icord

annual report 2021-22

THE UNIVERSITY OF BRITISH COLUMBIA

ICORD Annual Report 2021-22

Inside:

ICORD at a glance:

People

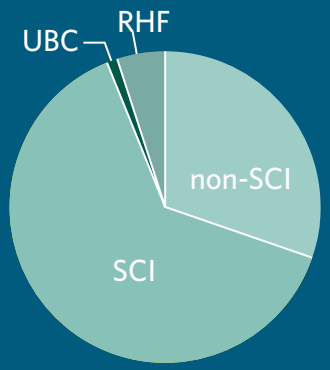
Researchers: 81
PIs: 43
Investigators: 20
Associate Members: 15
Emeriti: 3

Trainees: 269
Undergrads: 105
Masters: 64
PhD: 65
Postdocs: 32
Residents: 3

Staff: 87
Technical: 82
Admin: 5

Volunteers: 143

Publications: 340
(including **253 peer-reviewed journal articles**, and **75 papers with multiple-ICORD authors)**



Funding

Competitively-funded research grants held by PIs: $26,198,659
(including $17,878,715 for SCI-related projects)

Rick Hansen Foundation (BICP): $1,175,261

UBC: $379,753

Cover photo: Oscar Seira and Michelle Poovathukaran of the Tetzlaff Lab

ICORD
Annual Report
2021-22

Introduction

It gives me great pleasure to present this annual report, covering ICORD's accomplishments from April 1, 2021, to March 31, 2022.

ICORD started the year tentatively, under slowly-relaxing COVID restrictions, but gradually our activities returned to almost-normal, with on-site work and clinical studies back to full-swing. We were even able to get together for lab photographs again, which you'll find throughout this report. I hope you enjoy seeing so many smiling faces (captured under pandemic precautions, with masks only removed momentarily for the shots!).

It seems that the pandemic did not lead to much loss of productivity in the past year. In fact, ICORD researchers brought in significantly more competitive research grants than last year (including a multi-year $24 million multi-institutional project funded by Canada's New Frontiers in Research fund—see page 5). We also published the same number of peer-reviewed journal articles as we did last year, and almost 30% of those peer-reviewed papers included two or more ICORD Principal Investigators as authors, which says a lot about the collaborative spirit here.

The funding support provided by the Rick Hansen Foundation (RHF) to ICORD has been vital to our success. Not only are the direct results of the funding beneficial to the centre but the indirect benefits of the support are far-reaching. With shared tech support and equipment, seed grants, travel awards, seminars and international exchange programs ICORD is an internationally-known centre where researchers and trainees want to come to do SCI research. In addition, the Best & Brightest program funded by RHF enabled us to help our new starting faculty and compete for academic renewal positions. This year UBC ranked among the top five institutes in the world for spinal cord injury research, and needless to say this is due to the work at ICORD. We look forward to building on the foundation laid to further the shared goals of RHF in the future.

On a personal note, I was sorry to accept the retirement of our long-serving Managing Director, Dr. Lowell McPhail. I've known Lowell since the mid-1990s when he joined my lab as a PhD student. It is rare that a single individual plays as pivotal, supportive and essential a role to an organization's growth and smooth operation as Lowell did for the researchers, students and staff at ICORD. My colleagues and I are sincerely grateful for Lowell's long, diverse and dedicated contributions to ICORD's development into the world-class SCI research centre it is today.

WOLFRAM TETZLAFF, MD, PHD
DIRECTOR OF ICORD
PROFESSOR, ZOOLOGY & SURGERY, UBC

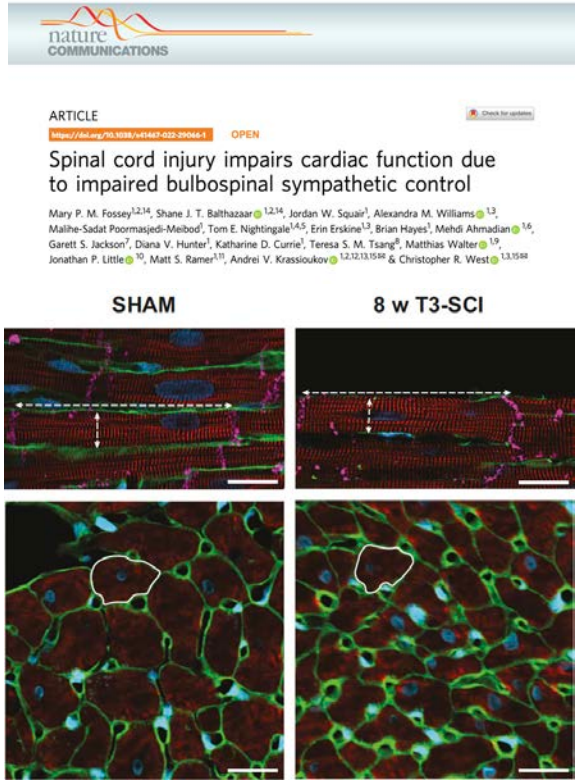
ICORD
Annual Report
2021-22

Dr. Tetzlaff and his lab

Highlights from 2020-21:

Paper published in high impact journal

A translational collaborative paper by ICORD trainees from the West, Krassioukov and Ramer labs was published in the prestigious journal Nature Communications in March, 2022. “Spinal cord injury impairs cardiac function due to impaired bulbospinal sympathetic control” is open access, meaning it can be read by everyone for free.



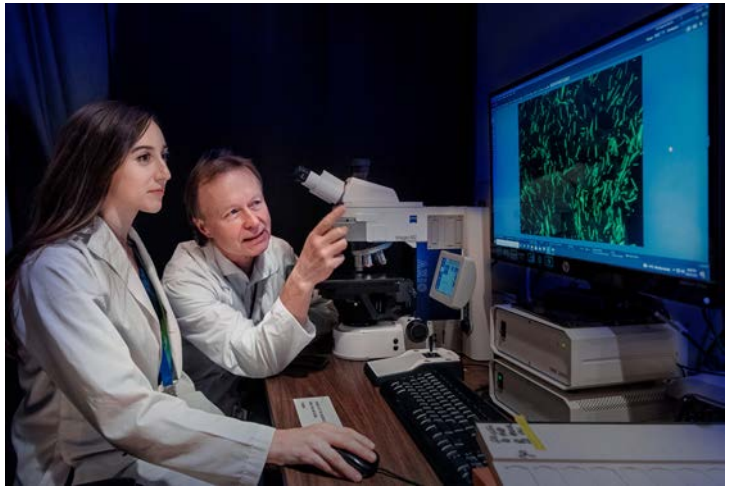
Sustaining an SCI chronically changes heart structure and function, and is associated with increased risk of cardiovascular diseases. In this publication, ICORD researchers investigated the acute to chronic cardiac consequences of SCI, as well as how changes in bulbospinal sympathetic control contribute to declined heart function after SCI. This study found that the loss of bulbospinal sympathetic control following SCI is what causes a rapid and sustained decrease in left ventricle function. The left ventricle (LV) is the thickest chamber in the heart and when the LV contracts, it sends oxygenated blood out to the body. Interestingly, reduction in left ventricular contractile occurs before structural changes at the cellular and organ levels. These findings indicate the importance for early interventions in preventing cardiac functional decline, and specifically highlight that future interventions should target the loss of sympathetic control following SCI. Twelve current or former ICORD trainees are authors (Mary Fossey, Shane Balthazaar, Jordan Squair, Alex Williams, Mali Meibod, Tom Nightingale, Erin Erskine, Brian Hayes, Mehdi Ahmadian, Diana Hunter, Katharine Currie, Matthias Walter).

ICORD researchers lead major new project

ICORD Director Dr. Wolfram Tetzlaff is the co-lead (together with Drs. John Madden and Karen Cheung, both new ICORD members in 2022-23) of an international group of researchers who received $24 million from Canada’s New Frontiers in Research Fund 2020 Transformation Stream. The project, named Mend The Gap, will investigate the use of biomaterials to repair the gap that is formed when the spinal cord is injured. This gap, typically a few centimetres wide, essentially blocks nerve impulses from getting through, leading to serious health issues that may include paralysis, loss of blood pressure, bladder and bowel control, sexual dysfunction, and chronic pain.

The Mend the Gap team, which includes ICORD researchers Brian Kwon, Dena Shahriari, Michael Berger, Corree Laule, Babak Shadgan, and Stephanie Willerth, in addition to Dr. Tetzlaff, will investigate using biomaterials—soft gels in particular—to heal the injury. The soft gel containing tiny magnetic rods will be injected into the site of the injury to serve

as a bridge for growing nerve fibres. The rods can be aligned using an external magnet, creating guides to support the nerve fibres growing across the gap. The full 32-member project includes researchers, engineers and surgeons from Canada, the United States, Europe and Australia. In Canada, the network includes UBC, ICORD, the University of Alberta, University of Western Ontario, McGill University and University of Toronto.



PhD student Katie Jeffris and Dr. Tetzlaff view rods in a soft gel

Bibliographic analysis highlights UBC work

A bibliometric analysis of the global SCI research field was published this past year and provided insight into output and trends in the literature between 1999 and 2019 ("A bibliometric analysis of global research on spinal cord injury: 1999-2019," *Spinal Cord* (2022) 60: 281-87). UBC was the second-ranked institution in the world by publication count and the fifth ranked institution by H index and citation count. Considering that most, if not all, researchers who study SCI at UBC are associated with ICORD, these rankings are reflective of research at ICORD.

ISCIB launched website

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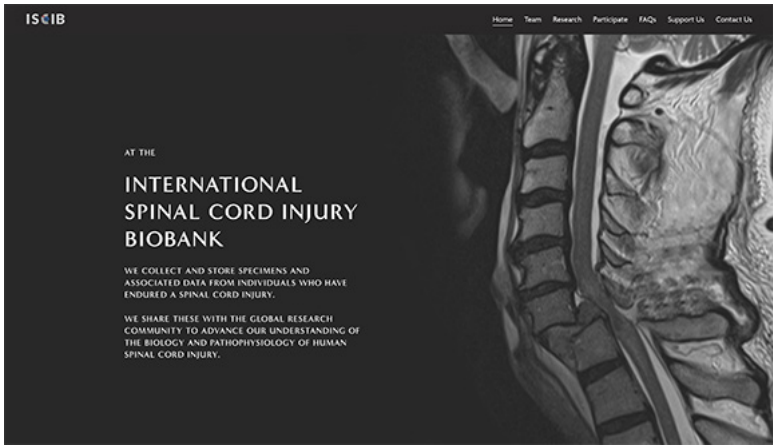
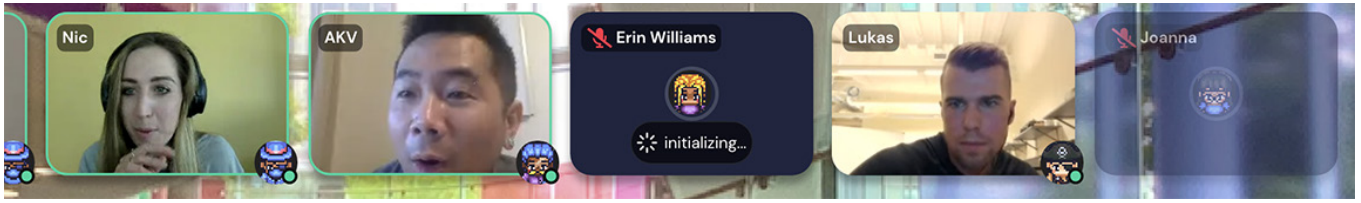
The International SCI Biobank (ISCIB) is a translational research resource consisting of a collection of biospecimens, images and data to support biomedical research and to ultimately improve patient outcomes following SCI. ISCIB is an international, "poly-user" biobank, meaning that all biospecimens and their associated information are made available to researchers globally, provided that the proposed research has undergone ethical review and aims to improve the overall understanding of SCI and the spine. ISCIB has curated biospecimens and associated data from three distinct acute and chronic SCI participant consent categories: alive, alive and participating in another research study, and deceased. From the "alive" categories, cerebrospinal fluid, plasma, serum, and PAXgene Blood RNA tubes are collected, while cerebrospinal fluid and spinal cord tissue are collected from the "deceased" category. In September 2021, ISCIB launched its official website, www.sci-biobank.org and Twitter page, @SCI_Biobank. As of March 31, 2022, ISCIB's website had been visited 1,063 times from 30 countries.





Two meetings were virtual successes

The ICORD Trainee Committee hosted the Trainee Symposium on September 23-24, 2021. This annual event is planned, organized and executed by ICORD trainees. It offers the organizing committee excellent networking experience and an understanding of the work it takes to host an event. In 2021, the symposium's theme was Impact and was held virtually with 115 registered participants. The event included eight student research talks, four plenary lectures and 33 poster presentations. Plenary talks were presented by Drs. Sean Mackey (Stanford University), Heather Gainforth (UBC Okanagan), Murray Blackmore (Marquette University) and Loren Martin (University of Toronto). A special pre-recorded talk on the challenges of living with SCI was given by Mr. Jim Ryan (Rick Hansen Foundation Ambassador).

generously supported by
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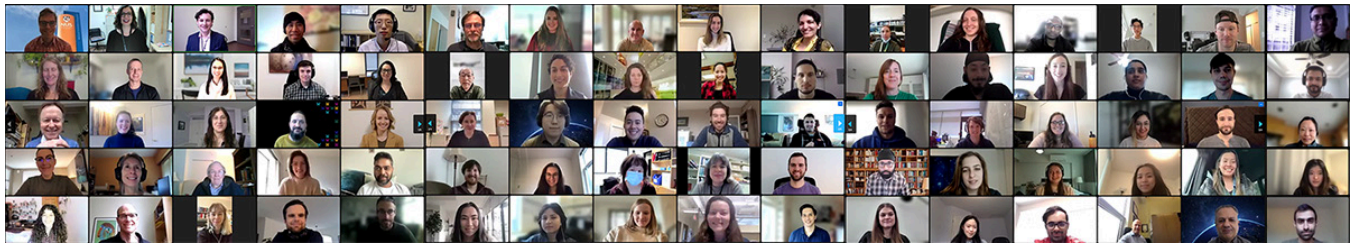
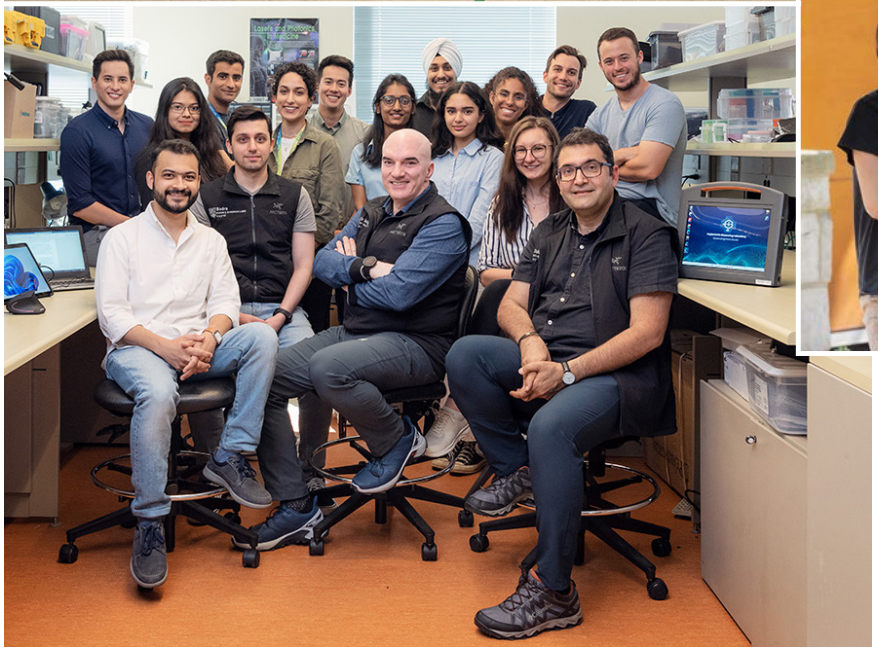
ICORD's eighteenth annual research meeting was held on March 10 and 11, 2022, with 195 registered participants. Faculty, staff, trainees and members of our partner organizations met virtually for the second year in a row to enjoy two plenary lectures, twelve talks and 57 poster presentations about new SCI research coming from ICORD labs. The Rick Hansen Plenary Lecture for 2022 was given by Dr. Samuel Stupp from Northwestern University and titled, "Supramolecular motion in bioactive scaffolds for spinal cord injury." This was a fascinating talk about peptides that self-assemble and are designed for movement of functional side groups that activate cellular receptors. Dr. Stupp's research is at the intersection of materials science, biology and medicine. He spoke of the potential for these biomaterials and spinal cord injury and created a vibrant discussion. The ICORD Plenary Lecture for 2022 was given by Dr. Robert Gaunt from the University of Pittsburgh and titled, "Bidirectional brain-computer interfaces for arm and hand function." This clinical topic on a neuroprosthetic technology was presented expertly to our broad audience. Our Annual Research Meeting brings together SCI researchers and community partners to share our work, forge new collaborations, and celebrate one another's accomplishments. It is a highlight in many researchers' academic year.

ICORD is sincerely grateful to the Rick Hansen Foundation for its ongoing and generous support of both of these important annual research events.



ICORD
Annual Report
2021-22



Clockwise from top left: Dr. Peter Cripton with members of the Orthopaedic and Injury Biomechanics Group, Students taking part in ICORD's Summer Research Program for Indigenous Youth, Dr. Babak Shadgan and his lab.

ICORD
Annual Report
2021-22

Building capacity

with the support of the Rick Hansen Foundation

In 2013, the Rick Hansen Foundation brought the Rick Hansen Institute (now Praxis) and ICORD together to form the Blusson Integrated Cures Partnership (BICP). The purpose of the BICP was to advance cures-focused research in the field of SCI. The BICP provided a unique opportunity for RHF, Praxis, and ICORD to lead through collaboration. Although Praxis is no longer a partner in the BICP, RHF and ICORD continue to work on many of the core strategies of the BICP and several ICORD researchers still play key roles in joint projects with Praxis. We are thankful for the support that has been provided and look forward to building on the foundation laid to further the goals of RHF in the future.

Seed Grants funded by the Rick Hansen Foundation since 2014 have leveraged more than $29M in competitively-funded research grants by the end of the 2022 fiscal year. This year, twelve new seed grants were awarded, and seed grants from past years were instrumental in the success of the following grant applications:

$20K → $368K: Drs. Cornelia Laule, Brian Kwon, Wayne Moore and Piotr Kozlowski leveraged results from a 2017 seed grant, *Histological validation of quantitative MRI in human spinal cord injury*, for a Craig H. Neilsen Foundation grant.

$20K → $420K: Dr. Christopher West with collaborators Drs. Gordon Mitchell and Malihe-Sadat Pourmasjedi-Meibod leveraged preliminary data from a 2018 seed grant, *Effect of acute intermittent hypoxia on cardiovascular function in a rodent model of spinal cord injury,* for an International Spinal Research Trust grant.

$20K → $2.065M: Drs. Andrei Krassioukov and Rahul Sachdeva leveraged results from a 2019 Seed Grant, *Transcutaneous spinal cord stimulation to modulate autonomic intraspinal networks and promote cardiovascular function after spinal cord injury*, for two Wings For Life grants ($313K) and a three-year US DoD grant ($2.3M).

$20K → $5.3M: Drs. Christopher West and Brian Kwon continued to leverage their 2015 seed grant for another DoD Translational Research Award ($2M) and DoD Spinal Cord Injury Research Program funding ($499K) in 2021.

Rick Hansen Foundation funding supports the International SCI Biobank (see page 6), SCIRE, and the Yuel Family Physical Activity Research Centre (see below and following pages). There are also indirect results of RHF funding, the most important being the strengthening of core support for all ICORD research taking place in the Blusson Spinal Cord Centre, including, but not limited to, the RHF/ICORD initiatives, which enhances the success of all ICORD researchers.

SCIRE

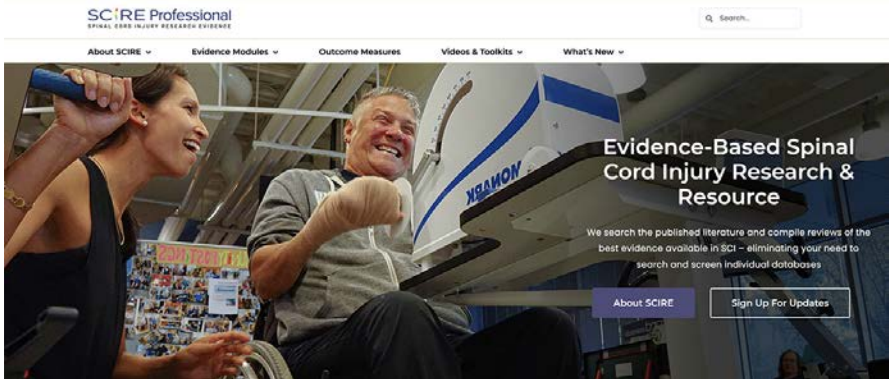
generously supported by Rick Hansen Foundation

SCIRE (Spinal Cord Injury Research Evidence) is a free online resource that covers a comprehensive set of topics relevant to SCI rehabilitation and community reintegration. SCIRE reviews, evaluates and translates existing research knowledge into a clear and concise format to inform health professionals (SCIRE Professional) and other stakeholders (SCIRE Community) of best rehabilitation practices following SCI. This past year was the second year that funding from the Rick Hansen Foundation was directly used to support SCIRE.

ICORD
Annual Report
2021-22

2021-22 highlights include:

- Launch of a re-developed SCIRE Professional website
- Addition of a much-anticipated Pediatric Module titled, Rehabilitation of Pediatric SCI
- New videos to the SCIRE YouTube channel, with content on neuromodulation and exercise after SCI, as well as a video series on breastfeeding after SCI
- Supporting the publication of 6 articles
- Providing SCIRE Community content in French and Greek



SCIRE Professional continues to perform well against other websites in the evidence-based genre (12,300 article downloads and 242,000 page views). SCIRE Community continues to add new content and saw an increase in Facebook and Twitter followers (468 followers with 145 new on Facebook and 1102 on Twitter) and a growth of the YouTube channel (1840 total subscribers with 592 new this year and 121,700 views).

Dr. Brian Kwon and members of his lab

PARC

generously supported by Rick Hansen Foundation

The Yuel Family Physical Activity Research Centre (PARC) is ICORD's most successful community engagement initiative. The goal of PARC is to advance best strategies to provide people with complete or partial paralysis due to spinal cord dysfunction with opportunities to be physically active and engage in exercise. Over 500 participants are registered with PARC, with approximately 120 attending the facility each week to partake in individual and group exercise. PARC houses an impressive range of strength machines including a large collection of HUR machines that use smart card technology that adjust the resistance automatically for each user according to their preset exercise program. The cardio machines include the AROW and ASKI devices created by researchers at ICORD that adapt standard rowing and skiing ergometers for wheelchair users. Most importantly, the equipment at PARC is adapted to make it widely accessible for wheelchair users and many devices can be used while still seated in a wheelchair (no need to transfer).

Dr. Andrea Bundon (left) with PARC staff and volunteers

PARC is staffed by a full-time manager and several UBC students in Work Learn roles that provide them with meaningful opportunities for employment while studying. In addition to the paid roles, 50-60 UBC Kinesiology students volunteer at PARC each term. Their role is to provide assistance to PARC users and help them with their exercise. Students also design and lead group exercise classes including adaptive spin class (arm cycles), adaptive boxercise, and adaptive yoga.

During the pandemic, the students were instrumental in creating a whole new series of online classes that required minimal equipment and could be done by participants at home. The online classes were so popular that the decision was made to continue even when PARC fully reopened and each week there are four to six live classes and full library of online videos that are also available for people to do on their own time. Next year, the School of Kinesiology will be launching a new course that will enable Kinesiology students to complete course work in exercise design and prescription and then gain course credits by implementing what they learn at PARC (supervised by Kinesiology faculty members and the PARC manager). This will allow for even more opportunities for new programs and initiatives including personal training programs. The Community Engagement Committee (seven individuals from the community along with PARC Manager and the PARC Principal Investigator) provide strategic advice and guidance for new initiatives.

In addition to providing opportunities for the local SCI community to engage in exercise, PARC nurtures the active exchange of ideas between those living with SCI and ICORD researchers. For example, the previously mentioned AROW and ASKI machines came from a project that started as a conversation at PARC about the need for more diverse offerings of cardio equipment. Through PARC, ICORD researchers can also connect with potential research participants and get feedback on the design of research projects. Other times, PARC provides the venue for exercise related research interventions. These projects directly benefit from having a fully equipped and accessible gym on site at ICORD.

PARC is also indirectly supported by RHF through Shared Services which provides technical support for maintenance and repair of equipment, clerical support for staff and student payroll, and communications support to promote PARC activities engage with community, and provide event support. Research supported by RHF, for example through the Seed Grants, are also able to utilize PARC.

PARC volunteer Priya Dhaliwal and participant Sydney Spraggs

See Appendix 1 for detailed Publications list

Publication highlights:

We asked ICORD researchers to tell us about the paper they're most proud of from the past year:

Sawatzky B, Herrington, B, Choi K, Mortenson WB, Borisoff J, Sparrey C, Mattie J, Laskin JJ Physiology of exercise on an adapted rowing machine in people with spinal cord injury or disease. *Spinal Cord* (2022).

Dr. Bonnie Sawatzky: *This started as a special project to design an accessible ergometer for a friend of Dr. Sparrey who was having difficulties training. Drs. Sparrey, Borisoff, and I got funding from the Craig Neilson Foundation to develop our rower and additional types of ergometers. Dr. James Laskin joined us to study the physiology and Dr. Ben Mortenson looked at designs from a qualitative perspective. None of this could have happened without a researcher listening to a need, finding like-minded researchers, and pooling our skills, students and resources to make it happen. What is so important about this work is listening to our people who live with spinal cord injuries/disease, learning about their goals and where they see the gaps. This collaborative work could not have been so organic if we were not already connected at ICORD, working on the same floor sharing offices and lab space.*

Castanov V, Berger MJ, Ritsma B, Trier J, Hendry JM. Optimizing the timing of peripheral nerve transfers for functional re-animation in cervical spinal cord injury: a conceptual framework. *J Neurotrauma*. 2021 Oct 29.

Dr. Mike Berger: *In collaboration with colleagues at Queen's University, we have developed the first clinical framework for differentiating between upper motor neuron and lower motor neuron paralysis in SCI.*

Borisoff: Khalili M , Jonathan C , Hocking N , Van Der Loos M , Mortenson B , Borisoff JF. (2021). Perception of autonomy among people who use wheeled mobility assistive devices: dependence on the type of wheeled assistive technology. *Assistive technology*: 1-9.

Dr. Jaimie Borisoff: *This paper highlights the benefits of new add-on products to manual wheelchairs, and how they improve a wheelchair user's autonomy compared to conventional devices. It's an example of our research that supports our current efforts to create innovative new add-on wheelchair products.*

Dean NA, Bundon A, Howe PD, Abele N. Gender parity, false starts, and promising practices in the Paralympic Movement. *Sociology of Sport Journal*. First Published Online: Sept. 25, 2021.

Dr. Andrea Bundon: *This paper challenges the popular narrative that the Paralympics are 'progressive' (aka aligned with social justice, equity, disability rights) by showing how the Paralympic Movement has failed to consider how women with disabilities are included/ excluded. It explores the policies and practices that can* actually *get at the 'gender gap' at the Games. It is one of the first studies to think about 'intersectional' identities in the context of disability sport. As we all know, SCI is very 'gendered' impairment and women with SCI are underrepresented in many contexts and not 'visible' in sport particularly.*

Crispo J, Liu L, Noonan V, Throgood N, Kwon BK, Dvorak M, Thibault D, Willis A, Cragg JJ. Pediatric traumatic spinal cord injury in the United States: a national inpatient analysis. *Topics in Spinal Cord Injury Rehabilitation* 2022;28(1):1-12.

Dr. Jacquelyn Cragg: *In the US, there were 1.48 tSCI admissions per 100,000 children; highest rates of hospitalization involved older (15-20 years), male, and Black children. Hospitalization involving male or Black children were less likely to involve a motor traffic accident. Hospitalizations of Black children were significantly more likely to have a diagnosis of tSCI resulting from a firearm incident or assault compared with hospitalizations of White children.*

Clockwise from top left: Dr. Andrei Krassioukov and his lab, students from Dr. Carolyn Sparrey's lab, Drs. Corree Laule Lab & Veronica Hirsch Reinshagen and their lab members.

See Appendix 1 for detailed Publications list

Booth GR, Cripton PA, Siegmund GP. The Lack of Sex, Age, and Anthropometric Diversity in Neck Biomechanical Data. *Frontiers in Bioengineering and Biotechnology*. 2021;9:14.

Dr. Peter Cripton: *What is interesting about this study is that it clearly shows marked underrepresentation of women in human subject testing of neck biomechanics and of young subjects in cadaveric testing. Since injury prevention devices such as helmets and seatbelts depend on this data the findings of this paper may point to the reasons that there are vastly different injury rates between men and women in some injury circumstances where the neck plays an important role (car crashes, bicycle crashes).*

Hoogenes B, Querée M, Townson A, Willms R, Eng JJ. COVID-19 and spinal cord injury: Clinical presentation, clinical course, and clinical outcomes: a rapid systematic review. *J Neurotrauma*. 2021 May 1;38(9):1242-1250.

Dr. Janice Eng: *This paper demonstrated our ability to assemble emerging information about the pandemic and get it out quickly to the community.*

McKay RC, Baxter KL, Giroux EE, Casemore S, Clarke TY, McBride CB, Sweet SN, Gainforth HL. (2022). Investigating the peer mentor-mentee relationship: characterizing peer mentorship conversations between people with spinal cord injury. *Disability and Rehabilitation*. March 2022.

Dr. Heather Gainforth: *This paper used an Integrated Knowledge Translation approach to understand how peer mentors with SCI support eachother in conversation and provides a novel methodology that has supported other ICORD researchers.*

Turner CT, Bolsoni J, Zeglinski MR, Zhao, H, Ponomarev T, Richardson K, Hiroyasu S, Schmid E, Papp A, Granville DJ. Granzyme B Mediates Impaired Healing of Pressure Injuries in Aged Skin. *NPJ Aging Mech Dis*. 2021 5;7(1):6.

Dr. David Granville: *Senior Postdoctoral Fellow Dr. Christopher Turner and our team published exciting findings linking granzyme B to healthy aging skin as well as pressure injuries in aging skin. Dr. Turner demonstrated that aging healthy human skin exhibits higher levels of granzyme B, a mediator of skin inflammation, compared to younger healthy skin. Moreover, in an experimental model of pressure injuries in aged skin, deletion of granzyme B reduced severity of pressure injuries and inflammation, while improving wound healing. Collectively, granzyme B is an important target for impaired wound healing in aged skin that may be relevant for people with SCI afflicted by pressure injuries.*

Fossey M, Balthazaar S, Squair J, Williams A, Poormasjedi-Meibod M, Nightingale T, Erskine E, Hayes B, Ahmadian M, Jackson G, Hunter D, Currie K, Tsang T, Walter M, Little J, Ramer M, Krassioukov A, West C. Spinal cord injury impairs cardiac function due to impaired bulbospinal sympathetic control. *Nat Commun*. 2022 Mar 16;13(1):1382.

See page 5 for more on this publication.

Dr. Andrei Krassioukov: *This study, funded by CIHR and the Craig Neilsen Foundation and done in collaboration with Dr. West's and Ramer's labs, showed the importance for early interventions in preventing cardiac functional decline, and specifically highlight that future interventions should target the loss of sympathetic control following SCI. Current and former trainees from all three labs were authors.*

See Appendix 1 for detailed Publications list

Skinnider MA, Rogalski J, Tigchelaar S, Manouchehri N, Prudova A, Jackson AM, Nielsen K, Jeong J, Chaudhary S, Shortt K, Gallagher-Kurtzke Y, So K, Fong A, Gupta R, Okon EB, Rizzuto MA, Dong K, Streijger F, Belanger L, Ritchie L, Tsang A, Christie S, Mac-Thiong JM, Bailey C, Ailon T, Charest-Morin R, Dea N, Wilson JR, Dhall S, Paquette S, Street J, Fisher CG, Dvorak MF, Shannon C, Borchers C, Balshaw R, Foster LJ, Kwon BK. Proteomic Portraits Reveal Evolutionarily Conserved and Divergent Responses to Spinal Cord Injury. *Mol Cell Proteomics*. 2021 Jun 12;20:100096.

Dr. Brian Kwon: *This was interesting because it was a large-scale proteomic analysis of both human and large animal SCI; it revealed for the first time a comparison between the two species, and demonstrated that GFAP was the most highly conserved biomarker between the two species.*

Williams AMM, Deegan E, Walter M, Stothers L, Lam T. Exoskeleton training to improve lower urinary tract function in people with motor-complete spinal cord injury: a randomized pilot trial. *J Rehabil Med*. 2021:53(8):jrm00222.

Dr. Tania Lam: *Exoskeletons and robotic prosthetics have continued to grow in popularity in rehabilitation centres for motor recovery following neurological injury. However, limited research has explored to what extent training with a robotic exoskeleton may improve secondary health considerations after SCI, including neurogenic lower urinary tract dysfunction, especially in people with motor-complete injuries. This pilot study demonstrates that walking in an overground exoskeleton activates pelvic floor musculature in this population, which may provide a novel means to train the pelvic floor and improve neurogenic lower urinary tract dysfunction for people with SCI.*

Martin Ginis KA, van der Ploeg HP, Foster C, Lai B, McBride CB, Ng K, Pratt M, Shirazipour CH, Smith B, Vasquez P M, Heath GW. (2021). Participation of people living with disabilities in physical activity: a global perspective. *The Lancet*, 398(10298), 443-455.

Dr. Kathleen Martin Ginins: *This was the first ever paper on disability to be included in* The Lancet's *quadrennial physical activity series. The paper is available as open access and was featured in a global webinar event on July 22 to launch The Lancet's quadrennial Physical Activity Series in advance of the Olympic and Paralympic Games.*

Prevost, VH, Yung A, Morris SR, Vavasour IM, Samadi-Bahrami Z, Moore GRW, Laule C, MacKay A, Kozlowski P. Temperature dependence and histological correlation of inhomogeneous magnetization transfer and myelin water imaging in ex vivo brain. *Neuroimage* 2021 Aug 1;236:118046.

Dr. Wayne Moore: *This paper showed the importance of temperature in correlation studies employing inhomogeneous magnetization transfer and myelin water imaging. This is directly applicable to the future interpretation of inhomogeneous magnetic resonance imaging and myelin water imaging of SCI.*

Simpson E, Sawatzky B, Forwell S, Backman CL, Symington D, Vu M, Mortenson WB. A mixed-methods study exploring and comparing the experiences of people who sustained a spinal cord injury earlier versus later in life. *Spinal Cord*. 2022 Feb 15.

Dr. Ben Mortenson: *This is one of the few mixed-methods studies to explore the experiences of people who acquired a spinal cord injury earlier versus later in life. The finding identified many similarities between these groups but also revealed some inequities. Those injured later in life generally had much higher incomes than those injured earlier in life, but they were also much more likely to be discharged into residential care rather than the community. This study was funded by my first ICORD seed grant and took lots of perseverance to publish given the relatively small sample size.*

ICORD
Annual Report
2021-22

Clockwise from top left: Dr. David Granville, Dr. John Kramer, Dr. Mike Berger, and Dr. Tania Lam with their lab members

See Appendix 1 for detailed Publications list

ICORD
Annual Report
2021-22

Mattucci S, Speidel J, Liu J, Tetzlaff W, Oxland TR. Temporal Progression of Acute Spinal Cord Injury Mechanisms in a Rat Model: Contusion, Dislocation, and Distraction. *J Neurotrauma*. 2021 Jun 9.

Dr. Tom Oxland: *Important differences in white matter degeneration were identified between injury types, with distraction injuries showing the least variability across timepoints These findings and the observation that white matter injury occurs early, and in many cases, without much dynamic change highlight the importance of injury type in SCI research.*

generously supported by Rick Hansen Foundation

Mah AJ, Ghazi Zadeh L, Khoshnam Tehrani M, Askari S, Gandjbakhche AH, Shadgan B. Studying the accuracy and function of different thermometry techniques for measuring body temperature. *Biology*. 2021; 10(12):1327.

Dr. Babak Shadgan: *This study, which was initiated during the COVID pandemic, was an effort to help people, particularly high-risk individuals, including people with SCI, to understand what kind of thermometers and thermometry techniques are more reliable and sensitive for regular monitoring of body temperature during COVID pandemic. Increasing body temperature is a principal clinical sign of developing viral pneumonia.*

Seira O, Kolehmainen K, Liu J, Streijger F, Haegert A, Lebihan S, Boushel R, Tetzlaff W. Ketogenesis controls mitochondrial gene expression and rescues mitochondrial bioenergetics after cervical spinal cord injury in rats. *Scientific Reports* vol 11, August 2021

Dr. Wolfram Tetzlaff: *this study demonstrates how the use of a ketogenic diet soon after injury helps improve the metabolic deficits observed after SCI by regulating the expression of genes associated with mitochondrial function and antioxidative stress, improving the impaired energy production in the cells, and reducing the levels of oxidative stress.*

Hayes BD, Fossey MPM, Poormasjedi-Meibod MS, Erskine E, Soriano JE, Scott B, Rosentreter R, Granville DJ, Phillips AA, West CR*. (2021) Experimental high thoracic spinal cord injury impairs the cardiac and cerebrovascular response to orthostatic challenge in rats. *Am J Physiol Heart Circ Physiol.* Oct 1;321(4):H716-H727.

Dr. Chris West: *This paper describes a novel model method for assessing the severity of orthostatic intolerance in rodent models of SCI. We also show that SCI worsens orthostatic tolerance. This article was featured as an Editor's Choice and I was invited to give a podcast for AJP Heart on the significance of this model development for the cardiovascular field. This work stemmed from a seed grant*

generously supported by Rick Hansen Foundation

De la Vega L, Abelseth L, Sharma R, Triviño-Paredes J, Restan M, Willerth, SM 3D bioprinting human pluripotent stem cells and drug releasing microspheres to produce responsive neural tissue. *Advanced NanoBioMed Research*. 2021. 2000077. 1-16.

Dr. Stephanie Willerth: *We showed we could bioprint functional tissues that resemble the spinal cord using our novel drug releasing technology.*

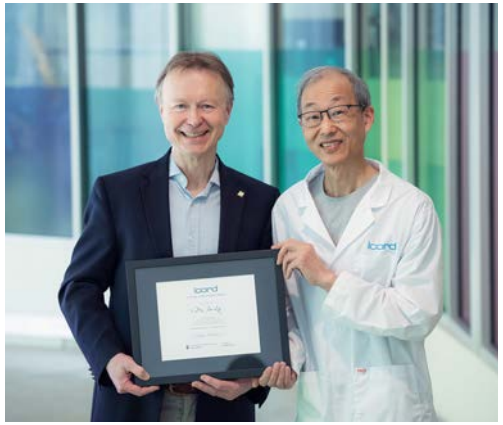
Raphaële Charest-Morin, Honglin Zhang, Jason R Shewchuk, David R Wilson, Amy E Phillips, Michael Bond, John Street. Dynamic morphometric changes in degenerative lumbar spondylolisthesis: A pilot study of upright magnetic resonance imaging. *Journal of Clinical Neuroscience* 2021:91, 152-158.

Dr. David Wilson: *This study presents a really interesting new approach using upright open MRI to investigate the mechanism of spodylolyisthesis.*

generously supported by Rick Hansen Foundation

People

Support staff



Research Associate Dr. Jie Liu (pictured, right, with Dr. Tetzlaff) won the inaugural **ICORD Lifetime Achievement Award** in March, 2022. Dr. Liu has been a member of the Tetzlaff Lab since 1998, and his surgical skills have been invaluable to a vast array of projects. He is kind, dedicated, patient, and really good at his job. We are extremely lucky to have him as a colleague!

Two members of ICORD's administrative team received prestigious awards for service in 2021-22. Facilities Assistant Nadia Ighaninazhad won the **Faculty of Medicine Applegarth Staff Service Award** in recognition of her outstanding contributions to the Faculty of Medicine, and Communications and Administrative Manager Cheryl Niamath won a 2021 **UBC President's Service Award for Excellence**. This is the top award presented to UBC staff in recognition of excellence in personal achievements and contributions to UBC and to the vision and goals of the University.

Above: Drs. Tetzlaff and Liu; below: ICORD's admin team

After 18 and a half years, ICORD's Managing Director, Lowell McPhail, started transitioning to retirement. Lowell has been part of ICORD's senior management team since before the BSCC construction started, and it was difficult to fill his position. In fact, his role was split in two: Facilities Manager and Managing Director.

Yuan Jiang is ICORD's new full-time Facilities Manager, responsible for the building, equipment, and vivarium. Yuan has been with ICORD since 2011 and has extensive experience with BSCC equipment and procedures.

Dr. Nancy Thorogood has joined us as Managing Director, responsible for strategic management, budgeting, reporting, partnerships, and many other duties. Nancy has a PhD in Genetics and ten years of SCI-related research experience as a Research Associate at Praxis.

ICORD
Annual Report
2021-22

Trainees

ICORD's 2021-22 Trainee Committee

Many of ICORD's graduate students and postdoctoral fellows hold one or more prestigous scholarships or fellowships. Notable trainees include PhD student Amanda Cheung (Kwon and Shadgan Labs), who has been awarded 35 national and international awards, grants and scholarships since she started as a graduate student, including the Killam Doctoral Scholarship (UBC) and the Vanier Canada Graduate Scholarship (CIHR); Lara Gouveia (Granville Lab) who won a Michael Smith Health Research BC Research Trainee Award; and Loay Al-Salehi (OIBG) and Todd Kamensek (Oruc Lab) who won 2021-22 Killam Graduate Teaching Assistant Awards.

Since 2010, ICORD has had a committee of dedicated students who volunteer their time to organize research, community outreach, and social activities. Members of ICORD's Trainee Committee elect an executive that includes a chair, symposium coordinator, seminar series coordinator, social coordinator, community outreach coordinator, secretary, treasurer, and workshop coordinator. Their time and energy is sincerely appreciated!

Research Faculty

Dr. Sekhon

Dr. Fewster

Dr. Bhatnagar

Drs. Mypinder Sekhon and Kayla Fewster joined ICORD as Investigators in 2021-2022, and Dr. Tim Bhatnagar joined ICORD as an Associate Member. Dr. Sekhon is an intensive care physician and clinician-scientist at Vancouver General Hospital, and a clinical associate professor in the Division of Critical Care Medicine and Department of Medicine at UBC. His research program aims to delineate the underlying cerebrovascular physiology and investigating novel resuscitative strategies for the prevention of secondary ischemic brain injury. Dr. Fewster is a new Assistant Professor in the UBC School of Kinesiology. Her main research interests lie in the biomechanics of the spine. Dr. Bhatnagar is an assistant professor in the UBC Faculty of Medicine (Orthopedics), and he runs the pediatric gait lab at BC Children's Hospital / Sunny Hill. He sees patients with SCI as well as congenital spinal cord issues (spina bifida, etc) and is ramping up his research program.

Dr. Aziz Ghahary retired, and Dr. Patricia Mills left ICORD during the past year. We wish them both the best.

Dr. John Street has moved into an Investigator role with ICORD.

ICORD
Annual Report
2021-22

ICORD's Principal Investigators

Dr. Michael Berger | *Clinical Assistant Professor, Physical Medicine & Rehabilitation, UBC* | **Focus:** Electrical stimulation, electromyography, nerve transfer, peripheral nervous system, physiatry.

Dr. Gary Birch | *Executive Director, Neil Squire Society; Adjunct Professor, Electrical and Computer Engineering, UBC* | **Focus:** Robotic control systems, EEG signal processing, digital signal processing, human-machine interface systems, direct brain-computer interface, biological signals, biological systems, assistive technology, accessible wireless technology, real-world application design for persons with disabilities.

Dr. Jaimie Borisoff | *Canada Research Chair in Rehabilitation Engineering Design; Research Director, British Columbia Institute of Technology; Adjunct Professor, Occupational Science and Occupational Therapy, UBC* | **Focus:** Increasing participation through improved accessible equipment design.

Dr. Andrea Bundon | *Assistant Professor, Kinesiology, UBC* | **Focus:** Community-based research, digital qualitative research, exercise, inclusion, paralympics, physical activity, qualitative methodologies, social participation, social support, sport.

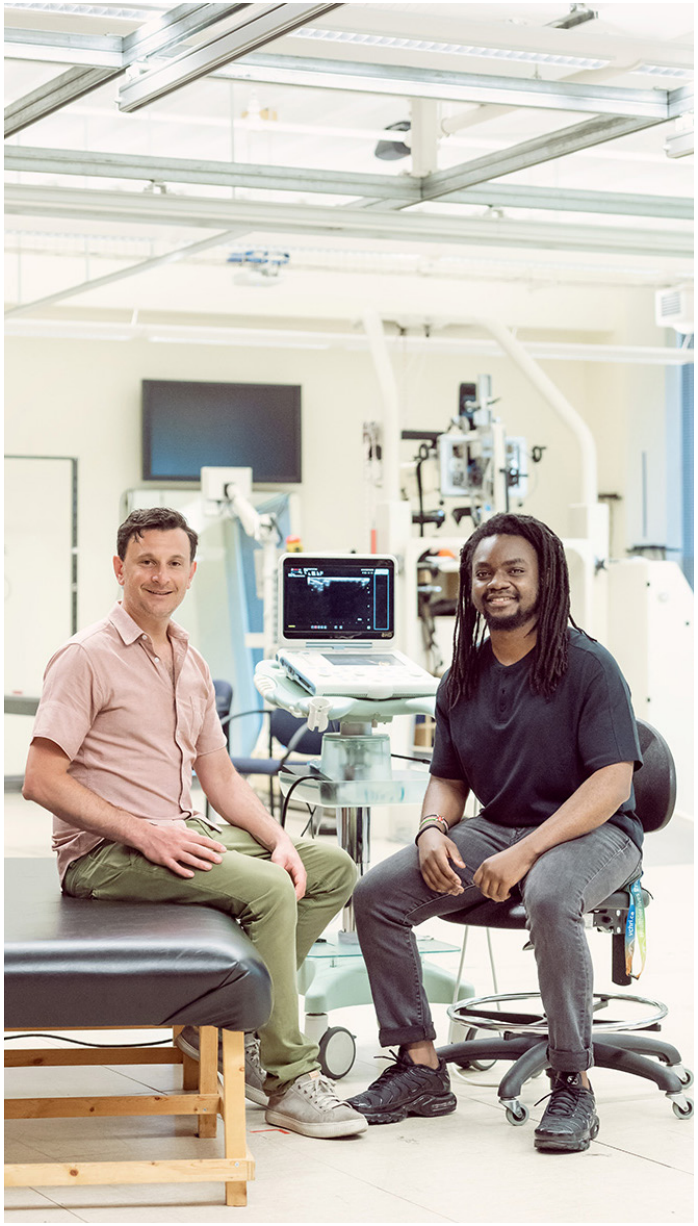
Dr. Victoria Claydon | *Professor, Biomedical Physiology and Kinesiology, SFU* | **Focus:** Impact of cardiovascular dysfunction on the quality of life of people with SCI.

Michael Smith Health Research BC Scholar Award

Dr. Jacquelyn Cragg | *Assistant Professor, Pharmaceutical Sciences, UBC* | **Focus:** Data science, drug effectiveness, drug safety, epidemiology, SCI progression.

Dr. Peter Cripton | *Professor and Co-Director, School of Biomedical Engineering, Director Undergrad, SBME, UBC* | **Focus:** injury biomechanics, orthopaedic biomechanics, injury prevention, helmet performance, spine injury, spinal cord injury, concussion, brain injury, hip injury, cycling injuries, medical evacuation.

Dr. Marcel Dvorak | *Professor, Orthopaedics, UBC; Cordula and Günter Paetzold Chair in Clinical SCI Research, UBC; Senior Medical Director, Vancouver Acute Services, Vancouver Coastal Health* | **Focus:** Adult



Dr. Mike Berger and Emmanuel Ouma

traumatic spine injury surgery; optimizing clinical decision-making in acute SCI.

Dr. Stacy Elliott | *Clinical Professor, Depts. of Psychiatry and Urologic Sciences, UBC; Medical Director, BC Centre for Sexual Medicine; Co-director, Vancouver Sperm Retrieval Clinic; Medical Director, Men's Sexual Assessment and Rehabilitation Service, Prostate Centre; Physician Consultant, GF Strong Sexual Health Rehabilitation Service* | **Focus:** Clinical studies in sexual and fertility rehabilitation, sperm retrieval, autonomic dysreflexia and brain neuroplasticity post SCI.

Faculty of Medicine Distinguished Achievement Award for Senior Faculty - Overall Excellence

Dr. Janice Eng | *Professor & Co-Director, Centre for Hip Health and Mobility, Vancouver Coastal Health Research Institute* | **Focus:** Rehabilitation, spinal cord injury, stroke, knowledge translation.

Dr. Susan Forwell | *Professor & Head, Occupational Sciences and Occupational Therapy; Research Associate, Multiple Sclerosis Clinic, Division of Neurology , UBC/VCH* | **Focus:** chronic disease self-management for SCI, MS, PD; employment for persons with disabilities; symptomatic management; disability policy.

Dr. Heather Gainforth | *Associate Professor, Health and Exercise Sciences, UBC Okanagan* | **Focus:** behaviour change; health promotion; kinesiology; knowledge translation.

Dr. David Granville | *Professor, Pathology & Laboratory Medicine, UBC; Executive Director, Vancouver Coastal Health Research Institute and Associate Dean, Research (VCHRI), UBC Faculty of Medicine* | **Focus:** Role of granzymes in the healing of injured tissue, inflammation, and neuronal damage.

2021 VCHRI Mentored Clinician Scientist Award

Dr. Veronica Hirsch Reinshagen | *Assistant Professor, Pathology & Laboratory Medicine, UBC* | **Focus:** Glial cells in CNS disorders including traumatic SCI.

Dr. Andy Hoffer | *Professor, Biomedical Physiology and Kinesiology, SFU; Associate Member, Engineering Science, SFU; Founder and Chief Scientific Officer, Lungpacer Medical Inc.* | **Focus:** Prevention of the loss of voluntary diaphragm

Justin Ng and Yannick Lehoux at PARC

function in acute SCI; restoring diaphragm in ventilator-dependent, chronic SCI patients. Biomechanical analysis of putting and chipping methods in golfers with tremor or focal dystonia.

Dr. Alex Kavanagh | *Clinical Assistant Professor, Urology, UBC* | **Focus:** neurogenic bladder, pelvic reconstructive surgery, electrical stimulation of the central nervous system.

Dr. Piotr Kozlowski | *Associate Director, Magnetic Resonance Imaging Research Centre, UBC; Professor, Radiology and Urologic Sciences, UBC; Associate Member, Physics and Astronomy, UBC; Research Scientist, Vancouver Prostate Centre* | **Focus:** Development and application of novel Magnetic Resonance Imaging techniques to study preclinical models of spinal cord injury and cancer.

Promoted to Associate Professor

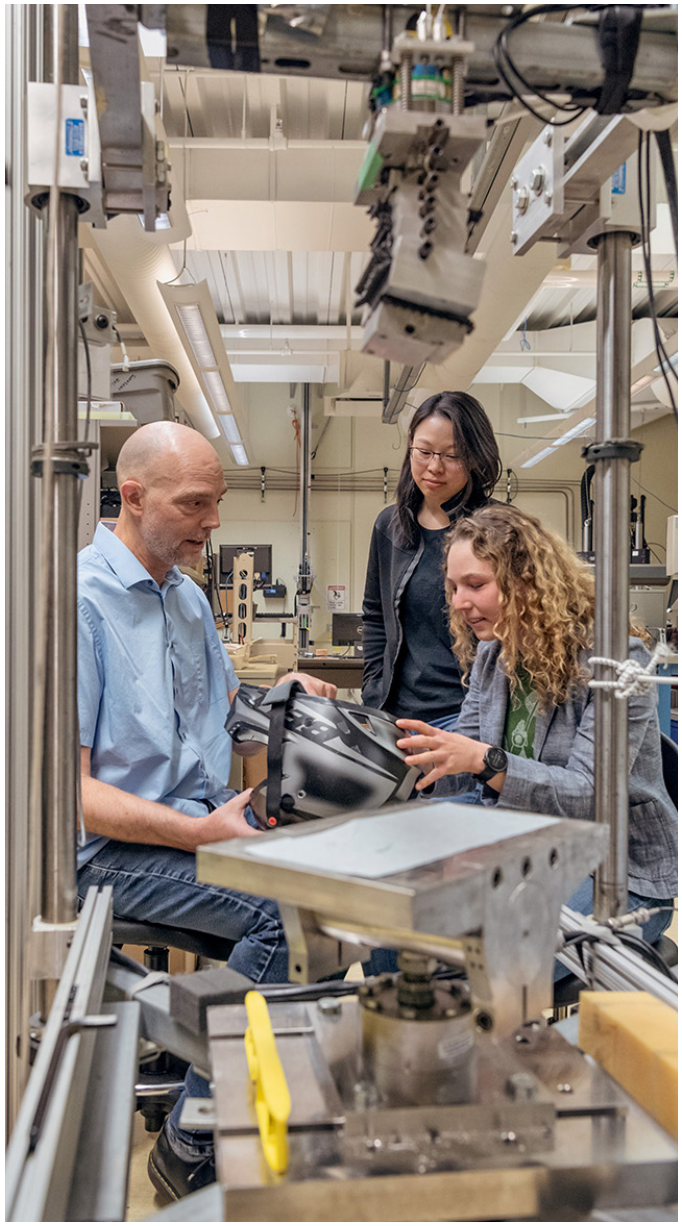
Dr. John Kramer | *Associate Professor, Anesthesiology, Pharmacology, and Therapeutics, UBC; Scholar, Michael Smith Foundation for Health Research* | **Focus:** Neuropathic pain medication and neurological recovery in SCI; open-access clinical trial data.

FoM Award for Excellence in Mentoring Early Career Faculty

Dr. Andrei Krassioukov | *Chair in Spinal Cord Rehabilitation Research, Professor, Physical Medicine & Rehabilitation, UBC; Spinal Cord Injury Rehab Rehabilitation Chair and Associate Director, Rehabilitation Research, ICORD; Staff physician, Spinal Cord Program, GF Strong Rehabilitation Centre; President, American Spinal Injury Association (ASIA)* | **Focus:** Autonomic dysfunctions, autonomic dysreflexia, spinal cord injury, blood pressure control, vascular dysfunctions, bowel, bladder, and sexual dysfunctions, epidural stimulation, transcutaneous stimulation, motherhood after SCI, pain.

Dr. Brian Kwon | *Canada Research Chair in Spinal Cord Injury; Professor, Orthopaedics, UBC; Spine Surgeon, Vancouver Spine Program, Vancouver General Hospital; Associate Director, Clinical Research, ICORD; Director, Vancouver Spine Research Program, Marcel Dvorak Chair in Spine Trauma, Vancouver General Hospital* | **Focus:** Neuroprotection, translational research, biomarkers, clinical trials, spine surgery.

Dr. Tania Lam | *Professor, Kinesiology, UBC* | **Focus:** pelvic floor muscle training, neurophysiology, genitourinary function, exoskeleton technology, locomotor control and adaptability, plasticity.



Dr. Peter Cripton, Vivian Chung, and Gabrielle Booth of OIBG

ICORD
Annual Report
2021-22

Senior Fellow of the International Society for Magnetic Resonance in Medicine.

Dr. Cornelia Laule | *Associate Professor, Radiology and Pathology & Laboratory Medicine, UBC; Associate Director, Education, ICORD* | **Focus:** MRI; myelin; neurodegeneration; pathology; spinal cord; brain; histology.

Dr. Kathleen Martin Ginis | *Professor, Health & Exercise Sciences, UBC Okanagan; Director, SCI Action Canada; Principal Investigator, Canadian Disability Participation Project; Fellow, National Academy of Kinesiology* | **Focus:** Community-based research; physical activity behaviour change; physical activity outcomes; psychosocial outcomes; social participation.

Dr. William Miller | *Professor, Occupational Science & Occupational Therapy, UBC; Associate Dean, Health Professions, UBC* | **Focus:** Technology, mobility, disability, wheelchairs, aging, participation, self-efficacy, fatigue, measurement; occupational therapy, clinical trials.

Dr. Wayne Moore | *Clinical Professor, Pathology & Laboratory Medicine, UBC* | **Focus:** pathology of multiple sclerosis (MS) and SCI.

Canadian Assoc. of Occupational Therapists Fellowship Award

Dr. W. Ben Mortenson | *Associate Professor, Occupational Science & Occupational Therapy, UBC; Adjunct Professor, SFU* | **Focus:** Assistive technology, social participation, caregiving, and self-management, centered on three main populations: assistive technology users, informal and formal caregivers, and individuals with spinal cord injury.

Dr. Mark Nigro | *Director, Provincial Organ Retrieval Program; Surgical Director of Renal Transplant, Vancouver General Hospital; Co-Director, Vancouver Ejaculatory Dysfunction Clinic; Clinical Professor, Dept. of Urologic Sciences, UBC* | **Focus:** Neurogenic Bladder, infertility, organ transplantation.

Dr. Ipek Oruc | *Associate Professor, Dept. of Ophthalmology & Visual Sciences, UBC* | **Focus:** Visual psychophysics; Face and object recognition; Applications of AI in medical image analysis.

Dr. Tom Oxland | *Professor, Orthopaedics and Mechanical Engineering, UBC; Associate Director, Discovery Science, ICORD* | **Focus:** Injury biomechanics; orthopaedic biomechanics; surgical implants.

Bobo Tong and Nicole Bailey of the Kramer Lab

Dr. Matt Ramer | *BC Neurotrauma Professor, ICORD; Associate Professor, Dept. of Zoology, UBC* | **Focus:** Spinal cord injury, regeneration, plasticity, pain, sympathetic neurons, sensory neurons.

Dr. Bonita Sawatzky | *Associate Professor, Orthopaedics, UBC* | **Focus:** Spinal cord injuries/diseases, arthrogryposis, wheelchair propulsion, energy expenditure, biomechanics, long term outcomes, assistive devices.

Dr. Babak Shadgan | *Assistant Professor, Orthopaedics, UBC; Scholar, Michael Smith Foundation for Health Research* | **Focus:** bio-sensing; clinical biophotonics; musculoskeletal and sports medicine; near-infrared spectroscopy; neuroprotection; translational research.

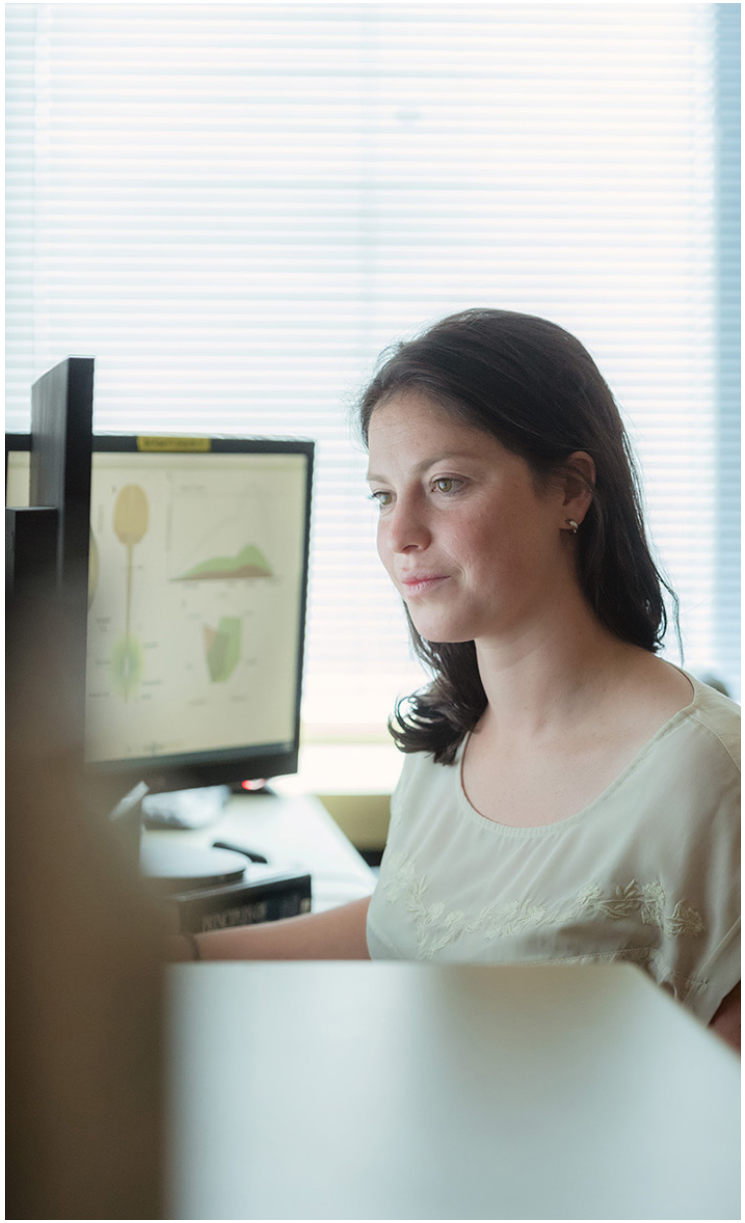
Dr. Dena Shahriari | *Assistant Professor, Orthopaedics, School of Biomedical Engineering, UBC* **| Focus:** Biomaterials development for spinal cord repair; bioelectronics for neuromodulation of the spinal cord.

Dr. Carolyn Sparrey | *Associate Professor, Mechatronics System Engineering, School of Engineering Science, SFU* | **Focus:** Improvement of animal injury models; wheelchair safety engineering.

Dr. Lynn Stothers | *Professor, Urologic Sciences, and Member, Depts. of Healthcare and Epidemiology, and Anesthesiology, Pharmacology and Therapeutics, UBC* | **Focus:** Neurogenic bladder, lower urinary tract function, brain mediation of LUTS, Female pelvic medicine.

Dr. Wolfram Tetzlaff | *John & Penny Ryan BC Leadership Chair in Spinal Cord Research; Professor, Zoology and Surgery, UBC; Director, ICORD* | **Focus:** Protection against secondary neural damage after SCI; facilitation of neural repair.

Dr. Darren Warburton | *Co-Director, Physical Activity Line; Co-Director, Physical Activity Promotion and Chronic Disease Prevention Unit, UBC; Professor, Kinesiology, UBC* | **Focus:** Indigenous health and wellness; cardiovascular health; chronic disease and disability; clinical exercise rehabilitation; high performance physiology; pediatric health; rehabilitation; sports cardiology; sports medicine.



Claire Shackelton, Krassioukov Lab postdoctoral fellow

Dr. Cheryl Wellington | *Professor, Pathology and Laboratory Medicine, UBC* | **Focus:** Mechanisms of neurodegeneration and injuries to the central nervous system.

Dr. Christopher West | *Associate Professor, Southern Medical Program, UBC Okanagan* | **Focus:** Mechanisms of changes to cardiovascular health in response to SCI; physical activity and exercises to mitigate cardiovascular damage.

Dr. David Whitehurst | *Assistant Professor, Faculty of Health Sciences, SFU* | **Focus:** Health economics; quality-of-life assessments for SCI population.

President's Award for Excellence in Teaching (U.Vic)

Dr. Stephanie Willerth | *Professor, Mechanical Engineering and Div. Medical Sciences, University of Victoria; Member, Centre for Advanced Materials & Related Technology* | **Focus:** Tissue engineering, neuroscience, spinal cord injury, stem cells, bioprinting.

Dr. David Wilson | *Associate Professor, Orthopaedics; Associate Member, Mechanical Engineering, UBC* | **Focus:** Joint mechanics; improvement of surgical treatments for SCI.

Dr. Lyndia Wu | *Assistant Professor, Mechanical Engineering, UBC; Scholar, Michael Smith Foundation for Health Research* | **Focus:** concussion; head impact sensing; soft tissue biomechanics; traumatic brain injury.

Dr. E. Paul Zehr | *Professor & Director, Centre for Biomedical Research, Division of Medical Sciences, School of Exercise Science, University of Victoria* | **Focus:** Neural control of ambulation; science communication.

Katharina Raschdorf, Brian Kwon, and Farnaz Sahragard

ICORD
Annual Report
2021-22

Fellow of International Association for Advanced Materials

New Investigator

Brain Canada Future Leaders in Canadian Brain Research grant ($100K)

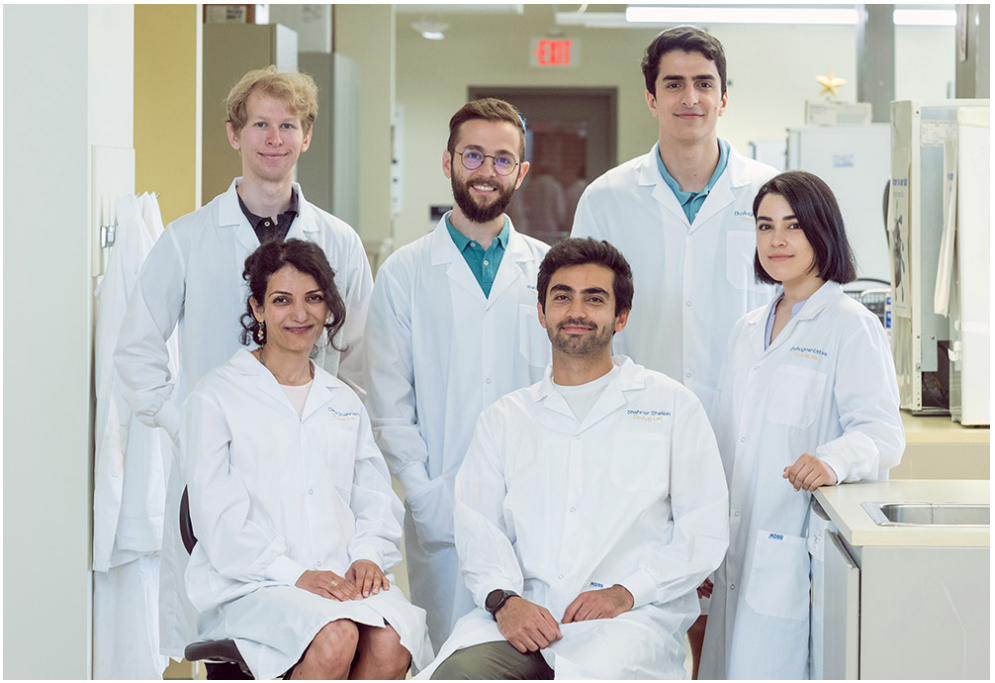
New Investigator

Investigators
Dr. Phil Ainslie
Dr. Mohsen Akbari
Dr. Hugh Anton
Dr. Sean Bristol
Dr. Erin Brown
Dr. Mark Carpenter
Dr. Anita Delongis
Dr. Christopher Doherty
Dr. Kayla Fewster
Dr. Josh Giles
Dr. Tal Jarus
Dr. Shannon Kolind
Dr. Tim O'Connor
Dr. Scott Paquette
Dr. Jacqueline Quandt
Dr. Jane Roskams
Dr. Myp Sekhon
Dr. William Sheel
Dr. John Street
Dr. Andrea Townson

New Associate Member

Associate Members
Dr. Tim Bhatnagar
Dr. Mike Boyd
Dr. Romeo Chua
Dr. Jens Coorsen
Dr. Kerry Delaney
Dr. Tim Inglis
Dr. Mohamed Javan
Dr. Andrew Laing
Dr. Nan Liu
Dr. Freda Miller
Dr. Michael Negraeff
Dr. Aaron Phillips
Dr. Miriam Spering
Dr. Paul van Donkelaar
Dr. Rhonda Willms

Emeritus Members
Dr. Tom Grigliatti
Dr. Catherine Pallen
Dr. John Steeves
(Founding Director)



Left:students of the Cragg Lab; right: Dr. Dena Shahriari and her lab

icord

is a world-leading health research centre focused on spinal cord injury. From the lab-based cellular level of understanding injury to rehabilitation and recovery, our researchers are dedicated to the development and translation of more effective strategies to promote prevention, functional recovery, and improved quality of life after spinal cord injury. Located at Vancouver General Hospital in the Blusson Spinal Cord Centre, ICORD is supported by the Rick Hansen Foundation, UBC Faculties of Medicine and Science, and Vancouver Coastal Health Research Institute.

Rick Hansen Foundation

UBC FACULTY OF MEDICINE

Vancouver CoastalHealth Research Institute

Thank you for reading our 2021-22 Annual Report.

Prepared by Cheryl Niamath, Katie Ashwell, Nancy Thorogood. **Photos by** Martin Dee. **For additional copies of this report or any other** ICORD publication, please call 604-675-8844 or email admin@icord.org.

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