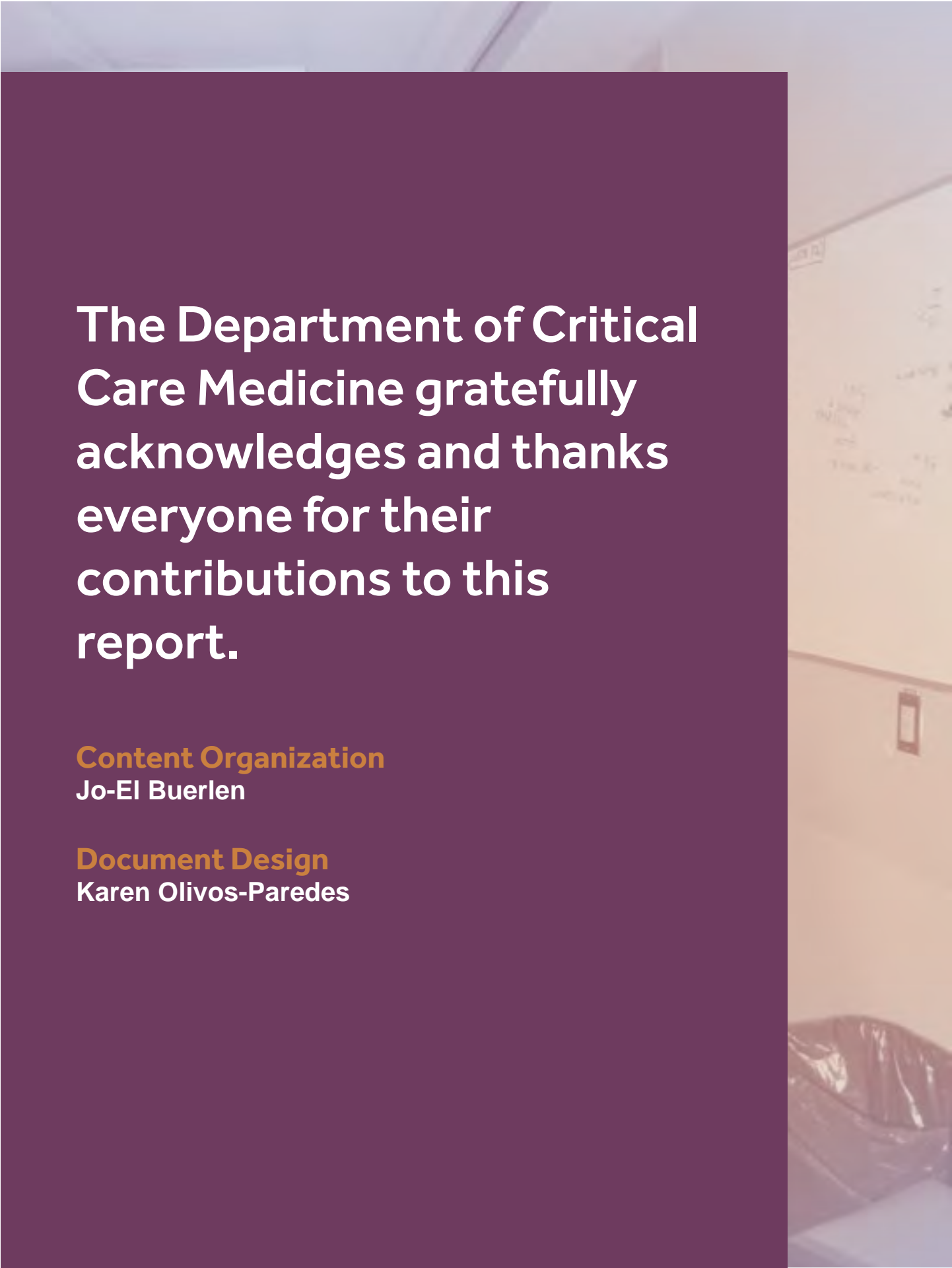
## Abstracts

1. Angus S, Henderson W, Banoei M, Molgat-Seon Y, Peters C, Parmar H, Griesdale D, Sekhon M, Sheel W, Winston BW, and Dominelli P. Effect of Therapeutic Hypothermia on Physiologic, Histologic and Metabolomic Markers of Injury in Experimental Acute Respiratory Distress Syndrome. Presented at the Experimental Biology Meeting 2021.
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5. Metwaly S, Côté A, Donnelly S, Banoei M, Lee C, Andonegui G, Yipp B, Vogel H, Fiehn O, and Winston BW, on behalf of the Canadian Critical Care Translational Biology Group (CCCTBG). ARDS Heterogeneity from A Metabolomics Perspective. Presented at the Aspen Lung Conference, September 2021.
6. Winston BW, Lee CH, Banoei M, Kumar A, Dos Santos C, Russell J and the ARBs I Group. A comparison of metabolomics in infectious causes of ARDS. Presented at the Canadian Critical Care Forum, December 2021. Winner of the Michael Ward Award for the best basic or translational science study.
7. Rosgen B, Cherak SJ, Soo A, Patten SB, Stelfox HT, Fiest KM. Healthcare utilization and mortality outcomes in patients with pre-existing psychiatric disorders after intensive care unit discharge: A population-based retrospective cohort study. Sebastian K. Littmann Research Day, The Mathison Centre for Mental Health Research, Cumming School of Medicine, University of Calgary, AB. Oral presentation. Mar 2021[Online]
8. Cherak SJ, Poulin T, Krewulak KD, Stelfox HT & Fiest KM. Patterns of Anxiety and Depression Symptom Severity Among Family Caregivers of Critically Ill Patients Engaged in Delirium Detection in the Intensive Care Unit: A Latent Profile Analysis. Women in Data Science Conference, University of Calgary, Calgary, AB. Oral poster presentation. Mar 2021 [Online]
9. Cherak SJ, Wollny K, Poulin TG, Cook DJ, Stelfox HT, Roze des Ordon A, Fiest KM. Bereavement Interventions to Support Informal Caregivers in the Intensive Care Unit: A Systematic Review. Sebastian K. Littmann Research Day, The Mathison Centre for Mental Health Research, Cumming School of Medicine, University of Calgary, AB. Oral presentation. Mar 2021 [Online]
10. Stelfox HT. Trauma Quality Improvement. Qatar Health 2021. Doha, Qatar (Virtual Conference). January 23, 2021. (550+ participants).
11. Stelfox HT. Closing Remarks for Vaccine Hesitancy: Convincing Canadians of the Importance of Vaccines. Empire Club Event Day. Toronto, ON. February 19, 2021 (550+ participants).
12. Stelfox HT. Falls in the ICU. Critical Care Canada Forum. December 6, 2021. (100+ participants)
13. Stelfox HT. Keynote Address, 2021 CIHR-ICRH/CCCS Distinguished Lecturer Award in Critical Care Sciences. Critical Care Canada Forum. December 9, 2021. (200+ participants).
14. Stelfox HT. Welcome and Opening Remarks for Anatomy of a Pandemic Seminar. Our children's burden – Safety, education and isolation during COVID-19. Calgary, AB. February 16, 2021 (433+ participants).
15. Stelfox HT. Welcome and Opening Remarks for Social and Structural Vulnerabilities Program Launch Event. Calgary, AB. January 20, 2021 (75+ participants).
16. Stelfox HT. Welcome and Opening Remarks for Anatomy of a Pandemic Seminar. Hopes and Challenges for the Coronavirus Vaccine. Calgary, AB. February 16, 2021 (200+ participants).
17. Stelfox HT. Welcome and Opening Remarks for Anatomy of a Pandemic Seminar. Health vs. Economy? How we leave COVID-19 behind. Calgary, AB. June 18, 2021 (150+ participants).
18. Stelfox HT. Presenter, "What to do with a PhD" panel discussion. University of Calgary. Calgary, AB. January 26, 2022.
19. Sauro KM, Kersen J, O'Rielly C, Soo A, Bagshaw SM, Stelfox HT. Critical illness among patients experiencing homelessness. Canadian Association for Health Services and Policy Research, Annual meeting 2021. Abstract 442.
20. Implementing a Delirium Care Bundle in Alberta Intensive Care Units: An Interrupted Time Series Analysis (Victoria Owen). American Delirium Society (ADS) 2021 Virtual Annual Conference. June 13-15, 2021
21. Impact of Family Presence on Delirium in Critically Ill Patients: A Retrospective Cohort Study (Samaha Mohsen). The World Congress of Intensive & Critical Care Annual Meeting. Virtual conference. September 11-12, 2021.



## Abstracts

22. Smiechowski J, Stelfox HT, Sinclair S, Sinuff T, Grindrod-Millar K, Roze des Ordons A. Vicarious spiritual distress in intensive care unit healthcare providers: A qualitative study. *Intensive Crit Care Nurs*. 2021 Apr;63:102982. doi: 10.1016/j.iccn.2020.102982.
23. Gershkovitch B, Slavikova Z, Schneider P, McDonald B. Bedside precision medicine in the ICU to prevent thromboembolic complications in severe COVID-19. Snyder Institute Research Symposium 2021. Virtual (Nov 5, 2021). Plenary Talk.
24. Schlechte J, Yu I, McDonald B. Dysbiosis of the gut microbiome and immune paralysis in critical illness: a multiomics and systems-based analysis. *ImmuNET Research Symposium 2021*. Virtual (Aug 19 2021). Plenary talk.
25. Zucoloto AZ, Strayer K\*, Yu I, McDonald B. Transkingdom dynamics in the gut microbiome of critically ill patients are dominated by progressive overgrowth of *Candida* species. *IMPACTT 2021 Microbiome Conference*. Virtual (June 16, 2021). Plenary talk.
26. Schlechte J, Zucoloto AZ\*, Yu I, McDonald B. Dysbiosis of the gut microbiome and immune paralysis in critical illness: a multi-omics and systems-based analysis. *IMPACTT 2021 Microbiome Conference*. Virtual (June 15, 2021). Poster.
27. Zucoloto AZ, Yu I, McCoy KD, McDonald B. The gut microbiota-derived metabolite D-lactate modulates neutrophil trafficking to the liver during systemic bacterial infection. *Immunology 2021 - American Association of Immunologists Congress*. Virtual (May 10, 2021). Poster and Plenary talk.
28. Zuege D. Moving data out of Connect Care – A Need, Challenges, Success. Presented to AHS Strategic Clinical Networks and Connect Care Provincial Workshop (Zoom) – June 2021.



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