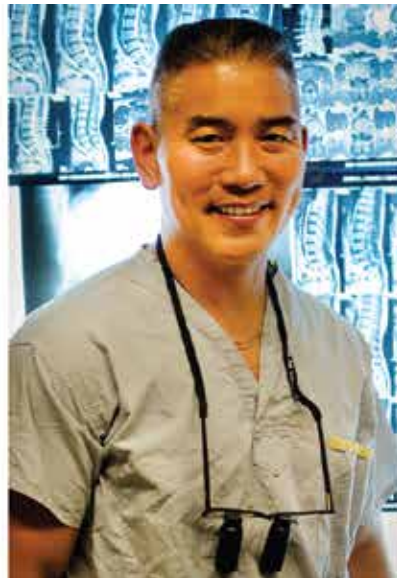


making spinal cord injury preventable, livable, and curable
SPINAL CORD INJURY RESEARCH AT ICORD, 2011-2016



UNIVERSITY OF BRITISH COLUMBIA + VANCOUVER COASTAL HEALTH + RICK HANSEN FOUNDATION



ICORD (International Collaboration on Repair Discoveries) is the product of a small group of University of British Columbia (UBC) researchers who came together in 1995 with the goal of advancing the science and treatment of spinal cord injury (SCI). The group's founder, UBC professor **Dr. John Steeves**, formed **CORD** with the support and vision of **Rick Hansen**. In 2002, CORD became ICORD. Today ICORD has grown into a multidisciplinary international research centre that supports **45 Principal Investigators** whose research programs are based in SCI, and many other members who collaborate on SCI science.

Among our members are neuroscientists, engineers, kinesiologists, physical and occupational therapists, practicing clinicians, and many other health researchers. This team continues to grow and diversify in order to take a **wide-ranging and inclusive approach** to fulfilling ICORD's mission of **making SCI preventable, liveable, and curable**. The majority of these researchers are based in the **Blusson Spinal Cord Centre** in Vancouver, Canada, where they engage in interdisciplinary collaborations to develop and translate effective strategies to promote prevention, functional recovery, and improved quality of life after SCI.

This report focuses on ICORD's history and accomplishments from early 2011 to the end of 2016, and what we hope to accomplish in the future.

Written by Simon Liem, Erin Crisfield, and Cheryl Niamath

Edited by Simon Liem

Designed by Cheryl Niamath

Photo credits: see page 48

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contents

Introduction	4
Meet ICORD	6
Timeline, 1993-2016.	10
The Blusson Spinal Cord Centre	16
People	17
ICORD research	23
▪ neuroscience	24
▪ wound healing	26
▪ engineering.	28
▪ rehabilitation & exercise science	30
▪ community.	32
Research Endowments	34
Local research partnerships.	38
International collaborations.	40
Rick Hansen.	42
Blusson Integrated Cures Partnership	43
Funding	44
Community partners.	45
Looking forward.	46
Photo credits & list of abbreviations	48

introduction

by Prof. Santa J. Ono
UBC President



Every year, around the world, hundreds of thousands of people experience an SCI. The effects—whether medical, economic, social, or psychological—can be devastating.

UBC researchers have been at the forefront of SCI research for decades. We are proud of their work, and we are proud of our role in founding and supporting ICORD.

ICORD is a unique initiative that brings together SCI researchers from the sciences, medicine, surgery, rehabilitation, engineering, education, and community-based humanities research. Not only is this work integral to finding a cure for SCI, but it also plays an important role in advancing a collective understanding of these injuries. ICORD is a leader in striving to improve the quality of life for those with SCI through the discovery, dissemination, and application of research across disciplines.

In reading over the work summarized in this report,

I am struck not only by the breadth and depth of the research being undertaken, but also by the ingenuity of the investigators, and by their passion and commitment to finding a cure for SCI and for improving the lives of people living with SCI.

You can read their stories in the following pages. I am excited by the projects the talented and dedicated ICORD investigators are currently working on.

For example, Dr. Andrei Krassioukov and a group of researchers worked with athletes from around the world at the 2015 Parapan Am Games in an effort to make competition safer and fairer for people with SCI. Dr. Krassioukov's research was part of an ongoing project with the International Paralympic Committee (IPC) to determine how damage to the autonomic nervous system, a common result of SCI, affects the performance and safety of athletes.

Dr. Aziz Ghahary and his lab study non-healing wounds

such as pressure ulcers, which are a common secondary complication of SCI. Dr. Ghahary and postdoctoral fellow Dr. Ryan Hartwell developed a drug that they hope will prevent scarring and autoimmune disease. The drug, called Fibrostop, is currently in clinical trials.

Other ICORD researchers are looking at such questions as:

- How can emerging technologies be made accessible for people with disabilities?
- What are the biological mechanisms that can predict clinical severity of spinal injury?
- Can we engineer personalized neural tissue to treat SCI?

Their work makes me hopeful for the future of SCI research. Read on and be inspired.

If you had experienced a spinal cord injury before the twentieth century, your outlook would have been grim. Even if you had survived your initial injury, complications would likely have overwhelmed you.

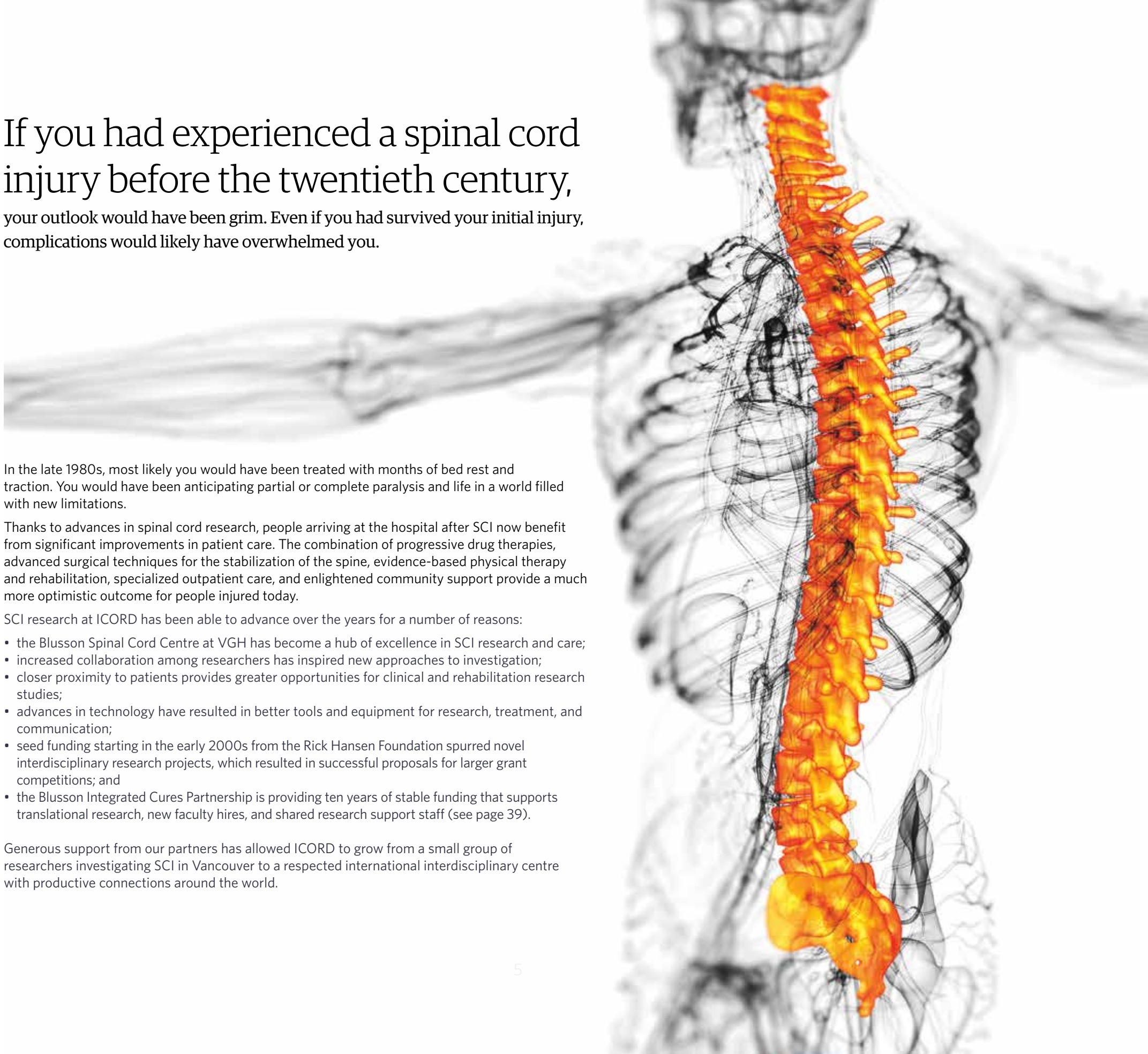
In the late 1980s, most likely you would have been treated with months of bed rest and traction. You would have been anticipating partial or complete paralysis and life in a world filled with new limitations.

Thanks to advances in spinal cord research, people arriving at the hospital after SCI now benefit from significant improvements in patient care. The combination of progressive drug therapies, advanced surgical techniques for the stabilization of the spine, evidence-based physical therapy and rehabilitation, specialized outpatient care, and enlightened community support provide a much more optimistic outcome for people injured today.

SCI research at ICORD has been able to advance over the years for a number of reasons:

- the Blusson Spinal Cord Centre at VGH has become a hub of excellence in SCI research and care;
- increased collaboration among researchers has inspired new approaches to investigation;
- closer proximity to patients provides greater opportunities for clinical and rehabilitation research studies;
- advances in technology have resulted in better tools and equipment for research, treatment, and communication;
- seed funding starting in the early 2000s from the Rick Hansen Foundation spurred novel interdisciplinary research projects, which resulted in successful proposals for larger grant competitions; and
- the Blusson Integrated Cures Partnership is providing ten years of stable funding that supports translational research, new faculty hires, and shared research support staff (see page 39).

Generous support from our partners has allowed ICORD to grow from a small group of researchers investigating SCI in Vancouver to a respected international interdisciplinary centre with productive connections around the world.



meet ICORD

Mustafa Hasan | research assistant

In 2003, Mustafa Hasan was on the roof of his house in Baghdad, Iraq. He was adjusting an antenna when an American missile exploded near by, knocking him off the building. The fall paralyzed Mustafa from the neck down, leaving him with a C5- to C6-level injury.

The next few years in war-torn Iraq were incredibly difficult for Mustafa and his family, but he was eventually able to move to Canada as a refugee via Jordan.



In 2009, he landed in Vancouver with the goal of starting a new life. He began physiotherapy at the GF Strong Rehabilitation Centre, where he first heard about ICORD's research studies. He contacted Dr. Tania Lam, who was conducting a study with robotic-assisted walking training. Mustafa became a mainstay of ICORD soon after.

Mustafa volunteered at the ICORD Resource Centre and participated in nearly 20 studies over the next four years. His health gradually improved, and he officially became part of the Dr. Lam's lab as an assistant on research projects. "The people and environment were so nice," he says. "They really helped me a lot."

He hopes that everyone is aware of the value of the research studies and the importance of both people with disabilities and able-bodied participants in the research. "The

studies gave me more knowledge about my body and improved my health as well," he says. "My muscles are getting stronger and my body healthier."

During his time at ICORD, Mustafa was recognized with the BC Rehab Gert Vorsteher Memorial Award for overcoming extreme challenges to live independently. Mustafa also received a Difference Maker award from Rick Hansen for his achievements. Mustafa left ICORD after he started a job with the Immigrant Services Society of British Columbia to assist with integrating Syrian refugees to Vancouver. He served as an interpreter and life-skills coordinator to help welcome some of the 25,000 Syrian refugees who settled in Canada in 2016.

Jacquelyn Cragg | postdoctoral research fellow

Dr. Jacquelyn Cragg started with ICORD nearly ten years ago, and she has become one of the best examples of our interdisciplinary approach to SCI research. "During my time with ICORD, I have had the opportunity to work in many different fields," she says.

Dr. Cragg began at ICORD in 2007 as an undergraduate student in Dr. Matt Ramer's lab, studying the sensory aspects of SCI in an animal model. She went on to work with numerous ICORD Principal Investigators (PIs) in several research areas, including rehabilitation medicine with Dr. Andrei Krassioukov,

basic science with Dr. Wolfram Tetzlaff, physiology with Drs. John Steeves and Victoria Claydon, and health services with Dr. Vanessa Noonan from the Rick Hansen Institute.

In 2015, she completed her PhD under the supervision of Dr. Jaimie Borisoff, investigating cardiovascular health in the SCI population. Her study published in the journal *Neurology* was the first time anyone quantified the excess risk of cardiovascular disease experienced by people with SCI. She also published a similar study on the risk of type 2 diabetes as part of her doctorate.



Dr. Cragg's research then led her to a postdoctoral position at Harvard with Dr. Marc Weisskopf at the T.H. Chan School of Public Health, all while forming international research collaborations with institutions in Switzerland and the United States. In 2016, she returned to ICORD under the prestigious Branco Weiss postdoctoral fellowship from Society in Science based in Zurich. The award supports her position in Dr. Wolfram Tetzlaff's and Dr. John Kramer's labs. Her research now is in neuro-epidemiology and the study of anticonvulsant drugs' effect on motor recovery after SCI.

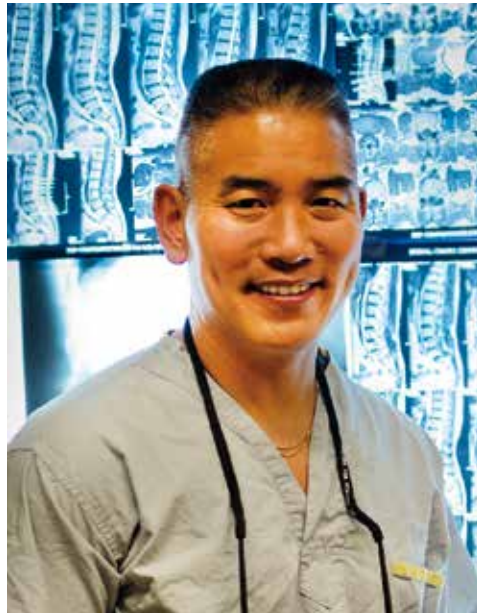
"ICORD has provided me with so many opportunities in knowledge dissemination and translation—and having fun with other trainees," she says. "When a fellow trainee and I approached the ICORD executive committee with the idea to host CIHR Café Scientifique events, they fully supported us. I can't think of a better place to work because there are so many great people at ICORD."

Brian Kwon | professor and spine surgeon

As an ICORD PI and attending spine surgeon at Vancouver General Hospital, Dr. Brian Kwon is involved in all aspects of the SCI research continuum. His work, which truly spans from bench to bedside, gives him a uniquely translational perspective on SCI.

His diverse set of accomplishments makes him one of ICORD's most valued investigators. He holds the Canada Research Chair in Spinal Cord Injury, has published more than 140 peer-reviewed papers, and possesses extensive experience in conducting clinical trials for acute SCI, in addition to being

ICORD's Associate Director of Clinical Research.



Among his current research projects, Dr. Kwon is leading important work on identifying biomarkers for SCI. In 2014, he began a three-year, \$3-million study funded by Brain Canada on "Biomarkers for Crossing the Translational Divide in Acute Spinal Cord Injury." Dr. Kwon has also spearheaded the establishment of the International SCI Biobank with funding from the Blusson Integrated Cures Partnership, which will store cerebrospinal fluid, tissue, and serum samples from individuals with early acute SCI. These projects are two approaches being used to examine the biological

mechanisms of SCI, establish biomarkers that identify the severity of injury to the spinal cord, and create biomarker linkages with an intermediary model for novel therapies to be developed for eventual human clinical trials.

In 2016, Dr. Kwon used a \$20,000 ICORD seed grant to gather pilot data, which was leveraged into a US\$1.9-million grant from the United States Department of Defense. The funds will support the evaluation of near-infrared spectroscopy, a light-sensor technology, as a method of monitoring the hemodynamics of an injured spinal cord.

"Ultimately, we hope to establish interventions that will allow SCI patients who are paralyzed to regain their function and walk away from their injury," Dr. Kwon says. "Our overall goal is to restore full physical function to individuals who have suffered a spinal cord injury."

Yasaman Best | rehabilitation engineer

ICORD has been lucky to have known Yasaman Best since 2011, when she became a volunteer at our Resource Centre during her time in between completing an undergraduate degree and starting a master's program in electrical engineering at UBC. She came back to ICORD in 2014 as our financial assistant. In 2017, ICORD hired Yasaman as a shared rehabilitation engineer to assist ICORD's PIs with technical support for hardware and software troubleshooting.



Before the position opened, Yasaman was unsure whether she would be able to find work in her field:

"Normally, the first question at a job interview was 'Why should I hire you instead of an able-bodied person?' At ICORD, they asked me, 'How can we help you do your job better?' I was shocked! Even when I talked to the PIs, their questions were always about how to accommodate my own skills. The expectations for my performance are the same as they would be for an able-bodied person, and I feel like I have the same chance to meet those expectations."

In June 2015, Yasaman gave birth to her son, Alexander. She was helped with advice and referrals from ICORD PIs Drs. Andrei Krassioukov and Stacy Elliott, who made sure

she had access to the resources that would guide her through the pregnancy, and Dr. Mark Nigro, who worked with Yasaman to monitor urinary tract infections, for which pregnant women, especially those with SCI, are at a greater risk.

ICORD's own research has also benefitted from Yasaman's participation. "Dr. Krassioukov's botox study for bladder health was life-changing for me. Every time I participate in a study, I learn how to take care of myself a bit better," she says. "What I like about ICORD is that it works for a cure but also care. The researchers are helping you live with SCI."

meet ICORD

Jordan Squair | md/phd student

One of ICORD's strengths is our team of clinician-researchers, who are inspiring new generations to follow them. Jordan Squair has been affiliated with ICORD since his undergraduate degree and is now part of UBC's combined MD/PhD Program, with a focus in SCI research and treatment.

Jordan works closely with his supervisors, Drs. Andrei Krassioukov and Christopher West, on the investigation of new methods to improve heart health after SCI. He published a significant paper in the *Journal of Neurotrauma* on strategies for improving cardiovascular function in people with SCI. His thesis also includes

research on developing a model to determine whether minocycline, one of the few treatments for SCI in clinical trials, is effective for improving cardiovascular outcomes.

The quality of his research and scholarship garnered Jordan two prestigious awards: the Killam Doctoral Scholarship and the CIHR Frederick Banting and Charles Best Canada Graduate Scholar award.

In addition to his work at UBC, Jordan is a team member for Dr. Susan Harkema's trial of epidural stimulation for treating many aspects of SCI, which is based at the University of Louisville and Frazier Rehab Institute. Jordan is contributing his expertise in cardiovascular assessments to the trial.

Jordan has also become an advocate for reinstating federal support for combined MD and PhD programs, publishing a manuscript on the important contributions that graduates in combined MD and PhD programs make to research and clinical medicine.

Jordan credits his diverse skills and interests to the research environment in which

he works. "Dr. Krassioukov and Dr. West have taught me a host of preclinical skills, clinical assessment in humans with SCI, and also the logistics of running a laboratory," he says.

"In our field there are so many different areas to consider and having people around with such varied expertise allows us at ICORD to answer questions about SCI from a well-rounded point of view," says Jordan. "That I can stop in at any lab and ask for help on a technique, analysis, or interpretation of data is incredibly valuable to me."



David Granville | professor

Dr. David Granville and his lab joined ICORD in 2016, strengthening our research capacity in non-healing wounds, such as pressure ulcers, and opening exciting new lines of inquiry into how neuronal damage is affected by granzymes, Dr. Granville's area of expertise.

For more than 20 years, Dr. Granville has been studying methods to reduce and repair tissue injury. Early in his career, Dr. Granville contributed to the development of Visudyne, the first treatment for age-related macular degeneration, the leading cause of blindness in the elderly.



In 2015, Dr. Granville published a major paper in *Aging Cell*, "Granzyme B mediates both direct and indirect cleavage of extracellular matrix in skin after chronic low-dose ultraviolet light irradiation." This study identified the role of granzyme B in visible human skin aging and inflammation. Granzymes are protein-degrading enzymes that the immune system can use to target and eliminate unwanted cells in the body, but their accumulation in a wound can prevent proper healing. This work led to Dr. Granville's collaboration with the Rick Hansen Institute to examine how granzymes affect pressure ulcers, a common secondary complication for many with SCI. Based on his granzyme research, his lab has produced several patents for therapeutics aimed at treating chronic non-healing wounds. In collaboration with the UBC Centre for Drug Research and Development and

a local biotechnology company, viDA Therapeutics, they have recently developed a topical drug that is showing efficacy in models of impaired healing. They are hoping to enter clinical trials within the next 12-18 months.

Shortly after joining ICORD, Dr. Granville received a seed grant for an exciting collaborative study with ICORD Director Dr. Wolfram Tetzlaff on the mechanisms by which granzyme B may contribute to neuronal damage after SCI. Research has shown that granzyme B is elevated after SCI, and the protein-eating enzyme has the potential to degrade myelin, the vital insulating material that sheathes nerve cells. Dr. Granville's work could identify a new target for the preservation of the nervous system after SCI.

Kyle Gieni | research participant

Since 2003, when Kyle Gieni sustained an SCI in a cycling accident, he has been a tireless contributor to the promotion of physical activity, safety awareness, and SCI research. He was the first participant at ICORD's Physical Activity Research Centre (PARC), and his continuing support has been instrumental to its success.

"You have to get out there and meet people. You can't have that opportunity if you're at home waiting for life to come get you," says Kyle about volunteering. "And if you get out there, you'll find out more things about yourself."



Kyle has never hesitated to help PARC and ICORD through the recruitment of volunteers or his own participation in research. In 2016, he was selected to lead spin classes on PARC's fleet of accessible arm cycles.

"We chose Kyle to lead the spin class, because he knows how to bring out the best in people," says Megan Brousseau, a PARC study coordinator, who has known Kyle since 2009 when they met as volunteers at the GF Strong Rehabilitation Centre. "I've known him as a volunteer, a colleague, and a friend, and he's effective in all capacities of his life. He's always working to make things better for other people, and his passion is so obvious and contagious."

Kyle was also the first participant in postdoctoral fellow Dr. Amanda Chisholm's study of the rehabilitative effects of using a robotic exoskeleton for walking. "It was definitely a treat to get up and walk around," says Kyle. "It will be good to see where it goes in the future."

Kyle encourages everyone to be aware of current studies and to come to ICORD to see all of the technology and resources dedicated to SCI research. He adds that getting involved with the community has been one of the biggest benefits to him. "Just to have a good group of people to workout beside you and push you to move forward is really important," he says.

John Steeves | founding director

Dr. John Steeves is ICORD's founder and will transition to Professor Emeritus status in 2017. Dr. Steeves has created an illustrious body of academic work, ranging from basic neuroscience to translational clinical research.

Early in his career, Dr. Steeves established the fundamental role of the neural pathways from the brainstem to the spinal cord in activating and controlling movement, especially walking. He later went on to help discover that although myelin in the brain and spinal cord helps neurons function more efficiently by wrapping around them, it also inhibits repair when neurons are injured.



He developed immunological approaches to temporarily suppress myelin at the site of an SCI.

In 1995, Dr. Steeves founded the Collaboration on Repair Discoveries at UBC, which encouraged and supported researchers interested in improving outcomes for people living with SCI. With assistance from the Rick Hansen Foundation and UBC, this scientific and clinical research organization would evolve into ICORD in 2002 and become part of the Faculty of Medicine in 2010.

In 2002, Dr. Steeves was appointed to the first BC Leadership Chair in SCI Research. In the same year, his proposal to the Canada Foundation for Innovation for the creation of the Blusson Spinal Cord Centre (BSCC) was successful. The funding supported the construction one of the most accessible buildings in the world (see page 16). The BSCC has become a major part of Dr. Steeves's legacy, distinguishing

ICORD as one of the most recognized international centres for SCI care, research, medicine, and advocacy.

With scientific and clinical colleagues from across the globe, Dr. Steeves continues to work on the ongoing development of effective clinical trial protocols. He was instrumental in establishing the first guidelines for conducting clinical trials for SCI and will continue to work with industry and foundations to define pragmatic approaches for the validation of SCI treatments.

milestones in ICORD's history

Rick Hansen Man In Motion Chair in Spinal Cord Injury Research (\$1.5M) is established with funding from Rick Hansen Foundation and UBC.

1993



Dr. Wolfram Tetzlaff is recruited as **Rick Hansen Man In Motion Spinal Cord Injury Chair**.



Dr. Steeves (R) in the lab with trainee Dr. Gordon Hiebert (L).

1995

Collaboration On Repair Discoveries (CORD) is founded as a **Research Group** within the UBC Faculty of Science by **Dr. John Steeves** with the support of **Mr. Rick Hansen** and UBC President **Dr. David Strangway**.

1997

BC Neurotrauma Fund Contribution Act is passed by British Columbia Legislature, whereby a percentage of income from traffic infractions is awarded annually to the **Rick Hansen Foundation** to support "services and projects respecting neurotraumatic injury and victims of neurotraumatic injury." With the BCNF funding, RHF establishes an annual grant competition funding SCI research.

BC Neurotrauma Professorship (\$2M) and **Rick Hansen Institute Spinal Cord Research Endowment** (\$1.5M) are established to fund CORD programs. Both endowments are funded by the Rick Hansen Foundation and UBC.

1999



Dr. Matthew Ramer recruited as **BC Neurotrauma Professor**.

2001

Application is made to **Canada Foundation for Innovation (CFI)** **Infrastructure Grant** program for \$12.9M for **ICORD (International Collaboration On Repair Discoveries): an interdisciplinary research centre for the development of effective strategies to promote functional recovery after SCI.**



Original artist's rendition of the new research centre created for the CFI application

CFI Grant awarded; CORD becomes ICORD.

Rick Hansen Foundation partners with the **BC Government, UBC, and Vancouver Coastal Health** to establish **three endowed Chairs**: BC Leadership Chair in Spinal Cord Injury Research (\$4.5M), Chair in Spinal Cord Rehabilitation Research (\$3M), & Cordula and Günter Paetzold Chair in Spinal Cord Clinical Research (\$3M).



The Community Advisory Panel's first meeting.

ICORD holds its first **Annual Research Meeting**. International and Community Advisory Panels are formed.

Dr. John Steeves is appointed as first **BC Leadership Chair in SCI Research**.

Trainee Travel Supplement program starts with funding from **Rick Hansen Foundation**.

John & Penny Ryan host the first of three annual **Reserved** gala fundraisers in Whistler in support of the BC Leadership Chair.

Aaron Moser and Gordon Hiebert Trainee Travel Awards are created. With a generous donation by the Aaron Moser Foundation and a contribution in memory of former ICORD trainee Gordon Hiebert, an endowment to fund trainee travel awards is established.



Dr. Gordon Hiebert



Aaron Moser

2002

2003

2004

Rick Hansen Foundation (RHF) dedicates **\$1M** in BC Neurotrauma Funding for **ICORD seed grants**.

With innovation support and seed funding from the **Rick Hansen Foundation**, the **Rick Hansen Spinal Cord Injury Registry** is established by **Dr. Marcel Dvorak** to collect comprehensive nation-wide SCI data for the purpose of improving SCI care and clinical outcomes, and to promote, encourage and support the pursuit of excellence in SCI health care management.

John & Penny Ryan pledge **\$1.5M** to **BC Leadership Chair endowment**. Chair renamed the John & Penny Ryan BC Leadership Chair in SCI Research in recognition of their contribution.



L-R: John Ryan, Penny Ryan, John Steeves + Rick Hansen in Whistler, BC



Dr. Armin Curt is recruited from Switzerland as **Chair in Spinal Cord Rehabilitation Research**. (Dr. Curt returns to Europe in 2009, and in 2013 **Dr. Andrei Krassioukov** becomes Chair.)

SCI Clinical Trials Guidelines are established. ICORD hosts a two-day symposium, with more than 100 participants from around the world, to examine the essential aspects of human SCI studies. A Working Group is formed to synthesize a set of guidelines for SCI clinical trials.



Spinal Cord Injury Rehabilitation

Evidence (SCIRE) is published. A highly accessible source of information used by health care professionals, clients and their families, funding agencies, policy-makers, and advocacy groups, SCIRE is a synthesis of the research regarding outcome measures and rehabilitation strategies, to improve the health of people living with SCI.



Construction starts on Blusson Spinal Cord Centre.



Official Groundbreaking Ceremony, November 7, 2006. L-R: Honorable Gordon Campbell (Premier of BC); Mrs. Marilyn Blusson; Mr. Rick Hansen; Dr. John Steeves; Dr. Stewart Blusson; Professor Stephen Toope (President & Vice Chancellor of UBC); Ms. Suzanne Corbiel (VP External Relations, Canada Foundation for Innovation); Ms. Ida Goodreau (President & CEO, Vancouver Coastal Health); Dr. Bernie Bressler (Executive Director, Vancouver Coastal Health Research Institute and Vice President Research of Vancouver Coastal Health).

Translational Research Network

is launched by RHF with funding from Health Canada.

Armin Curt heads TRN Rehabilitation Working Group. [The TRN is now the **Rick Hansen Institute (RHI)**]

2005

World Health Organization invites ICORD to participate in development of **International Classification of Functioning (ICF) Core Sets for SCI**.



Dr. Marcel Dvorak accepts **Cordula & Günter Paetzold Chair in Spinal Cord Clinical Research**.



ICORD moves from the Faculty of Science to the **Faculty of Graduate Studies**.

2006

ICORD moves from the Faculty of Graduate Studies (FoGS) to the **College for Interdisciplinary Studies** when FoGS splits into two bodies.

Stewart & Marilyn Blusson donate **\$10M** to RHF: \$8.75M is directed towards the new building.

2007



Construction on Blusson Spinal Cord Centre progresses.



Blusson Spinal Cord Centre officially opens November 18, 2008.



VIPs visit. On March 21, 2010, Rick Hansen celebrates the 25th anniversary of the start of his world tour. Prime Minister Stephen Harper and BC Premier Gordon Campbell visit ICORD's research space in the Blusson Spinal Cord Centre as part of the celebratory events.



Pictured L-R: Dr. David Farrar (Provost & VP Academic, UBC); Dr. David Ostrow (CEO, Vancouver Coastal Health); Dr. Brian Kwon (ICORD PI & VCH Clinician); Mr. Colin Ewart (Rick Hansen Foundation); Premier Gordon Campbell; Prime Minister Stephen Harper; Ms. Anna Sammarco (ICORD research study participant); Mr. Rick Hansen; Mr. Daryl Rock (Board Chair, Rick Hansen Institute); Dr. Tania Lam (ICORD Associate Director & PI); Ms. Katie Pahl (ICORD Study Coordinator); Dr. Antoinette Domingo (ICORD Postdoctoral Fellow); Dr. Tom Oxland (ICORD Acting Director & PI); Dr. Wolfram Tetzlaff (ICORD Associate Director & PI); Mr. Lyall Knott (Board Chair, Rick Hansen Foundation).

2008



Dr. Gary Birch is awarded the **Order of Canada** for his work with the Neil Squire Society.

Construction of **Blusson Spinal Cord Centre** is completed. ICORD groups start moving from UBC Point Grey campus in October.



2009

Vancouver Coastal Health's **Brenda & David McLean Integrated Spine Clinic** opens on BSCC 2nd floor. The clinic is designed to provide out patients with access to many different spine specialists at one time.

2010

ICORD moves from CFIS to **Faculty of Medicine**, reflecting a strong interprofessional focus across health disciplines for research and patient outcomes, and strong connections to Vancouver Coastal Health and Vancouver Coastal Health Research Institute.



FACULTY OF MEDICINE

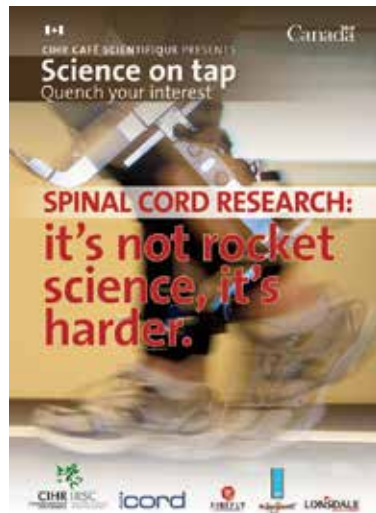


Dr. Tom Oxland becomes **Acting Director of ICORD**. Dr. Oxland is a Professor in Orthopaedics and Mechanical

Engineering. He is Co-Director of the Orthopedics and Injury Biomechanics Group, and has been an ICORD Principal Investigator since 1998.



Dr. Jaimie Borisoff is named a **Canada Research Chair** for his work in Rehabilitation Engineering Design at BCIT.



ICORD presents the first of six well-attended CIHR-funded **Café Scientifique** evenings.



Federal Health Minister Hon. Leona Aglukkaq announces new **CIHR funding for research on cardiovascular health for people with SCI**. The team research project, led by Dr. Andrei Krassioukov, is entitled *Improving cardiovascular health for Canadians living with spinal cord injury: Effects of exercise and targeted education*. The team includes Drs. Janice Eng, Tania Lam, and Matthew Ramer.

Dr. Brian Kwon is named a **Canada Research Chair** for his work in for his work in SCI.

2011

2012



Cathedrals of Science concert features the world premiere of two pieces commissioned by the Vancouver Cantata Singers and composed especially for performance in the Blusson Spinal Cord Centre.

ICORD presents a symposium at the American Association for the Advancement of Science annual conference. ***Curing spinal cord injury: the need for global collaboration*** is moderated by Dr. Michael Fehlings of Toronto Western Hospital, with speakers Rick Hansen, Wolfram Tetzlaff, Marcel Dvorak, Judy Illes (UBC), Charles Tator (U of Toronto) and Naomi Kleitman (NIH).



Dr. Wolfram Tetzlaff becomes Interim **Director of ICORD**. He will go on to accept the appointment as Director in 2013.



Drs. Jaimie Borisoff, Stacy Elliott, and Brian Kwon receive **Queen Elizabeth II Diamond Jubilee Medals**.



SCI Community Resource Centre opens in Blusson Spinal Cord Centre atrium, with funding from the *Spinal Chord Gala*.



Rick Hansen announces the creation of the **Blusson Integrated Cures Partnership**. This 10-year, \$20M grant supports researchers and clinicians at the Blusson Spinal Cord Centre to accelerate preclinical and clinical research in SCI. This funding is aimed at strengthening the partnership between the **Rick Hansen Institute** and ICORD, and leveraging their existing strengths for greater impact.

Drs. Christopher West and **John Kramer** receive Michael Smith Foundation for Health Research Scholar awards and become Principal Investigators at ICORD.



ICORD and **Spinal Cord Injury BC** jointly hire a peer recruitment coordinator to help researchers connect with members of the SCI community.



Dr. David Granville joins ICORD with his staff and students, bringing the number of ICORD Principal Investigators based in the Blusson Spinal Cord Centre to 27.

2013

2014

2015

2016



The **Physical Activity Research Centre (PARC)** at ICORD opens, under the guidance of Dr. Tania Lam.

The Province of BC supports PARC with \$350K grant.

Ekso Bionic suit arrives, for use in rehab research.



HRH Sophie, the Countess of Wessex, visits ICORD and presents **Rick Hansen Difference Maker Awards** to Peggy Assinck and Mustafa Hasan.



Dr. Andrei Krassioukov and his team run a cardiovascular clinic and collect research data at the Toronto 2015 Parapan Am Games.



A generous donation by the **Northrop family** goes toward supporting new faculty positions at ICORD.



the Blusson Spinal Cord Centre

In 2002, ICORD won a Canada Foundation for Innovation award for the construction of the Blusson Spinal Cord Centre (BSCC), a 10,000-m² state-of-the-art research and clinical facility. The completion of this project in 2008 was made possible by additional funding from the British Columbia Knowledge Development Fund, UBC, Vancouver Coastal Health, and benefactors Stuart and Marilyn Blusson via the Rick Hansen Foundation. This collaboration between private donors, academia, and provincial and federal governments brought together clinicians, researchers, and community members under one roof to improve the lives of people with SCI.

The Rick Hansen Institute, on the sixth floor of the BSCC, is focused on the translation of novel research findings into best clinical practice and the creation of critical platform technologies for clinical research. RHI has also formed a network of clinical sites across Canada and at strategic global locations, which will expedite the conduct of clinical trials in SCI. RHI is designed to influence all aspects of SCI treatment and care for newly, acutely, and chronically injured individuals, both through the development of new therapies and by decreasing the time required for research to be translated into real-life benefits. Its work can also potentially be used for other health conditions such as traumatic brain injury or stroke.

The Brenda and David McLean Integrated Spine Clinic on the second floor consists of three major elements of care: the Acute Spinal Ambulatory Services; Spinal Cord Injury Rehabilitation Ambulatory Services and Integrated Clinical Research. These three services work together with the goal of integrating clinical service provision with translational research to support the vision of the BSCC partners. The Acute Spinal Ambulatory Services include both a surgical and a medical component, with the services of the Medical and Surgical Spine Program, and the Pain Management Service. The SCI Rehabilitation Ambulatory Services is a continuum of clinical care that includes the services of the SCI Wound Program, Cystoscopy, and Urodynamics Services, Sexual Health (specifically the Vancouver Sperm Retrieval Clinic), Interdisciplinary SCI Rehabilitation Assessment, and Autonomic Assessment and Intervention.

ICORD's laboratories and researchers occupy the first, third, fourth, and fifth floors in the BSCC, which include engineering, discovery, translational, and rehabilitation research space. The BSCC is home to some of the most advanced research infrastructure for SCI research. This includes state-of-the-art imaging equipment, cellular and tissue culture facilities, microscopy equipment, medical assessment devices, injury-simulators, high-speed cameras, and robotic exoskeletons. On the third floor is a wheelchair skills training course and rehabilitation research space. On the ground floor is the Physical Activity Research Centre (PARC), which has become an important centre for Vancouver's SCI community where people meet, share knowledge, and build relationships. PARC also serves as a physical-activity research centre with a fully accessible workout space with modern gym equipment.

The proximity of the three groups based in the BSCC creates a collaborative dialogue between academia, health care providers, stakeholders, and the SCI community, where each party contributes to the goals of the other.

In addition to the valuable resources that the BSCC houses, the building's design is representative of its mission. A primary feature of the BSCC is the three-storey ramp, which surrounds the atrium and allows for non-elevator access to the second and third floors. The ramp has also become a training apparatus for SCI athletes and PARC participants. The BSCC notably has no accessibility signage, as the building is completely accessible to wheelchair users. All hallways are wide enough for two wheelchairs to pass one another, each washroom is single-user with support bars for people with mobility issues, and the elevators feature large floor-level panels to select floors, which can be activated without using one's hands or the ability to reach.

This design has helped ICORD attract researchers of all physical abilities, and has made the BSCC one of the most accessible buildings in the world.

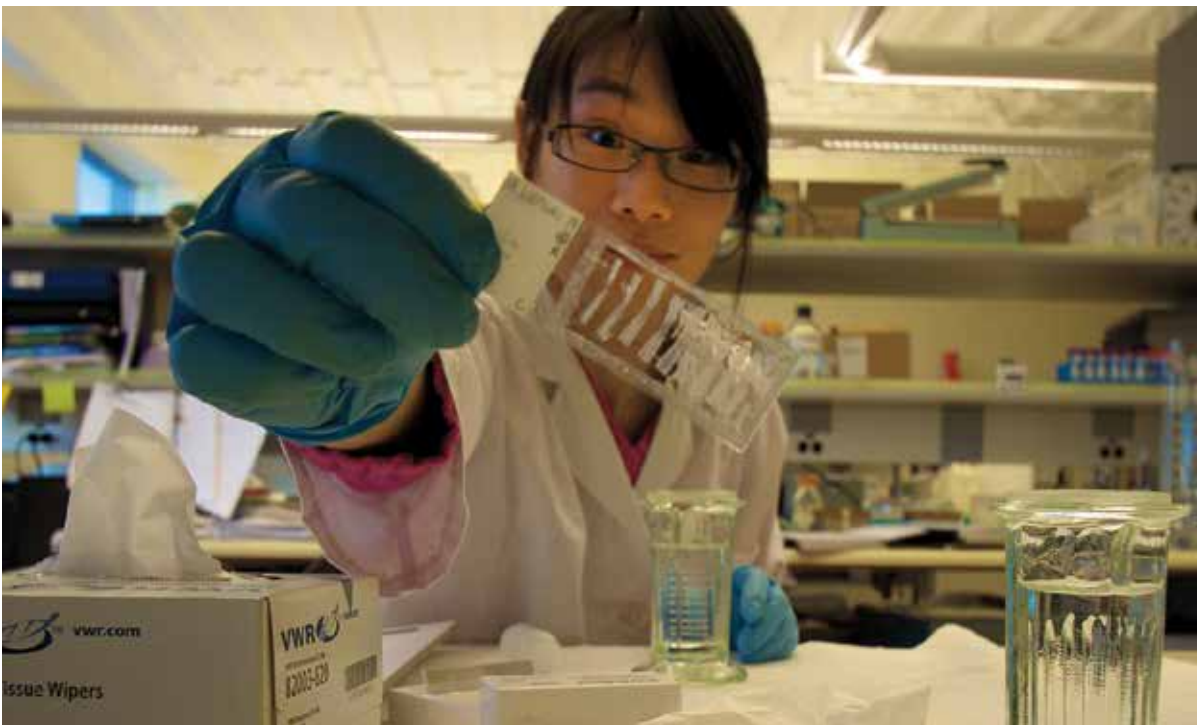


people

ICORD's state-of-the-art labs would be of little use without the research faculty and trainees who make use of them. These researchers, in turn, rely on support staff to keep their labs running smoothly and their research programs on track. All the while, administrative staff work behind the scenes, taking care of facilities, finances, communications, and events on behalf of ICORD.

At the BSCC, ICORD personnel are fortunate to share space, not only with other research teams but also with the Rick Hansen Institute and the Brenda and David McLean Integrated Spine Clinic of Vancouver Coastal Health, giving us the opportunity to collaborate with and learn from an immensely varied group of people with a tremendous array of expertise.

And sometimes we just have fun together in the atrium.



ICORD researchers in 2016

Dr. Gary Birch | Executive Director, Neil Squire Society; Adjunct Professor, Dept. of Electrical and Computer Engineering, UBC | **Focus:** Ensuring assistive technology is accessible to people with disabilities.

Dr. Paul Bishop | Clinical Professor, Dept. of Orthopaedics, UBC | **Focus:** Biological mechanisms of spinal nerve root injury and myelopathy.

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

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

Dr. Peter Crompton | Co-director, Orthopaedic and Injury Biomechanics Group, UBC; Professor and Associate Head – External, Dept. of Mechanical Engineering, UBC; Associate Member, Dept. of Orthopaedics, UBC | **Focus:** Mechanical and computational models of SCI; injury prevention.

Dr. Marcel Dvorak | Professor, Dept. of Orthopaedics, UBC; Head, Div. Spine, Dept. of Orthopaedics, UBC; Cordula and Günter Paetzold Chair in Clinical SCI Research, UBC; Scientific Director, Rick Hansen Institute; Medical Director, Combined Neurosurgical and Orthopaedic Spine Program (CNOSP), Vancouver General Hospital; Co-Chair, Spine Trauma Study Group | **Focus:** Adult 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:** Sexual health after SCI; autonomic dysfunction during sexual activity, pregnancy, and childbirth.

Dr. Janice Eng | Professor, Dept. of Physical Therapy, UBC | **Focus:** Web-based technologies designed to provide the SCI community with information about recovery and evidence-based treatments.

Dr. Susan Forwell | Associate Professor and Head, Dept. of Occupational Science & Occupational Therapy, UBC | **Focus:** Fatigue, pain, mobility, and employment among the SCI and traumatic brain injury populations.

Dr. Aziz Ghahary | Director, BC Professional Fire Fighters' Burn and Wound Healing Research Group; Professor, Dept. of Surgery, Associate Member, Dermatology & Skin Sciences, UBC | **Focus:** Development of therapeutics for chronic non-healing wounds and autoimmune diseases.



Dr. Paul Bishop



Dr. Jaimie Borisoff



Dr. Victoria Claydon



Dr. Peter Crompton



Dr. Stacy Elliott



Dr. Janice Eng



Dr. Susan Forwell



Dr. Aziz Ghahary



Dr. David Granville



Dr. Reza Jalili

Dr. David Granville | Professor, Dept. of Pathology & Laboratory Medicine, UBC; Scholar of the Royal Society of Canada; Associate Director, BC Professional Firefighters' Burn and Wound Healing Research Laboratory, Div. Plastic Surgery, Dept. of Surgery, UBC; Founder and Chief Scientific Officer, viDA Therapeutics Inc.; Adjunct Professor, Institute of Molecular Biology and Biochemistry, SFU | **Focus:** Role of granzymes in the healing of injured tissue, inflammation, and neuronal damage.

Dr. Andy Hoffer | Professor, Dept. of Biomedical Physiology and Kinesiology, SFU; Associate Member, School of Engineering Science, SFU; Founder and Chief Scientific Officer, Lungpacer Medical Inc. | **Focus:** Prevention of the loss of voluntary diaphragm function in acute SCI; restoring diaphragm in ventilator-dependent, chronic SCI patients.

Dr. Sandra Hundza | Associate Professor, Dept. of Exercise Science, University of Victoria; Adjunct Professor, Island Medical Program, Faculty of Medicine, University of Victoria | **Focus:** Neural control of human movement and motor rehabilitation after SCI.



Dr. Piotr Kozlowski



Dr. John Kramer

Dr. Reza Jalili | Assistant Professor, Dept. of Surgery, UBC | **Focus:** Management of pressure ulcers and other chronic, non-healing wounds; improving cell viability and functionality in tissue wounds with an optimal extracellular matrix.

Dr. Piotr Kozlowski | Associate Director, Magnetic Resonance Imaging Research Centre, UBC; Associate Professor, Depts. of Radiology and Urologic Sciences, UBC; Associate Member, Dept. of Physics and Astronomy, UBC; Research Scientist, Vancouver Prostate Centre | **Focus:** Magnetic resonance imaging for the measurement of white matter damage.

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



Dr. Andrei Krassioukov



Dr. Brian Kwon

Dr. Andrei Krassioukov | Professor, Dept. of Medicine, Div. 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; Adjunct Professor, Depts. of Physical Medicine and Rehabilitation, University of Western Ontario; Chair of International Autonomic Standards Committee, ASIA/ISCOS | **Focus:** Management of autonomic dysreflexia after SCI; development and implementation of international Paralympic classifications.

Dr. Brian Kwon | Canada Research Chair in Spinal Cord Injury; Professor, Dept. of 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:** Proteomic, metabolomic, and genomic changes occurring after acute SCI; International SCI Biobank.



Dr. Tania Lam



Dr. Cornelia Laule

Dr. Tania Lam | Associate Professor, School of Kinesiology, UBC; Associate Director, Education, ICORD | **Focus:** Training functional community ambulation after SCI; robotic exoskeletons for rehabilitation.

Dr. Cornelia Laule | Assistant Professor, Dept. of Radiology and Pathology & Laboratory Medicine, UBC | **Focus:** Magnetic resonance imaging for quantitative measurements of myelin in the brain and spinal cord.

Dr. Kathleen Martin Ginis | Professor, School of Health & Exercise Sciences, UBC Okanagan; Director, SCI Action Canada; Principal Investigator, Canadian Disability Participation Project; Fellow, National Academy of Kinesiology | **Focus:** Physical activity behaviour change after SCI; increasing physical activity participation in the SCI community.

Dr. William Miller | Professor, Dept. of Occupational Science & Occupational Therapy, UBC; Associate Dean, Health Professions Education, UBC | **Focus:** Optimizing mobility through the use of assistive technology.

Dr. Patricia Mills | Clinical Assistant Professor, Dept. of Medicine, Div. Physical Medicine & Rehabilitation, UBC | **Focus:** Management of cardiovascular health and spasticity after SCI.

Dr. Wayne Moore | Clinical Professor, Dept. of Pathology & Laboratory Medicine, UBC | **Focus:** Basic histopathology and immunopathology behind SCI; pathogenesis of multiple sclerosis.

Dr. W. Ben Mortenson | Associate Professor, Dept. of Occupational Science & Occupational Therapy, UBC; Adjunct Professor, SFU | **Focus:** Community participation among those with SCI; scooter-skills training on safety and participation.

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:** Home monitoring to reduce urinary tract infections.

Dr. Ipek Oruc | Assistant Professor, Dept. of Ophthalmology & Visual Sciences, UBC | **Focus:** Brain mechanisms behind higher-level vision; visual dysfunction caused by brain disorders (e.g., prosopagnosia, autism spectrum disorder).

Dr. Tom Oxland | Professor, Depts. of Orthopaedics and Mechanical Engineering, UBC; Associate Head – Research, Dept. of Orthopaedics, UBC | **Focus:** Evaluation of mechanical parameters to predict the degree of damage from SCI.

Dr. Catherine Pallen | Professor, Dept. of Pediatrics, and Associate Member, Dept. of Pathology & Laboratory Medicine, UBC; | **Focus:** Protein tyrosine phosphatase alpha regulation of oligodendrocyte differentiation and influence on myelination.

Dr. Scott Paquette | Clinical Assistant Professor, Dept. of Surgery, UBC | **Focus:** Spinal tumours and SCI; spine education and fellowship curriculum development.

Dr. Matt Ramer | BC Neurotrauma Chair, ICORD; Associate Professor, Dept. of Zoology, UBC | **Focus:** Function of the transcription factor ATF3 in the injured nervous system; mechanisms of neuropathic pain after SCI.

Dr. Bonita Sawatzky | Associate Professor, Dept. of Orthopaedics, UBC | **Focus:** Optimizing wheelchair functionality and use; longitudinal study of adults with Arthrogryposis Multiplex Congenita.

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



Dr. Kathleen Martin Ginis



Dr. William Miller



Dr. Wayne Moore



Dr. W. Ben Mortenson



Dr. Tom Oxland



Dr. Matt Ramer



Dr. Bonita Sawatzky



Dr. Carolyn Sparrey



Dr. Miriam Spering



Dr. John Steeves

Dr. Miriam Spering | Assistant Professor, Dept. of Ophthalmology & Visual Sciences, UBC | **Focus:** Visual cues to the brain for the control of movement; impact of neurological damage on vision and related motor responses.

Dr. John Steeves | Founding Director and Professor, ICORD; Chair, SCOPE | **Focus:** Arm and hand rehabilitation after SCI; guidelines for clinical trials; translational research.

Dr. Lynn Stothers | Professor, Dept. of Urologic Sciences, and Member, Depts. of Healthcare and Epidemiology, and Anesthesiology, Pharmacology and Therapeutics, UBC | **Focus:** Improvement of bladder health after SCI.



Dr. Lynn Stothers



Dr. Wolfram Tetzlaff

Dr. John Street | Assistant Professor, Dept. of Orthopaedics, UBC | **Focus:** Minimization and accurate recording of adverse events in SCI population.

Dr. Wolfram Tetzlaff | John and Penny Ryan BC Leadership Chair in Spinal Cord Research; Professor, Depts. of 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, School of Kinesiology, UBC | **Focus:** Effects of physical activity, exercise, and training on cardiovascular health.



Dr. Cheryl Wellington



Dr. Christopher West

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

Dr. Christopher West | Assistant Professor, School of Kinesiology, UBC; Scholar, Michael Smith Foundation for Health Research | **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.



Dr. David Whitehurst



Dr. Stephanie Willerth

Dr. Stephanie Willerth | Associate Professor, Mechanical Engineering and Division of Medical Sciences, University of Victoria; Member, Centre for Advanced Materials & Related Technology | **Focus:** Personalized neural tissue and biomaterial scaffolds for the treatment of neurological damage caused by SCI.

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

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.

ICORD trainees

Over the years, hundreds of trainees have completed programs with ICORD researchers, as graduate students, medical residents, postdoctoral research fellows, and visiting international students. Today, many of these trainees are continuing their studies in SCI, researching for public or private institutions, teaching, or enjoying fulfilling careers in other fields. Wherever they have gone, they have taken with them a deeper understanding of the challenges faced every day by people with SCI.

Trainees play a central role in ICORD's research: organizing and running experiments, writing scientific papers to share their findings, and training and mentoring undergraduate students. ICORD trainees are supported by their supervisors' operating grants or by fellowships. Additionally, travel awards made available through the Blusson Integrated Cures Partnership allow trainees to present their research nationally and internationally, and the annual W.L. McLean Elementary, Aaron Moser, and Gordon Hiebert awards encourage excellence in trainee research.

staff

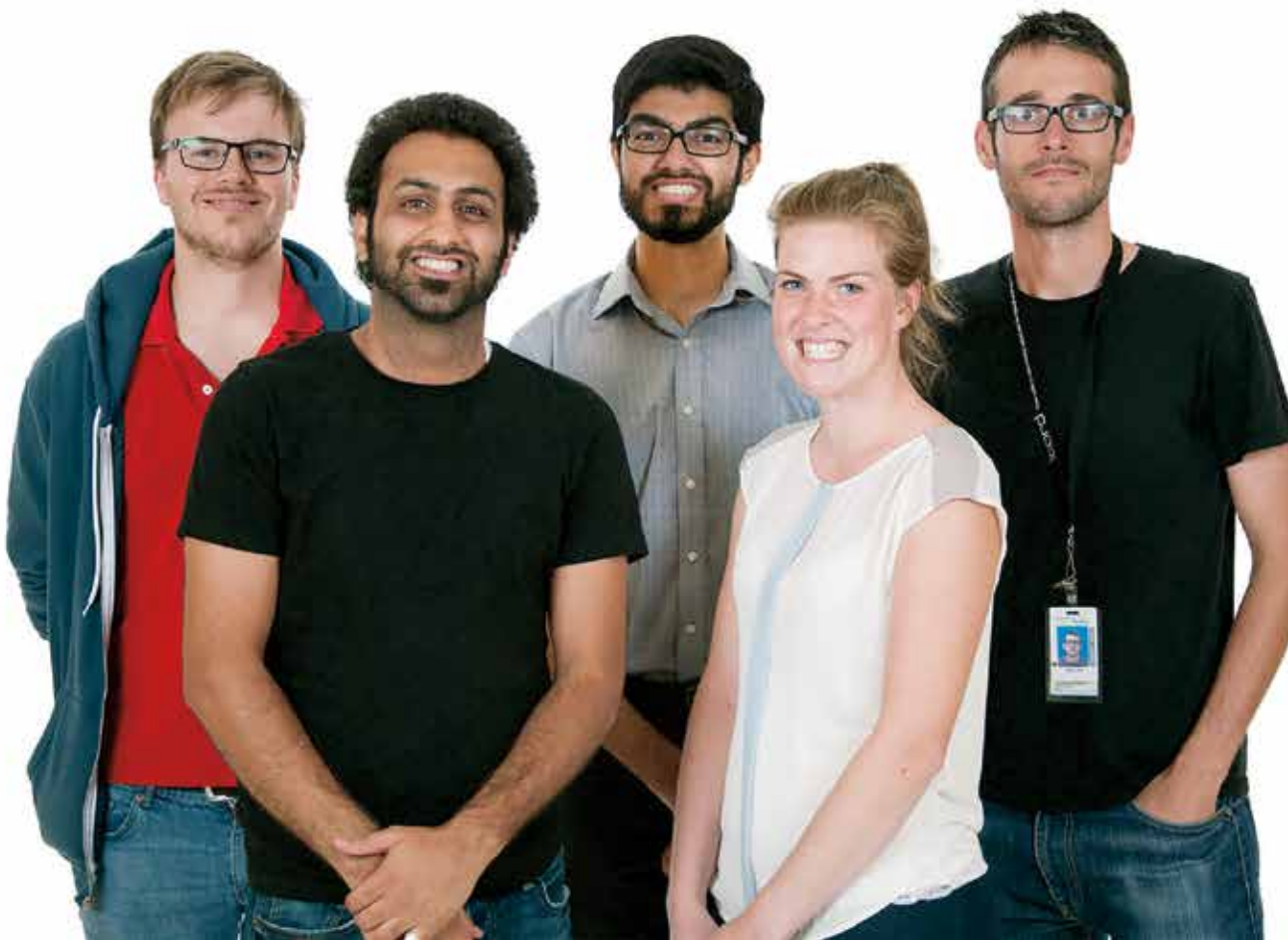
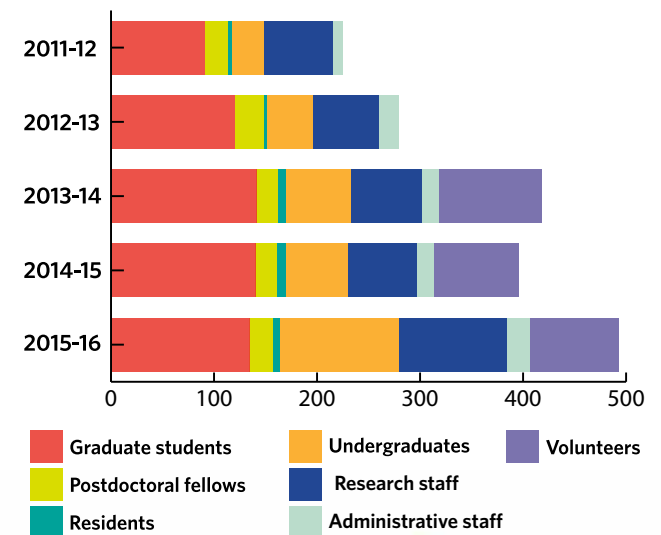
ICORD's operations are complex and require a diverse team with a variety of skills to complete the daily tasks that allow science to move forward.

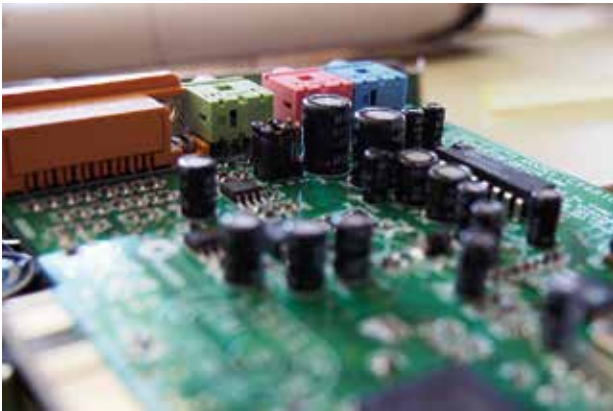
Behind every research project are administrative personnel paying invoices and managing HR, lab technicians running experiments and repairing equipment, and research associates managing projects.

ICORD would not be able to be as successful as it is without the support of this staff, who together possess more than 210 years of UBC experience. Among our staff are the 2014 UBC President's Staff Award for Leadership winner and two members of UBC's 25-year club. We are fortunate to have such a dedicated group of individuals who are committed to making contributions to support SCI research.

ICORD trainees, staff and volunteers, 2011-2016

There was an average of 217 trainees, 74 research staff, and 17 administrative staff per year at ICORD between 2011 and 2016.





ICORD research

Scientific research is at the heart of ICORD's approach to improving the lives of people with SCI. The connections inspired by founder Dr. John Steeves' research in basic neuroscience have continuously grown, making ICORD into the interdisciplinary research network that it is today. This collaborative strategy is what we believe is necessary for understanding and addressing the complexities of SCI.

While often thought of as a single traumatic event, SCI is best understood as a chronic condition. While paralysis is the most common association with SCI, this injury cascades into myriad complications. Damage to the nervous system, a higher likelihood of physical inactivity, and the drastic changes to basic lifestyle bring with them a greater risk of heart disease, urological problems, depression, diabetes, and several other

secondary issues. The understanding of this has led ICORD to gather experts from a set of diverse fields, so that they can share knowledge and inform the direction of future research.

In the following pages, you will read about how ICORD's neuroscientists work to support better clinical trials, how wound healing experts can inform research into neurotrauma, how community participation can improve quality of life, how basic injury modeling will support better research, and how assistive technology can aid rehabilitation. These are just some of the research initiatives happening at ICORD. Notably, most of these projects involve multidepartmental collaborations, which would have likely never taken place without ICORD's mission to see this research through the lens of SCI.

Productivity

ICORD researchers have produced 1,829 publications since 2011—about one per day—with 1,114 of these being peer-reviewed journal articles.

2011-12	376	176
2012-13	384	229
2013-14	324	241
2014-15	371	234
2015-16	374	234

■ All publications 🌸 Peer-reviewed journal articles

ICORD research: neuroscience

Acute SCI causes direct trauma to the central and peripheral nervous systems. As part of ICORD's mission is to make SCI curable, our researchers focus on understanding these effects by studying the fundamental mechanisms of the injury. ICORD's discoveries in this field of research lay the foundation for creating therapeutics and interventions to protect and rehabilitate the injured spinal cord and nervous systems.

Notable publications:

Early administration of gabapentinoids improves motor recovery after spinal cord injury. Warner F, Cragg JJ, Jutzeler CR, Röhrich F, Weidner N, Saur M, Maier DD, Schuld C, Curt A, Kramer JK. Accepted at **Cell Reports** 2017.

Dermatomal somatosensory evoked potentials and electrical perception thresholds during recovery from cervical spinal cord injury. Kramer JK, Taylor P, Steeves JD, Curt A. **Neurorehabilitation and Neural Repair**. 2010 May;24(4):309-17.

Re-establishment of cortical motor output maps and spontaneous functional recovery via spared dorsolaterally projecting corticospinal neurons after dorsal column spinal cord injury in adult mice. Hilton BJ, Anenberg E, Harrison TC, Boyd JD, Murphy TH, Tetzlaff W. **Journal of Neuroscience**. 2016 Apr 6;36(14):4080-92.

High-resolution myelin water imaging in post-mortem multiple sclerosis spinal cord: A case report. Laule C, Yung A, Pavolva V, Bohnet B, Kozlowski P, Hashimoto SA, Yip S, Li DK, Moore GW. **Multiple Sclerosis**. 2016 Oct;22(11):1485-1489.

Magnetic resonance of myelin water: an in vivo marker for myelin. MacKay AL, Laule C. **Brain Plasticity**. 2016;2(1):71-91.



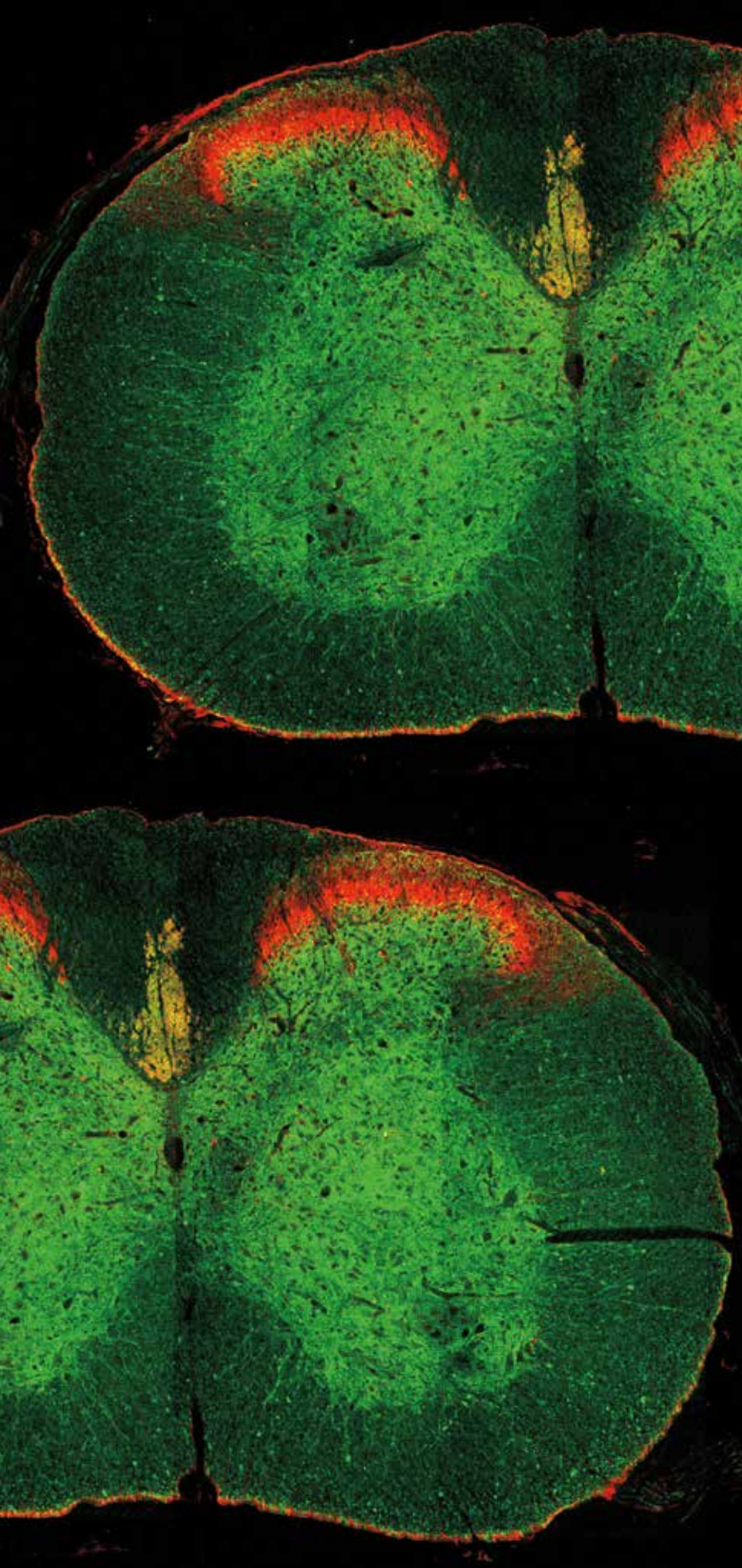
Above: Drs. Laule and Kramer; right: image of a rat spinal cord from the Hilton, et al 2016 *J. Neuroscience* paper.

Dr. Cornelia Laule

Dr. Laule is an Assistant Professor in UBC's Departments of Radiology and Pathology & Laboratory Medicine with a research background in the measurement of myelin with magnetic resonance imaging (MRI). She was recognized by the Multiple Sclerosis Society of Canada with the Transitional Career Development Award. She joined ICORD as a Principal Investigator in 2013, and her expertise in myelination, imaging, and multiple sclerosis has led to collaborations in SCI research with Drs. Piotr Kozlowski, John Kramer, and Wayne Moore.

Myelin is the protective sheath that surrounds axons and aids nerve pulses traveling from the brain to the rest of the body. It is often damaged in neurotrauma and neurodegenerative diseases. In one of the few studies examining myelin water serially in the human spinal cord, Dr. Laule's research showed that people with primary progressive MS had a 10 per cent decrease in myelin over two years, while the controls remained stable. This suggests that progressive demyelination occurs, and myelin water may help follow the pathological processes that contribute to clinical disability in progressive MS.

Dr. Laule's work has also shown that it is possible to quantitatively measure myelin in living humans and animals with MRI. Dr. Laule recently published a study in the journal *Multiple Sclerosis*, demonstrating that the myelin water fraction imaging technique can capture spinal cord anatomy in superb detail. This technique offers a valuable tool in the assessment of neurological health over time, revealing the progress of myelination after an injury, rather than relying on ex vivo histopathology.



Dr. John Kramer

In 2014, Dr. Kramer won a Michael Smith Foundation for Health Research Scholar Award and became an ICORD Principal Investigator and Assistant Professor in the UBC Department of Kinesiology. He has received recognition for his commitment to SCI research from the Rick Hansen Institute, the International Foundation for Research in Paraplegia, and North American Spine Society.

Dr. Kramer is an emerging leader in the field of SCI neuroscience. His research program is focused on better understanding sensory neurophysiology and anatomy underlying the perception of pain. Dr. Kramer has repeatedly shown that spinal cord sensory pathways can be examined with a variety of quantitative techniques sensitive to minor changes in sensory impairments. Furthermore, his work using evoked potentials has demonstrated improved potential for tracking changes in sensory function corresponding to individual spinal segments.

Dr. Kramer's lab is pioneering the concept of drug repositioning in the field of SCI. He is testing the hypothesis that some drugs administered for various comorbidities common in the early stages of SCI may affect long-term neurological outcomes. Rather than relying on animal experiments, Dr. Kramer tests for possible effects in humans, using existing observational and clinical trial data with the goal of expediting translation. Dr. Kramer's lab is leading a four-nation team of researchers for this work, in the project "Repurposing acute therapies for enhanced recovery after spinal cord injury," which is supported with CIHR funding through the European Union's ERA-NET NEURON program.

Dr. Wolfram Tetzlaff

In addition to being ICORD's Director, Dr. Wolfram Tetzlaff has a distinguished career in neuroscience, currently holding the John and Penny Ryan British Columbia Leadership Chair in Spinal Cord Research. His research spans several decades with more than 160 peer-reviewed publications. He is a co-inventor in the discovery of adult neural progenitor/stem cells with his colleagues Drs. Brent Reynolds and Samuel Weiss. Dr. Tetzlaff was the first to describe the differences in the gene expression response to injury between central nervous system (CNS) and peripheral nervous system neurons, and the role of neurotrophic factors on the injured CNS neurons.

Dr. Tetzlaff has continued to contribute significant findings to basic neuroscience. In 2016, Dr. Tetzlaff's PhD student (now postdoctoral fellow) Dr. Brett Hilton published in the prestigious *Journal of Neuroscience* the study "Re-establishment of cortical motor output maps and spontaneous functional recovery via spared dorsolaterally projecting corticospinal neurons after dorsal column spinal cord injury in adult mice." Drs. Tetzlaff and Hilton investigated the role of a specific nerve pathway called the dorsolateral corticospinal tract in bringing about spontaneous recovery following SCI. Using rodent models, they demonstrated that while this pathway has less than 400 nerve fibres, it is able to substantiate significant recovery after a partial SCI that spares this tract. Scientists have long suspected that a small number of nerve fibres mediate recovery after SCI, but it had not been conclusively proved until this study. Other projects focus on the role of macronutrients in recovery from SCI, the role of myelin formation after injury, and the use of skin-derived progenitor cells to repair the injured spinal cord.

Dr. Tetzlaff also directs the SCI Translational Research Platform. This effort, funded by the BICP, addresses the lack of suitable therapeutics to treat the acutely injured spinal cord. Notably, there are more than 300 compounds with reported benefits for neuroprotection, immunomodulation, neuroplasticity, and neuroregeneration in animals. The few of these that have been evaluated in clinical trials for SCI have failed due to numerous scientific and translational obstacles. The Platform assembles experts from numerous fields to select the most promising candidate treatments, and provides the scientific infrastructure to accelerate the evaluations of those candidates in clinically relevant models of SCI developed by ICORD's engineers under the direction of Dr. Oxland.

ICORD research: wound healing

Pressure ulcers are a persistent and dangerous secondary complication of SCI. They can cause infection, painful scarring, and stress on the health care system. Because chronic non-healing wounds are not only a concern of people with SCI, this field of ICORD's research has implications for other conditions, such as diabetic ulcers and burn wounds, demonstrating the value of our investigators to areas beyond SCI research.

Notable publications:

Expression of indoleamine 2,3-dioxygenase in dermal fibroblasts functions as a local immunosuppressive factor. Ghahary A, Li Y, Tredget EE, Kilani RT, Iwashina T, Karami A, Lin X. **Journal of Investigative Dermatology**. 2004 Apr; 122(4):953-64.

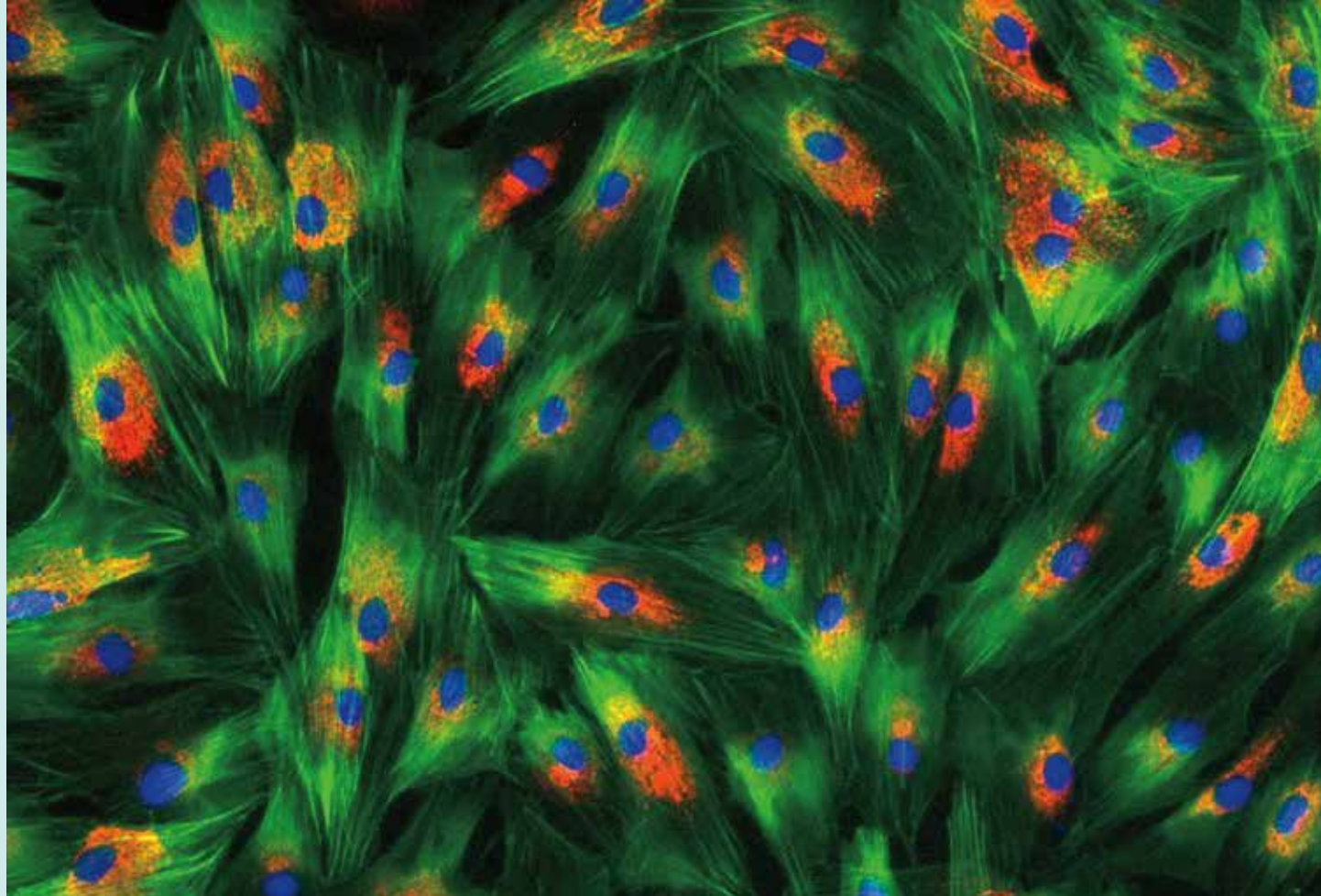
Anti-scarring properties of different tryptophan derivatives. Poormasjedi-Meibod MS, Hartwell R, Kilani RT, Ghahary A. **PLoS ONE**. 2014 March 17.

Accelerating skin wound healing by M-CSF through generating SSEA-1 and -3 stem cells in the injured sites. Li Y, Jalili RB, Ghahary A. **Scientific Reports**. 2016 July.

Fibroblast cell-based therapy for experimental autoimmune diabetes. Jalili RB, Zhang Y, Hosseini-Tabatabaei A, Kilani RT, Khosravi Maharlooee M, Li Y, Salimi Elizei S, Warnock GL, Ghahary A. **PLoS One**. 2016 Jan.

Granzyme B mediates both direct and indirect cleavage of extracellular matrix in skin after chronic low-dose ultraviolet light irradiation. **Aging Cell**. 2015 Feb; 14(1):67-77.

A new transcriptional role for matrix metalloproteinase-12 in antiviral immunity. Marchant DJ, Bellac CL, Moraes TJ, Wadsworth SJ, Dufour A, Butler GS, Bilawchuk LM, Hendry RG, Robertson AG, Cheung CT, Ng J, Ang L, Luo Z, Heilbron K, Norris MJ, Duan W, Bucyk T, Karpov A, Devel L, Georgiadis D, Hegele RG, Luo H, Granville DJ, Dive V, McManus BM, Overall CM. **Nature Medicine**. 2014 May; 20(5):493-502.



Above: stem cells turning into fibroblasts; top right: cultured skin substitute; lower right: members of the Ghahary Lab with Rick Hansen in 2014

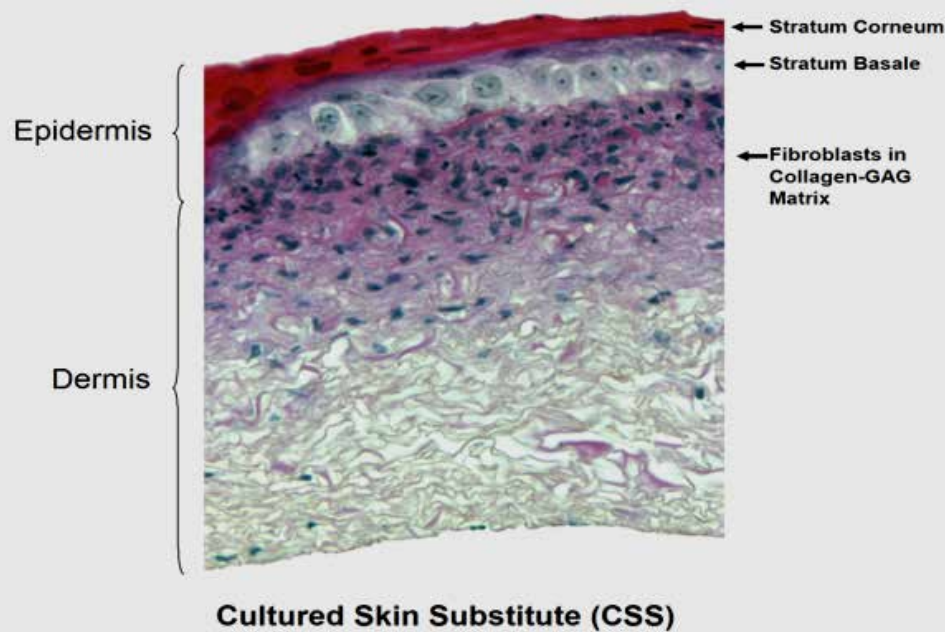
Dr. Aziz Ghahary

Dr. Ghahary is a Professor in the Department of Surgery at UBC and the Director of the BC Professional Fire Fighters' Burn and Wound Healing Research Group. He joined ICORD as a Principal Investigator in 2011 and is an active staff member at the Vancouver General Hospital.

Dr. Ghahary was ICORD's first PI with a focus in the biology of wound healing. His work became the foundation for our commitment to the treatment of non-healing wounds, such as pressure ulcers, a common condition associated with SCI. Dr. Ghahary's approach is directly translational, and he holds several patents for his discoveries. Currently, the product Fibrostop, developed by Dr. Ghahary and his postdoctoral fellow Dr. Ryan Hartwell, is in clinical trials. This therapeutic stems from the work that Dr. Ghahary's team did to identify kynurenine—a metabolite of tryptophan—and one of its products, kynurenic acid, as an inhibitor of scarring.

Pressure ulcers are among the top five leading causes of re-hospitalization in patients with SCI. Although there are numerous advanced wound care strategies that attempt to treat complicated wounds in conjunction with pressure-alleviating devices, current conventional prevention and treatment methods have neither decreased the prevalence of these ulcers nor significantly improved treatment outcomes. To address this difficulty, Dr. Ghahary's team invented a reconstituteable skin substitute system called MeshFill, which can be directly applied to pressure ulcers. The advantage of this liquid substitute is that it can penetrate and fill the cavities present in a wound bed. Dr. Ghahary's team has already shown that application of MeshFill accelerates healing in a delayed wound healing model. The future plan is to manufacture MeshFill for clinical trials, which will be conducted at ICORD and the Vancouver General Hospital. It is believed that this new method can significantly accelerate the healing of ulcers and improve the health of people with SCI.

Development of Non-rejectable Cultured Skin Substitute



Dr. Reza Jalili

Dr. Jalili worked with Dr. Aziz Ghahary for several years as a PhD student and postdoctoral fellow before joining ICORD as a Principal Investigator and UBC's Department of Surgery as an Assistant Professor. Dr. Jalili received a Michael Smith Foundation for Health Research Trainee Award in 2013, and he is a member of the American Burn Association, Endocrine Society, and Canadian Diabetes Association. Dr. Jalili also collaborates with Dr. Frank Ko, Canada Research Chair and UBC Material Engineering Professor, in the development of nanofibre scaffolds for delivering silver nanoparticles and other anti-inflammatory small molecules to prevent wound infection and to promote healing.

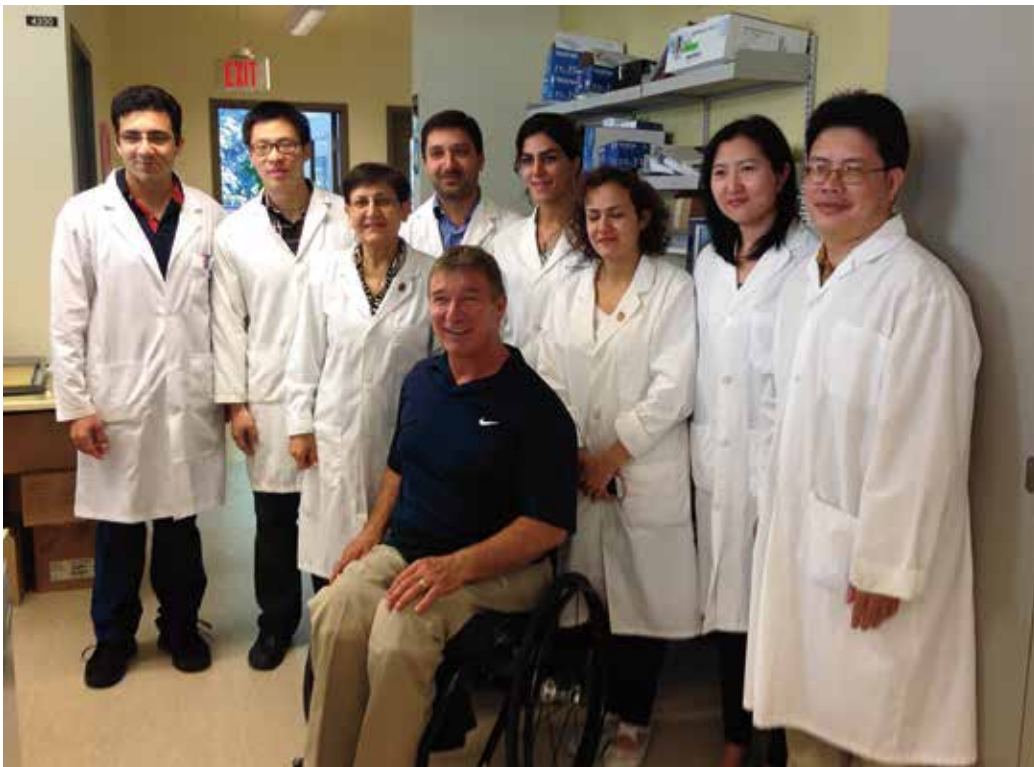
As a former trainee and frequent collaborator with Dr. Aziz Ghahary, Dr. Jalili's research program is rooted in finding innovative and clinically translatable treatments for different types of chronic wounds. One treatment that Dr. Jalili is exploring is a combination of novel bioengineered skin substitute systems and adipose-derived stem cells, which have the potential to promote the formation of new blood vessels, secretion of growth factors, and differentiation into multiple lineages upon appropriate stimulation. This approach is an integration of fundamental aspects of biomaterials design with cellular and molecular regenerative medicine, which will hopefully result in a robust and practical composite skin substitute for the treatment of chronic wounds. Dr. Jalili's research in this area is driven greatly by translational efforts to move these types of therapies into clinical trials.

Dr. David Granville

Dr. Granville became an ICORD Principal Investigator in 2016, bringing with him a depth of experience both in industry and academia. He is a Professor in the Department of Pathology & Laboratory Medicine, the Associate Director of the BC Professional Firefighters' Burn and Wound Healing Research Group, and the founder and Chief Scientific Officer of viDA Therapeutics Inc. Since arriving at UBC, his research has resulted in the filing of 30 patents.

Dr. Granville's work has most recently been focused on a family of enzymes, known as granzymes, or granule-secreted enzymes, that break apart proteins. His research identified that granzymes are elevated and contribute to the pathogenesis of conditions associated with impaired healing and inflammation. This discovery has broad implications for several disorders, including multiple sclerosis, discoid lupus erythematosus, pressure and diabetic ulcers, spinal cord injury, and cardiovascular, pulmonary, and skin injuries. In order to study granzymes in such a diverse set of indications, Dr. Granville has established an extensive network of clinical and scientific collaborators, one being with ICORD Director Dr. Wolfram Tetzlaff. Together, they are working on a pilot project to examine granzyme B's role in demyelination and damage to the nervous system after SCI.

His lab first became involved in SCI research through work on pressure ulcers supported by the Rick Hansen Institute. This research is related to Dr. Granville's discovery that granzyme B can interfere with proper wound healing, and that its inhibition can prevent degradation of the skin's extracellular matrix. This work has led to the development of a topical drug that has had successful results in models of impaired healing, and it is expected to reach clinical trials within the next one to two years.



ICORD research: engineering

From molecules to the entire human body, ICORD's engineers work to understand all aspects of SCI. Our biomedical engineers are exploring innovative methods to perform cellular repair after neurotrauma, while biomechanical engineers devise techniques to best model injuries, so researchers around the world can understand the mechanisms of SCI.

Notable publications

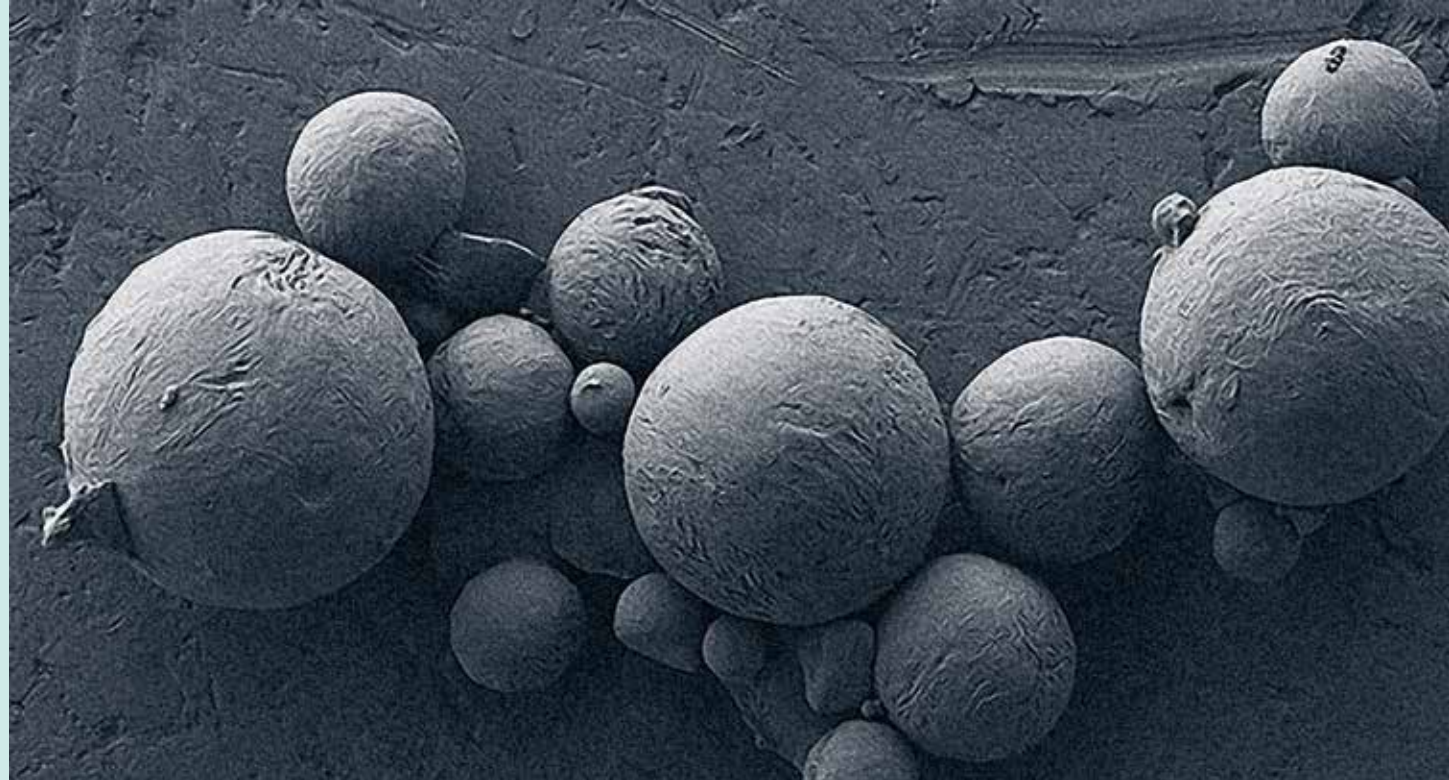
The effects of soluble growth factors on embryonic stem cell differentiation inside of fibrin scaffolds. Willerth SM, Faxel TE, Gottlieb DI, Sakiyama-Elbert SE. **Stem Cells**. 2007 Sep;25(9):2235-44.

Engineering personalized neural tissue using functionalized transcription factors. Willerth SM. **Neural Regeneration Research**. 2016 Oct;11(10):1570-1571.

Differential Histopathological and Behavioral Outcomes Eight Weeks after Rat Spinal Cord Injury by Contusion, Dislocation, and Distraction Mechanisms. Chen K, Liu J, Assinck P, Bhatnagar T, Streijger F, Zhu Q, Dvorak MF, Kwon BK Tetzlaff W, Oxland TR. **Journal of Neurotrauma**. 2016 Sep 15;33(18):1667-84.

Bicycle helmets are highly effective at preventing head injury during head impact: head-form accelerations and injury criteria for helmeted and unhelmeted impacts. Cripton PA, Dressler DM, Stuart CA, Dennison CR, Richards D. **Accident Analysis and Prevention**. 2014 Sep;70:1-7.

Concept proposal for a detachable exoskeleton-wheelchair to improve mobility and health. Borisoff JF, Mattie J, Rafer V. **IEEE International Conference on Rehabilitation Robotics**. 2013 Jun;2013:6650396.



Above: single emulsion microsphere photographed by Jose Carlos Gomez of the Willerth Lab; top right: artificial neck set up in the OIBG; bottom right: Dr. Borisoff's prototype detachable exoskeleton wheelchair design.

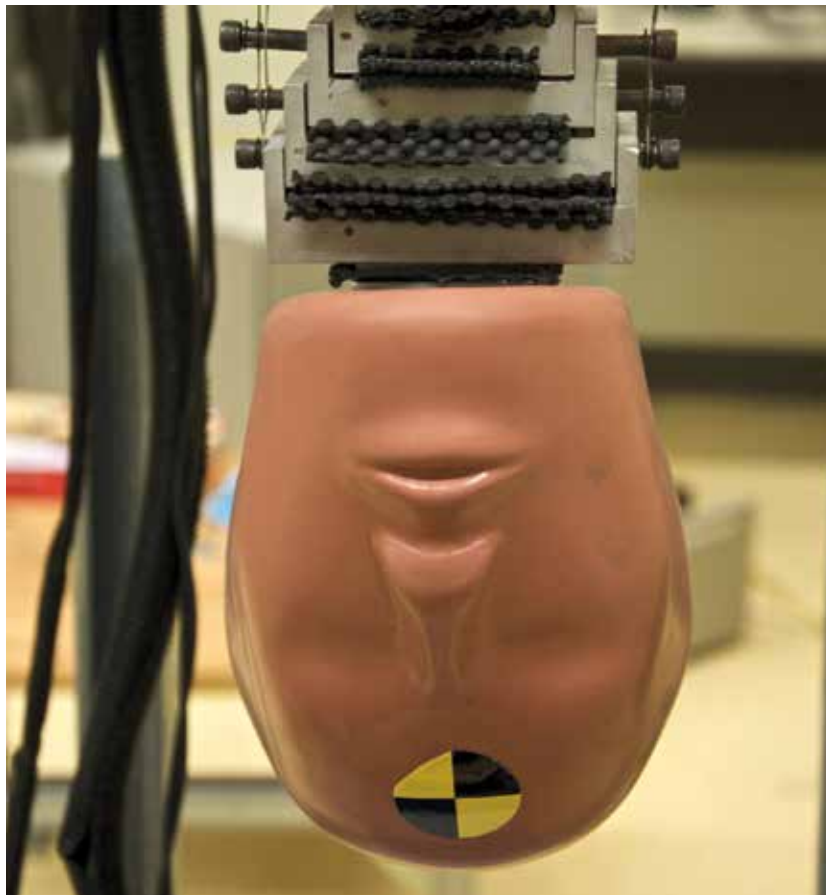
Orthopaedic and Injury Biomechanics Group

The Orthopaedic and Injury Biomechanics Group (OIBG) is a joint effort of UBC's Departments of Orthopaedics and Mechanical Engineering, led by the co-directors and ICORD Principal Investigators Drs. Peter Cripton and Tom Oxland. OIBG's lab is located on the fifth floor of the BSCC and is home to state-of-the-art injury-modeling technology.

The lab's team conducts research on the biomechanics of a wide-range of injuries, from investigating and developing injury-prevention technology to refining models of injury, which is crucial for ICORD's researchers. Dr. Oxland with several co-author ICORD PIs published the study "Differential histopathological and behavioral outcomes eight weeks after rat spinal cord injury by contusion, dislocation, and distraction mechanisms" in the *Journal of Neurotrauma*, which examined the long-term outcomes after spinal cord injury in an animal model induced by one of three distinct biomechanical mechanisms: dislocation, contusion, and distraction. These different injury mechanisms yielded distinct results in terms of white matter damage and behavioural outcomes. These findings will help inform which models of injury will be most useful for producing clinically relevant research.

Dr. Cripton has considerable expertise in experimental impact testing, spine trauma, and injury prevention technology, and has been a featured source in media for his knowledge of bicycle helmet safety. He published the first peer-reviewed study that demonstrated the effectiveness of off-the-shelf bicycle helmets in experimental models. This study found that in a 1.5-metre fall, striking the head, helmets reduced the risk of skull fracture or severe brain injury from 99.9 per cent to nine per cent.

Dr. Cripton's studies in spinal cord deformation in head-first impact supported his development of the **Pro-Neck-Tor**, a sports helmet designed to reduce cervical spine fractures from head-first impacts, which has been granted patents in the United States and Hong Kong.



Dr. Stephanie Willerth

Dr. Willerth is an Associate Professor in the Department of Mechanical Engineering at the University of Victoria, and she holds the Canada Research Chair in Biomedical Engineering. She has won numerous awards and recognitions, including the Young Innovator in Cellular and Molecular Bioengineering in 2015 and the Woman of Innovation Award in 2017, given each year to 20 Canadian women who have made significant contributions to engineering.

As a graduate student, Dr. Willerth was the first to determine the conditions needed to grow embryonic cells in fibrin scaffolding. Her work with three-dimensional fibrin scaffolds involves environments that closely resemble the human body, allowing for a better understanding of how cell-tissue processes work. For example, her research has shown how naturally occurring proteins and hormones can change stem cells into recovery cells.

Dr. Willerth's current research focus is on methods for restoring function to diseased or damaged tissue. Her lab has engineered a number of biomaterial scaffolds that can efficiently promote the differentiation of human-induced pluripotent stem cells (hiPSCs) into neurons. hiPSCs are a type of stem cell derived from adult cells, which can differentiate into every other cell type in the body. Dr. Willerth is investigating how modifying the chemical and mechanical properties of 3D fibrin scaffolds can efficiently generate functional neural tissue from hiPSCs, with the ultimate goal creating personalized treatments for neural damage.

Dr. Jaimie Borisoff

Dr. Borisoff is the Canada Research Chair in Rehabilitation Engineering Design and leads the British Columbia Institute of Technology's Rehabilitation Engineering Design Lab. He is also an Adjunct Professor in the Department of Occupational Science and Occupational Therapy and the Biomedical Engineering Program at UBC. Dr. Borisoff has won numerous awards and honours, including Mobility Management's Best Pick Award for his Elevation Wheelchair.

Dr. Borisoff's research focuses on how technology development can improve accessibility and mobility for people with SCI and other disabilities. He led the development and commercialization of the Elevation Wheelchair, which features an on-the-fly seating adjustment mechanism. This innovation allows wheelchair users to quickly and easily change the height and angle of their seats to suit whatever activity they may doing.

Dr. Borisoff is currently working on the design of a detachable exoskeleton wheelchair in collaboration with an exoskeleton company. This proposed technology combines his previous work on on-the-fly seating adjustment and robotic exoskeletons. While gait training with robotic exoskeletons has many therapeutic benefits to those with SCI, the exoskeletons are currently impractical as daily mobility devices. By combining a detachable exoskeleton with a wheelchair with dynamic seating positioning, Dr. Borisoff hopes to create a device that improves mobility, facilitates more participation, and offers therapeutic benefits.

ICORD research: rehabilitation + exercise science

A pillar of ICORD's mission is to make SCI livable, which is embodied by our commitment to rehabilitation research. Relief from the secondary complications that often accompany an injury to the spinal cord is one of the highest priorities for people living with SCI. Cardiovascular disease is one of the leading causes of death for people with chronic SCI, and much of ICORD's work is to understand and to improve heart health after SCI.

Notable Publications

Rigid and remodelled: cerebrovascular structure and function after experimental high-thoracic spinal cord transection. Phillips AA, Matin N, Frias B, Zheng MM, Jia M, West C, Dorrance AM, Laher I, Krassioukov AV. *Journal of Physiology*. 2016 Mar 15;594(6):1677-88

Passive hind-limb cycling improves cardiac function and reduces cardiovascular disease risk in experimental spinal cord injury. West CR, Crawford MA, Poormasjedi-Meibod MS, Currie KD, Fallavollita A, Yuen V, McNeill JH, Krassioukov AV. *Journal of Physiology*. 2014 Apr 15;592(8):1771-83.

Physical exercise improves arterial stiffness after spinal cord injury. Hubli M, Currie KD, West CR, Gee CM, Krassioukov AV. *Journal of Spinal Cord Medicine*. 2014 Nov;37(6):782-5.

Online Training Improves Paramedics' Knowledge of Autonomic Dysreflexia Management Guidelines. Martin Ginis KA, Tomasone JR, Welsford M, Ethans K, Sinden AR, Longeway M, Krassioukov A. *Spinal Cord*. 2017 Feb;55(2):216-222.



Above: the Ekso Bionics exoskeletal suit, used for rehabilitation research at ICORD; top right: working out at PARC; lower right: CHOICES participants, staff, and volunteers.

Dr. Christopher West

Dr. West joined ICORD as a Principal Investigator and the UBC Department of Kinesiology as an Assistant Professor in 2014, upon winning a Michael Smith Foundation for Health Research (MSFHR) Scholar Award. Prior to becoming a UBC faculty member, Dr. West worked as a postdoctoral fellow for Dr. Andrei Krassioukov, with support from the Craig H. Neilsen Foundation and MSFHR, and he is a winner of the Young Investigator award from the American Spinal Injury Association. In 2016, Dr. West won a CFI award to support the development of his Translational Integrative Physiology Laboratory.

Dr. West's expertise in cardiovascular health, with a focus on the role of physical activity and exercise, has greatly bolstered ICORD's research capacity. Since starting his laboratory in 2014, he showed for the first time that SCI induces reductions in both the pressure and flow-generating capacity of the heart that are independent of loading conditions. He has also found that exercise that engages the lower limbs passively is more efficacious than active upper limb exercise in offsetting cardiac dysfunction.

Dr. West has also made a substantial contribution to the elite Paralympic sport literature with research demonstrating that the degree of remaining cardiovascular function is a critical determinant of exercise performance in athletes with SCI, such that those with more "intact" cardiovascular control are able to perform better during tests of endurance performance than those with minimal cardiovascular control.

Dr. West currently collaborates with Drs. Andrei Krassioukov, Brian Kwon, and Wolfram Tetzlaff on examining the mechanisms of cardiovascular changes after SCI in both humans and animal models.



Dr. Tania Lam and PARC

ICORD's Physical Activity Research Centre is a fully accessible gym, community centre, and research facility, under the leadership of Dr. Tania Lam. PARC opened its doors in 2012 with equipment purchased through the support of the CFI, the government of British Columbia, UBC, and private donations.

PARC now serves more than 250 participants who live with traumatic and non-traumatic SCI, offering them adaptive gym equipment and recreational space. PARC's many volunteers and participants have built the organization around a tight-knit community, in which peers and mentors work together and share experiences.

The facility also functions as a valuable educational resource. PARC hosts workshops for community-centre fitness leaders to give them the knowledge to assess individuals with SCI, understand secondary health complications, and make recommendations for exercise regimens. UBC Department of Kinesiology students are able to volunteer at PARC to gain skills in working and doing research with clients with disabilities.

In addition to her contributions to community involvement, Dr. Lam has a research focus in the use of robotic exoskeletons for rehabilitative purposes. Her postdoctoral fellow Dr. Amanda Chisholm and MSc student Raed Alamro have conducted studies with the Ekso Bionics robotic exoskeleton, a device which provides support for overground ambulation and requires continuous participation from the users to maintain their balance while shifting their weight from one limb to the other in order to activate the Ekso's legs to walk. They found that gait training with Ekso activates the trunk muscles in people with motor-complete SCI at or above the level of T6. This training may lead to better postural stability and may improve seated balance control following SCI, which is particularly important for SCI wheelchair users because it increases independence with activities of daily living.

Dr. Andrei Krassioukov and the CHOICES Project

The Cardiovascular Health / Outcomes: Improvements Created by Exercise and education in SCI (CHOICES) Project is a multidisciplinary effort to improve the lives, health, and care of Canadians living with SCI by examining the benefits of optimized exercise and targeted education for cardiovascular health. CHOICES is made possible by a CIHR Team Grant, which supports a team of cardiovascular and SCI experts led by Dr. Andrei Krassioukov, all working collaboratively on a translational knowledge project that seeks to engage the SCI community, identify the mechanisms of exercise-mediated cardiovascular benefits, and translate this knowledge into effective clinical interventions.

CHOICES has given support to several studies and ongoing projects, such as Dr. Krassioukov's ABC's of Autonomic Dysreflexia (AD) project, which is an online course to educate health care providers about the dangers of AD, a cardiovascular condition common to people with chronic SCI. AD causes sudden dangerous spikes in blood pressure, increasing the risks of heart attacks and strokes.

Dr. Krassioukov's CHOICES team also published a study on the effect of exercise on arterial stiffness. The study found that athletes with SCI exhibited improved central arterial stiffness compared to non-athletes, which is in agreement with the previous able-bodied literature. The research demonstrated that chronic exercise training may improve arterial health and potentially lower cardiovascular disease risk in the SCI population.



ICORD research: community

Those who have experienced an SCI are familiar with the drastic changes it causes to the lifestyles of the injured person and their family and friends. Beyond the immediate trauma, the new physical demands and health care regimens for people with SCI can cause stress, contribute to an increased risk of depression, and discourage community participation. Many ICORD researchers work with the SCI community to identify interventions that ease adaptation to living with a chronic injury and ultimately improve quality of life.

Notable publications:

The development of evidence-informed physical activity guidelines for adults with spinal cord injury. Ginis KA, Hicks AL, Latimer AE, Warburton DE, Bourne C, Ditor DS, Goodwin DL, Hayes KC, McCartney N, McIlraith A, Pomerleau P, Smith K, Stone JA, Wolfe DL. **Spinal Cord**. 2011 Nov;49(11):1088-96.

“When I saw walking, I just took it as wheeling”: Interpretations of mobility-related items in generic, preference-based health state instruments. Michel YA, Engel L, Augestad LA, Rand-Hendriksen K, Whitehurst DGT. **Health and Quality of Life Outcomes** 2016; 14: 164

Health state descriptions, valuations and individuals’ capacity to walk: a comparative evaluation of preference-based instruments in the context of spinal cord injury. Whitehurst DGT, Mittmann N, Noonan VK, Dvorak MF, Bryan S. **Quality of Life Research** 2016; 25(10): 2481-96

Spinal cord injury rehabilitation in Riyadh, Saudi Arabia: time to rehabilitation admission, length of stay and functional independence. Mahmoud H, Qannam H, Zbogor D, Mortenson B. **Spinal Cord**. 2017 Jan 31.

Association between mobility, participation, and wheelchair-related factors in long-term care residents who use wheelchairs as their primary means of mobility. Mortenson WB, Miller WC, Backman CL, Oliffe JL. **Journal of the American Geriatrics Society**. 2012 Jul;60(7):1310-5.



Above and right: community-based physical activity for people with SCI; bottom right: UBC Occupational Science & Occupational Therapy students using the wheelchair skills course at ICORD.

Kathleen Martin Ginis

In the summer of 2016, Dr. Martin Ginis moved her lab to the UBC Okanagan campus and became ICORD’s newest Principal Investigator. She has been dedicated to SCI research with a focus in physical activity behaviour change and knowledge translation since 1999. Dr. Martin Ginis is the Director and founder of SCI Action Canada, a national, interdisciplinary organization that addresses the psychological and physiological consequences of physical activity in the SCI community. She is also a Fellow of the National Academy of Kinesiology and a recipient of the Ontario Medal for Good Citizenship.

As an esteemed SCI researcher and advocate, Dr. Martin Ginis joined ICORD already participating in several collaborations with ICORD PIs. She is a researcher on Dr. Andrei Krassiukov’s CHOICES Project. She is also the PI for the Canadian Disability Participation Project with ICORD co-investigators, Drs. Gary Birch, Jaimie Borisoff, Janice Eng, Susan Forwell, William Miller, and Ben Mortenson. This is an alliance of private, public, and governmental institutions and community-based organizations to advance research and knowledge translation projects to promote physical activity and other types of social participation among Canadians with disabilities.

Dr. Martin Ginis contributes significant findings about SCI participation and physical activity research along with the development of methods for putting those findings into practice. Dr. Martin Ginis was the lead author of the first evidence-based physical activity guidelines for people with SCI, published in the journal *Spinal Cord*. Her research has led to best-practices for developing and implementing physical activity behaviour-change interventions in the SCI community.



Dr. David Whitehurst

Dr. Whitehurst is an Assistant Professor in the Faculty of Health Sciences at Simon Fraser University. Before joining ICORD in 2011, he completed a postdoctoral fellowship at UBC funded by CIHR and the Rick Hansen Institute. Dr. Whitehurst is a member of the International Society for Quality of Life Research, the Society for Medical Decision Making, the EuroQol Group, and several other research organizations.

Dr. Whitehurst is a health economist with a research interest in quality-of-life measurement for individuals living with spinal cord injury—more specifically, the validation of preference-based quality-of-life measures suitable for use in economic evaluation. His research explores the empirical validity of such measures, which helps investigators select suitable questionnaires for quality-of-life research with people living with SCI.

Dr. Whitehurst was the project lead for “Spinal cord injury & secondary complications: a mixed-methods evaluation of preference-based instruments” with ICORD Principal Investigator Dr. Marcel Dvorak and the Rick Hansen Institute. Research from this project found that despite “cost-effectiveness” being an increasingly important consideration for decision makers in all areas of health care, there is a distinct lack of conceptual or empirical research regarding the appropriateness of alternative preference-based health-related quality of life measures for SCI populations. With colleagues at ICORD, SFU, and the University of Oslo, Dr. Whitehurst’s work has also identified a need for further research regarding the way that standardized quality of life measures frame questions about mobility impairment.



Dr. W. Ben Mortenson

Dr. Mortenson is an Associate Professor in the Department of Occupational Science and Occupational Therapy of UBC and an Adjunct Professor at Simon Fraser University. He returned to academia and research in 1999 after practicing as an occupational therapist for seven years. In addition to being an ICORD PI, Dr. Mortenson is also a member GF Strong Rehabilitation Program and a winner of the Banting Postdoctoral Fellowship and the CIHR Institute of Aging New Investigator Award (2016 to 2021).

Dr. Mortenson examines the topics of aging, social participation, outcome measurement, and assistive technology with a focus on individuals with SCI, assistive technology users, residents of care facilities, and both formal and informal caregivers. In his pedagogical work, Dr. Mortenson also instructs UBC Occupational Science and Occupational Therapy students in wheelchair skills training. Dr. Mortenson’s research found that improved wheelchair skills are associated with increased mobility and social participation among long-term care residents.

In a recent study published in the journal *Spinal Cord*, Dr. Mortenson explored factors associated with improvements in functional independence among people with SCI in a rehabilitation unit in Saudi Arabia. The results suggested that shortening the time between injury and admission to rehabilitation programs may improve outcomes for people who have experienced a traumatic SCI.

research endowments

ICORD's research towards the development and translation of more effective strategies to promote prevention, functional recovery, and improved quality of life after SCI is enriched by five endowments. Interest generated by these endowments has provided for the establishment of four chairs and a professorship. Chairs and professorships allow outstanding researchers to focus on particular areas of interest. The aim of each ICORD chair is to bolster and enhance ICORD's research program.

ICORD's research endowments were established through the generous support of the Rick Hansen Foundation, the University of British Columbia, Vancouver Coastal Health, Mr. John and Ms. Penny Ryan, Ms. Cordula and Mr. Günter Paetzold, and the Province of British Columbia.

Dr. Andrei Krassioukov

The Spinal Cord Rehabilitation Chair, 2013-present

Dr. Krassioukov is a clinician-scientist who is internationally recognized as an SCI expert, regularly presenting invited lectures and keynote addresses at international conferences. As the holder of the Spinal Cord Rehabilitation Chair, he has secured significant grant funding and recently hosted the 4th International Autonomic Symposium, on dysfunctions of the autonomic nervous system. His many collaborations range from Beijing to Los Angeles and, along with his mentorship of graduate students and team members, have led to award-winning research and publications.

Dr. Krassioukov's research examines the effects of SCI on blood pressure, the heart, and other internal organs in individuals with SCI. He explores the effects of body-weight treadmill training on the cardiovascular health of people with SCI. He also conducts research with Paralympic athletes to better understand the challenges they experience during training and competitions due to SCI-related cardiovascular dysfunction. His work with his research team at the Paralympic games in Vancouver (2010), London (2012), Sochi (2014), and latest Parapan Am Games (2015) evaluated athletes' experiences during competition as it relates to their blood vessel and heart controls.

A key application of this research is progress on eliminating the dangerous practice of boosting—the use of painful stimuli to increase blood pressure in order to improve athletic performance. Dr. Krassioukov is working to have a new component added to the international classification of Paralympic athletes, recognizing the autonomic differences in SCI athletes. This change in classification will level the playing field for these athletes, reducing the pressure to artificially enhance endurance.

At the core of Dr. Krassioukov's work is a focus on understanding and improving autonomic dysfunctions through innovative and cutting-edge research projects that lead to tangible benefits for the SCI community. A bench to bedside approach to research, and emphasis on knowledge translation initiatives for health care practitioners, supports this commitment to enhance the quality of life for individuals living with SCI.





Dr. Matt Ramer

The BC Neurotrauma Professor, 2001-present

As the BC Neurotrauma Fund Professor and a discovery scientist at ICORD, Dr. Matt Ramer carries out research to unravel the basic workings of the spinal cord and the numerous changes that occur following injury. One of the main questions the Ramer lab asks is whether the remarkable ability of a developing nervous system to grow and make connections can be revisited in adults with SCI. He has made several important advances in the basic biology of nerve cells. In particular, Dr. Ramer has described the qualities of a previously unrecognized set of neurons in the spinal cord and has discovered a new neuronal organelle that may govern the ability to regrow following injury.

Through a recent sabbatical at the Vesalius Institute in Leuven, Belgium, and King's College in London, England, Dr. Ramer established several new international collaborations as well as advances in research. During this sabbatical, he developed a new genetic tool for the investigation of neuronal responses to injury, building on expertise he acquired in state-of-the-art genetic techniques. Dr. Ramer also generated preliminary data on the treatment of pain and disability following nervous system injury.

"The freedom from heavy teaching and administrative loads endowed by the BC Neurotrauma Fund over the past 16 years has been pivotal in my ability to attract funding and high-quality personnel, and to carry out cutting-edge research," says Dr. Ramer.

Dr. Ramer's research includes work on sensory neurons, examining how low sensory information works at the spinal cord level, how signals are processed to transmit pain and manage locomotion, how sensory fibres can reconnect with the spinal cord after injury, and how uninjured fibres compensate for damaged ones. He also studies whether exercise and growth factors can be used to improve recovery.

Another major area of his work is in the profound changes

in the sympathetic nervous system after SCI. Recently, he has been examining the roles of glucose and cholesterol metabolism in the nervous system's reactions to trauma.

Publishing in such high-impact journals as *Cell Metabolism* and *Lancet Neurology*, Dr. Ramer explores the contradictory interactions of several body systems in regenerating after injury. It is these interactions that result in the most troublesome complications of SCI. The value of these findings will be in the shift from so-far unsuccessful cure efforts focused on single therapeutics to refocusing on how neural changes interact in different body systems after injury. Designing personalized treatments to address these interacting effects could lead to spinal cord regeneration and cure.

Dr. Marcel Dvorak

The Cordula and Günter Paetzold Chair in Spinal Cord Clinical Research, 2005-present

As a spine surgeon, educator, and leader, Dr. Marcel Dvorak finds time to investigate the clinical problems he sees in his SCI patients and to mentor junior clinical faculty members in research. This work would not be possible without the Cordula and Günter Paetzold Chair in Spinal Cord Clinical Research. "This chair has enabled me to accelerate my progress towards investigating best clinical practices for the treatment of spinal cord injured individuals," he says.

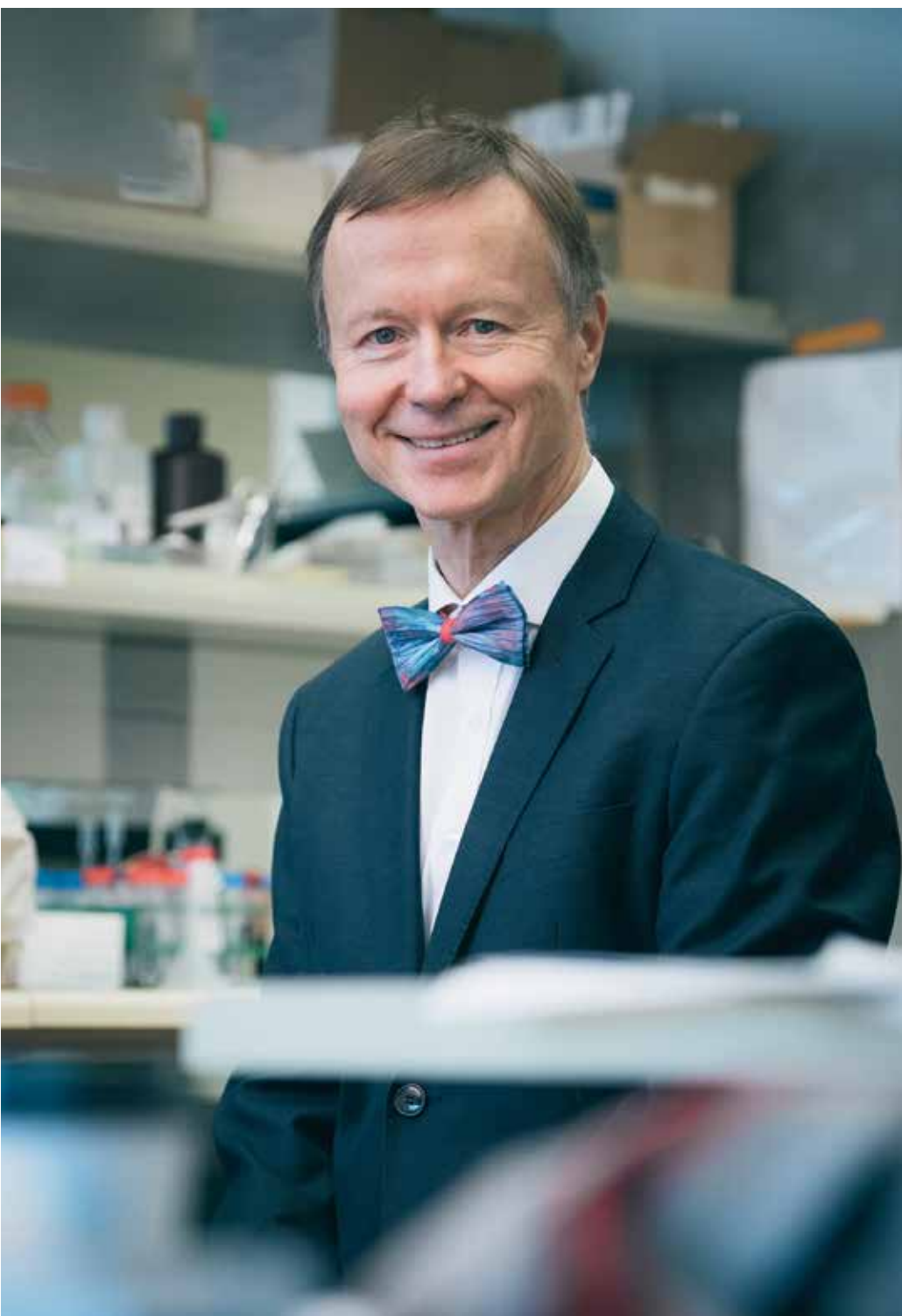
Since accepting the chair in 2005, Dr. Dvorak and his team have contributed scientific evidence that has driven improvements in clinical care. These advances have led to a marked change in treatment from when Dr. Dvorak was in residency training at UBC in the late 1980s. "Instead of leaving newly injured people on bed rest for what used to be months and months, we can now stabilize the spine so that it is actually stronger than it was prior to the injury and create an environment for the injured spinal cord that is free of compression and optimal for neurological recovery," he says. The Paetzold Chair is fundamental to supporting Dr. Dvorak's passionate approach to improving patient care.

Dr. Dvorak, along with his collaborators, continues to advance his research in multiple directions. "The funding from the chair enables me to hire clinical research associates who are the point of contact with patients and coordinate data collection for multiple clinical studies," he says. A significant study proposed a new classification system of SCI: The Trauma Severity Model. This model acknowledges the heterogeneity and diversity of the anatomic structure of the spinal cord, as well as the varying severity of injuries. The research team demonstrated that clinical trials can be more effective and efficient in identifying interventions that have a real influence on the recovery of these patients if the Trauma Severity Model is used.

Endowment funds supported clinical data collection for sequential MRI studies of individuals with acute SCI and the evolution of signal changes in their cervical spine MRIs. Dr. Dvorak and his team anticipate that a quantitative analysis of these MRI changes will form a surrogate measure for neurological recovery and may also assist in stratifying patients for clinical trial inclusion.

Dr. Dvorak's pioneering data registry on the recovery of patients with SCI published data that is being used to improve patient outcomes through better timing to surgery. Dr. Dvorak also authored several papers with ICORD researchers, advancing research into neuroregeneration therapies for human testing and evaluating surgical implants. In 2013, he was recognized by the North American Spine Society for his exceptional leadership in clinical spine research.





Dr. Wolfram Tetzlaff

The John and Penny Ryan BC Leadership Chair, 2013-present;

Rick Hansen Man in Motion Chair, 1995-2013

Dr. Wolfram Tetzlaff accepted the ICORD Directorship in July 2013 and vacated the Rick Hansen Man in Motion Chair to take the John and Penny Ryan BC Leadership Chair in Spinal Cord Injury Research. He set out his vision and leadership direction in ICORD's Strategic Plan and in the Blusson Partnership framework, which have led to significant funding and the appointment of new Principal Investigators to the ICORD team. A collaborative, global approach to the search for cures for SCI is at the core of Dr. Tetzlaff's vision for ICORD.

Dr. Tetzlaff has secured several sources of funds for ICORD's operations, including infrastructure grants and joint funding from the Michael Smith Foundation for Health Research to support the new PIs, Drs. John Kramer and Christopher West, who have boosted ICORD's programs in pain and cardiovascular complications after SCI.

Leveraging his collaborative approach to the search for cures, Dr. Tetzlaff travels regularly to build international partnerships, to promote Canadian leadership in SCI research, and to share research with a variety of knowledge users. In Vancouver, he works to build strong relationships within UBC and to develop internal collaborations. Dr. Tetzlaff also connects with wider audiences, presenting his research extensively to the SCI community, including through Café Scientifique events and webinars for Spinal Cord Injury BC.

Dr. Tetzlaff continues to advance his own research, recently publishing the important finding that a ketogenic diet, when initiated after SCI, improves functional outcomes. He forged a partnership with physicians in China to train scientists and exchange research procedures, and to conduct tandem preclinical trials of the high-fat, low-carbohydrate ketogenic diet (commonly used in epilepsy), to aid in neural recovery in acute SCI. This project received funding from an innovative CIHR Canada-China Partnership Grant, with the goal of bringing this pioneering work to clinical trials for patients with SCI.

As one of the earliest members of ICORD, Dr. Tetzlaff has seen many advances in his research program, with many significant findings. Among these findings is the discovery that nerve cells, which were previously believed to be dead after SCI, instead survive in a shrunken state and can actually be revived. In addition, Dr. Tetzlaff is studying the potential of skin-derived stem cells to treat the injured spinal cord, as they have promoted myelination and nerve fibre regeneration in rat models of SCI. Dr. Tetzlaff's lab shared the discovery that minocycline, primarily used to treat acne and other skin infections, can effectively improve outcomes after SCI by virtue of dampening inflammation.

As a researcher and leader, Dr. Tetzlaff's work is pivotal in the search for cures. "The primary objective of this chair is to engage in cutting-edge spinal cord research and to direct the research activities of ICORD," says Dr. Tetzlaff. "Since I took the chair in 2013, I secured millions of dollars of grant funding for ICORD and my academic research."

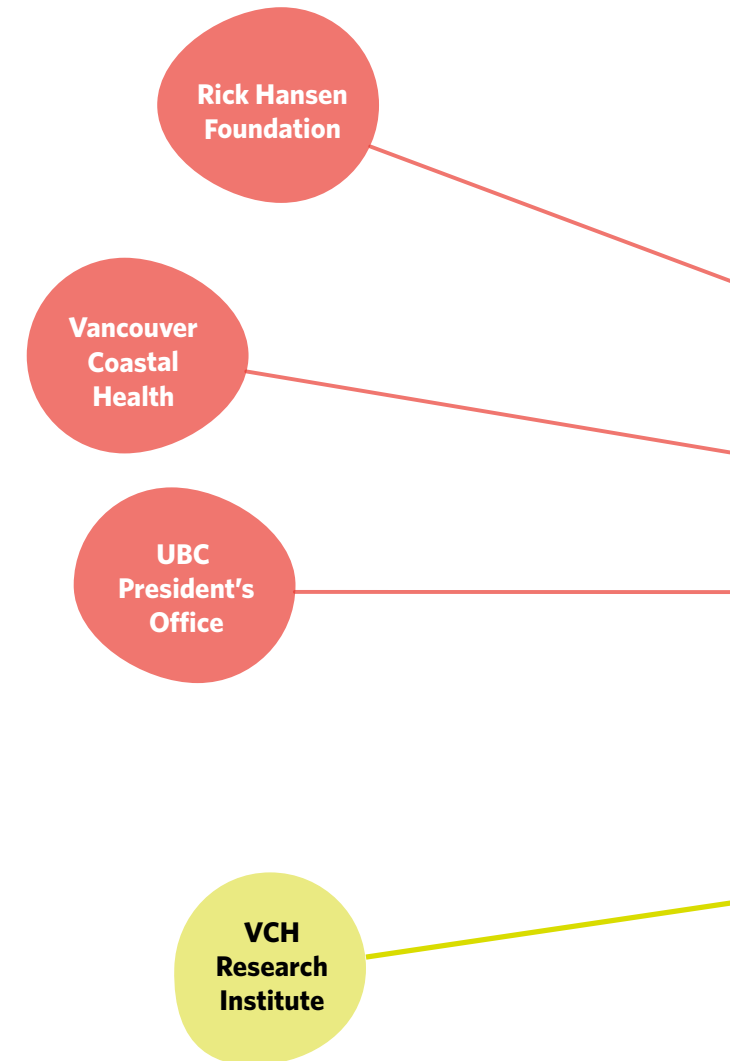
local research partnerships

It has been said that any group is greater than the sum of its parts, and ICORD is a testament to that philosophy. Just as individual researchers share insights and advances, the larger organization itself benefits immensely from association with our myriad partners.

ICORD would not exist without the founding partnership of the Rick Hansen Foundation, UBC and Vancouver Coastal Health. Other funders and institutional partners nurture research projects and further our research directions. Community partners energize and inspire researchers in new and exciting ways.

Although ICORD is an interdisciplinary research centre in UBC's Faculty of Medicine and the Vancouver Coastal Health Research Institute, a number of our researchers belong to other UBC departments and Canadian institutions. The operational and salary support provided to our researchers by these institutions continues to be invaluable.

Partnership is a uniquely empowering activity. As much as an individual can accomplish alone, those accomplishments increase exponentially when partners share achievements, ideas, and resources. ICORD is enriched in so many ways by the connections and powerful cross-pollination brought about through interaction with our partners, and for that we are sincerely grateful.



THE UNIVERSITY OF BRITISH COLUMBIA



Rick Hansen Institute
Institut Rick Hansen



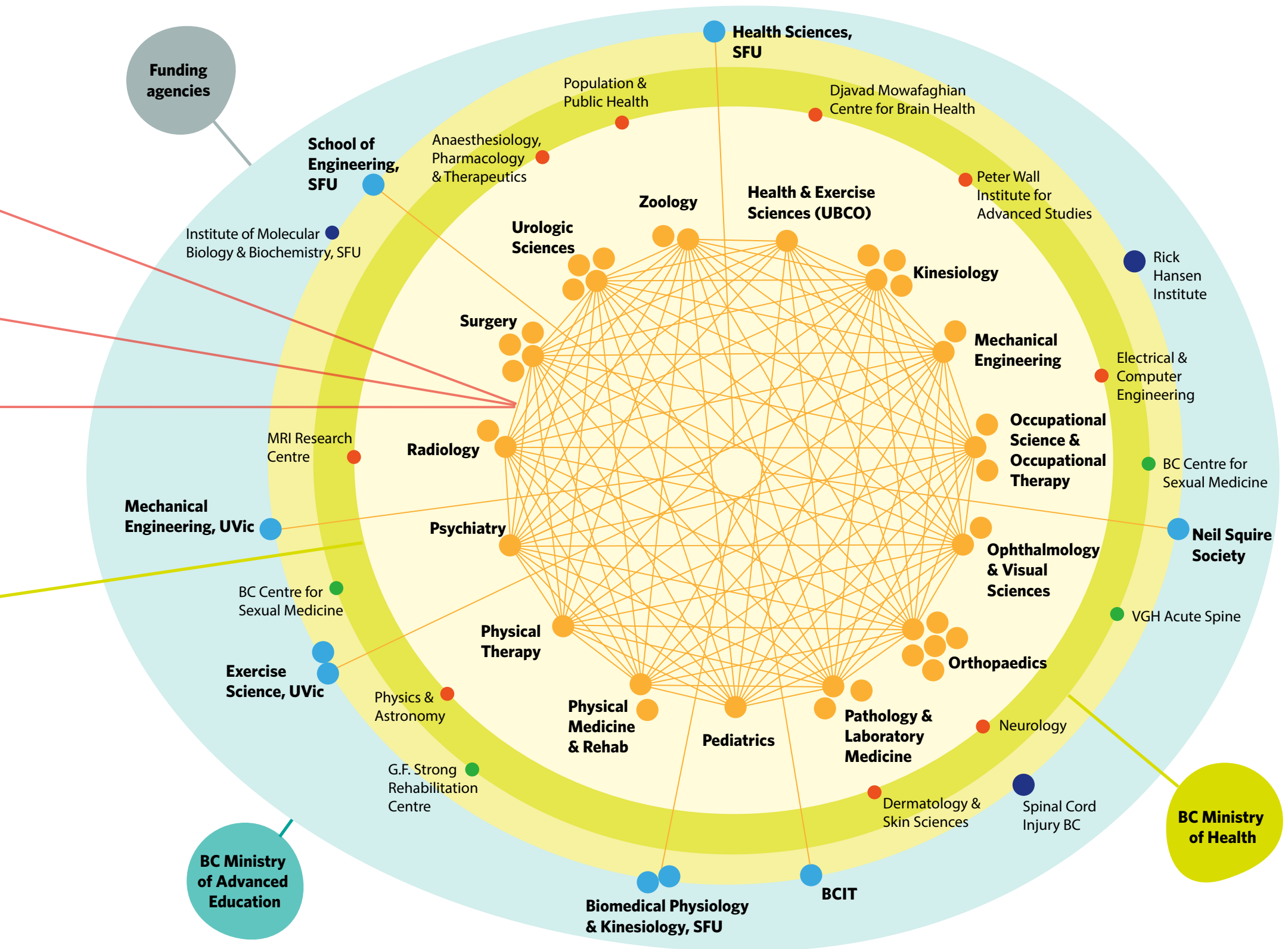
SIMON FRASER UNIVERSITY



University
of Victoria



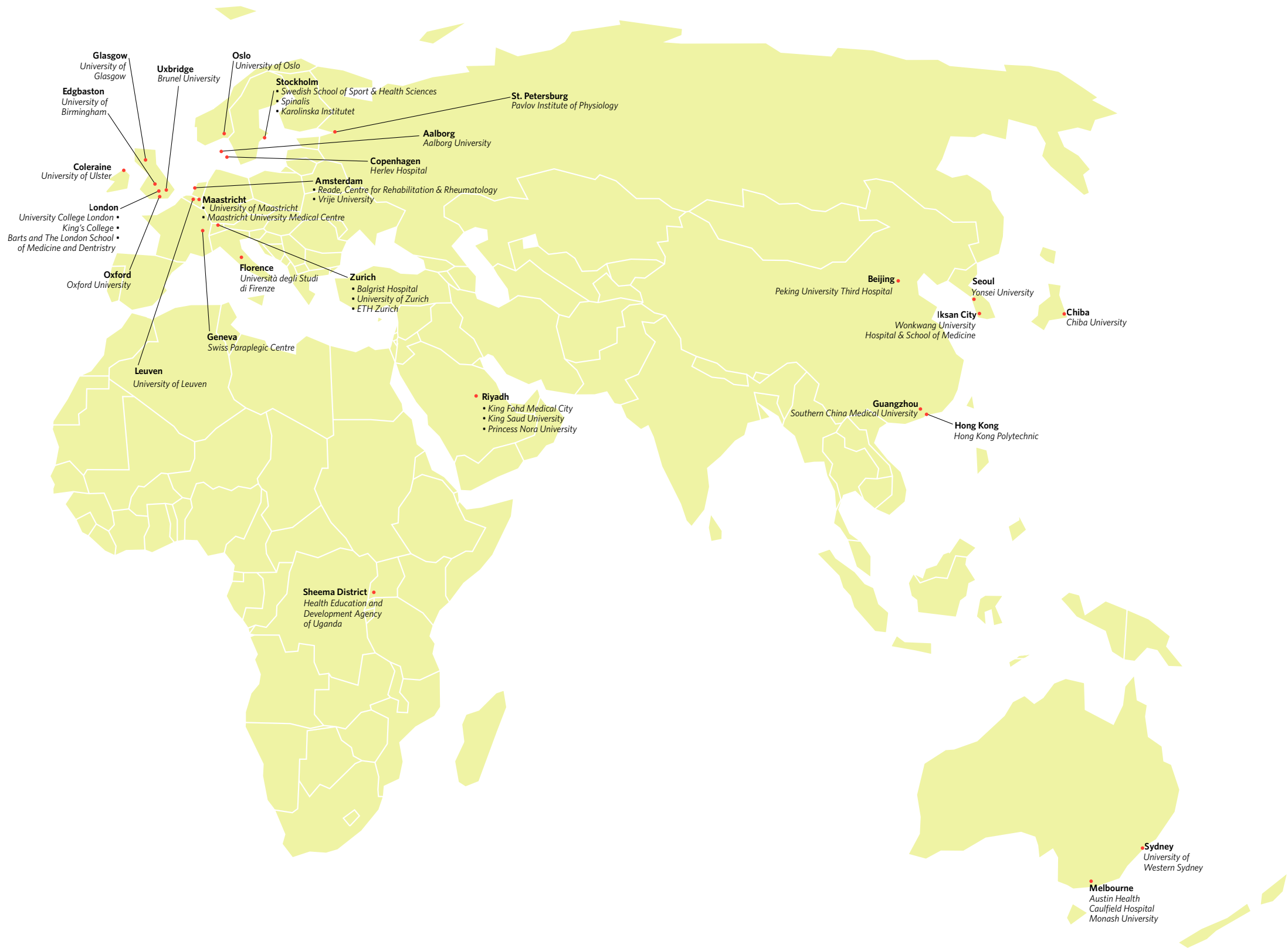
- ICORD Researchers at UBC
- ICORD Researchers at other institutions
- Research collaborations at UBC
- Research collaborations at Vancouver Coastal Health
- Research collaborations at other local institutions





international collaborations

ICORD researchers have an extensive network of national and international collaborations with investigators from a wide range of prestigious hospitals and universities, and renowned SCI researchers.



legendary inspiration: a profile of Rick Hansen

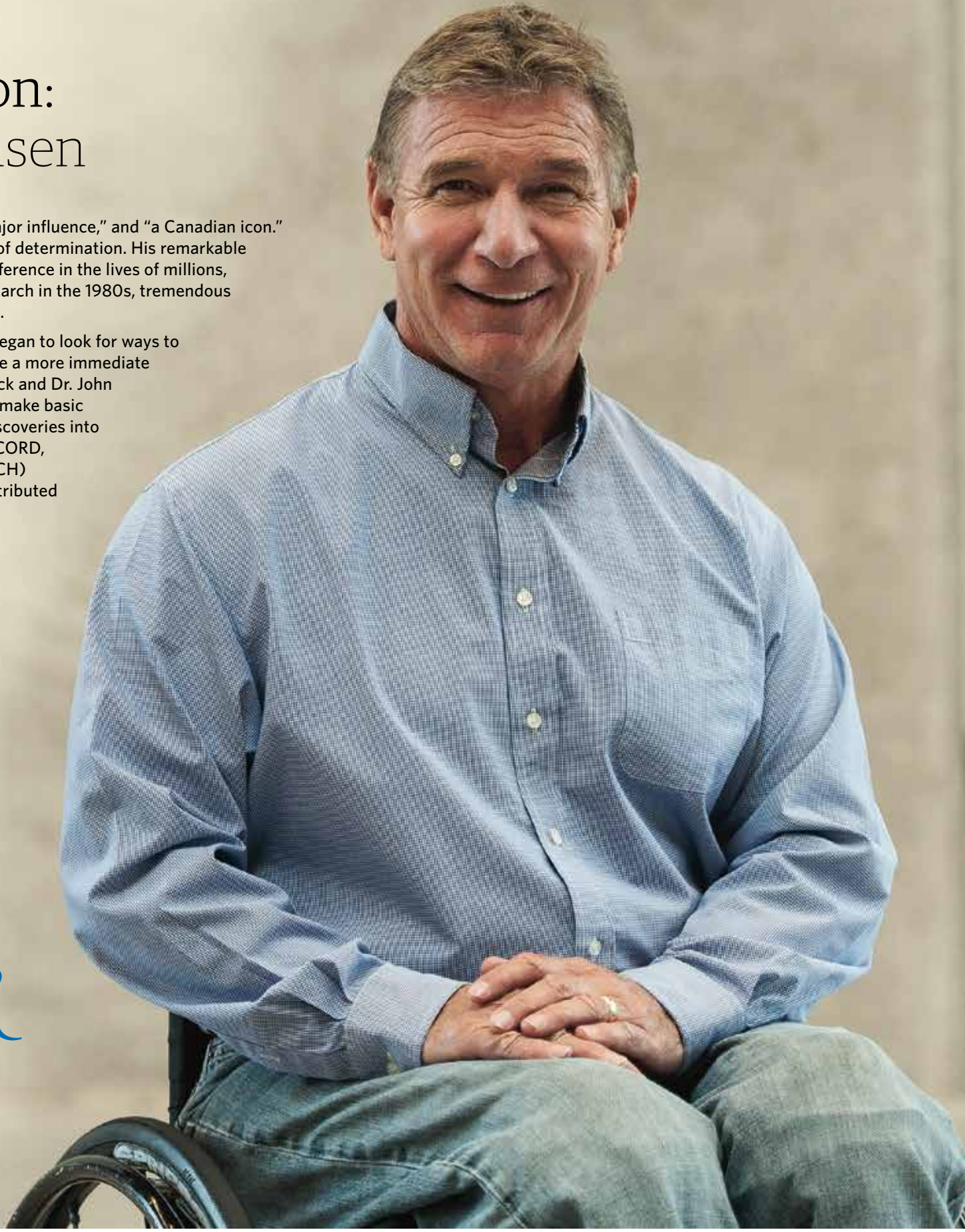
He has been described as having “true grit,” and being “a major influence,” and “a Canadian icon.” Today, there is no question that Rick Hansen is the epitome of determination. His remarkable contributions and tireless efforts have made a significant difference in the lives of millions, and since he became Canada’s leading advocate for SCI research in the 1980s, tremendous advancements have been made in science for those with SCI.

Following his epic Man In Motion World Tour, Rick Hansen began to look for ways to accelerate the pace of discovery globally so that it could have a more immediate impact in the day-to-day lives of people with SCI. In 1995, Rick and Dr. John Steeves of UBC came up with a way to achieve this goal—to make basic research more relevant to people with SCI by getting new discoveries into the community more quickly and efficiently by establishing CORD, a group of dedicated UBC and Vancouver Coastal Health (VCH) researchers and clinicians. The Rick Hansen Foundation contributed generously to support CORD, which later grew into ICORD.

A driving force behind the development of ICORD, Rick’s vision and commitment has helped create one of the largest SCI research facilities in the world and a major destination for scientists and doctors around the globe. Because of his leadership, generosity, and fortitude, the Blusson Spinal Cord Centre, home of ICORD, was made possible. Rick’s guidance also helped to establish ICORD’s five research chairs, including the Rick Hansen Man In Motion Chair in SCI Research held by Dr. Wolfram Tetzlaff until 2013, which significantly contributes to the work we do every day.

As a proud partner of the Rick Hansen Foundation, ICORD strives to realize Rick Hansen’s dream of improving the lives of people with SCI—and ultimately finding a cure.

Rick Hansen
Foundation





the Blusson Integrated Cures Partnership: enriching the research environment

Advancing research and improving the kind and quality of care available are key ingredients in improving outcomes and health of people living with SCI. Both are essential for strengthening individuals, families, caregivers and communities, for reducing the high cost of SCI to society as a whole, and for achieving scientific breakthroughs that hold the promise of better lives.

The Blusson Integrated Cures Partnership (BICP), a collaboration between ICORD and the Rick Hansen Institute (RHI), was established to do just this. In April 2013, the Rick Hansen Foundation, a leader in accessibility and awareness, committed \$20 million over ten years to support researchers and clinicians at the Blusson Spinal Cord Centre to accelerate preclinical and clinical research in SCI. This funding is aimed at strengthening the partnership between RHI and ICORD, and leveraging our existing strengths for greater impact.

The purpose of the BICP partnership is threefold:

- to become the world's leading partnership in innovative and collaborative preclinical and clinical research to accelerate the discovery of SCI cures;
- to develop and promote an International Clinical Trial and Research Network that will enable international collaboration in promising clinical trials and research efforts; and
- to inform and empower people with SCI so that they can become champions and active participants in creating a world without paralysis after SCI.

At ICORD, the BICP supports:

Translational research

Translational Research is research that makes its way from the laboratory to the clinic. In this area ICORD is leading the SCI Translational Research Platform, which is a program designed to identify treatments at the preclinical stage that have the best chances of succeeding in human clinical trials. This research may involve discovering a new therapy or validating an existing treatment for application in SCI. Another program is the first International SCI biobank, which will store tissue samples, blood samples, and spinal cord fluid. Using the biobank, researchers hope to identify the different biological mechanisms at work in different types of injuries, which could guide clinicians to use the best treatment for the circumstance. For example, an appropriate therapy for a bruised spinal cord may not be correct for a dislocated spinal column.

These efforts are to ensure that the science being done in the lab has the best chance to benefit the doctors and patients working to optimize outcomes.

Best & Brightest

The BICP operates with the knowledge that people are one of the most valuable resources in discovering effective treatments for SCI. The Best and Brightest is a strategy to support the development of talent and novel ideas in SCI research. The resources from this strategy are used to recruit new faculty, provide seed grants for creative research projects, and give awards for travel and research, with a focus on students and early-career investigators. The Best and Brightest strategy also supports ICORD's Annual Research Meeting and Trainee Symposium, both of which bring international investigators from a wide variety of disciplines to Vancouver to work together on SCI research.

This strategy gives promising researchers the ability to work within a lively and supportive environment designed to bring out the best of their talents while they focus on a common goal.

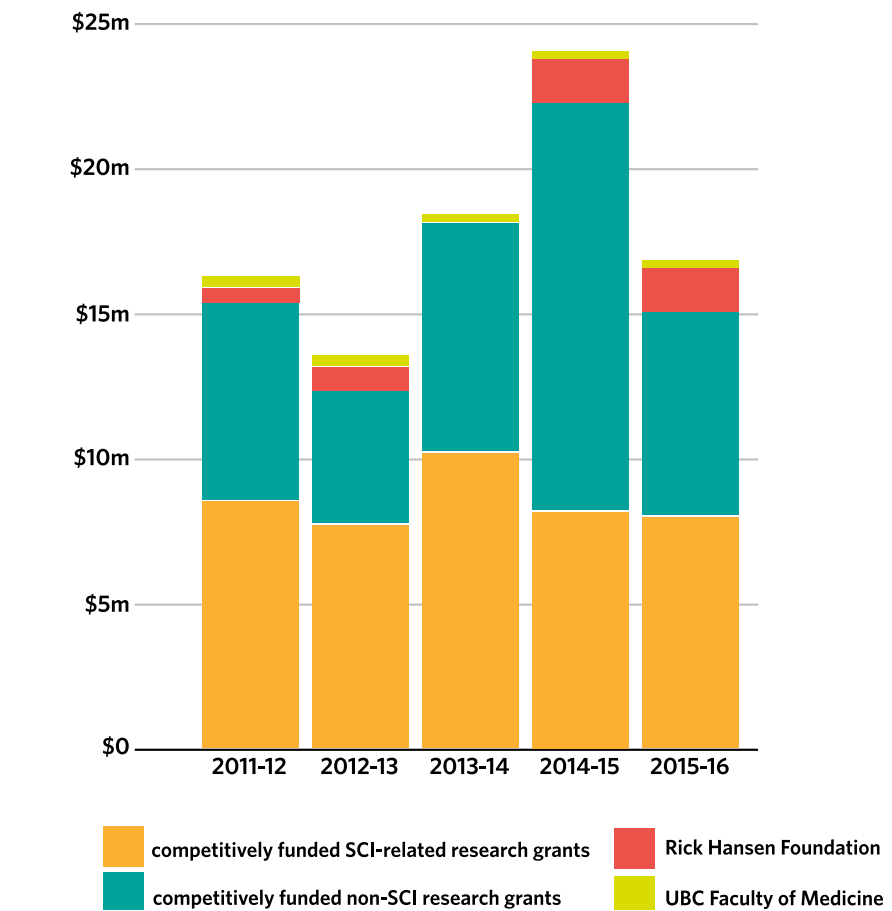
funding

The generous support of **Rick Hansen, Stewart and Marilyn Blusson**, the **Canada Foundation for Innovation**, the **British Columbia Knowledge Development Fund**, **Vancouver Coastal Health**, **Vancouver Coastal Health Research Institute**, and the **University of British Columbia** has helped us to become a world leader in SCI research.

With a common goal of discovering and implementing meaningful solutions for people with SCI, ICORD researchers receive several million dollars annually in competitively funded research grants. Between the beginning of fiscal 2011 and the end of fiscal 2016, ICORD researchers received more than \$83.5 million in competitively funded research grants, with nearly \$43 million for SCI-specific projects. In addition, the Rick Hansen Foundation provided \$4.25 million through the Blusson Integrated Cures Partnership (since 2014) and bridge funding (2011-13), and UBC provided \$1.2 million for research support.

We are pleased to recognize the tremendous commitment of the funding agencies and foundations who have provided major grant funding to our researchers. As well, we are thankful for the generous donations made to ICORD by **John and Penny Ryan**, the **Aaron Moser Foundation**, the **Hong Kong Spinal Cord Injury Foundation**, **King Saud University**, the students of **W.L. McLeod Elementary School** (Vanderhoof, BC), the **Northrop Family**, and other private donors. Every donation, large or small, is sincerely appreciated and put to good use furthering ICORD's mission.

These organizations have provided significant grants to ICORD or ICORD researchers:



community partners

ICORD clearly has expertise in knowledge translation; however, we can more effectively move towards defining best practices and policy changes by forming important partnerships with organizations such as the **Rick Hansen Institute, Spinal Cord Injury BC** and the **Sam Sullivan Disability Foundation**. Our partnerships and community engagement, combined with interdisciplinary research and external communication, will allow ICORD to continue to be a leader in the search for a cure.

Partnerships with other organizations such as **BC Wheelchair Sports** and the **Tetra Society** afford new opportunities to forge links with the SCI community, and our fundraising partnership with the **Vancouver Cantata Singers** proved to be rewarding in many ways for both organizations.



Sam Sullivan

DISABILITY FOUNDATION



looking forward

Since becoming the Director of ICORD in 2012, I have seen our membership grow from 31 Principal Investigators to 45. With each new member, ICORD gained a team of individuals who are committed to research that will make real differences, directly or indirectly, in the lives of people with SCI. This expansion has been fuelled by ICORD's belief in collaborative, interdisciplinary research, which is vital to finding ways to treat SCI.

Cumulatively, ICORD researchers produced more than 1,800 publications since 2011. This amounts to a publication every day, with many in high-impact scientific journals.

Over the past five years, we have seen important advances in ICORD's mission. The opening of our Physical Activity Research Centre, led by Dr. Tania Lam, has bolstered our research capacity in physical activity rehabilitation and given Vancouver's SCI population an accessible gym and community hub. The Blusson Integrated Cures Partnership (BICP) between ICORD and the Rick Hansen Institute has provided resources for innovative pilot projects, opportunities for students to participate in international academia, and support for multiple aspects of ICORD's daily operations.

Today, our investigations continue to range from molecular and cellular-level investigations of injury to clinical rehabilitative studies within the SCI community. I have had the pleasure of contributing my own research to some of these projects, all which have a focus on translation. Our researchers are currently running clinical trials for treatments for SCI-related cardiovascular disorders and non-healing wounds, which will hopefully reduce the burden of secondary complications after SCI.

In the coming years, we are most excited about the BICP-funded SCI Translational Research Platform. We believe this program will expedite the discovery of therapeutics for the treatment of the acutely injured spinal cord, one of our most important goals. Our partner organization the Rick Hansen Institute continues to play an important role in these efforts.

ICORD's success thus far can be attributed to a large network of organizations and individuals. We could not exist without the support of the University of British Columbia Faculties of Medicine and Science and the Vancouver Coastal Health Research Institute. The Rick Hansen Foundation has been a key benefactor throughout ICORD's history. Our faculty, trainees, staff, and technicians are vital to the day-to-day operations and our long-term vision for SCI research. And ultimately, it is the people who live with SCI who are the most important members of our network. Without their guidance and participation, our work could not be as strong as it is. It is with great thanks to these people and organizations that we continue ICORD's mission to make SCI preventable, livable, and curable.



Wolfram Tetzlaff
Professor, UBC Departments of Zoology & Surgery
John and Penny Ryan British Columbia Leadership Chair
Director, ICORD



SPINAL

MAKING

CORD

INJURY

PREVEN

-TABLE

LIVABLE

CURABLE



abbreviations

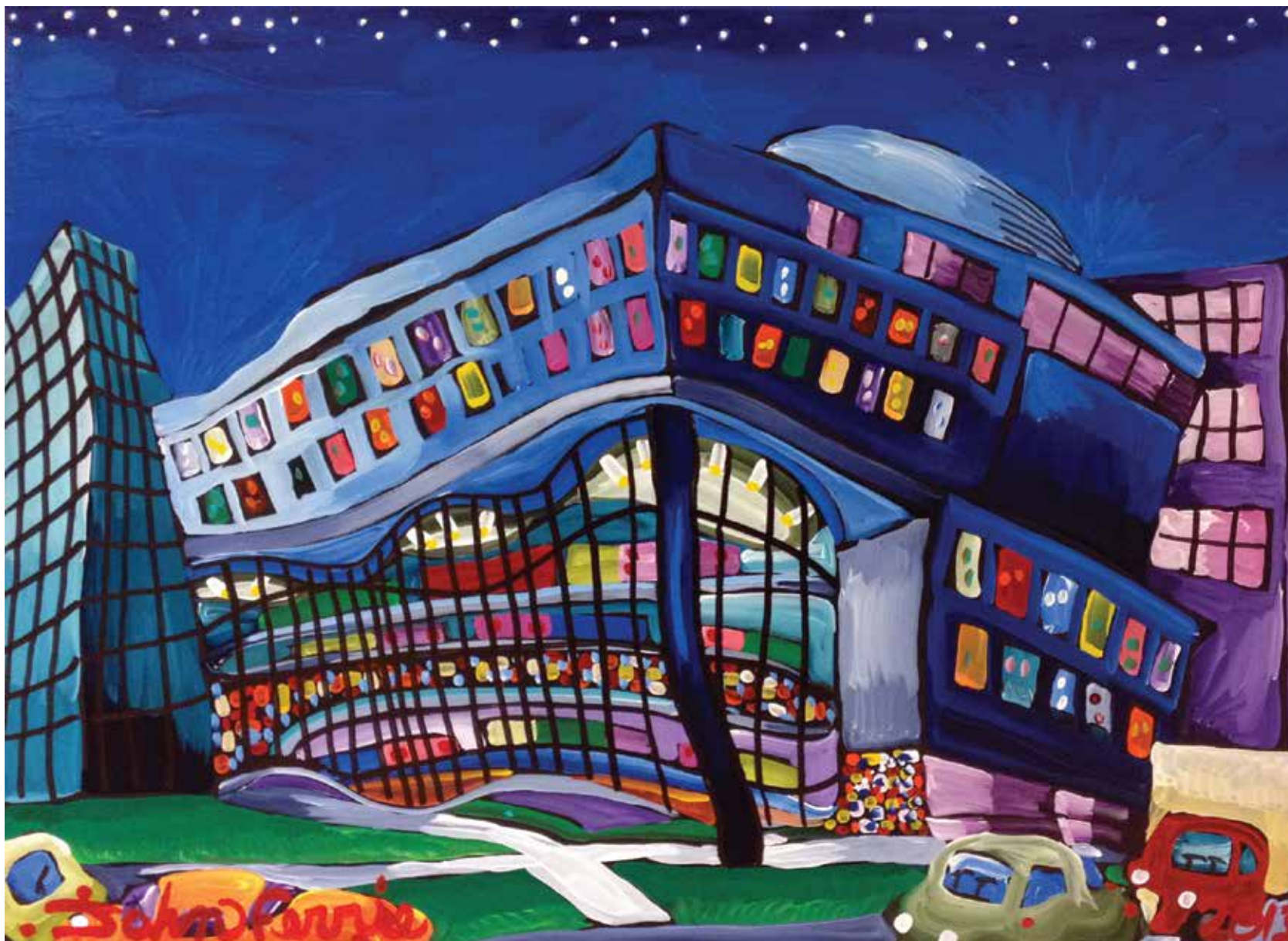
BCIT: British Columbia Institute of Technology
BICP: Blusson Integrated Cures Partnership
BSCC: Blusson Spinal Cord Centre
CFI: Canada Foundation for Innovation
CIHR: Canadian Institutes of Health Research
ICORD: International Collaboration on Repair Discoveries.
MSFHR: Michael Smith Foundation for Health Research
PI: Principal Investigator
RHF: Rick Hansen Foundation
RHI: Rick Hansen Institute
SCI: spinal cord injury
SFU: Simon Fraser University
U.Vic: University of British Columbia
UBC: University of British Columbia

photographs

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INTERNATIONAL COLLABORATION ON REPAIR DISCOVERIES



THE UNIVERSITY OF BRITISH COLUMBIA

Rick Hansen
Foundation



Vancouver
Coastal Health Research Institute
Healthier lives through discovery