





a place of mind

THE UNIVERSITY OF BRITISH COLUMBIA

ICORD at a glance, April 2015-March 2016 **INVESTIGATORS: 8** People: 551 **Researchers: 58** ASSOCIATE PRINCIPAL MEMBERS: 8 **INVESTIGATORS: 42** Trainees: 279 UNDERGRAD: 115 Staff:128 **RESIDENT: 7** ADMIN 23 Volunteers: 86 Publications: 374 PEER-REVIEWED JOURNAL ARTICLES: 234 Funding: \$16,877,576 UBC FoM: SCI-RELATED \$300,000 RESEARCH PAPERS WITH TWO OR COMPETITVELY-FUNDED GRANTS: MORE ICORD AUTHORS: 45 RESEARCH GRANTS: \$8,065,936 \$15,102,576 BLUSSON CUMULATIVE IMPACT FACTOR: 583 INTEGRATED CURES PARTNERSHIP: \$1,475,000

Welcome from ICORD's Director

WOLFRAM TETZLAFF, MD, PHD | PROFESSOR, ZOOLOGY & SURGERY, UBC

Having completed my fourth year as Director of ICORD, I remain impressed and heartened by the steadfast commitment to spinal cord injury research shown by our researchers, trainees, technicians, staff, and study participants. Their hard work is what maintains ICORD's reputation as a world-leading centre for bench-tobedside (and back again) SCI science.

Between April 2015 and March 2016, our investigators published 234 peerreviewed studies, 45 of which had two or more ICORD authors. These collaborations span many disciplines and are fostered by the lively environment of our centre, where scientists and clinicians can interact and converse on a daily basis. In my own research, I had the privilege of co-authoring articles with ICORD researchers Drs. Jaimie Borisoff, Peter Cripton, Piotr Kozlowski, Brian Kwon, Thomas Oxland, and John Steeves, as well as many promising ICORD trainees.

As in previous years, ICORD broadened discussions of science to include those

outside of academia. In March 2016, we hosted another well-attended Community Research Meeting, which sparked a lively discussion between members of the SCI community and researchers about the future that robotics will play in SCI rehabilitation and prosthetics.

This year we also continued to reap the benefits of the Blusson Integrated Cures Partnership (BICP), the collaboration between ICORD and the Rick Hansen Institute funded by the Rick Hansen Foundation. The BICP has awarded seed grants that have been leveraged into more than a million dollars of additional research funding, provided travel grants for international collaborations, and supported ICORD with talented technical and administrative staff to maintain the day-to-day operations of our centre.

In the years to come, we anticipate that these efforts will only grow and become more fruitful as ICORD works to making SCI preventable, livable, and curable. It is my pleasure to present to you these successes in more detail in this annual report.

Woeper Tetral

Dr. Tetzlaff (front row, second from left) with some of the talented staff and trainees in his laboratory.

Highlights from April 2015–March 2016

ICORD PIs and their trainees

collaborated on numerous research projects during the past year, publishing forty-five peer-reviewed papers with two or more ICORD authors. Six of these papers also included co-authors from the **Rick Hansen Institute.**

One important paper by **Drs. Tom Oxland, Wolfram Tetzlaff, Brian Kwon, Marcel Dvorak,** and their teams, published in the *Journal of Neurotrauma*, showed that different SCI mechanisms (contusion, distraction, or dislocation injuries) result in distinct patterns of histopathology and behavioural recovery.



Drs. Brian Kwon and Peter Cripton co-authored a paper published in the *Journal of Neurotrauma* on the effect of vibration on SCI. The study, funded by the US Defense Medical Research and Development Program, gave insights into how acutely injured spinal cords could be affected during pre-hospital transportation.

Drs. Andrei Krassioukov, Christopher West, and Matt Ramer collaborated on a study, published in *Neurorehabilitation and Neural Repair,* on the therapeutic benefits of passive hind-limb cycling on autonomic dysreflexia (dangerous episodes of high blood pressure), a common secondary complication of SCI.



A paper on cerebral blood flow regulation and spinal cord injury by postdoctoral fellow **Dr. Aaron Phillips**, along with Drs. Andrei Krassioukov, Chris West, and their colleagues, was selected as the Editor's Choice and cover article of the

March 15, 2016 issue of *The Journal of Physiology.* Dr. Phillips found "novel evidence that experimental SCI leads to inward cerebrovascular remodelling, increased stiffness and impaired reactivity of the largest cerebral artery."



Dr. Andrei Krassioukov and a group of researchers worked with athletes from around the world at the 2015 Parapan Am Games in Toronto in an effort to make competition safer and fairer for people with SCI. Dr. Krassioukov ran the Parapan Games Cardiovascular Health Clinic, where ICORD's team studied how elite athletes' cardiovascular systems function during exercise and other tests. The 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. The researchers conducted a variety of tests and equipped wheelchair rugby players with heart monitors to record their cardiovascular activity during competitions. This clinic was the sixth of its kind for Dr. Krassioukov, the previous being held at the 2008 Paralympic Games in Beijing, continued at the 2010 games in Vancouver, the 2012 Games in London, 2013 World Paracycling Championships in Baie-Comeau, and the 2014 Winter Paralympic Games in Sochi.

Dr. Aziz 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. Dr. Ghahary and his lab study non-healing wounds such as pressure ulcers, which are a common secondary complication of SCI. **Dr. E. Paul Zehr** won the Society for Neuroscience's *Science Educator Award*, a recognition given to two neuroscientists each year for their devotion to outreach and public education in neuroscience. He received the award on October 19 in Chicago at the 2015 Society for Neuroscience conference.

Dr. Zehr began getting serious about science communication ten years ago when he used Batman to explain concepts of kinesiology and neuroscience, his fields

of study. In *Becoming Batman: The Possibility of a Superhero,* he explored the science behind the fiction by finding out what it would take for someone in real life to achieve the physical and mental prowess of Batman.



Dr. Stephanie Willerth was recognized as a *Young Innovator in Cellular and Molecular Bioengineering* by the Biomedical Engineering Society, based based on the work presented in her paper, "Incorporation of retinoic acid releasing microspheres into pluripotent stem cell aggregates for inducing neuronal differentiation." This study was supported by an ICORD Seed Grant.

Bishop Lab research staff

ICORD's Principal Investigators: what are they thinking about? We asked our PIs to tell us their top research questions. Here are some of their answers.

		How can emerging
What are the biological mechanisms that can predict clinical severity of spinal nerve root	Gary Birch, OC ← Executive Director, Neil Squire Society;Adjunct Professor, Department of Electrical & Computer Engineering, UBC → Paul Bishop Clinical Professor, Orthopaedics, UBC	technologies be made accessible for people with disabilities?
injury?		How can wheelchairs
What is the impact of cardiovascular autonomic dysfunction on quality of life after SCI?	Canada Research Chair in Rehabilitation Engineering Design, Applied Research, BCIT Victoria Claydon Associate Professor, Biomedical Physiology and Kinesiology, SFU Peter Cripton Co-Director, Orthopaedic and Injury Biomechanics Group;	be further improved? How can inaccessible environments (e.g. the beach) be rendered more accessible with new equipment designs?
	Professor, Mechanical Engineering UBC	14/1 1 1
Can a liquid skin substitute be used to treat non-healing wounds like pressure ulcers?	Marcel Dvorak Professor, Orthopaedics, UBC; Spine Surgeon, VCH Stacy Elliott Medical Director, BC Centre for Sexual Medicine, VCH; Clinical Professor, Psychiatry and Urologic Sciences, UBC Janice Eng Professor, Physical Therapy, UBC Sue Forwell	What is the physiological risk of - autonomic dysreflexia with sexual activity, pregnancy, delivery, and lactation, and does it prevent sexual quality of life after SCI?
	Associate Professor and Head, Department of Occupational	
What is the best MRI technique for accurate <i>in</i> <i>vivo</i> assessment of white matter damage resulting from spinal cord injury?	Sciences & Occupational Therapy, UBC Aziz Ghahary Professor, Surgery / BC Professional Firefighters Burn and Wound Healing Lab, UBC Andy Hoffer	How can we prevent loss of voluntary diaphragm function during the acute phase following SCI?
	Professor, Biomedical Physiology and Kinesiology, SFU; Founder	How can we more
How can we develop and implement international Paralympic	+ CEO, Lungpacer Medical Inc. Reza Jalili • Assistant Professor, Surgery, UBC • Piotr Kozlowski	effectively treat chronic wounds, including pressure ulcers?
classifications keep elite	Associate Professor, Radiology & Urologic Sciences, UBC	
level the playing field for fair competitions?	John Kramer Assistant Professor, Kinesiology, UBC Andrei Krassioukov Denformer, Divised Medicine & Debab, UBC	impact neurological recovery after SCI?
How can we better	Brian Kwon	What proteomic
assess and train functional (community) - ambulation in SCI?	Professor, Orthopaedics, UBC; Spine Surgeon, VCH Tania Lam Associate Professor, Kinesiology, UBC	metabolomic, and genomic changes occur after acute SCI?
	Cornelia Laule	
How can we optimize mobility through the use of assistive technology so that adults can fully	Assistant Professor, Radiology & Pathology and Laboratory Medicine, UBC Bill Miller Professor, Occupational Science and Occupational Therapy, UBC;	How does the structure of myelin influence MRI signal?
participate in daily life?	Associate Dean, Health Professions, Faculty of Medicine, UBC	



	Patricia Mills	
What is the histopathology of human SCI?	Clinical Assistant Professor, Physical Medicine & Rehab, UBC • Wayne Moore Clinical Professor, Pathology and Laboratory Medicine, UBC Ben Mortenson •	What is the impact of scooter skills training on safety, mobility and participation?
	Associate Professor, Occupational Science & Occupational	participation
Dess haves maritarian	Therapy, UBC	
Does nome monitoring	Mark Nigro	Does the manner in
LITL in those with SCI2	Clinical Professor, Urological Sciences, UBC	which the spinal cord
off in those with oon	lpec Oruc	is injured affect the
	Assistant Professor, Opthalmology, UBC	resulting cellular damage
How does $PTP\alpha$ regulate	Iom Oxiand Drafagear Orthonoodias & Machanical Engineering, LIPC	in the cord, the functional
myelination?		behaviour, and the MR
	Neurosurgeon SPINE VCH	image of the injury?
How can we make	Catherine Pallen	
wheeling easier for	Professor, Pediatrics, UBC	Can relief from neuropathic
people with SCI?	Matt Ramer •	pain be achieved by
	Associate Professor, Zoology & Neurosurgery, UBC	interfering with the
How well do respiratory	Bonita Sawatzky	function of oxygen-sensing
muscles "compete" for	Associate Professor, Orthopaedics, UBC	proteins?
their share of cardiac	─── William Sheel	
output during exercise?	Professor, Kinesiology, UBC	
	Carolyn Sparrey	-
How do impact	Assistant Protessor, Mechatronic Systems Engineering, SFU	Can eye movements be
mechanics translate	Assistant Professor Onthelmology LIPC	trained, and does training
to SCI?	Iohn Steeves	affect other functions?
	Professor and ICORD Founding Director	
	John Street	
How can we prevent	Assistant Professor, Orthopaedics, UBC; Spine Surgeon, VCH	
urinary tract infections in	→ Lynn Stothers	By what mechanisms do
patients with SCI?	Professor, Urological Sciences, UBC	oral ketones protect the
	Wolfram Tetzlaff •	injured spinal cord?
	Professor, Zoology & Surgery, UBC; Director, ICORD	
	Darren Warburton	1
	Professor, Kinesiology, UBC	What are the mechanisms
What mechanisms		of diffuse axonal injury,
underlie cardiac changes	Professor, Pathology and Laboratory Medicine, OBC	both acute and long-term?
in response to SCI?	Assistant Professor Kinesiology LIBC	
	David Whitehurst	
Can we engineer	Assistant Professor, Health Sciences, SFU	Is it possible to determine
personalized neural	→ Stephanie Willerth	which generic, preterence-
tissue to treat SCI?	Canada Research Chair in Biomedical Engineering; Associate	quality of life instrument is
	Professor, Mechanical Engineering & Medical Sciences, UVic	'the best' in the context of
What kind of guadrupada	E. Paul Zehr	SCI, using existing data?
are "bipedal" humana?	Professor & Director, Rehabilitation Neuroscience Laboratory	
are pipedar numans?	& Centre for Biomedical Research, UVic	

Find out more: icord.org/our-researchers

This page: West Lab. Previous page, left: Orthopaedic & Injury Biomechanics Lab; right: Lam Lab.





The Blusson Integrated Cures Partnership: enriching the research environment

In 2013, the Rick Hansen Foundation announced a ten-year commitment to support the Blusson Integrated Cures Partnership (BICP), an innovative collaboration bringing RHI and ICORD together to advance cures-focused research in the field of SCI. The BICP supports pre-clinical research studies as well as the development and operationalization of the first biobank for human spinal cord and cerebro-spinal fluid in Canada, and a range of initiatives that form a well-rounded program designed to attract and nurture highly qualified personnel, including trainees, staff, technicians, and faculty.

Exchange Awards are designed to foster excellence amongst investigators, trainees, and staff. *VISIT Awards* support extended stays either by scholars visiting ICORD, or ICORD Investigators visiting an international lab. *Trainee Travel Awards* allow ICORD students to advance their careers by presenting and networking at scientific conferences. Seven VISIT Awards and thirty two Trainee Travel Awards were awarded between April 2015 and March 2016.

BICP funding continued to be used to **support faculty appointments** for Drs. Chris West and John Kramer.

Seed grants are provided to foster new areas of research and enhance research partnerships. Funded projects are expected to form the basis of grant applications to other funding agencies.

Eight grants were awarded in 2015-2016.

The Seminar Series is excellent. It allows and encourages new collaborations with international experts in a variety of fields. - John Kramer

I have been extremely fortunate to have won seed grants, and to have been supported in my purchase of a new confocal microscope by the BCIP. This support has allowed me to leverage funding from the International Foundation for Paraplegia, and to generate preliminary data for other grant submissions. collaborate with Dr. David Magnuson of the University of Louisville to bring trainees from Kentucky to ICORD to conduct studies into the cardiovascular consequences of SCI and the effect of exercise. These trainees taught us some new techniques and learned some new assessments themselves. This BICP-funded collaboration resulted in increased quality of science and generated data for future grant submissions.

The VISIT program allowed me to

- Chris West

The BICP also funds **personnel who support the research infrsstructure** in the Blusson Spinal Cord Centre, including a research engineer, a discovery science technician, a research grant facilitator, and administrative staff.

- Matt Ramer

The BICP has provided essential funds to create infrastructure for our human biobank. Seed grant funding has also been used to leverage large grants – it has been critical for generating the pilot data that can be used in large grant competitions. – Brian Kwon

Ramer Lab

ICORD's international reputation and our environment has allowed me to attract students from all over the world. Since I have been here, I've received students from Australia, Iran, the Netherlands, Germany, Mexico, Saudi Arabia, and India. We can offer a great experience due to the exceptional infrastructure that ICORD offers. – Bonita Sawatzky

The annual ICORD **Trainee Symposium** is an opportunity for ICORD trainees to develop their leadership skills as well as to showcase their research. The 2015 symposium, which took place on June 15, featured two international speakers: Dr. Amy Moore (Assistant Professor, Washington University School of Medicine) and Dr. Liz Bradbury (Professor, King's College London), as well as local researcher Dr. Gunter Siegmund (Professor, University of British Columbia). Trainees from eleven ICORD labs were featured, including those of Dr. Jaimie Borrisof, Dr. Peter Cripton, Dr. Susan Forwell, Dr. Aziz Ghahary, Dr. Brian Kwon, Dr. Andre Krassioukov, Dr. Cornelia Laule, Dr. Wayne Moore, Dr. Ben Mortenson, Dr. Bonita Sawatzky, Dr. Wolfram Tetzlaff, and Dr. Paul Zehr.

ICORD's **Seminar Series**, funded by the BICP, provided important opportunities for faculty and trainees to discuss research findings and new developments, and identify areas for future research synergies and collaboration with each other as well as with local, national, and international experts. Fourteen seminars were presented in 2015-16.

Our BICP funding is being used for SCI model development & refinement. Our rodent models are at the forefront internationally, and we have been working to enhance the repeatability of our dislocation model. We are also beginning a new study on shear behaviour of the human cervical spine, which will help us better understand the situations that result in fracture-dislocation injuries. The latter study is being conducted by a visiting student from the Netherlands in collaboration with a UBC graduate student. We have submitted a CIHR Project grant to support expansion of the shear study in collaboration with numerical modelling experts at the University of Waterloo. BICP funding has been crucial to these efforts. - Tom Oxland

ICORD's thirteenth Annual Research Meeting was a great success, starting on March 7 with the Robot Revolution community talk on the use of exoskeletons in SCI rehabilitation, co-hosted by SCI-BC. After having dinner and visiting displays about a variety of research projects taking place at the Blusson Spinal Cord Centre, participants heard short talks about the ReWalk and Ekso Bionic exoskeletons by Drs. Jaynie Yang of the University of Alberta and Amanda Chisholm of ICORD, followed by a demonstration of ICORD's Ekso suit by Kyle Gieni, and a panel discussion with the speakers plus Drs. Jaimie Borisoff and Wolfram Tetzlaff. This event was part of a community outreach effort intended to engage people with SCI by sharing research developments in order to encourage participation in research studies. Nearly a hundred people participated in this meeting.

The scientific program started on March 8, with a plenary lecture by Dr. Jaynie Yang, followed by the first of two lively poster sessions and and opening reception/networking session. March 9 was a full day, starting with a plenary lecture by Dr. Dalton Dietrich from the Miami Project to Cure Paralysis, followed by research talks by Victoria Claydon, Miriam Spering, Brian Kwon, Jin. W. Tee, Rob Boushel, Aziz Ghahary, Heather Gainforth, Jaimie Borisoff, Vanessa Noonan, Amanda Chisholm, Aaron Phillips, and Wolfram Tetzlaff, as well as a second poster session.

This year's event set a record for the highest number of research posters ever presented at an annual research meeting.

The funding support from ICORD and Rick Hansen Institute has been vital in the establishment of my independent research activities as a new investigator. In particular, the Seed Grant I received enabled me to start a promising line of research for treatment of pressure ulcers. - Reza Jalili

Mortenson Lab

The 2015 Spinal Chord Gala raised \$42K



The seventh annual *Spinal Chord Gala*, held in October, 2016, was our most successful ever, with more than 230 guests raising over \$42,000 to support ICORD and Vancouver Cantata Singers. Funds raised are shared by both organizations. At ICORD, gala funds are used for equipment grants, community initiatives like PARC and the Resource Centre, and awards for staff excellence in research and service.

We are very grateful to our presenting sponsor Medtronic for their continued support, and to the other 96 individuals and businesses who sponsored the gala last year.

The 2016 Spinal Chord Gala takes place October 22.



See **spinalchordgala.com** for a complete list of 2015 gala sponsors.

Thank you for reading our 2015-16 Annual Report.

Contributors: Cheryl Niamath, Simon Liem, Lowell McPhail, Matt Sahl, Clarice Kwok, Edward Lai

For additional copies of this report or any other ICORD publication, please call 604-675-8844 or email admin@icord.org.

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