Report on Research Activities in the Pediatric Neurosurgery Program

January 1st, 2022 to March 31st, 2022

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1. INTRODUCTION

This report contains up to date information on the ongoing research projects that are supported by the Clinical Research Coordinator (CRC) of the University of British Columbia's (UBC's) Division of Neurosurgery at BC Children's Hospital for the period of Jan 1st, 2022 to Mar 31st, 2022. The main objective of the report is to familiarize the staff of the Division of Neurosurgery of UBC with the current research activities that are being supported by their CRC. The studies that are supported by the CRC in this report are divided into three categories of studies: prospective studies, retrospective studies, and inactive/ completed studies. The number of studies per category is presented in the table below.

Number of Ongoing Studies			
Prospective	Retrospective	Inactive/ Completed Studies	Total
7	4	10	21

Detailed description of the purpose, objective, budget and sample size of each study supported by the CRC is presented in the following sections of this report.

2. ONGOING PROSPECTIVE STUDIES

1. ConAnx Study – Caregiver and Child Experiences in the Neurosurgical Clinic:

PI: Dr. Ash Singhal; Co-PI: Rayumand Tabeshi, Ross Hengel

Funding	Source	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
No	N/A	2014-2022	50	50	Yes	Data collection completed	N/A

Referral to a pediatric specialist can induce a significant amount of stress and anxiety in children and parents of children who have a newly recognized need for pediatric specialist consultation. Many practitioners feel their consultation with families lowers anxiety, but there is little evidence to support this. A better understanding of the factors associated with child and caregiver anxiety pre and post neurosurgical consultation could lead to focused interventions to potentially mitigate these factors, which could benefit the long term well-being of the patient and family.
The purpose of this study is to conduct an interview-based study to explore salient themes associated with caregiver and child anxiety pre and post neurosurgical consultation and to identify if consultation with a neurosurgeon lowers anxiety. The knowledge gained from this study will provide a conceptual framework from which targeted interventions will be developed as well as improved neurosurgical consultation communication practices to help caregivers and children cope with anxiety before and after neurosurgical consultation.
There are 50 subjects enrolled. Data collection completed - analysis and manuscript preparation is underway.

2. Craniosynostosis Study - Craniofacial self-image and well-being after non-syndromic, single suture craniosynostosis treatment in infancy: a long-term outcome study

PI: Dr. Paul Steinbok, Co-PI: Dr. Peter Woerdeman, Dr. Doug Cochrane, Dr. Ash Singhal

Funding	Source	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
OPSEI	N/A	2012-2022	60	49	Yes	Active	N/A

The purpose of this study will be to assess the craniofacial self image and well being (CSI&WB) outcome after surgery, as carried out at BCCH, or after no treatment, if that was opted for by the parents, on the eventual head shape after completion of cranial growth in patients with non-syndromic single suture sagittal or metopic craniosynostosis.

Hypothesis: We expect a high level of satisfaction with the aesthetic of the head in the operated non-syndromic, isolated craniosynostosis patients. We expect a modest level of satisfaction with the aesthetic of the head in the non-operated patients. However, we hypothesize that this difference of head shape satisfaction does not impact the level of self-esteem or fear of negative evaluation at adolescence.

Significance: We expect our findings will be very valuable and of great importance when counselling parents with children who have the condition of a non-syndromic, single suture

sagittal or metopic craniosynostosis. The information will assist parents in deciding if to opt for surgery or not. The sample size is 60 patients.

There are 49 enrolled subjects. A total of 32 subjects have completed the study. Data analysis and manuscript write up underway.

3. **<u>CSF Shunt Infection Study</u> – Novel Biomarker Investigation for Patients Undergoing CSF Shunt Infection Treatment**
   Site PI: Dr. Mandeep Tamber; Co-PI: Dr. Ash Singhal, Dr. Faizal Haji

Funding	Source	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
Yes	NIH	2016-2022	300 @ BCCH	144	Yes	On hold	N/A

The primary objective of this prospective observational study is to investigate the utility of several novel biomarkers in the management and treatment of CSF shunt infection with a focus on quantitative 16S rRNA PCR amplification, high throughput sequencing of CSF, and microscopy of hardware. We will obtain samples relevant to the investigation of CSF shunt infection, including the CSF shunt apparatus that was removed as well as additional CSF over the course of treatment for CSF shunt infection. We will determine how several proposed biomarkers can inform management and treatment of CSF shunt infection. In addition, CSF and shunt samples will be collected from patients undergoing temporizing hydrocephalus surgeries, initial CSF shunt placement, and CSF shunt revision or removal both as negative controls and to understand the evolution of the biomarkers prior to development of CSF shunt infection. This data will be supplemented with clinical data obtained from chart review. Biological samples not used immediately in this study will be banked for future studies of CSF shunt infections.

There are 144 subjects enrolled into the study, 9 of which were enrolled in the last period. Collection of CSF is temporarily halted until new funding is secured.

4. **<u>HCRN ESTHI</u>** – Endoscopic versus Shunt Treatment of Hydrocephalus in Infants
   Site PI: Dr. Mandeep Tamber; Co-PI: Dr. Ash Singhal

Funding	Source	Amount	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
Yes	NIH - NINDS	$140,273	2020-2025	176 in 14 centres; 4 @ BCCH	0	Yes	Active	N/A

Hydrocephalus is commonly treated with the placement of a shunt. Another treatment is endoscopic third ventriculostomy with choroid plexus cauterization (ETV+CPC). This study aims to determine if there are any differences in long term outcomes between shunt and ETV+CPC on brain function. Both of these surgical procedures are standard and are commonly performed by pediatric neurosurgeons; neither one is experimental. Enrolled patients will have neurocognitive testing done before and after, questionnaires will be administered to assess the patient's progress, CSF samples will be collected during the operation, and follow-up data will be collected.

The purpose of this study is to conduct a prospective randomized control trial to compare intellectual outcome and brain structural integrity between 2 hydrocephalus treatments (shunt or ETV+CPC), to help families make the best treatment decision for their baby. The Primary Hypothesis of this study is that a strategy of initial treatment of hydrocephalus with ETV+CPC will result in 12-month cognitive outcome, as assessed by Bayley Scales of Infant and Toddler Development-Third Edition (Bayley-III), that is not inferior to cognitive outcome achieved with initial treatment with shunt, among infants eligible for either procedure. Non-inferiority is defined as rejection of the null hypothesis that 12-month Bayley-III Cognitive Scale score is at least 1.5 points lower among infants randomized to ETV+CPC versus those randomized to shunt. This is a multicentre study being carried out by the HCRN. Dr. McDonald is the Site PI at BCCH and Dr. John Kestle is the study PI.

The study is open to enrolment – there are no participants enrolled at this site.

5. **<u>HCRN Registry</u>** – Characterizing Patient Populations in the Hydrocephalus Clinical Research network (HCRN)
   Site PI: Dr. Patrick McDonald; Co-PI: Dr. Paul Steinbok, Dr. Ash Singhal, Dr. Mandeep Tamber

Funding	Source	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
No	N/A	2014-2023	All eligible	244	Yes	Active	N/A

The Hydrocephalus Clinical Research Network (HCRN) has been established by philanthropic funding to conduct multi-institutional research (clinical trials and observational studies) on pediatric hydrocephalus. The HCRN Core Data Project has been developed to obtain data about all neurosurgical hydrocephalus events from the network Clinical Centers, and to create a database to be used by HCRN investigators. The ongoing maintenance of the Core Data Project serves two main purposes: (1) it will help investigators understand the variability, progression, and current treatment practices for hydrocephalus in children, with an ultimate goal of better guiding and assessing therapeutic intervention and providing recommendations on patient care and; (2) it will provide pilot and descriptive data necessary for hypothesis generation and study design (i.e. preliminary power analyses, recruitment projections) for studies under development by the HCRN. This multi-institutional database will be maintained throughout the lifetime of the HCRN, and may be useful for tracking trends in pediatric hydrocephalus over time.

There are 244 subjects included in the registry from BCCH. 8 new subjects were included in the last period.

6. **<u>Parental Peer Support Network Study:</u>**
   PI: Dr. Ash Singhal; Co-PI: Dr. Patrick McDonald, Dr. Mandeep Tamber

Funding	Source	Amount	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
Yes	MASES	$5,000	2018-2022	185	159	N/A – QI study	Active	N/A

The initial diagnosis of a pediatric neurosurgical condition is often a very overwhelming and stressful time for patients and families. The normal challenges of parenthood can be exacerbated by their child's diagnosis of a medical disorder - parents now have to deal with both the normal challenges of raising a child, as well as advocate and be responsible for their child's health needs. The purpose of this study is to determine whether a peer and family support network would be beneficial within the BC Children's Hospital (BCCH) pediatric neurosurgical department.
This study consists of two phases that will use a series of interview and survey questions to collect qualitative and quantitative data to determine whether a better support network is needed, and what families believe to be the most important features of a family-to-family support group.
Phase 1 – Semi-structured interviews
Initial interviews will be conducted on a group of long term follow up patient families which represents the main neurosurgical disorders treated at the clinic. Interviews will then be thematically analyzed for key patterns. We will continue interviews until thematic saturation (the point where we are not receiving any new answers), which we hypothesize will be around 12 families.
Phase 2 – Survey
Once thematic saturation has been achieved with the semi-structured interviews, a quantitative survey will be designed using the themes found in our thematic analysis of the transcribed interviews. The survey will then be administered to families on an iPad in clinic in order to look at what they find to be the most important features of a support group.

The survey phase is now completed. Data analysis and drafting of a manuscript is underway. In addition, a support network is now being setup.

7. **Spatiotemporal Mapping and Decoding Oculomotion Functions in the Frontal Eye Fields**:
   PI: Dr. Ash Singhal; Co-PI: Dr. Mandeep Tamber, Dr. Stephano Chang, Dr. Faizal Haji, Alexander Cheong

Funding	Source	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
No	N/A	2021-2023	10	12	Approved – Need VCHRI approval for VGH	Active	N/A

The frontal eye field, often described as an important control area, located on a specific part of the brain in the prefrontal cortex. However, the exact localization and function of this area are still debated. A study of functional localization of this region in pediatric population does not exist and may help understand the development of eye function in humans, making epilepsy surgery safer for this population. As a part of normal standard of care, patients would be monitored using electrodes implanted on their brain. We propose to collect additional eye movement data during this period.
There are 2 enrolled subjects enrolled this period. To add VGH as a participating site.

3. ONGOING RETROSPECTIVE STUDIES

1. **Craniometry of Pediatric Patients Based on Three Dimensional CT**
   PI: Dr. Pual Steinbok; Co-PI: Dr. Cristina Schaurich, Dr. Rainer Haetinger

Study period	Approval	Sample Size	Status	Abstract/Paper/ Manuscript	Funding
2018-2022	Yes	441	In progress	N/A	N/A

The modern era of surgical treatment for craniosynostosis started in 1970 and aside from some minor changes has largely remained the same. It is important to point-out the importance of a morphological review of characteristics of normal skull grown as premature fusion of cranial sutures in children causes serious significant craniofacial alterations, often requiring several surgeries to correct. Current literature reveals that the craniofacial skeleton growth is based on two key-concepts: dislocation and bone remodeling.

It is increasingly clear that current practiced surgical treatment requires higher technical accuracy. Therefore, it is necessary to develop a better way to properly quantify cranial regional growth and alterations through the use of craniometry – the identification of superficial anatomical references to infer adjacent brain structures.

The purpose of this study is to define accurate measures for craniometrics points in each age groups and establish a cephalometry protocol with the purpose of studying the cranial dimensions that characterize each age through the measurements between craniometrics points. In addition, develop a statistical head model for 0-77 year old children and obtain accurate mathematical parameters of the stanadard craniometrics points for lateral ventricular cannulation in children from 0-7 years old with age related modifications to Kocher's and Frazier's points.
Data analysis and manuscript write up underway

2. **HCRN Posterior Fossa Brain Tumor (PFBT) Treatment Durability Study** –
   Measuring the duravility of CSF diversion for persistent hydrocephalus following posterior fossa tumor resection: endoscopic third ventriculostomy (ETV) and ventriculoperitoneal shunting (VPS)
   PI: Dr. Mandeep Tamber; Co-PI: Dr. Ash Singhal, Dr. Faizal Haji

Study period	Approval	Charts Reviewed	Status	Abstract/Paper/ Manuscript	Funding
2022-2023	Yes	11 @ BCCH	Active	N/A	N/A

Persistent hydrocephalus following resection of a posterior fossa brain tumor (PFBT) remains one of the most common causes of pediatric hydrocephalus. Traditionally, this disease has been treated by diverting cerebrospinal fluid (CSF) via placement of a ventriculoperitoneal shunt (VPS). While mechanically effective, a VPS is prone to obstruction and infection, frequently requiring repeat operations throughout the patient's lifetime. More recently, endoscopic third ventriculostomy (ETV) has been proposed as an alternative to VPS in this pediatric population. ETV is a safe, minimally invasive procedure that offers the advantage of a life free of shunt dependency. However, the data supporting ETV for PFBT-associated hydrocephalus is limited. Specifically, little is known regarding the survival duration of ETV in this patient population.

The purpose of this study is to compare the time-to-failure (TTF) between first time ETV and VPS in patients who undergo treatment for persistent hydrocephalus following surgical resection of a PFBT at participating Hydrocephalus Clinical Research Network (HCRN) centers. Results will lay the groundwork for a future prospective randomized trial.
Data entry completed - waiting for other sites to complete their data collection.

3. **Spinal Ultrasound Study**
   PI: Dr. Mandeep Tamber

Study period	Approval	Charts Reviewed	Status	Abstract/Paper/ Manuscript	Funding
2021-2022	Approved	400	Active	N/A	N/A

Primary spinal anomalies are a broad group of developmental malformations of the spine and its surrounding tissues. These include the spinal dysraphisms, a series of malformations caused by inappropriate development of the neural tube or its overlying ectodermal layers, tethered cord syndromes, or split cord malformations. These disorders range from being asymptomatic to having severe motor, bowel/bladder, and musculoskeletal manifestations in children and young adults. Some spinal anomalies are associated with cutaneous manifestations visible on the lower back, such as a tuft of hair, hemangioma, skin tag, or sacral dimple. As such, routine physical examination of all newborn babies includes an assessment for these findings. Patients with concerning physical exam findings often are referred for lumbosacral imaging to rule out a spinal anomaly. It has been our anecdotal experience that many primary care physicians continue to order ultrasound imaging to investigate simple dimples in neonates, despite clinical practice recommendations against them, causing unnecessary cost and utility of resources.

We hypothesize that current use of ultrasound in children for workup of suspected spinal anomaly is inappropriately over-utilized. The purpose of this study is to assess the current landscape of ultrasounds performed for investigation of spinal anomalies in babies with ultrasound. The potential impact is that considerable cost savings to our healthcare budget may result from this quality assurance initiative.
Data collection has been completed – awaiting data analysis and manuscript write up.

4. **Unintentional Falls Study**:
   PI: Dr. Ash Singhal; Co-PI: Dr. Mandeep Tamber, Dr. Stephano Chang, Dr. Ruth Mitchell, Alexander Cheong

Study period	Approval	Charts Reviewed	Status	Abstract/Paper/ Manuscript	Funding
2021-2023	Approved	1000	Approved	N/A	N/A

Unintentional falls are the leading cause of non-fatal injuries in the pediatric population, with falls representing one of the most common reasons for emergency department visits. Children under the age of 5 are particularly vulnerable to falls from windows and balconies, which result in serious injuries and are largely preventable. Public health initiatives such as community education and installation of window guards in several cities have successfully decreased the incidence of window falls among children - one such initiative, a city health code mandating

window guards where children 10 years or younger live, resulted in a 96% decrease in the incidence of unintentional window falls. In addition to the prevention of numerous serious injuries, these relatively low-cost solutions would likely free up significant healthcare and community resources required to treat these patients.
The pediatric population in the province of BC remains theoretically vulnerable to these preventable falls from windows due to our current provincial building code. Understanding the local epidemiological patterns of unintentional falls and trauma are essential to determining the most appropriate and likely-to-be-effective interventions. We are interested in retrospectively accessing the BCCH trauma database to understand the demographics, specific circumstances, and treatments for patients involved in unintentional falls from windows over the past 20 years.
Approved this period – To review charts.

4. INACTIVE OR COMPLETE STUDIES

1. **<u>Assessing the Quality of Meta-Analyses and Systematic Review with AMSTAR in the Current Neurosurgical Literature</u>:**
   PI: Dr. Mandeep Tamber; Co-PI: Hanna Parmar

Study period	Approval	Charts reviewed /Sample Size	Status	Abstract/Paper/ Manuscript	Funding
2019	N/A	N/A	Completed	N/A	N/A

There has been a proliferation of systematic reviews as one of the key tools for evidence-based healthcare. This has presented both opportunities and risks – The opportunities being that it creates an environment where researchers can base decisions on accurate, succinct, credible, comprehensive and comprehensible summaries of the best available evidence on a topic thereby minimising error and bias. The risks include variation in quality and empirical validation. Standardized assessment tools such as AMSTAR (a measurement tool to assess systematic reviews) scores each article based on their quality. This checklist looks at the authors review methodology, search criteria, descriptions of reviewed studies, bias assessment, report of funding sources, statistical methodology, heterogeneity in the results, as well as other criteria. By providing a quality score to each systematic review, healthcare practitioners are able to make more informed evidence-based decisions.
The purpose of this study is to gauge the quality of neurosurgery/ pediatric neurosurgery meta-analyses and systematic reviews being published in the literature in the past 5 years, scoring them based on the AMSTAR checklist.
Data collection and analysis for this literature review completed. Manuscript is being drafted.

2. **C-LCH Study - Non-Operative Management of Suspected Calvarial Langerhans Cell Histiocytosis:**
   PI: Dr. Paul Steinbok; Co-PI: Dr. David Dix

Funding	Source	Amount	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
Yes	Rare Disease Foundation	$3,500	2012 - Present	30	29	Yes	Closed	Abstract accepted at the ISPN 2021 Meeting

The purpose of the proposed study is to prospectively accumulate and evaluate a relatively large series of children with solitary calvarial EG managed with an initial protocol of observation only. Because of the rare occurrence of this disorder, a multicenter study is proposed. It is hypothesized that spontaneous regression will occur without therapeutic intervention in most children with a solitary calvarial EG, diagnosed on the basis of characteristic clinical and radiological features. If the hypothesis of the study proves to be correct and most children with solitary calvarial EG have spontaneous regression with reconstitution of the lytic defect in the bone, an expectant approach can be recommended generally for solitary EG of the skull. If

adopted, this would benefit the patients, with avoidance of the risks of surgery, avoidance of the associated cranioplasty and possibly more complete restitution of the calvaria.

This is a multicentre study, and so far, there are 9 participating sites across North America. Seven centres including BCCH have ethics approvals. Abstracts were accepted for poster presentation in the autumn of 2014, and several additional study centres indicated their interest in participating in this study.

There are 29 subjects enrolled in this study – Manuscript submitted to New England Journal of Medicine as a letter to the editor

3. Craniofacial Screening Tool

PI: Dr. Ash Singhal; Co-PI: Dr. Patrick McDonald, Alexander Cheong

Funding	Source	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
No	N/A	2019-2021	72	74	Yes	Closed	Abstract accepted at AANS/CNS Peds NSurg and ISPN 2020

Craniofacial abnormalities, such as positional plagiocephaly or craniosynostosis are one of the most common reasons primary care providers refer a child to a neurosurgical subspecialty. There has been an increase in referrals for positional plagiocephaly. Positional plagiocephaly is often considered primarily a minor or cosmetic issue and can usually be managed without surgery. Craniosynostosis is not as common as positional plagiocephaly. Unlike positional plagiocephaly, craniosynostosis does require surgical intervention. In addition, earlier treatment is associated with fewer complications and more treatment options. If left untreated, it can result in worsened cranial deformity, cranial growth restriction, increased intracranial pressure (ICP), and possible psychosocial issues from the child's peer interactions. Diagnosis of either craniosynostosis or positional plagiocephaly can often be made on the basis of the child's history and a physical examination of the head. In select patients, radiographic imaging is also required. With an increase in referrals to pediatric neurosurgical subspecialty some hospital programs sought other alternatives to examining each referral. Programs such as plagiocephaly clinics have been set up to screen referred patients without the aid of a neurosurgeon. In the literature, only a handful of studies have looked at the use of photography or video as a tool to measure or screen for cranial deformities.

Therefore, the purpose of this study is to investigate if it is possible to accurately screen and identify craniofacial abnormalities that require neurosurgical intervention by looking at a series of photos taken by the caregivers with a cell phone camera.

Participant enrollment has been completed. Abstracts were accepted at 2 conferences. Manuscript preparation for the journal Pediatrics is underway.

4. **Ethics Education in Neurosurgery Residency Program Study** - A Multicenter Prospective Study of Endoscopic Third Ventriculostomy (ETV) and Choroid Plexus Cauterization (CPC) in Children with Hydrocephalus PI: Dr. Patrick McDonald

Funding	Source	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
No	N/A	2016-2020	114	47	Yes	Completed	Abstract accepted

Clinical medical ethics education is an important part of all residency training programs and is considered a core competency by both the Royal College of Physicians and Surgeons of Canada and the Accreditation Council for Graduate Medical Education in the United States. Despite this, very little is known about how ethics education is done during residency training. Neurosurgical residents confront complex ethical dilemmas regarding futility, end of life care, and resource management among others. The purpose of this project is to assess the state of ethics education in neurosurgical residency training programs across North America.
Enrolment has been completed with a total of 47 respondents completing the survey – Manuscript preparation is underway.

5. **Evaluation of Ethics Education in Neurosurgery Residency Across Canada:**
PI: Patrick McDonald; Co-PI: Vivian Braithwaite, Dr. Serge Makarenko, Alexander Cheong

Funding	Source	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
No	N/A	2017-2020	155	57	Yes	Completed	In progress

Clinical medical ethics education is an important part of all residency training programs and is considered a core competency by both the Royal College of Physicians and Surgeons of Canada and the Accreditation Council for Graduate Medical Education in the United States. Despite this, very little is known about how ethics education is done during residency training. Neurosurgical residents confront complex ethical dilemmas regarding futility, end of life care, and resource management among others. The objective of this project is to assess the state of ethics education in neurosurgical residency training programs across Canada

The study will use a cross-sectional web-based survey to look at respondent and residency program demographics, form and methodology of ethics education, ethics education resources available, ethics topics felt to be important in neurosurgery as well respondent attitudes towards the importance of ethics education and barriers to providing it. The survey will be sent to a list of neurosurgical residents across Canada through Fluid Survey.
Enrolment has been completed with a total of 57 respondents completing the survey – Manuscript preparation is underway.

6. **HCRN Craniosynostosis Study** – The Management of Hydrocephalus Associated with Craniosynostosis
   PI: Dr. Patrick McDonald; Co-PI: Dr. Paul Steinbok, Dr. Ash Singhal

Study period	Approval	Charts Reviewed	Status	Abstract/Paper/ Manuscript	Funding
2017-2019	Yes	2 @ BCCH	Completed	In progress	N/A

The most common permanent surgical procedure in the treatment of hydrocephalus arising from a variety of etiologies is the placement of a VP shunt. Although the use of standardized surgical protocols and improved shunt components have led to fewer complications, VP shunt failures, and infections still routinely occur, requiring additional surgeries to revise or replace the VP shunt. Moreover in the craniosynostosis population, utilizing VPS as the primary treatment of hydrocephalus is thought by some to possibly have a negative impact on the patient's craniosynostosis. In a late phase, the chronic diversion of CSF and possibly an excessive decrease of ICP due to the action of the CSF shunting device may result in craniocephalic disproportion due to both an early fusion of normal cranial sutures (secondary synostosis) and bone deposition at the inner surface of the calvarial bones.

The purpose of this retrospective chart review study is to determine whether ETV (with or without CPC) is viable and effective in the treatment of hydrocephalus in pediatric patients with craniosynostosis and will compare the efficacy with those craniosynostosis patients receiving a VP shunt to treat hydrocephalus.

Manuscript was submitted and is currently being revised.

7. **HCRN Entry Site Trial** - A Randomized Controlled Trial of Anterior versus Posterior Entry Site for CSF Shunt Insertion
   Site PI: Dr. Patrick McDonald; Co-PI: Dr. Paul Steinbok, Dr. Ash Singhal, Dr. Mandeep Tamber

Funding	Source	Amount	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
Yes	PICORI	$73,927	2015-2020	448 in 14 centres; 50 @ BCCH	19	Yes	Active	N/A

The primary objective of the Entry Site Trial is to compare the survival time (time to first shunt failure) of ventriculoperitoneal (VP) shunts inserted through an anterior entry site with those inserted through a posterior entry site. Entry Site is determined by randomization and the primary outcome measure is shunt failure determined by an adjudication committee. This is a four year study with an estimated sample size of 448 subjects. Subjects must have clinical and radiographic evidence of hydrocephalus as determined by a pediatric neurosurgeon and require a simple VP shunt and subjects can have no prior history of shunt insertion and must be less than 18 years of age. The hypothesis of this study is that shunt entry site (anterior or posterior) has a significant effect on the subsequent risk of shunt failure. This is a multicentre study being carried out by the HCRN. Dr. McDonald is the Site PI at BCCH and Dr. William Whitehead is the study PI.

The study has been completed. Manuscript has been published in Journal of Neurosurgery: Pediatrics Ethics to be kept open until notified by the HCRN.

8. **<u>Hydrocephalus Long Term Outcome Questionnaire Study:</u>**
   PI: Dr. Patrick McDonald

Funding	Source	Study period	Anticipated enrolment	# of subjects enrolled	Approval	Status	Abstract/ Paper/ Manuscript
No	N/A	2014-2020	1,500 in 5 centres; 330 @ BCCH	318	Yes	Completed	N/A

The overall objective of this study is to improve the health of children with hydrocephalus. Specific objectives are:

- To identify the determinants of health outcome by testing for associations between several independent variables and the HOQ (Hydrocephalus Outcome Questionnaire) – primary objective.
- To describe comprehensively the health status of children with hydrocephalus using an outcome measure validated in this specific population (the HOQ).
- To establish the psychometric properties and feasibility of a child-completed version of the HOQ.
- To establish the relationship between child and parent assessments of health outcome in the pediatric hydrocephalus population.
- To establish the relationship between the HOQ scores and specific neuropsychological assessments of cognitive function.
- To assess the relationship between the HOQ and healthy utility scores, using the Health Utilities Index – 2 (HUI-2).

There are 318 subjects enrolled in the study. Of those, 311 subjects have completed the study as per the study protocol, and 26 subjects have been lost to follow-up. In addition, 168 patients have been re-enrolled for additional follow-up and 161 of these patients have completed the study. Study is closed for enrolment – manuscript preparation is underway.

9. **<u>Transitioning to Adulthood with Hydrocephalus: A Patient's Perspective</u>**:
   PI: Dr. Patrick McDonald; Co-PI: Dr. Ash Singhal, Dr. Mandeep Tamber, Dr. Thomas Zwimpfer

Funding	Source	Study period	Anticipated enrolment	# of subjects enrolled	Approvals	Status	Abstract/ Paper/ Manuscript
No	N/A	2019-2021	20	30	Yes	Approved	N/A

Patients with chronic medical conditions are often faced with challenges when transitioning from pediatric to adult care. This process is usually inconsistent or inadequate as adolescents with chronic conditions find themselves feeling lost or neglected. There is a lack of engagement in the many adult health care systems that are associated with lower rates of follow-up and higher risk

of morbidity and mortality. Conditions such as hydrocephalus require lifelong awareness as cerebral spinal fluid (CSF) shunts can continue to fail in adulthood. The acute presentation of hydrocephalus requires immediate surgical intervention via CSF diversion procedure – either a CSF shunt or endoscopic third ventriculostomy (ETV). With advances in medical care, more patients with chronic conditions, such as hydrocephalus, are living into adulthood. Young adults transitioning must be aware of the related signs and symptoms of hydrocephalus and should be cognisant of the care required.

Although there have been a few studies that have highlighted challenges of the transition period, there have been no formal studies in the literature that provide a patient's perspective when transitioning with hydrocephalus. The purpose of the study is to quantify the various factors that challenge young adults with hydrocephalus as they go through this transitioning period by utilizing both a qualitative and quantitative approach.
Interviews have been completed. Abstract submitted to the Canadian Neurological Sciences Federation Congress. Minor revisions to be submitted to JNS Peds.

10. **<u>Imaging Practices for Hydrocephalus at BCCH</u>** – A comparison of two historical epochs
    PI: Dr. Patrick McDonald; Co-PI: Anahat Sahota, Alexander Cheong, Dr. Ash Singhal, Dr. Mandeep Tamber

Study period	Approval	Charts Reviewed	Status	Abstract/Paper/ Manuscript	Funding
2018-2020	Yes	300	Active	In progress	N/A

Hydrocephalus is a common debilitating condition of the brain in children of all ages. This condition is caused by the excessive accumulation of cerebral spinal fluid (CSF) in the ventricles of the brain. The diagnosis of hydrocephalus is confirmed via magnetic resonance (MR) imaging, computed tomography (CT) scan, and or ultrasound. Obtaining brain images of hydrocephalic patients not only confirms the diagnosis, but also reveals abnormalities that could potentially influence the patient's course of treatment.
Although both short and long term outcomes of hydrocephalus have been studied extensively in the current literature, few studies have looked at how imaging practices for hydrocephalic patients have evolved over time. By better understanding how imaging practices have evolved, the neurosurgeons are able to provide more information to families, which may potentially reduce anxiety. We aim to compare trends over time in frequency and modality of imaging in cohorts of patients newly diagnosed with hydrocephalus at British Columbia Children's Hospital (BCCH) in 2 distinct temporal epochs.
Chart review has been completed – Manuscript completed, sent to Dr. McDonald for review.