Stewardship Report

BCCH MRI RESEARCH FACILITY

2012 - 2022

Acknowledgments

We gratefully acknowledge the Canada Foundation for Innovation, the BC Knowledge Development Fund, the BC Children's Hospital Foundation, Mining for Miracles, and the Provincial Health Services Authority for our start-up funding. We also acknowledge the ongoing support achieved through the collaborative partnership between the Department of Pediatrics, University of British Columbia and the Provincial Health Services Authority. This essential support allows the BC Children's Hospital MRI Research Facility to continue to lead translational pediatric MRI research, technology development and healthcare innovation in British Columbia.

The BC Children's Hospital MRI Research Facility operates on the traditional, ancestral, and unceded territory of the Coast Salish peoples-- xʷməθkwə ỷəm (Musqueam), Skwxwú7mesh (Squamish), Stó:lō and Səlílwətaʔ/Selilwitulh (Tsleil-Waututh) Nations. Further, this acknowledgment, gratitude, and respect extends to all the First Nations communities on whose traditional territories the MRI Research Facility builds relationships and operates in BC.

THE UNIVERSITY OF BRITISH COLUMBIA

BC Children's Hospital

Provincial Health Services Authority
Province-wide solutions. Better health.

Contents

MESSAGE FROM OUR DIRECTOR

Celebrating 10 Years 2012–2022

The establishment at BC Children's Hospital of a dedicated pediatric 3T MRI research facility and functional MRI brain mapping laboratory was the result of strategic long-term infrastructure and network development involving many highly valued colleagues, collaborators, partners, leaders, and sponsors.

The inspiration, motivation and vision to establish a pediatric MRI research facility at BC Children's Hospital began with development of functional MRI brain mapping capabilities for children, first achieved by our collaborative research team in 1996. This was followed by our involvement in the creation of the UBC MRI Research Centre, led by Dr. Alex Mackay.

The pivotal next step was the rapid subsequent evolution of innovative neonatal brain MRI research at BC Children's Hospital, led by Dr. Steven Miller and his collaborators. Neonatal neuroimaging research, pediatric functional MRI methodology development, and collaborative neuroinformatics infrastructure development provided a solid foundation for the establishment of the BCCH MRI Research Facility, which opened in 2012.

Now in its tenth year of operation, the BCCH MRI Research Facility focuses on the developing child and shares its unique pediatric and functional MRI research resources with over 45 research teams from diverse disciplines studying brain, lung, heart, skeleton and other systems. Our highly qualified staff share their expertise in supporting projects, while maintaining a safe, child-friendly environment for pediatric MRI research, technology development, and innovation.

We are grateful for the ongoing engagement of talented principal investigators and their teams, comprised of faculty, staff, and learners engaged in MRI research, who bring successful projects to the Facility. We have highlighted key aspects of work by some of these teams and we have listed our investigators separately in this report.

As we reflect on events of the past two years, we recognize the profound impact of COVID-19 on children and families across BC and upon our research community. Yet, we have also seen evidence of resilience and adaptation as well as emergence of new opportunities, some of which are highlighted in this report.

As we look to the future, ongoing advances in MRI technology require us to enhance key components of our MRI infrastructure to maintain excellence in pediatric MRI science and expand our capacity to support translational precision child health research.

On behalf of the investigators and staff of the BCCH MRI Research Facility, I would like to express sincere gratitude to all those who support our resources, projects, staff, and teams. I also wish to thank the children and families whose participation makes child health research possible.

Bruce Bjornson, MD, FRCPC
Director BCCH MRI Research Facility
February 24, 2022

A Unique Resource
for BC's Children & Families

The BC Children's Hospital MRI Research Facility is conveniently located on the campus of the BC Children's Hospital (the only pediatric hospital serving British Columbia and the Yukon), Sunny Hill Health Centre (BC's pediatric rehabilitation centre) and the BC Women's Hospital and Health Centre (BC's only tertiary maternity care facility).

The BC Children's Hospital MRI Research Facility is a core facility of the BC Children's Hospital Research Institute. Proximity and close-working relationships with clinical programs on-site provide researchers with the ability to engage neonates, children and youth in healthcare research in a child-friendly environment that respects their needs.

Founded in 2012 with funding awarded by the Canada Foundation for Innovation, the BC Knowledge Development Fund, the BC Children's Hospital Foundation, Mining for Miracles, and the Provincial Health Services Authority, the BCCH MRI Research Facility is the only clinically accredited, dedicated pediatric MRI research facility in Western Canada.

The uniquely developed resources available to researchers at the MRI Research Facility facilitate pediatric MRI research, technology development, and healthcare innovation.

ADVANCING MRI SCIENCE FOR BETTER HEALTH

- utilizing hyperpolarized Xenon to study lung structure and function to improve respiratory function in individuals with cystic fibrosis and those who have recovered from a COVID-19 related hospitalization (PIs: Rayment, Yang)

- employing a MRI compatible incubator to scan at-risk, preterm neonates to map and improve developmental trajectories (PI: Grunau), and to scan neonates with prenatal drug exposure (PI: Oberlander)

- preparing children for MRI scans using our custom designed, child-friendly MRI simulator to reduce anxiety, increase success rates, and avoid sedation (PIs: Bjornson, Doan, Grunau, Schrader, Zwicker)

- supporting the use of transcranial magnetic stimulation to improve motor recovery following stroke (PI: Boyd)

- performing controlled carbon dioxide challenges to measure cerebrovascular reactivity to optimize evaluation and treatment of arterial ischemic stroke in children (PI: Bjornson),

- shortening the duration of functional MRI brain scanning by using multi-band acquisitions (simultaneously collect multiple MRI "pictures") to improve children's scanning experience (PIs: Bjornson, Schrader, Weber)

- using our language mapping tools and expertise to enhance neurosurgical guidance for deep-brain stimulation to control spasmodic dysphonia (PI: Honey)

- recording simultaneous EEG and functional MRI (EEG-fMRI) to guide epilepsy surgery (PI: Bjornson)

- implementing a comprehensive pediatric functional MRI brain mapping laboratory to facilitate image-guided neurological care and neurosurgical planning for children (PI: Bjornson)

- establishing, maintaining and sharing an advanced data repository for multimodality imaging research

- supporting the development of new MRI technology through academic-industry partnerships, including the recent development of Myelin Water Imaging (PI: MacKay [UBC], Zhang [GE Healthcare Canada])

SUPPORTING OUR MRI RESEARCH COMMUNITY

PROTOCOL REVIEW COMMITTEE

Before a research study can begin at the BCCH MRI Research Facility, an application made by a PI must be reviewed and approved by the Protocol Review Committee. Committee members have a common interest in MR research, and volunteer their time and expertise to ensure that all MR proposals are given a thorough review. This committee evaluates MRI research proposals to determine the feasibility and suitability of each study protocol; to ensure that necessary resources are available, safety concerns are addressed, and costs assessed; and to set up individualized rate agreements, billing accounts, MRI data storage accounts, and MRI safety training sessions, as necessary and appropriate to enable each approved study to proceed.

MEMBERSHIP:

Dr. Donna Lang, *Chair*, Associate Professor, Department of Radiology, UBC
Dr. Bruce Bjornson, *Director*, Clinical Assistant Professor, Department of Pediatrics, UBC
Steffany Ellingham, Operations Manager, CMRF
Dr. Debbie Giaschi, Professor, Department of Ophthalmology and Visual Sciences, UBC
Michelle Lau, Head MR Technologist, CMRF
Dr. Vesna Popovska, Director Research, Neurosciences Program, BCCH
Dr. Lynne Williams, Staff Scientist, Technology Integration Manager, CMRF
Dr. Qing-San Xiang, Professor, Department of Radiology, and Associate Member, Department of Physics & Astronomy, UBC

Donna Lang
(Chair)

Deborah Giaschi
(Former Chair)

MRI EDUCATION

Offering MR education has been a focus for the facility since opening in 2012. Safety training is offered to all research team members, with over 70 individuals being trained in MR safety each year.

Each summer since 2017, over 90 trainees have attended full-length courses on MR concepts and techniques, with the only break occurring due to COVID.

Finally, guest lecturers and speakers have provided continuing education opportunities.

NEW PROTOCOL DEVELOPMENT

Many of our researchers present ideas which require new MR protocols and sequences to be developed. Michelle Lau, in collaboration with other staff and our MR scientists, works with these research teams to ensure that the goals of each study are achieved.

SAFETY COMMITTEE

From the MR environment to COVID, ensuring that children of any age feel safe and secure in our child-friendly MR environment is our priority. Our safety committee ensures that our safety policies exceed the standard and that both staff and researchers have the latest training and are kept up to date in safety protocols. The Safety Committee also ensures that all standards for maintaining clinical accreditation are implemented.

MEMBERSHIP:

Michelle Lau, Head MRI Technologist, Chair
Steffany Ellingham, Operations Manager
Lynne Williams, Staff Scientist,
Technology Integration Manager

MANAGEMENT/OPERATIONS COMMITTEE

The Management/Operations Committee meet regularly to ensure that the facility is maintained and managed in a fiscally responsible way. It is also responsible for adjusting service demands to meet researcher and financial needs.

MEMBERSHIP:

Bruce Bjornson, Director, Chair
Steffany Ellingham, Operations Manager
Michelle Lau, Head MRI Technologist
Danny Kim, Neuroinformatics Engineer
Lynne Williams, Staff Scientist,
Technology Integration Manager

GREAT IMAGES DON'T HAPPEN BY CHANCE

Our 3T GE Discovery 750 scanner wouldn't run without our exceptional team. Under the direction of Dr. Bruce Bjornson, our team makes great images happen.

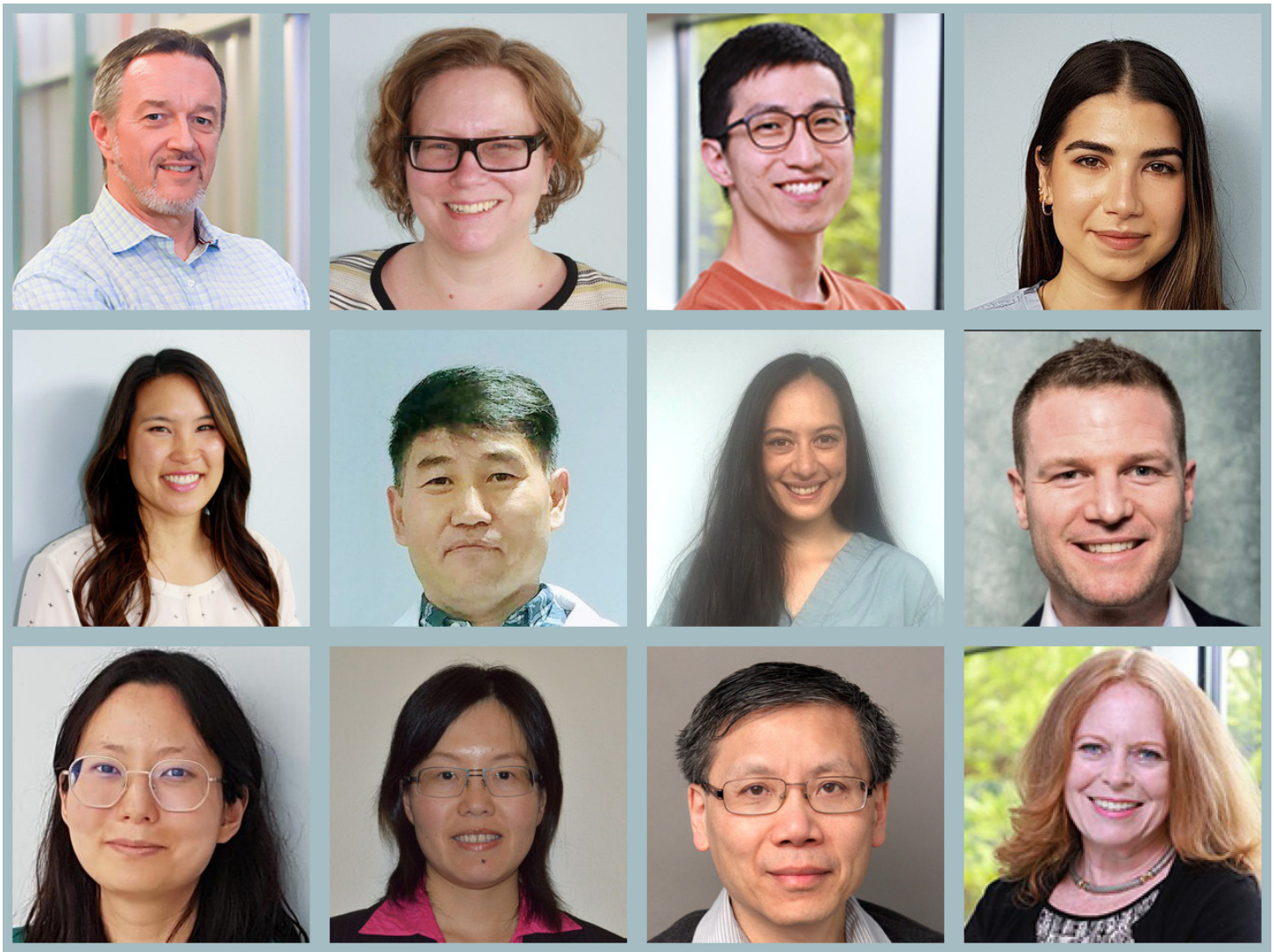
Michelle Lau, our head MRI technologist, along with Stuart Brice, Jaemin Chung, Kevin Moon, and Katrina Stasyk, our casual MR technologists, are essential for the operation of the MRI scanner, acquisition of quality images, and continued safety of research participants, families, researchers, and MRI Research Facility staff. Danny Kim, our Neuroinformatics Engineer, oversees the software infrastructure, and coordinates our local multi-modality imaging data centre using XNAT, which is crucial to our ability to host multi-centre imaging data. Dr. Lynne Williams, our Staff Scientist and Technology Integration Manager, provides training and mentorship to researchers, and assists our trainees to gain experience in MRI data analysis and help design multi-modality functional MRI research studies (including EEG-fMRI and NIRS-fMRI). Ghoufran Talib, our research assistant, conducts specialized MRI data analysis. Steffany Ellingham, our Operations Manager, provides operational support for the facility, and assists investigators who have questions about starting new studies.

Working with Dr. Qing-San Xiang, Professor, Radiology, UBC and Dr. Jing Zhang, GE MRI Scientist, facility staff have developed many new scan sequences tailored to the specific needs of individual research studies. These scan sequences include MP2RAGE structural scans, multi-band ultra-short TR functional MRI brain scanning, a sequence for scanning cartilage and bone development, and a scan sequence to detect hyperpolarized Xenon for functional lung scanning.

Contact us today and let us help you bring your MR research ideas to life!

Contact Information:
BCCH MRI Research Facility
mri.research@bcchr.ca
604-875-2000 x 5460

OUR TEAM



From Left to Right: *(Top) Dr. Bruce Bjornson, Dr. Lynne Williams, Danny Kim, Ghoufran Talib. (Middle) Michelle Lau, Kevin Moon, Katrina Stasyk, Stuart Brice. (Bottom) Jaemin Chung, Dr. Jing Zhang, Dr. Qing-San Xiang, Steffany Ellingham*

IMPACT


45
RESEARCH TEAMS
XeMRI
1ST IN WESTERN NORTH AMERICA
470
PUBLICATIONS
WE'RE CLINICALLY ACCREDITED
DID YOU KNOW?
26M
TRI-COUNCIL FUNDING
500+
SAFETY TRAINING SESSIONS
100
TRAINEES
1000
SCAN SESSIONS IN 2020/21

MANAGING OUR RESOURCES

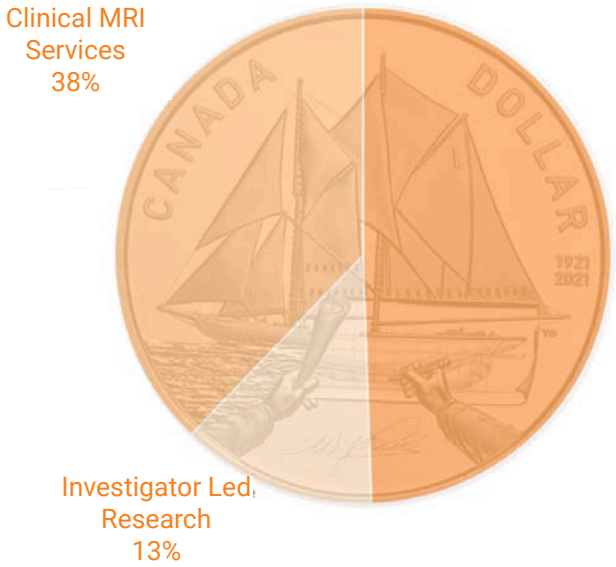
The BCCH MRI Research Facility operates on a cost-recovery basis, with the funding required to maintain operations generated by booked scanning time on the 3T MRI. In typical years, the fees generated by this scan time support the salaries for 4.5 full-time personnel, as well as all innovation and operating costs, including a significant expense to maintain a service contract for our magnet.

We were required by the UBC and PHSA to close the facility for scanning services for over 3 months in 2020 due to the COVID-19 pandemic, interrupting our sole source of revenue generation. Since permission to scan again was granted in June 2020, many of our researchers have encountered significant COVID-related issues in recruiting research participants. Because of reduced utilization by researchers and with the support of PHSA we assisted Lower Mainland Medical Imaging in reducing the backlog of clinical MRI scans by using non-booked research scan time to conduct clinical scans. The facility gratefully acknowledges the ongoing support of LMMI, which has continued to give us the flexibility to deliver much needed clinical services while maintaining highly valued research capacity throughout the pandemic. The revenue generated from this Initiative enabled the Facility to maintain the budget levels required to support our annual costs.

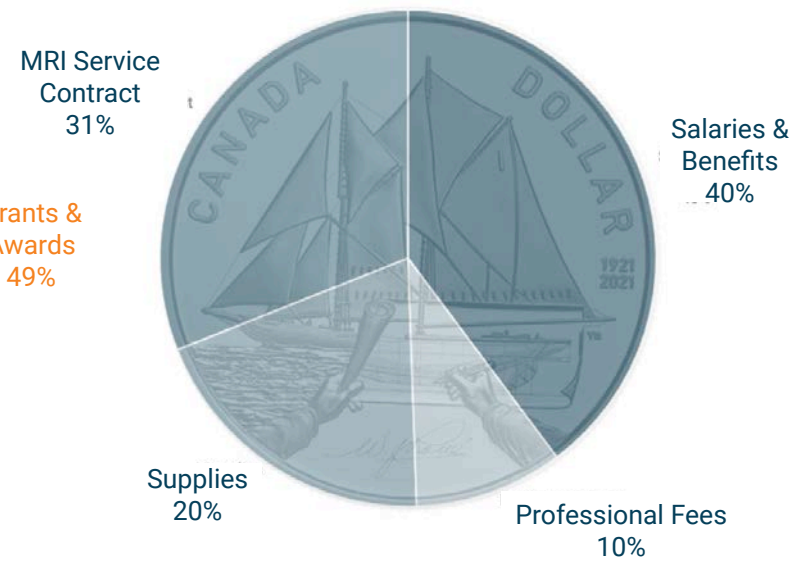
The BCCH MRI Research Facility was fortunate to receive unexpected financial support in 2020 through the Canada Research Continuity Emergency Fund and UBC's Research Facility Support Grant. This unexpected support has enabled the Facility to maintain critical programs designed to support researchers and replace some outdated or broken equipment.

2020 - 21 FISCAL YEAR (COVID-19)

INCOME



EXPENDITURES



BRAIN INJURY, STROKE & NEUROPLASTICITY

ADVANCING CONCUSSION ASSESSMENT IN PEDIATRICS (A-CAP) PI: QUYNH DOAN

A mild Traumatic Brain Injury (mTBI), also commonly known as a concussion, occurs very commonly in children and youth. Standard therapy for children coming into an emergency department with a mTBI includes a physical exam with neurological assessment, and evaluation of symptoms after injury. Symptoms typically resolve over time; however, in 15-25% of cases, some children and youth experience ongoing symptoms that affect their quality of life.

Working with other emergency departments across Canada, Dr. Quynh Doan, Director of Clinical Research and Pediatric Emergency Physician at BC Children's Hospital, scanned approximately 200 children and youth who had recently presented in the emergency department to more accurately identify mTBI, and to predict its long-term outcomes by studying a broad pool of neurological and psychosocial markers used in its diagnosis.

Yeates KO, Beauchamp M, Craig W on behalf of Pediatric Emergency Research Canada (PERC), et al.
BMJ Open 2017; 7: e017012. doi:
10.1136bmjopen-2017-017012

CHARACTERIZING ARM RECOVERY IN PEOPLE WITH SEVERE STROKE PI: LARA BOYD

The prevalence and severity of stroke-related arm impairment is increasing. Those people who have very little movement in their arm after stroke are not often studied, but are believed to have the most trouble regaining functional use of their arm after stroke.

Dr. Lara Boyd, Professor in UBC's Department of Physical Therapy, and her research team seek to advance our understanding of how the severely damaged brain changes over the first 12-months post stroke by assessing patients at multiple time-points to determine what the key drivers of recovery of arm function after stroke are, such as changes in the structure of the brain or changes in how brain regions interact with one another, and changes in the ability to use the arm or the amount of arm training that is performed.

Brenton Hordacre, Martín Lotze, Mark Jenkinson, Alberto Lazari, Christen D. Barras Lara Boyd, Susan Hillier (2021). Fronto-parietal involvement in chronic stroke motor performance when corticospinal tract integrity is compromised. NeuroImage: Clinical, 29, https://doi.org/10.1016/j.nicl.2021.102558

SURVEILLANCE IN HIGH SCHOOL TO REDUCE CONCUSSIONS AND CONSEQUENCES OF CONCUSSIONS IN CANADIAN YOUTH: SHRED CONCUSSIONS PI: IAN PIKE & SHELINA BABUL

Dr. Ian Pike, Director of the BC Injury Research and Prevention Unit, and Dr. Shelina Babul, Associate Director, Sports Injury Specialist, BC Injury Research and Prevention Unit, are collaborating with Dr. Carolyn Emery, University of Calgary, to conduct this multicentre study geared to develop better models for preventing, managing and treating sport-related concussions among high-school athletes by combining clinical and self-reported data with imaging and blood biomarkers.

Working closely with academic sports coaches to identify potential participants with concussion, participants will undergo a one-hour MRI session at time of concussion and again at 30 days post-concussion. Age- and sex-matched control participants with no concussion history will undergo a single MRI session.

ADVANCED NEUROIMAGING IN PEDIATRIC STROKE
PI: BRUCE BJORNSON

Although pediatric arterial ischemic stroke (AIS) is rare compared with adults, the estimated incidence ranges from 1.6 to 13 per 100,000 children, and appears to be rising. Research in pediatric AIS has lagged far behind adult stroke. In addition, results of adult stroke research are not directly applicable to children due to considerable differences between pediatric stroke and stroke in adults. Advanced imaging has the real potential to inform us on the choice and risks versus possible benefits for stroke treatment in individual children, enabling intelligent patient selection for treatments in the future.

Dr. Bruce Bjornson, neurologist at BC Children's Hospital and Director of the Brain Mapping, Neuroinformatics & Neurotechnology Lab, Is participating In this multicentre longitudinal study, funded by Brain Canada, where serial MRI and neurodevelopmental outcome data Is acquired at three time points following acute stroke: first week, 3 months, and 12 months. The overall objective of this study is to discover mechanisms of injury and repair in children with stroke and correlate these with better and worse neurodevelopmental outcomes.

deVeber,GA et al. Epidemiology and Outcomes of Arterial Ischemic Stroke in Children: The Canadian Pediatric Ischemic Stroke Registry, Pediatric Neurology, 2017, 69:58-70.

NEONATAL NEUROSCIENCE, NEURODEVELOPMENT & NEUROPSYCHIATRIC DISORDERS

ANALGESIA & SEDATION IN THE PRETERM NEONATE: BRAIN DEVELOPMENT AND OUTCOME PI: RUTH GRUNAU

In Canada, like many other countries, more infants are being born prematurely. Survival of these very premature babies is now much better, but unfortunately some babies still have long-lasting complications. Doctors do not know why some babies do well and others can show difficulties later on in childhood; however, research indicates that some therapies used in the hospital may be more protective of the developing brain. Dr. Ruth Grunau, Professor In UBC's Division of Neonatology, in collaboration with Dr. Steven Miller, Head, Division of Neurology at SickKids Hospital In Toronto, use MRI to examine brain structure and function soon after birth in babies born at 24 to 32 weeks gestational age. The babies are then followed carefully after hospital discharge to watch their development. In this way, more will be learned about NICU therapies and how they can affect outcome in preterm babies, so that ways of treating or preventing long-term damage can be developed.

TRAJECTORIES OF BRAIN DEVELOPMENT AND NEUROCOGNITIVE OUTCOMES IN CHILDREN BORN PRETERM PI: RUTH GRUNAU

Complementing her research with premature babies, Dr. Grunau conducts an additional research study at the MRI Research Facility to discover why and how children born very early are so developmentally vulnerable. Neonatal brain injury and altered neonatal brain microstructure, in association with repeated procedural pain exposure and systemic illness, result in long-term changes in brain development at school-age. A better understanding of the factors that affect long-term brain development will allow care providers to directly improve the neurodevelopmental outcome of preterm newborns by targeting those factors that promote good outcomes.

Phillips H., McLean M.A., Williams L., Bjornson B., Chau, C. al., . Cognitive Functions of Working Memory and Matrix Reasoning are Related to Performance on Mental Rotation Task in 8-year-olds Born Very Preterm. 52nd Annual Meeting of the International Society for Developmental Psychobiology. October, 2019.

EARLY CHILD BEHAVIOR: RELATIONS TO EARLY BRAIN/ STRUCTURE, FUNCTION AND MATERNAL MOOD

PI: TIM OBERLANDER

Maternal mood disturbances and in utero serotonin reuptake inhibitors (SRI) exposure are common prenatal exposures and are both associated with behavioral disturbances in early childhood. Rates of depression and SRI use in pregnancy is increasing, and there is a need to determine the potential effects on children. SRIs have not been approved for use during pregnancy and concern about developmental effects has led to US and Canadian warnings regarding 3rd trimester use, often leaving women with difficult choices about treatment options during pregnancy. Non-treatment increases the risk for relapse and is not an option. Thus it is imperative to determine the developmental risks associated with such prenatal exposures to help guide mothers and their clinicians.

Dr. Oberlander and his team aim to link fetal blood flow and childhood behavior with neonatal MRI brain development, comparing neurobehavioural outcomes between SRI and non-SRI exposed infants. Using the facility's MRI compatible incubator to scan newborns, early brain development and behavior were studied as key early developmental outcomes reflecting possible brain plasticity and recovery, and a capacity for both developmental vulnerability and resiliency.

Rotem-Kohavi, N, Williams, LJ, Virji-Babul, N., Bjornson, BH, Brain, U,. Werker, JF, Grunau, RE, Miller, SP, Oberlander, TF. Alterations in Resting-State Networks Following In Utero Selective Serotonin Reuptake Inhibitor Exposure in the Neonatal Brain. Biological Psychiatry: Cognitive Neuroscience and Neuroimaging, 2019, 4: 39-49. https://doi.org/10.1016/j.bpsc.2018.08.004.

Campbell, KSJ, Williams, LJ, Bjornson, BH, Weik, E, Brain, U, Grunau, RE, Miller, SP, Oberlander, TF. Prenatal antidepressant exposure and sex differences in neonatal corpus callosum microstructure. Developmental Psychobiology, 2021: 1-15. https://doi.org/10.1002/dev.22125

The BCCH MRI Research Facility MRI compatible incubator for neonatal scanning

INTEGRATING BRAIN IMAGING AND REHABILITATION TO IMPROVE OUTCOMES FOR CHILDREN WITH CO-OCCURRING DCD & ASD PI: JILL ZWICKER

Many children have a neurodevelopmental disorder known as developmental coordination disorder (DCD). Children with DCD struggle to learn motor tasks and may take longer to learn tasks typical of childhood, such as tying shoes, printing, riding a bike, or playing sports. DCD also affects many children with Autism Spectrum Disorder (DSD), but the motor difficulties are poorly understood and are rarely the focus of therapy.

Dr. Jill Zwicker is studying the differences of the brain in children with co-occurring DCD and ASD to children with DCD, DCD and Attention Deficit Hyperactivity Disorder (ADHD) and typically-developing children. Dr. Zwicker's team will determine if occupational therapy intervention will cause changes in the brain structure and function in children with co-occurring DCD and ASD, and if the brain changes are still present at 3 months after the rehabilitation treatment.

Brown-Lum M, Izadi-Najafabadi S, Oberlander TF, Rauscher A, Zwicker JG. Differences in White Matter Microstructure Among Children With Developmental Coordination Disorder. JAMA Netw Open. 2020;3(3):e201184. doi:10.1001/jamanetworkopen.2020.1184

A NEUROIMAGING STUDY OF PEDIATRIC OBSESSIVE-COMPULSIVE DISORDER (OCD), AT-RISK SIBLINGS, AND HEALTHY CONTROLS PI: EVELYN STEWART

Obsessive-compulsive disorder (OCD) is a common, debilitating neuropsychiatric illness that frequently begins in childhood. Dr. Evelyn Stewart and her research team are examining the cortical structure and functional activation in the regions implicated in OCD in OCD-affected, OCD-unaffected siblings, and healthy children and adolescents to ultimately combine these measures with clinical and genetic data to create OCD phenotypes, which will be tested in future samples for their usefulness in predicating OCD onset and treatment response.

Jaspers-Fayer, F, Lin, SY, Chan, E, Ellwyn, R, Lim, R, Best, J, Belschner, L, Lang, D, Heran, MKM, Woodward, TS, Stewart, SE. Neural correlates of symptom provocation in pediatric obsessive-compulsive disorder, NeuroImage: Clinical, 2019, 24, 102034, https://doi.org/10.1016/j.nicl.2019.102034.

BRAIN MECHANISMS UNDERLYING HUMAN MOTION PERCEPTION PI: DEBORAH GIASCHI

Dr. Deborah Giaschi and her team used the MRI Research Facility's MRI to map the brain areas involved in perceiving motion to learn more about a developmental eye problem called amblyopia (lazy eye). Amblyopia occurs in about 4% of the population and interferes with motion perception and other aspects of vision. Brain activity in healthy children with amblyopia was compared to brain activity in healthy children without amblyopia to learn more about the areas of the brain that are affected by amblyopia.

INTERVENTIONS FOR DYSLEXIA: EFFECTIVENESS AND NEUROLOGICAL CORRELATES PI: DEBORAH GIASCHI

Dr. Deborah Giaschi and her research team worked with the North Vancouver School Board to advance knowledge of reading development and how tutoring can improve reading skills in children . Dr. Giaschi incorporated the use of the MRI Research Facility's unique MR simulator to prepare children, aged 7 – 9, for reading tasks later conducted in our MR scanner to focus on the cause of reading problems like dyslexia by evaluating the brain networks related to reading and reading disability, intervention-mediated changes in brain structure and function, and neuroimaging measures that can predict gains from reading interventions.

Partanen, M, Kim, DHC, Rauscher, A, Siegel, LS, Giaschi, DE. White matter but not grey matter predicts change in reading skills after intervention. *Dyslexia*. 2021; 27: 224– 244. https://doi.org/10.1002/dys.1668.

Partanen,M,Siegel,LS,Giaschi,DE.Effectofreadingintervention and task difficulty on orthographic and phonological reading systems in the brain, *Neuropsychologia*, 2019: 130, 13-25, https://doi.org/10.1016/j.neuropsychologia.2018.07.018.

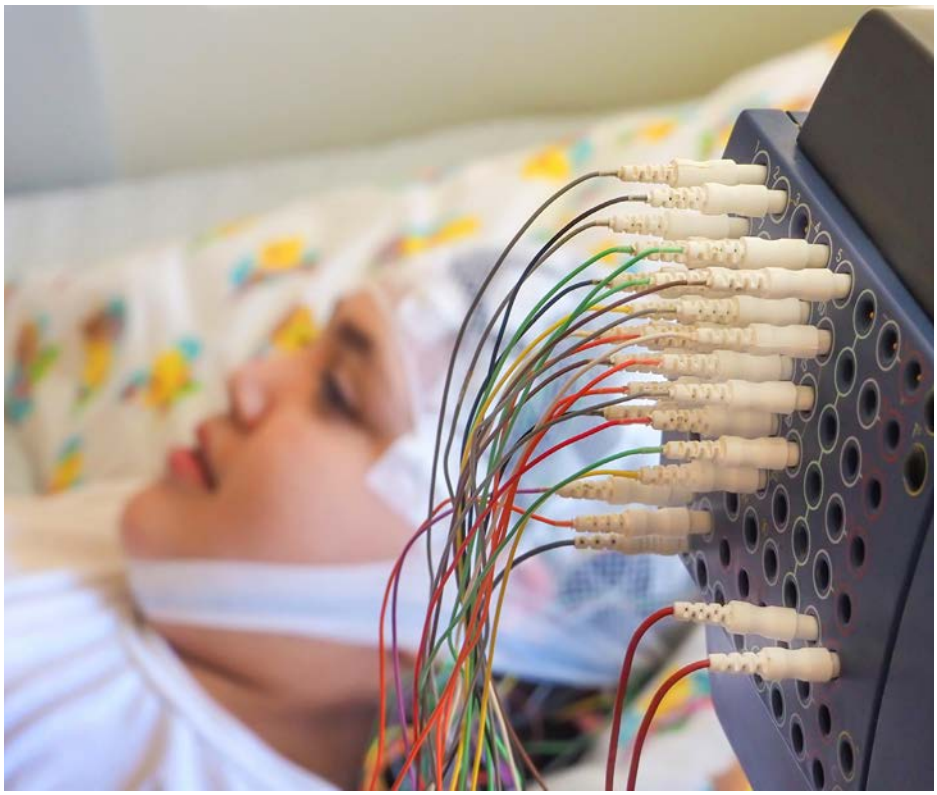
BRAIN MAPPING, NEUROINFORMATICS & NEUROSURGICAL GUIDANCE

MULTI-SITE PEDIATRIC NETWORK FOR FMRI MAPPING IN CHILDHOOD EPILEPSY PI: BRUCE BJORNSON

This study has been running since soon after the MRI Research Facility opened in 2012, and is led by Dr. Bruce Bjornson, the Director of the BCCH MRI Research Facility and a neurologist at BCCH. Dr. Bjornson and his team in the Brain Mapping, Neuroinformatics & Neurotechnology Laboratory work closely with pediatric neurosurgeons to optimize surgical outcomes for epilepsy patients seen at BC Children's Hospital.

Brain mapping with functional magnetic resonance imaging (fMRI) has significantly improved the evaluation of patients undergoing epilepsy surgery by identify brain areas that are involved in important brain functions such as control of movement, speech and language, In a non-Invasive manner In order to protect these vital areas during surgery. In order to compare fMRI with other more invasive methods, this study has established a registry of clinical information, clinical characteristics and MRI data of approximately 1,200 children and young adults with epilepsy from multiple health care centres in North America, using a range of language tests that have already been tested in healthy children and children with epilepsy.

Gelinas, J, Fitzpatrick, KPV, Kim, HC, Bjornson, BH. Cerebellar language mapping and cerebral language dominance in pediatric epilepsy surgery patients, NeuroImage: Clinical, 2014, 6: 296-306, https://doi.org/10.1016/j.nicl.2014.06.016.



CONNECTOME-INFORMED SIMULATION OF PEDIATRIC EPILEPSY SURGERY PI: DEWI SCHRADER

Approximately 10,000 Canadian children suffer from drug-resistant epilepsy. While surgery is the most effective treatment for drug-resistant childhood epilepsy, approximately 30% of these children have seizures after surgery, and many suffer from difficulties with thinking and reduced quality of life. There is currently no way to accurately predict which patients will have these unwanted outcomes prior to surgery on an individual basis.

Dr. Dewi Schrader, neurologist at BC Children's Hospital, uses ultra-fast functional MRI using multi-band scanning to derive brain connectome-based outcome predictions of epilepsy surgery and how to determine how these networks change after surgery. Analysis will be done to compare these changes to seizure outcomes and changes in the scores on neuropsychological (i.e. thinking) testing. By building up a database of how brain networks change after surgery, a computer model will be created to allow physicians to predict how a specific surgery will affect an individual patient.

Sara Larivière, Yifei Weng, Reinder Vos de Wael, Birgit Frauscher, Zhengge Wang, Andrea Bernasconi, Neda Bernasconi, Dewi V. Schrader, Zhiqiang Zhang, Boris C. Bernhardt. Functional connectome contractions in temporal lobe epilepsy: microstructural underpinnings and associations to surgical outcome bioRxiv 756494; doi: https://doi.org/10.1101/756494.

HEMISPHERE DOMINANCE IN SPASMODIC DYSPHONIA PI: CHRISTOPHER HONEY

In a recent peer-reviewed publication, Dr. Chris Honey and his research team demonstrated that vocal control at the thalamic level was unilateral, not bilateral. In a single patient case report, this unilateral control co-lateralized to the expected dominant language hemisphere (i.e. left thalamus in a right-handed patient). Dr. Honey now wants to determine if this is a universal phenomenon in a larger cohort of patients

In this study, patients with spasmodic dysphonia (SD) who are going to have unilateral thalamic deep brain stimulation (DBS) in order to ameliorate their symptoms, undergo fMRI so that the lateralization of their dominant language hemisphere can be confirmed. The standard protocol is to place the electrode in the thalamus ipsilateral to the dominant language hemisphere. This has been performed on 6 right-handed patients with success, and will be expanded to include left-handed patients and ambidextrous patients.

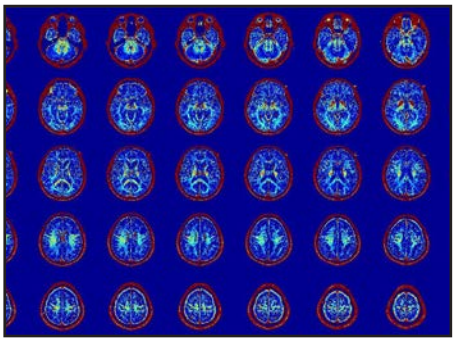
Avecillas-Chasin, JM, Poologaindran, A, Morrison, MD, Rammage, LA, Honey, CR. Unilateral Thalamic Deep Brain Stimulation for Voice Tremor. Stereotactic and Functional Neurosurgery, 2018; 96; 392-399.

MRI INNOVATIONS & TECHNOLOGY DEVELOPMENT

MYELIN WATER IMAGING PI: ALEX MACKAY & JING ZHANG

Since 2014, the BCCH MRI Research Facility has collaborated with MR physicists, Dr. Alex McKay (UBC) and Dr. Jing Zhang (GE Healthcare) to develop advanced myelin water imaging techniques for rapid data acquisition and long T2 component measurements on a GE platform. In 2022, we are ready to offer you acces to their sequence.

These myelin water images give an *in vivo* way of measuring the integrity of myelin along neural fibres. Myelin acts as the insulation around nerve fibres that facilitates electrical impulses to pass through. This new technology allows better measurement of myelin in demyelinating diseases, such as multiple sclerosis, as well as neuronal growth or regrowth during natural development or following traumatic brain injury.



Zhang, J., Vavasour, I., Kolind, S., Baumeister, B., Rauscher, A., & MacKay, AL (2015). Advanced myelin water imaging techniques for rapid data acquisition and long T2 component measurements. In Proceedings of the 23rd Annual Meeting of ISMRM

Zhang, J., Kolind, S. H., & MacKay, A. L. Comparison of Myelin Water Fraction Brain Images Using Multi-Echo T2-Weighted GRASE Relaxation and Steady-State Methods. Poster presented at ISMRM, 2013.

USING MRI METHODS TO ASSESS HEALED PERTHES' DISEASE
PI: KISHORE MULPURI

Perthes' disease is a hip disorder that occurs in childhood, and involves changes in blood supply to the femoral head (the ball part of the hip joint), which can cause cartilage damage and the bone of the femoral head to weaken and deform, often permanently changing the shape of the joint. Adults who had Perthes' disease as children have a higher risk of hip arthritis.

Dr. Kishore Mulpuri, Pediatric Orthopedic Surgeon, and his research team use MRI to study cartilage health to determine whether there is a strong connection with hip joint shape. Currently, cartilage damage is most often clinically diagnosed with x-rays, but x-rays can only detect degeneration long after it begins. As MRI can detect cartilage damage much earlier, but requires a special MRI sequence to acquire. Inspired by this need, Dr. Jing Zhang, GE MRI Physicist, implemented a new hybrid Gradient and Spin Echo sequence on our scanner.

Using this sequence, Dr. Mulpuri's team is studying which treatments are most effective to prevent or treat changes in hip joint shape, when they should be applied, and new treatment decisions as they learn more about how hip joint shape is linked to cartilage health.

Kannan, A., Hodgson, A., Mulpuri, K. et al. Leveraging voxel-wise segmentation uncertainty to improve reliability in assessment of paediatric dysplasia of the hip. Int J CARS

IMAGING MEASURES OF RESPIRATORY HEALTH

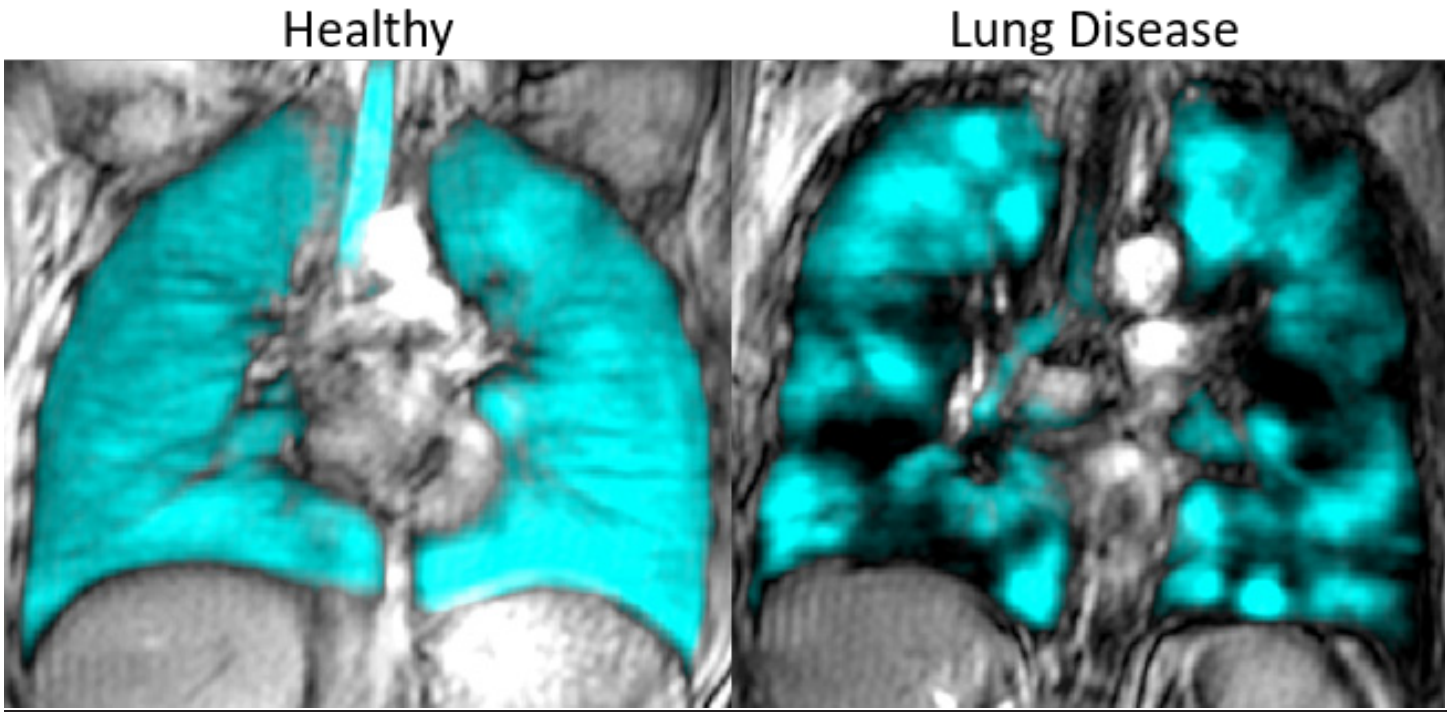
PI: JONATHAN RAYMENT

Over the past two years, a major advance in pediatric pulmonary functional MRI has been achieved by a team led by Dr. Jonathan Rayment, with the support of Dr. Bruce Bjornson and the BCCH MRI Research Facility team.

In collaboration with Dr. Don Sin, Director and the De Lazzari Family Chair of the Centre for Heart Lung Innovation located at St. Paul's Hospital, and Dr. Jonathon Leipsic, Chair of the Department of Radiology for Providence Health Care, lung functional MRI scanning has been successfully implemented using inhalation of hyperpolarized Xenon 129.

As a result, Dr. Rayment and his team were the first in western North America to succeed in creating innovative functional MR images of human lungs. Based upon his early successes, Dr. Rayment is already applying this promising new research tool to study children with lung disorders, such as cystic fibrosis, and to evaluate recovery from COVID-19.

Jonathan H. Rayment, Marcus J. Couch, Nancy McDonald, Nikhil Kanhere, David Manson, Giles Santyr and Felix Ratjen. Hyperpolarised 129Xe magnetic resonance imaging to monitor treatment response in children with cystic fibrosis. *European Respiratory Journal* 2019 53: 1802188; DOI: 10.1183/13993003.02188-2018



Xenon MRI at the BCCH MRI Research Facility. Image compliments of Drs. Jonathan Rayment and Rachel Eddy.

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Ultra-Fast
Neuroscience
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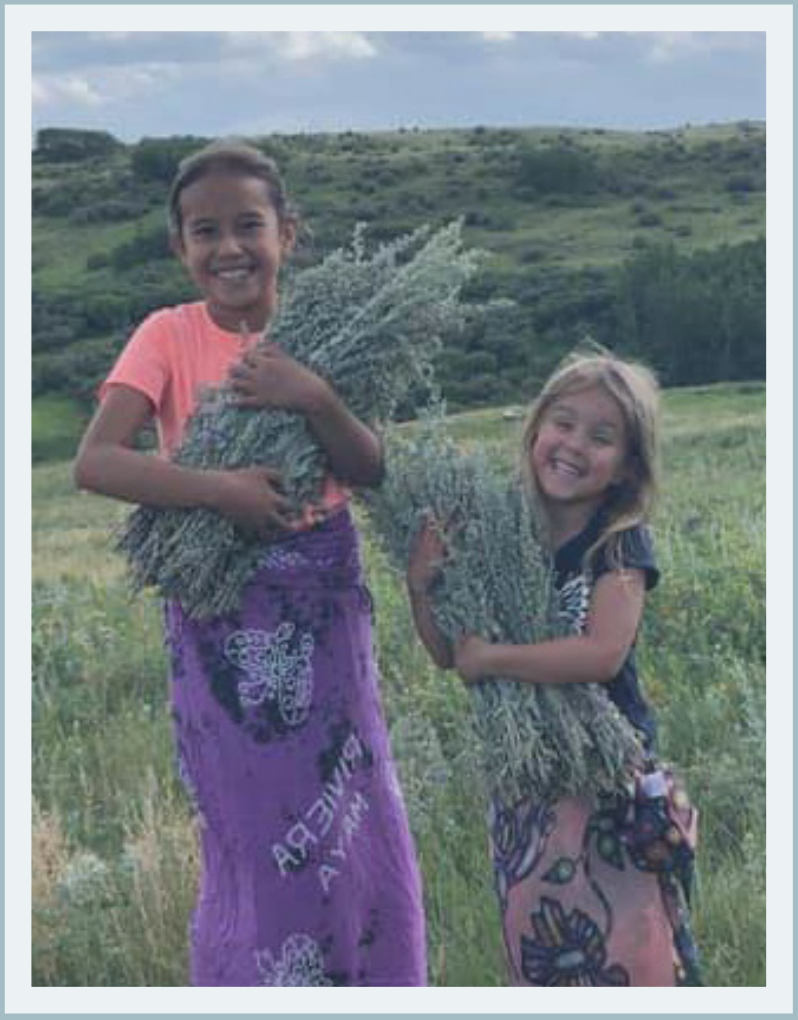
Tractography
Multiband
Province-Wide
Pediatric
Partnership
Xenon
Technology Development
Myelin Water
Unique
Collaboration
Expertise
Volunteers
Child Friendly
Positive
Experienced
Better Health
Helping
Highly Qualified Personnel
Heart
Brain
Accreditation
Neonatal
Connectomics
Families
Learners
Safe
Lungs
Functional MRI
Innovation
Caring
XNAT Data Archive

We gratefully acknowledge the children and families whose participation makes MRI research possible.



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