Abstract Book

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Participation after Paediatric Acquired Brain Injury: Exploring Levels of Participation in Children and Young People After Discharge from Inpatient Rehabilitation

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Background: NHS England (2013) estimates 40,000 children and young people (CYP) sustain an acquired brain injury (ABI) per year in the UK which can lead to lifelong disability as a result of physical, cognitive, social, emotional and behavioural long-term impairments (Andersson et al., 2016).

Overarching multidisciplinary rehabilitation goals are improved quality of life and societal participation (Gordon, 2014, Baque et al., 2016). Participation is defined as “involvement in a life situation” with restrictions being “problems an individual may experience in involvement in life situations” (World Health Organisation, 2002) Research shows greater participation is associated with increased quality of life, social competence and educational success of CYP with disabilities and highlights restrictions in participation at home, school and in the community that CYP with ABI experience in the USA and Australia (Bedell & Dumas, 2004; Galvin et al., 2010).

Objective: To explore levels of participation UK CYP with ABI experience at home, school and in the community to improve understanding of issues they face after discharge from inpatient rehabilitation.

Methodology: Multi-centre, cross sectional online survey of parents/carers of CYP with ABI who received neuro-rehabilitation at one of four UK regional specialist centres between October 2014 and September 2016. Potential participants were invited by local clinicians via letter to participate. Inclusion and exclusion criteria were applied. The Child and Family Follow-Up Survey (Bedell, 2011) was used and included parent and CYP aged 11-18 reports. Ethical approval was given by a National Research Ethics Committee.

Results: Time constraints, low recruitment and response rate resulted in results from three participants (age range 6-15). Mean time since injury was 26 months (range 21-33). Participation restrictions were reported across 19 of the 20 domains of participation. Parents reported community structured events/activities, moving around the neighbourhood and educational activities as most restricted. CYP reported social/play/leisure activities with friends at home, in the community and at school, family chores at home and communication in the community as most restricted. Factors impacting on participation were cognitive-based and movement skills, family stress and lack of support/encouragement in the community.

Conclusions: Whilst the results cannot be considered representative of the wider population, important information was gained, highlighting the restrictions to participation experienced by these three individuals two years after injury. Knowledge gained from a larger sample could inform clinical decision-making, service developments and further research into interventions to support this complex population in their continued recovery, aiming to fully participate in life.
Increased GABA Concentration Following Acute Pediatric Concussion

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Mild Traumatic Brain Injury (mTBI) or concussion heads the list of different types of TBI in amount of cases. The highest-risked group are children. Typically, there are not any MRI and CT-visible anatomical structure abnormalities of brain with concussion, but mTBI can result in a number of physical, cognitive and emotional disruptions. These symptoms may be associated with disturbances of excitatory and inhibitory neurotransmission processes in central nervous system (CNS). Localized proton magnetic resonance spectroscopy (1H MRS) is a unique non-invasive method for quantification of metabolic concentrations in all human tissues and organs. Extension of MRS with edited MEGA-PRESS pulse sequence [1] can estimate in vivo concentrations of major neurotransmitters: inhibitory-gamma-Aminobutyric acid (GABA) and excitatory-glutamic acid (Glu). Thus, the main aim of this work was to estimate changes in vivo cerebral GABA and Glu concentrations after acute mTBI using 1H MRS.

Two groups of participants were included in the study: patients group consisted of 11 children hospitalized in the Clinical and Research Institute of emergency Pediatric Surgery and Trauma, Moscow (5 males, 6 females, mean age - 16±2 years, mean time between trauma and MRI examination 40±20 hours, Glasgow Coma Score (GCS) - 15) with acute phase of mTBI; group of healthy volunteers consisted of 8 children (5 males, 3 females, mean age - 16±1 years) without history of any TBIs and other cerebral pathologies. All investigations were performed on scanner Phillips 3.0T Achieva. GABA (TE/TR=80ms/1900ms, NSA – 8, 12ms editing pulses applied at 1.9 ppm and 1.5 ppm, 42 averages.) edited spectra were obtained using MEGA-PRESS sequence. REST slabs were used for suppressing unwanted water signal from ventricles. Corresponding PRESS spectra with the same parameters (TE/TR=80ms/1900ms, NSA – 64) were also performed for obtaining NAA, Cr, Cho and unsuppressed water signal intensities. All Voxels in size of 25×25×30mm were located in the frontal lobe. Participants and their parents signed an informed consent.

The main effect on the [GABA] was found (Z=2.03, p<0.05), with the patients having higher [GABA] as compared to the control group (36%). Absolute concentrations of NAA+NAAG, tCho, tCr and glutamate were unchanged.

This study for the first time revealed increased cerebral [GABA] as well as disorders in the [GABA]/[GLX] balance in the pediatric acute mTBI. The most likely cause of [GABA] increase is growth of free pool of GABA (non-related to GABA receptors). Postconcussion changes of neurotransmitter revealed in the present study could be promising for understanding of functional consequences of MRI negative TBI

Patient and Parent-Reported Outcomes in Paediatric Acquired Brain Injury

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Background and Objectives: Current neurosurgical and neurological practice offer highly effective acute management for acquired brain injury (ABI). However, despite gold-standard care, children who experience brain injury often suffer long-term disability. Neurocognitive symptoms may evolve over time as the child matures. The objectives of this study were to describe neurocognitive symptoms in a cohort of children with ABI.

Design: A retrospective observational study.


Methods: Data were collected from electronic clinical records for first follow up appointment at a multidisciplinary clinic consisting of a consultant paediatric neurologist, clinical nurse specialist, neuropsychological therapist and 3rd sector child and family worker from the Child Brain Injury Trust (CBIT). Data were scored for patient and parent-reported injury-associated problems in 10 domains, including sleep, behaviour, relationships, school and mood.

Results: Mean time between injury and clinic assessment was 1 year. Mechanism of injury included trauma (72.4%), infection (17.2%) and Stroke (3.4%). Problems with sleep, energy and fatigue were reported for 60.3% of patients; 56.9% of patients experienced problems with mood. Problems at school were reported for 55.2% of patients; 44.8% of patients reported problems with higher functioning (cognition, memory, attention and planning); 37.9% of patients reported problems with pain; 37.9% reported problems with sport, activity and motor skills.

Conclusions: Children with ABI of all causes are at increased risk of long-term neurocognitive problems which evolve over time. Paediatric ABI patients suffer diverse long-term disability following injury. Follow up services are essential to support these patients following acute neurosurgical management. Further studies must elucidate how to increase recognition of this disability, to optimise service provision and to best target support.
Demographic Characteristics of Patients Attending A Novel Paediatric Acquired Brain Injury Clinic

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**Background and Objectives:** Paediatric acquired brain injury is prevalent. Following acute management, children with no further acute surgical need are discharged. Often these children experience long-term resultant problems. Current healthcare models largely fail to address this. Childhood is a time of great development, growth and vulnerability to lifelong disability with lifelong personal and societal costs associated. A specialist service is required to optimise long-term outcome for paediatric brain injury patients. This study describes a cohort of patients attending a novel multidisciplinary clinic designed to meet this need.

**Design:** A retrospective observational study.

**Subjects:** Patients (n=58) attending a novel multidisciplinary paediatric acquired brain injury clinic between January 2016 and September 2017.

**Methods:** Data were collected from electronic clinical records for first follow up appointment at a multidisciplinary clinic consisting of a consultant paediatric neurologist, clinical nurse specialist, neuropsychological therapist and 3rd sector child and family worker from the Child Brain Injury Trust (CBIT). Data were analysed for (1) cohort demographics, (2) patient flow and (3) clinical management.

**Results:** Mean age was 7.9 years at injury and 9.0 years at first presentation to clinic; 62.1% of patients were male. Trauma and infection were the most common mechanisms of injury with a prevalence of 72.4% and 17.2%, respectively. In total, 55.2% of patients were referred to clinic by paediatric neurologists; 19.0% by neurosurgeons, 8.6% by general paediatricians, 5.2% by GPs. A total of 75.6% of patients were attending school full-time. Further follow up in the clinic was required for 67.2% of patients.

**Conclusions:** A multidisciplinary specialist clinic offers unique potential to address current unmet needs in paediatric acquired brain injury in a highly efficient and cost-effective manner.
Is It Time to Helm Up?

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Background: In the Netherlands bicycling is exceptionally common, but recorded helmet use is very low. Numerous studies have shown that wearing a helmet reduces the risk of traumatic brain injuries (TBI). This study reviews the number of children admitted with TBI to PICU at AMC-Emma Children’s Hospital, Amsterdam over a 10-year period from a bicycle accident, with helmet use.

Methods: This was a retrospective study of children < 18 years between 2006-2016 collecting information from hospital records regarding age, gender, mode of accident, injury severity and helmet use. Severity of brain injury was classified by the Glasgow coma scale and the initial CT scan using the Marshall classification of TBI.

Results: During 2006-2016, 185 children were admitted to PICU with TBI. Of these 47 (25%) were from bicycle accident (55% male, 45% female). Children 10-15 years were the most represented group (38%), and vehicle collision the most common mode of accident (68%). Use of helmets was not documented in a single case. Overall 49% were classified on the Glasgow coma scale as severe and 41% as a mild. All patients had a CT scan at admission with the Marshall classification of diffuse injury II most common (49%).

With severe injury the majority of patients were male (65%), aged 10-15 years, with motor vehicle collision (83%) the commonest mode. 48% of this group had diffuse injury II on Marshall classification.

Discussion: Over a ten-year period, a quarter of children admitted to a major PICU with TBI were due to a bicycle accident. Helmet use was not documented in a single case and with the low helmet usage in the Netherlands is it likely that it was significantly low, or even absent. Our study shows that TBI occurs more commonly amongst older children, most likely due to be out on the open road, and with a high proportion in collision with another vehicle, this highlights the importance of overall road safety.

However, with so many studies showing helmet use significantly reduces the severity of TBI in bicycle accidents, one has to ask whether it must be time to Helm up in the Netherlands?
fNCI: Innovative Treatment and Diagnosis of mTBI for the Pediatric Population

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Purpose: Behavioral and cognitive difficulties (e.g., academic, social, and physical challenges) are frequently observed in the pediatric population who are subject to mild traumatic brain injury (mTBI). These difficulties complicate the normal progression through childhood and adolescence, in addition to the heavy emotional burden carried by the individual and their family. Traditional treatment for mTBI fails to address the underlying pathophysiology; focusing, rather, on limiting both physical and cognitive activity. This type of treatment is not sufficient to produce lasting change or improvement. Our innovative treatment seeks to promote well-being for those affected by brain injury. We have developed functional NeuroCognitive Imaging (fNCI), which uses a standardized protocol of functional magnetic resonance imaging (fMRI) and adapted neuropsych evaluations to effectively quantify neurovascular coupling (NVC) function within the brain, and to direct treatment and therapy. Our targeted and individualized therapy consistently produces substantial improvement in our pediatric sample. We present evidence-based data demonstrating the efficacy of fNCI as an appropriate measure of NVC and in directing treatment of mTBI.

Methods and Materials: 124 concussed patients (ages 7-18) were assessed with fNCI to establish pretreatment NVC benchmarks as shown by an objective Severity Index Score (SIS). fNCI and self-reported, subjective, post-concussion symptom scale (PCSS) findings were used to develop individualized, targeted, sustained, and cyclical week-long Enhanced Performance in Cognition (EPIC) therapy incorporating cognitive, occupational, and neuromuscular modalities. PCSS and fNCI-directed measures were used to evaluate post-treatment outcomes.

Results: Treatment was measured by calculating the percent change from pre- to post-treatment. After one week of EPIC treatment, patients demonstrated an average of 76% improvement in SIS (Pre: 3.3, Post: 0.8) and 59% improvement in PCSS (Pre: 27.5, Post: 10.1). SIS is measured on a scale from 0-6, while PCSS scores range from 0-138.

Conclusions: Children and adolescents are particularly susceptible to the detrimental effects of brain injury, which highlights the importance of effective brain injury treatments. EPIC is a targeted and individualized treatment that seeks to take proactive measures to improve quality of life and well-being as quickly as possible for individuals with mTBI. This approach follows a targeted, sustained, cyclical, and multimethod-based treatment that isolates the mTBI pathophysiology specific to each patient and allows an individualized, PCS targeting treatment plan. This innovative, individualized pattern of treatment facilitates improved patient outcome and quality of life, demonstrated by accelerated improvement in a large pediatric patient sample across both SIS and PCSS measures.
Model of Integrated Support: Triangulation of Rehabilitation Across Clinical, Therapeutic and Community Settings

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The Child Brain Injury Trust Model of Integrated Support is a unique family support intervention model that combines all aspects of rehabilitation, partnering with professionals from the range of disciplines, and centring support around the specific needs of individual children/young people and their family environment. The Model has been developed for the purpose of 'Promoting well-being in children and young people with acquired brain injury and their families'.

The Model is embedded in Major Trauma Centres across the UK and provides immediate support from the acute phase of ABI, working initially in the clinical setting, facilitating smooth transition back to home/community, education, providing long term support through growth and development, through to transition into adult services. It is the only long-term support framework in place for paediatric ABI in the UK and is unique in the range of partnerships and length of support available.

The presentation will explore the impact of ABI and the sudden life changing situation that families experience and show how the triangulation of coordinated and consistent support is an essential part of the rehabilitation process for all families. It will look at how this approach aligns with rehabilitation standards currently being developed in the UK.

In summary, the triad of settings faced by families following childhood acquired brain injury will be explored through the experiential contributions of those involved at each stage.
From Outcomes Measure in Research to Daily Rehabilitation Practice-Step Variability

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The majority of children sustaining a severe traumatic brain injury (TBI) regain independent ambulation; however, their walking performance are limited; the walking speed is slower - 0.99±0.20 m/sec vs. 1.37±0.30 m/sec in typically developed (TD) age and gender matched controls. Their step variability, which defined as the fluctuation in gait characteristics between steps, is higher; for example, the step length variability (in percentage) is significantly larger as compared with children TD 14.8±12.1 vs 6.9±7.0 respectively. Moreover, the energy expenditure (EE) is elevated as compared to TD age and gender matched controls.

In order to test the use of step variability measures as markers of impaired performance, we investigated the relationship between step variability and different performance in series of cross-sectional studies. We have noted that step variability parameters are highly associate with balance performance. Such as; the Pearson correlation coefficients (rp) between step variability and the “timed up and go” test results, was positive and significant (rp=0.62-0.88, (p<0.05)). The association between step variability and walking velocity was strong, negative and significant (rp= (-0.68) -(-0.71), p<0.01). Moreover, these associations were noted only in these group of children, no association was noted in TD controls. But, while an association was noted between muscle strength and step variability in TD children, in children post TBI no significant associations were noted.

Step variability parameters found to be highly sensitive to any demands or changes during walking in children post TBI; a significant increased variability during dual task condition (increased by 2.6-fold as compared to 1.02 in age and gender matched TD controls), or significant interaction effect of treadmill walking, which significantly reduce step variability in age and gender matched TD controls slight increase variability was noted in children post TBI.

It seems that measures of step variability can provide a sensitive assessment of the neuro-motor performance. It may reflect additional aspects of impaired walking and balance. In addition, these measures are beyond those commonly used test that used average gait data as walking velocity over 10 meters or ordinal scales for assessing balance as Berg Balance Scale.

We start to implement step variability parameters as part of rehabilitation baseline and follow-up assessment. We use these measures to assess the state of a child as well as changes in his abilities. We use the step variability measures within treatment session to assess task complexity, to assess assisted devices contribution on gait performance.

In this presentation we will describe the baseline findings from the cross-sectional studies as well as two case studies that highlighted the use of step variability measures in the daily evaluations and treatment of a child post severe TBI in physiotherapy sessions.
All Party Parliamentary Group on Acquired Brain Injury

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The All Party Parliamentary Group on Acquired Brain Injury (APPG on ABI) was established in 2017 to:
• Raise awareness of ABI and seek improvements in support and services for people directly affected by ABI and also their families and careers
• Provide a voice for those who are not always heard by Ministers and MPs
• Be the main forum for ABI in Parliament, raising key issues across health, social care and welfare which all affect people living with ABI in the UK

To date the APPG on ABI has held four round table meetings in order to raise political awareness, engage and interest parliament, and highlight the key issues affecting children and adults with ABI and their rehabilitation.

The APPG has listened to the written and oral evidence presented at each of the following meetings:
• Neurorehabilitation Services and the role of the Rehabilitation Prescription
• ABI and the Criminal Justice System
• ABI and Education Services for Children and Young People
• ABI and Sport

The report from the meetings and its recommendations to Parliament will be presented.
Paediatric Brain Injury Repair Via Coordination Dynamics Therapy

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A movement-based learning treatment, called coordination dynamics therapy (CDT), was developed with which it is possible to partly repair the injured, malfunctioning or degenerating CNS. With two paediatric case reports it is demonstrated that brain and spinal cord injuries can partly be repaired by administering CDT. This treatment became possible because of a new development in human electro-neurophysiology with which it was possible to analyze the CNS self-organization of neuronal networks at the neuron level under physiologic and pathologic conditions. By using the System Theory of Pattern Formation, a correlation between neural network organization patterns at the neuron level and movement patterns became possible. CDT repairs CNS functioning by improving the impaired phase and frequency coordination of neuron firing when exercising on a special CDT device and by plasticity which means that other brain parts take function over from the damaged ones by exercising movement automatisms and other specific movements. This neural repair treatment is that powerful that even a coma patient who lost approximately 50% of his brain tissue could be brought out of coma with five years of CDT.

Case report 1. The three boys, aged nine, twelve and fourteen years old (Benjamin, Mario, and Andrej, respectively), suffered severe brain injuries almost at the same time, two in a car accident and one in a bicycle accident. Their vigilant coma lasted for three to five months. Benjamin obtained a rather optimal CDT over 18 years and reached a meaningful life. He won the bronze medal in 100m sprint in 2016 and succeeded to finish university with a Master’s Degree in English-German Translation Studies. Mario and Andree, to whom mainly conventional therapy was administered, are living now at parents’ home as disabled adults.

Case report 2. The five-year-old Nefeli acquired cancer (neuroblastoma). When the cancer was removed, she suffered a spinal cord injury at the levels Th10/11 by medical malpractice. Being in the wheelchair, eight months of conventional physiotherapy were administered to her with little progress. She had difficulties to manage at school. Later on, Nefeli refused further conventional physiotherapy, mainly because no further progress was achieved. At an age of nine the spinal cord injury patient Nefeli started CDT. Within two years of CDT, Nefeli learned to walk and her urinary bladder and bowel functions were partly repaired. She could manage now much better at school. She could also walk to the white-board and write there.

For Literature see:
Conceptualizing Concussion: A Critical Qualitative Exploration of Drawings of Concussion

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Objective: It is increasingly recognized that young people possess unique insights into health topics and have the capacity to share these insights. However, in the vast body of knowledge concerning childhood concussion, young people’s perspectives are rarely sought. This inadequate representation of young people’s perspectives has resulted in an incomplete knowledge base from which to inform clinical practice. Using a research orientation that values first-hand accounts and methods that encourage different knowledge than has traditionally been sought, the objective of this research is to explore young people’s conceptualizations of concussion (i.e., how they think and feel about concussion).

Method: In this critical qualitative arts-based research study, drawing is used as an adjunct to traditional interviewing methods to generate data with young people 6-18 years of age. Those without a history of concussion completed a drawing in response to the written phrase ‘when I hear the word concussion…’. Those with a history of concussion completed two drawings: the first in response to the written phrase ‘before I had my concussion…’ and the second in response to the written phrase ‘now I…’. Each young person then participated in a semi-structured interview to explain his/her drawing (i.e., the content, intended message, and intended audience). Interview data was recorded and transcribed. Analysis is ongoing and is guided by an adapted critical visual methodology informed by the work of Rose and Guillemin.

Results: Preliminary analysis of drawing and interview data represents varied discourses wherein concussion is understood as a widespread phenomenon with serious consequences that is indiscriminate, yet preventable. The word ‘concussion’ evokes a strong fear reaction in young people, even those who lack a basic understanding or personal experience of the injury. Concussion has an indiscriminate nature with every young person being at risk of sustaining concussion and certain ‘irresponsible’ young people (e.g., those who don’t wear helmets, who are not cautious) being at increased risk.

Conclusions: The accounts of young people are notably absent from the knowledge base concerning childhood concussion. When enabled by a research orientation that privileges first-hand accounts and methods that enable the conveyance of abstract concepts, young people are capable of contributing unique insights regarding how they understand concussion: as a sweeping phenomenon that all young people are at risk of and that should be feared. When taken seriously, such insights can enable the development of public health initiatives and clinical practices targeted to the specific educational and support needs of young people.
Amazing Brains Project – Raising Awareness in Education for Education Professionals and for Pupils

Louise Wilkinson

Child Brain Injury Trust, Bicester, United Kingdom

An aim of the charity is creating awareness of childhood ABI in schools, so that education professionals have an understanding of ABI and its impact on academic progress and attainment.

The common response when approaching schools and educate them about ABI is “we don’t have any children with a brain injury”. From the systematic review conducted by Nathan Hughes et al (2012) TBI has a higher reported prevalence rate than many other more well-known and acknowledged areas of special educational needs, such as ASD and ADHD. The review conducted by Hughes et al stated prevalence rates for TBI alone were between 24-31.6%; therefore, it is statistically possible that schools have a number of pupils affected by ABI in each of their year groups. The number of children affected by ABI is potentially higher as the review by Hughes et al only looked at TBI; those children affected by ABI following illness such as meningitis, or hypoxic injury, stroke and tumour, were not included in this research.

Therefore, it is argued that almost every school will have children affected by ABI. Some will be known to have an ABI; however, there will also be an undiagnosed number who have been impacted by previous accident, illness, stroke tumour or poisoning, or non-accidental injury, and are seen by education professionals as “a bit different”.

We needed a “hook” to enable us to engage with schools, without initially mentioning ABI in children. Our siblings book “Rearrange your brain”, was the perfect tool as it has some subtle cognitive behaviour therapy integrated into the story of the brother who acquired a brain injury. The refrain in the book “I feel afraid cos things are strange, I need my brain to rearrange” fits perfectly with the current Key Stage 2 curriculum covering Growth Mind-set – helping children to believe it is possible to achieve and overcome anything. The project targets a region at a time offering “Amazing Brains” resources without charge to KS2 schools, for their work on Growth Mind-sets.

Schools are offered:
- Teachers Pack including full lesson plan for learning about the brain and how amazing it is; including functions and basic neuroscience around connections etc. Also included is information about ABI and how children are affected, with information about supporting children in schools following ABI.
- Set of 6 classroom activity sessions aiding learning about the brain.
- 30 “Rearrange your Brain Books”
- Packs for children that includes a leaflet for their parents, a puzzle and a bookmark

We also offer a limited number of opportunities within each region to visit the participating schools and deliver our “Amazing Brains” workshop to the pupils in the school.

In conjunction with the regional roll out of the Amazing Brains Project, we also offer those schools who have engaged in the project, the opportunity for their staff to attend our free one-day awareness workshop for educational professionals.

The Amazing Brains project therefore enables us to engage with schools who would otherwise have dismissed any approaches by the charity on the grounds that they “don’t have any children with brain
injuries”. Through this project we have been able to increase the number of schools and education professionals who are aware of ABI and also plant the seed in the minds of young children that their brains are so amazing, and it is vital that they look after them through wearing helmets, using car seatbelts etc. Like brain injury itself there is often an alternative path to achieve the same result – this is exactly what the Amazing Brains Project does for awareness raising.
All About My Brain

Louise Wilkinson

Child Brain Injury Trust, Bicester, United Kingdom

“All about my brain” are two short booklets to help children and young people better understand about how our brains work, what happens when the brain is injured, and the strategies that could help them in their everyday lives. There are two versions of the book, with age/ability appropriate illustrations and language in each version.

Although written specifically for children and young people affected by ABI, the books are proving an invaluable tool for families as a whole to better understand the issues their son or daughter is facing.

When a young person acquires a brain injury they are often not told explicitly about the way that the brain functions and why their particular injury has changed the way they now think, feel, and process information, emotions, and feelings.

We realised that we had a plethora of information for families (parents and care givers), including books specifically for siblings. However, we had nothing written especially for the child or young person themselves that covered how the brain functions, what happens when it is injured, together with strategies that could help them in their everyday lives at home and at school.

We also wanted to make sure that the resource helped children and young people to normalise their changed abilities, feelings and emotions, to enable them to not feel so isolated about the brain injury. We therefore used the concept of the Experts who are brain injury survivors and guide the reader through the book. The Experts explain how their brain injury has impacted them and what strategies they find useful to overcome their difficulties.

Taking into account the vast differences in cognitive processing and reading ability of children and young people affected by acquired brain injury, we realised in the early stages of development that one book would not cover these diverse needs. We therefore produced two versions of the book. The second version used some of the basic content, however the language has been simplified to cater for a lower reading ability. For the second version, we also incorporated our Teddy mascot Albie, as younger children find it are better able to relate to a character when reading non-fiction. Albie has therefore been incorporated in the illustrations throughout the second version of the book, which is more visual that the first, older, version.

Although the book is primarily aimed at children and young people affected by ABI, the guidance for parents/care givers suggest that either an adult or sibling should read with the child or young person. This guidance has brought about a further benefit for the publications as many parents and siblings are finding the book invaluable in their own learning and understanding of the family member with ABI and how it affects them.

Although the books were only first published in December 2017 and March 2018 we are starting to see the impact of the project across entire families – enabling greater understanding, and in turn, improved familial support for children and young people affected by ABI.
Jaundice to Kernicterus: The World’s Most Avoidable Chemical Brain Injury

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Jaundice is common in newborns. It is easily diagnosed and is caused by an excess of bilirubin in the blood. Jaundice can be simply and inexpensively treated with phototherapy. In serious cases, it can be treated with an exchange transfusion procedure. When providers fail to use these treatments, jaundice can result in severe irreversible brain damage known as kernicterus or bilirubin neuro-toxicity. Obvious clinical signs and symptoms of bilirubin neurotoxicity can result in kernicterus encephalopathy.

Kernicterus is on the rise in Westernized countries. It is an acquired syndrome that is avoidable and preventable. Newborns should be monitored for the classic signs of kernicterus. This presentation will discuss the litigation process for these types of medical negligence cases using the case of Maclain Agnew from Gluckstein Personal Injury Lawyers in Toronto, Canada. The care providers in Maclain’s case adhered strictly to an outdated clinical guideline, known as the “McMaster Guideline”, to assess and treat the infant’s jaundice and failed to exercise any clinical judgment in their assessment and treatment methods.

Maclain’s kernicterus was caused by the reliance on a phototherapy protocol that was over 22 years old and was based on research that applied to well-term babies. Maclain was a pre-term unwell baby. His care providers did not follow the most up-to-date information concerning the bilirubin levels at which phototherapy should have been used. In 2010, three years after Maclain’s birth, the proper treatment protocol was determined. Had that guideline been in effect when Maclain was born, he would have received phototherapy and would not have the serious brain injury that he suffers from today.

After years of litigation, Gluckstein Lawyers obtained a significant settlement for Maclain and his family. Importantly, Maclain’s case prompted positive changes in the outdated guidelines. The guidelines for the management of jaundiced babies now apply to all babies, not just well-term babies, and involve clinical judgment and common sense. Maclain’s story is, unfortunately, not unique. His brain damage was preventable with inexpensive low-risk treatment. His care providers failed him by using an outdated clinical practice guideline and by failing to exercise clinical judgment.

Guidelines for the use of phototherapy should be based on current literature and should continually be reviewed and updated every five years. These guidelines must consider both well-term and unwell babies. Clinical judgment needs to be exercised in the care of infants exhibiting jaundice, which can result in kernicterus encephalopathy, requiring treatment with great caution. A worldwide protocol for phototherapy should be developed by the pediatric community to help prevent this phenomenon, emphasizing the importance of exercising clinical judgment in every case. We are all here for the same purpose: to see that, in the future, there are no more cases of kernicterus.
Vestibular Rehabilitation: Ensuring Proper Sequencing in Rehabilitation

Deborah Crowe¹
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Stop, Look & Listen!

Vestibular rehabilitation has become an integral part of pediatric brain injury.

Know what the symptoms are and don't be fooled.

Ensure you have the right professionals on your team to address the concerns of the child.

Know when to implement the correct modality for ears, eyes and neck rehabilitation.

Dizziness, vertigo, proprioception difficulties, tinnitus, they all have interconnectivity.

It's vital to the child to address the symptoms at the right time and in an order that will set the child up for success and ongoing symptom management and sustainment.

A concussion results in damage to the brain and causes strain on the muscles of the neck and upper back. The damage to the muscles in these areas reduces blood flow to the brain, which can decrease brain function and recovery from the physical, cognitive, emotional/behavioral as well as sleep disturbance symptoms from the concussion.

A concussion can occur from a direct blow to the head or whiplash. A concussion can occur from an automobile accident or a sports injury. In most cases, you will not lose consciousness. The 'incident' that can cause a concussion can and will be as unique as the person who sustained it.

The upper back and neck muscles are the 'suspension system' for the brain. If you have sustained a concussion, your brain is forcefully moved within the skull (coup-contrecoup injury) and the muscles of the neck and the upper back come under strain-absorbing some of the forces. The damage to the upper back and neck can cause restricted blood flow to your brain - producing or exacerbating specific concussion-related symptoms.

When managing children this is crucial to growth and development. These injuries must be taken into account when assessing and implementing the correct treatment plan and protocol and particularly in the correct sequence.

Deborah will show two different pediatric cases and how these cases differed due to the sequencing of treatment.
Preliminary Results of the Neuro-Rehabilitation Program at Sub-Acute Stage on Pediatric Oncology

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Introduction/Objectives: Cognitive functioning requires a constant interaction between different brain areas. This connectivity can be altered by the different co-adjuvant treatments and by the tumor location itself. Due to these aspects, as well as the high vulnerability of a developing brain, an adequate neuropsychological rehabilitation plan is necessary at the sub-acute stage, with the aim of achieving greater functional plasticity.

Material and Methodology: Two groups of patients were compared in this study. One group consisted of 3 patients who completed an 8-month multimodal neuropsychological rehabilitation circuit at the sub-acute stage. The other group, a control group, was made up of, 3 patients with the same oncological characteristics, but who did not receive this rehabilitation. Descriptive measurements, the medians of the different neuropsychological variables for each group, were calculated in order to compare said groups.

Results: The results obtained after the early and intensive intervention reflect a clear improvement in the executive and attentional functioning. This improvement correlates with a greater functionality and autonomy of the child in their daily life, in comparison to the group that did not perform rehabilitation.

Conclusions: Multimodal and interdisciplinary programs of rehabilitation are necessary for the early detection of cognitive sequelae, avoiding nonfunctional plasticity in a brain in a fully develop. The improvement in cognitive processing, shows us the validity of these rehabilitation programs in the sub-acute phase, ecological and multidisciplinary program.
The Long Term Psychological, Adaptive and Social Outcome 15 Years Following Severe Traumatic Brain Injury Sustained in Pediatric Age and A Comparison with Other Brain Lesions

Valentina Pastore¹, Susanna Galbiati¹, Katia Colombo¹, Monica Recla¹, Valentina Manfredi¹, Sandra Strazzer¹

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Objectives: Acquired brain injuries (ABI) in childhood are a leading cause of disability and death worldwide and can severely interfere with developmental milestones. ABI-related difficulties in childhood and adolescence have the potential to make transition into adult age particularly stressful and complicated. Another crucial challenge for patients suffering ABI in childhood arises when they begin their occupational life.

The present study aims to:
- Study employment rates of patients who suffered an ABI in childhood at 15 years from the pathological event;
- Identify patients particularly at risk for their social and working integration;
- Identify the clinical and sociodemographic variables predictive of the integration chance;
- Study the impact of the brain lesion's etiology on the outcome and integration at 15 years from the ABI suffered in childhood.

Methods: 147 patients (mean age at pathological event=8.75 years) were recruited from a cohort of young adults with acquired brain injury referred to our Institute for a clinical and functional assessment during developmental age. All the patients received an age-appropriate clinical functional assessment. Most subjects had suffered a brain lesion of traumatic etiology (63.9%), while other patients had sustained a brain lesion of vascular, infective or anoxic etiology.

Results: At 15 years from the brain lesion, 16.3% of the total sample presents with a particularly severe outcome and they do not have an occupation; 25.9% of the sample attends a day time center (where they work, if their clinical picture allows it); 29.3% of the sample presents with a favorable outcome and they have a regular and not protected work; 15.6% of the sample has a study activity; finally, 12.9% of the patients does not work or study although a favorable outcome. Despite differences are not statistically significant, we found that patients with brain lesions of traumatic etiology have slightly better chances to have a good working and social integration.

Conclusions: We believe that a successful medical rehabilitation may end with a failure, too, when adults who sustained a brain lesion in pediatric age experience a difficult integration at work, with severe consequences from a psychosocial and economical point of view. Therefore, it is crucial to increase our knowledge in this field by studying and identifying the factors that have the potential to affect the social and working integration of these patients.
Pilot Study for An Intensive Memory-Focused Training Programme for Children with Acquired Brain Injury (IMF-TPC)

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Objectives: Pediatric Acquired Brain Injury (ABI) has many causes including trauma, infections, vascular catastrophes or malignant neoplastic formations. The most common sequelae include attention and memory deficits, decreased speed of information processing and working memory problems. Memory-related deficits include anterograde memory, retrograde memory and working memory difficulties. The effectiveness of cognitive rehabilitation for adults suffering traumatic ABI has been demonstrated in several studies, while the pediatric field still has to face the belated disclosure of validated methods for the cognitive remediation. The aims of this study are: (i) to implement an intensive rehabilitation program focused on memory remediation and training; (ii) to assess its efficacy in a pilot group of pediatric patients with ABI; (ii) to assess its employability in an in-patient rehabilitation setting and during the post-acute stage of the disease.

Methods: 11 pediatric subjects were recruited from a cohort of children and adolescents with ABI referred to Scientific Institute «Eugenio Medea» for a clinical assessment and rehabilitation. At admission, the main demographic and clinical data were collected for all patients; each patient also received a psychometric evaluation at enrollment (T0), which was repeated after four weeks (T1). A brain MRI was performed by using a 3.0 T imaging scanner. The rehabilitation program consisted in an intensive treatment lasting 4 weeks with 3 daily interventions during working days (5 working days per week, for a total of 20 days of treatment and 60 sessions). The 3 daily sessions were organized into: 1 physio-kinesis and/or occupational therapy, 1 speech therapy, and 1 neuro-psychology treatment. Each session lasted 45 minutes.

Results: After 4 weeks of intensive treatment, a marked improvement in both immediate and delayed recall in prosodic memory was observed, as was an improvement in immediate verbal learning (semantically related and unrelated words) and visual recall.

Conclusions: This preliminary study involves a limited number of pediatric patients but shows encouraging results as regards the effectiveness of an intensive and early rehabilitation program in the subacute phase. On the contrary, previous studies focused on interventions during outcome and included just one daily session, mainly in tele-rehabilitation.
Don’t Forget the Parents! The ‘Parents in Mind’ Support Group Intervention for Parents/Carers of Children with an Acquired Brain Injury

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Objectives: Parents in Mind is a six-session support and information group for parents of children and adolescents with an acquired brain injury (ABI). We describe the design and content of the groups, and report outcomes from initial delivery in local NHS services in the UK. We discuss qualitative data on parent experiences of the group, and consider the benefits and challenges to group interventions, including barriers reported by non-attenders.

Methods: A group intervention was developed for parents/carers of children with ABI. It aimed to provide opportunities to develop understanding of key neuropsychological issues and to access additional peer support. Groups consisted of six evening sessions, delivered by two clinical psychologists. They included presentations and discussions on psychological and neuropsychological issues associated with childhood ABI (e.g. memory/emotions/behaviour). Parents/carers completed questionnaires on overall satisfaction, content and format of the groups. They were also asked whether their expectations were met and if they would recommend the group to others. Parents were then contacted by telephone to give more detailed feedback, and a questionnaire about reasons for non-attendance was sent to parents who had been invited but did not attend.

Results: Session-by-session and overall satisfaction ratings indicated parents/carers found the group supportive, helpful and relevant. Parents/carers valued opportunities to discuss concerns with professionals and other parents/carers; all said they would recommend it to others. Some had already made changes in light of the information provided. Reasons for non-attendance was varied but included distance to travel and childcare concerns. The benefits of peer support were highlighted by the parents staying in touch after the group.

Conclusions: Initial data and qualitative feedback from the Parents in Mind groups demonstrates the value of an intervention of this kind for parents/carers of children with ABI. The group is being rolled out to parents of children with a range of neurological conditions and shared with other centres in the UK. Challenges included making groups accessible to patients from a wide geographical area and considering the clinician cost-benefit ratio. Numerous benefits were highlighted in parent feedback, including parent confidence in advocating for their child, enhancement of the ongoing relationship with clinicians, and reductions in feelings of isolation.
Service Evaluation of ‘Youth Matters’: A Charity Programme Offering Community Support Services to Young People Across Northern Ireland Affected by Acquired Brain Injury

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Background: Previous research indicates experiencing an acquired brain injury (ABI) in childhood contributes to poorer measures in social interaction (Ryan et al., 2014), employment (Anderson et al., 2009) and quality of life (Anderson et al., 2011). A recent Swedish cohort (Sariaslan et al., 2016) found individuals who experienced an ABI in childhood or adolescence were at greater risk of low educational achievement (28%), outpatient mental health services visits (31%) and inpatient mental health services admission (57%) in adulthood, compared to peers without an ABI. This indicates the importance of on-going and monitoring and reviewing of this population post-rehabilitation (Dasarathi et al., 2010) and the potential benefit of targeted secondary preventative support services in adolescence and early adulthood.

In Northern Ireland, the Service Framework for Children and Young People (DHSSPS, 2015) states that “Children with disabilities should be fully supported to participate in valued childhood experiences and to have access to the same opportunities, life experiences and services as other children” and “teenagers with disabilities should receive high quality multi-agency support allowing them to have choice and control over life decisions in order to maximise opportunities for education, leisure, employment and independence.”

The Northern Ireland Acquired Brain Injury Pathway for Children & Young People (RABIIG, 2011) highlighted the important role the voluntary sector plays in supporting community rehabilitation and re-integration for children and families post-acquired brain injury (ABI). Organisations within the voluntary sector are often in the privileged position of being able to offer individualised and on-going support to children and young people across the domains outlined by the Service Framework for Children and Young People.

As a result of the RABIIG (2011) guidelines the HSC Children’s Acquired Brain Injury Consultation Service was launched in 2012, however no children’s service provision was made to replicate those of adult ABI services. Although other charities have made efforts to provide family support post-acute rehabilitation, regionally there was no dedicated clinical service providing ABI-specific input directly to children experiencing post-ABI difficulties in Northern Ireland. Brain Injury Matters have attempted to address this by providing a multi-professional and goal-orientated ABI-specific service to meet the long-term rehabilitation needs of this population.

Objectives: In 2018, Brain Injury Matters commenced ‘Youth Matters’; a secondary preventative programme offering one-to-one and group-based support services to young people (13 – 18 years) across Northern Ireland affected by ABI. The programme aims to help young people achieve self-identified goals, promote age appropriate independence, maximise social and educational engagement, promote psychological adjustment post-ABI and improve overall well-being.

Methods: The multi-disciplinary programme is delivered both at home and in community, employing a systemic and solution-focused approach to helping young people identify and achieve functional and meaningful goals.
Results: The Canadian Occupational Performance Measure (a standardised goal setting tool), self-report measures and rating scales are delivered as part of an initial assessment and reviewed at agreed intervals to measure service user’s perceived improvements over time. Individual case studies will be presented with pre- and post-intervention scores analysis.

Conclusions: This presentation will review the service to date, including the demographic of service users, quantitative and qualitative outcomes, critical reflections and areas for future development.
Diagnostic Criteria of Shaking: A Crucial Advance into Knowledge on the Abusive Head Trauma Through Shaking (AHT)

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AHT through shaking constitutes a major public health risk. Guidelines have been established to help health professionals cope with the diagnosis of this syndrome. (2011)

Methodology used: A conference of experts was organised by the French Society of Physical and Rehabilitation Medicine (SOFMER) under the patronage of the Ministry of Health.

The French High Authority of Health provided methodological support. Guidelines for professionals emerged from these conclusions.

The method used was to compare the most frequent lesions observed in SBS which are multifocal subdural hematoma and retinal haemorrhages (HR) with the lesions induced by mechanism often pointed out by the adults when the child is brought to hospital or later during the judicial process.

If the lesions induced are the same as those of AHT therefore the mechanism is acceptable. If not the mechanism is rejected.

From these results, diagnostic criteria of shaking were established based exclusively on the lesions observed and, on the history, related by the caretaker to explain the child’s state and not on the risk factors.

Moreover, in 2017 it has been possible to go further.

Other mechanisms have been brought forward: vaccines, apparent life-threatening events (ALTEs)...

And the knowledge on the type of lesions in case of SBS has also improved: type and location of the SDH/ lesions newly described as the rupture thrombosis of the bridging veins, intra thecal SDH...

The diagnostic criteria were updated from these results.

These diagnostic criteria are: For an infant, at the end of the clinical and radiological assessments, whatever the initial symptoms, after having ruled out differential diagnosis (infection/ metabolic disease) and if the clinical history is absent, incoherent, changes over time or is incompatible with the observed lesions or the child’s age, the diagnosis of shaking can be considered as secure:

- in case of multifocal SDH with rupture thrombosis of the bridging veins
- or in case of multifocal SDH with RH whatever they are.
- or in case of unifocal SDH with spinal or cervical lesions.

And the diagnosis of shaking can also be considered as probable:

- in case of multifocal SDH, even in the absence of RH or other lesions.
- or in case of RH multi-layered and or extended out of the posterior pole to the periphery of the retina.

In all cases, other elements can be present and reinforce the diagnosis of shaking: hypoxic or by laceration brain damage: cervical and/ or spinal damage, bone lesions, bruising (particularly on the face, ears, neck, and torso).
Conclusion: These guidelines to professionals make it easier to diagnose AHT through shaking
Diagnostic guidelines in abusive head trauma: key recommendations of a French public hearing. Anne S.
Frequencies of Occurrences of Violence Prior to A Diagnosis of Shaking

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Introduction/Background: The AHT through shaking constitutes one of the most severe paediatric head traumas.

Objective: When an SBS diagnosis is confirmed, take up a survey of how many children showed previous signs suggesting violence.

Material and Method: The study spanned over 50 legal cases on child abuse from 2011 to 2015. For each case, from all medical and legal information, we established if there were previous signs of violence, which they were and when they appeared.

Results: The average age at the date of diagnosis was 5 months. Signs of previous violence were found among 80% of children; 42.5% had been admitted to emergency services and 67.5% had been examined by a General Practitioner or a pediatrician when signs could already be noticed.

The signs were: Unusual vomiting without fever or diarrhea in 64% of cases (isolated in ¼ of cases), a break in the growth chart of head circumference (45%) or in the growth chart of weight (25%), bruises (34%), an occurrence of faintness (17%).

The mean age of these signs related to the occurrence of the episode leading to the diagnosis was 30 days (SD 32 days; median line 20 days) It was of at least 45 days in 25% of cases.

Conclusion: These results are evocative of a very frequent reiteration of violence; it is not in this case “a clap of thunder in a calm sky”. They also show the great difficulty most professionals run into when they want to speak of violence and set its diagnosis, above all when the signs are not obvious. Yet the earliest possible detection of the first signs of violence is the best to prevent reiteration and to protect the child. Lack of knowledge in this field may be an explanation and is detrimental to children. Better training for everyone is the key.
Information on the Perpetrators of Abused Head Trauma (AHT) Through Clinical Dating

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Introduction: The AHT is one of the most severe head traumas for infants because of their very young age, diffuse lesions and the repeated shaking. Thus, the early detection of the first signs of violence by the carers and the identification of the perpetrators by justice is essential to prevent any violent reiteration. Guidelines on the diagnosis of Abused Head Trauma by shaking were published by the French High Authority of Health in 2011 and updated in 2017. Some criteria for the diagnosis of shaking were established. The possibilities of dating the shaking were studied. Several publications which have analysed comprehensive accounts of shaking state that the symptoms occur immediately after the trauma. (Gilliland 1998; Starling 2004; Biron 2005; Adamsbaum 2014) The immediate occurrence of the symptoms after shaking is corroborated by the fact that in case of accidental trauma, the lesions are straightaway symptomatic: (Willman KY 1997). The object of our study is to use clinical dating to find out the perpetrator of shaking and to compare our results to those in the medical literature.

Method: The study spanned over 50 successive legal cases on child abuse between 2011 and 2015. The breakdown was 84% boys and 16% girls with among them 34% premature babies. The average age at the date of diagnosis was 5 months.

For each case, from all medical and legal information, we established when possible:
- the moment or the period when the child changed behaviours.
- which adults were then in his/her vicinity.

And we could thus identify the perpetrator of the shaking.

Results: In three cases, the perpetrators were the parents without any possibility to know the respective responsibility of the father or the mother. In the 47 other cases, they were 26 (52%) child-minders, 92% of whom were registered, 14 (28%) fathers, 6 (12%) mothers and 1 foster father i.e. 30% men and 70% women. No child was under day-nursery care.

Discussion: We found a strong predominance of women among the perpetrators unlike other studies (Starling 1999 and 2004). If our results are confirmed, it will be necessary to understand the reason why. We found a majority of child-minders, followed in numbers by fathers and then mothers. In contrast, the data coming from confessions (Starling 1999 and 2004) contrarily placed the child-minders in the last position, with a reduced tendency to confess compared to the mothers and above all the fathers.

Conclusion: To enable clinical dating, the legal expert must be provided with all the necessary medical and judiciary information including the recording of the phone call to the emergency services. Greater knowledge of the perpetrators based on clinical dating and some risky situations should facilitate prevention, particularly through targeted training.
The Brains Ahead! Intervention for Children and Adolescents with Mild Traumatic Brain Injury and their Caregivers: Rationale and Description of The Treatment Protocol

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Introduction: Approximately twenty percent of the children and adolescents after mild traumatic brain injury (MTBI) will not fully recover. They suffer long-term post-concussive symptoms and may experience limitations in activities and participation. Research suggests that early psychoeducational interventions may prevent long-term post-concussive symptoms. The Brains Ahead! intervention was developed to prevent long-term symptoms and, furthermore, to establish a more successful return to activities and participation after MTBI in children and adolescents.

Aim: To describe and explain an early intervention developed for children with MTBI and their caregivers.

Rationale: Providing individualized information and personal advice in addition to standardized information about the injury and possible consequences early after the injury may enable patients and caregivers to recognize and anticipate on relevant symptoms at an early stage and to prevent problems in activities and participation.

Theory into practice: The Brains Ahead! intervention is a psychoeducational intervention for children and adolescents who sustained a mild traumatic brain injury and for their caregivers. The Brains Ahead! intervention is a combination of screening for MTBI symptoms, psycho-education and follow-up. During the first 2-4 weeks post injury, a health professional experienced in working with children with TBI schedules a face-to-face appointment with the child with MTBI and parents. During this one-hour meeting, general information and a standardized questionnaire about brain injury related symptoms is used to screen for consequences. Depending on the results of the questionnaire individualized education is provided. The general information is offered both verbally and in a booklet in three different versions: one for children aged 6-12 years, one for children aged 12-18 years, and one for the parents. Six to eight weeks after the injury a telephone follow up of thirty minutes is planned. The children and parents can contact the professional more often and referral for rehabilitation treatment can be arranged if needed.

Discussion: The Brains Ahead! intervention is expected to prevent long-term post-concussive symptoms and problems in activities and participation in children and adolescents after mild traumatic brain injury. The strength of the intervention is the standardized psychoeducational information combined with an individual approach for children with MTBI and their parents starting at an early stage after the injury. The intervention is currently being evaluated in a multicenter randomized controlled trial.
Febrile Infection-Related Epilepsy Syndrome (FIRES): Rehabilitation Challenges Associated with This Diagnosis

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Febrile Infection-Related Epilepsy Syndrome (FIRES) is a rare childhood epilepsy syndrome. The cause of FIRES is unknown, but onset typically follows a mild febrile illness. The child experiences sudden onset of seizures which can quickly escalate and prove difficult to control. Using the NRH’s experiences of 4 recent cases of FIRES, this presentation will outline some of the challenges associated with providing rehabilitation services to this complex and heterogeneous group. While focusing on cognitive, social and behavioural factors, this presentation will outline the lifelong impact of this syndrome on the child and their families.
Education in Action: Evaluating Kids Concussion Infographics

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Objective: There is a knowledge gap concerning how to best educate youth on concussion, and what strategies are considered to be effective in translating concussion knowledge. Knowledge translation (KT) plays an important role in how information is shared. In the field of sports concussion, use of images such as infographics, are becoming a popular KT strategy for mobilizing sport concussion information. The objective of this study was to assess the impact of infographics on enhancing concussion knowledge and their effectiveness as a KT strategy.

Methods & Analyses: Six infographics were created to provide information about concussion that is easily accessed and understood by youth and families. A prospective, post-survey design was used to assess the infographics as a KT strategy. A self-developed survey consisting of 16 open and close ended questions was designed to gather information about the value and utility of the infographics and to determine additional knowledge needs. Frequency distributions were calculated for the close ended questions and a thematic analysis approach was used for the open-ended questions. Data (N=166) was collected from youth (47%) and adults (53%), representing athletes, students, teachers, healthcare trainees and healthcare professionals.

Results: Ninety-one percent of participants identified that the infographics met their knowledge needs, and 87% of participants indicated that the infographics gave them new knowledge. Participants identified that they intend to use the infographics to build knowledge (89%) and educate others (59%). Feedback provided about the infographic format was positive and participants suggested creating infographics for other topic areas including concussion recovery and management.

Conclusion: Infographics are a potentially effective KT strategy that are appealing and meet the knowledge needs of many audiences. Study results suggest that individuals intend to use these infographics to fill knowledge gaps, educate others about concussion, help others cope with concussion and inform concussion clinical care. Participants felt that infographics could be used to share additional concussion information, specifically in the areas of concussion recovery and management. While infographics have shown to be an effective KT strategy, it is important to recognize that sharing information in creative and effective ways is not easy. It is essential to keep KT principles in mind when creating concussion KT products to help minimize concussion knowledge gaps.
Successful Return-to-School for Canadian Youth Following a Concussion: The Experiences of School Staff, Students, Parents and Health Professionals

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Background: Youth spend much of their time in school where concussion symptoms may translate into difficulty paying attention and learning new material. There is limited research in understanding the challenges of supporting youths’ return-to-school post-concussion.

Objective: The objective of this study was to explore the experiences of school personnel, students, parents and health professionals who participated in a particular eight-stage post-concussion return-to-school protocol (the protocol).

Methods: Twenty-four participants (10 teachers, 1 school administrator, 5 students, 4 parents, and 4 health professionals) completed a semi-structured interview to provide insight into individual experiences using the protocol. The questions were designed to learn how participants were introduced to the protocol, their experiences using the protocol, and recommendations to improve future users’ experiences. Interviews were analyzed through thematic analysis where codes and over-arching themes and categories were established.

Results: Common themes that emerged were related to concussion management experience prior to and during the implementation process of the current protocol, and satisfaction with and challenges in using the protocol. School staff and health professionals reported experiencing improved concussion management after implementation of the protocol. Participants expressed a high level of confidence and ease when using the protocol. School staff found the steps and stages of concussion management to be clearly defined and highly valuable. Participants were satisfied with the protocol but had some difficulty understanding their roles in using the protocol, as well as monitoring and tracking students.

Conclusion: Participants expressed great value in the protocol and would like to see more schools using this protocol for concussion management. They strongly recommended promoting awareness and increasing educational opportunities of the protocol for school personnel, students, families, and physicians. Teachers, parents, and health professionals would like to see an electronic version of the protocol made to help improve communication, accessibility, and accountability. Students suggested streamlining the content and improving the visual display of the information. The results of this study informed the development of a new resource (SCHOOLFirst: Enabling Successful Return-to-School for Canadian Youth Following A Concussion) for teachers to support students in their return-to-school after a concussion.
PARASPORT: Therapeutic Activities that Promotes Physical, Social and Emotional Wellbeing for Brain Injured Kids and their Families

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The origin of the Paralympic Games date back to 1948 when the International Wheelchair Games were staged to coincide with the London Olympic Games. The event gradually grew, encompassing more sports and other disability groups, and is now the ultimate international competition for world class athletes with a disability.

In 1976, the Paralympic Summer Games were hosted in Toronto, following which the Canadian government was inspired to grant funding to be spent in developing sport opportunities for people with a disability – marking the beginning of ParaSport® Ontario (PO).

PO works in collaboration with local communities and provincial multi-sport organizations in delivering year-round parasport activities. The mission of PO is to provide support to all members of the disability community by finding, connecting with, and helping members to participate in competitive and recreational sport programs and activities of their choice while enhancing physical function and quality of life. PO believes that there is a sport or active living opportunity for everyBODY.

Initially, PO’s campaign focused on encouraging people with a physical disability to participate in some form of activity or exercise. However, it was quickly brought to their attention the need to provide opportunities to promote health and active lifestyles for the entire disabled population, including: those living with a brain injury.

Research has shown that 38% of children with a disability do not exercise after school, compared to their able-bodied peers at 10%. Children with acquired brain injury (ABI) who exercise show fewer symptoms of depression, fatigue and cognitive impairments. Exercise forces you to stay focused and concentrate long after engagement has been withdrawn.

There are often invisible barriers with which families of children with ABI must contend, including: attitudes, physical environment and equipment needs. Often, it is hard for a family to find programs for their child outside of a clinical or educational setting that will accommodate their child’s needs. PO has been working to breakdown these barriers by advocating for disabled children and their families with their innovative “TRY ME” program. It introduces newcomers to a variety of adaptive sport opportunities and connects them with related sports organizations and clubs within the community.

Bottom line: We must do everything we can to provide opportunities to our special children to engage in exercise which has been proven to improve a child’s recovery following a brain injury: mentally, physically, socially and emotionally. And ALL for the FUN of it!

On account of the years that Gluckstein Lawyers has been involved with advocating for children with ABI, we have become one of the founding members of PO, in the hope that children with ABI will be provided with diverse opportunities to participate in many sports!
Peer Event Initiative Developed to Address Social Interaction and Integration During Acute Neurorehabilitation following Acquired Brain Injury

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It is well documented that the peer relationships of children and adolescents are important for the development of social competence and confidence, and for mental health and wellbeing. Following Acquired Brain Injury (ABI), problems with disinhibition, impulsiveness, poor social judgement, lack of emotional response and slowed processing can all contribute to difficulties maintaining relationships with peers as well as difficulties in acquiring new ones. Evidence shows that when children and young people attempt to reconnect with their pre-injury peers the result is often a gradual loss of friendships and increasing isolation. Loneliness has been reported as one of the dominant concerns for individuals living with a brain injury.

In keeping with this, our routine patient/family follow-up interviews at 6 and 12 months after patients leave our neurorehabilitation program, demonstrate an overwhelming theme of friendship difficulties and isolation. At this conference in 2015 we presented social function being the greatest ongoing burden of disability on objective measures of outcome for children and young people after neurorehabilitation in our service.

To address this concern, we developed a peer event initiative within our acute neurorehabilitation service, based in a busy teaching hospital and major trauma center in London, to seek to improve the social interaction and integration of children and adolescents following ABI. Our aim was to promote better social competence and confidence, to reduce the likelihood of peer rejection for our patients, and to enhance understanding and involvement of their close friends in their peer’s brain injury and recovery from it.

The program has to date run for 2 years, involving 10 Peer Events. For the event, a group of friends chosen by the patient are invited to an all afternoon session at a nearby non-hospital facility. On each occasion the therapy team has offered brain injury education appropriate to the age group, information about the rehab process and how they could help their friend, a forum for questions, sharing thoughts and feelings and a supported social activity. Feedback questionnaires are distributed after each session.

The feedback has shown that the majority of the peers reported that the amount of information provided in each section identified above was ‘just right’ (87%). Following the session 73% of the peers reported that they had a better understanding of their friend’s injury, and 65% reported feeling better about the situation. These areas had been identified by them as previous barriers to support for their friends. Finally, they were able to identify practical and realistic support that they could provide. Patients and their families also reported positive outcomes from these sessions.

We regard this peer event initiative important in addressing the ongoing burden of social integration difficulties in children and young people following neurorehabilitation for ABI in their initial transition into community and school.
The SCHOOLFirst Return-To-School Resource: Evaluating the Usability and Satisfaction

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Background: Re-engagement in school-based roles and activities is paramount for youth following concussion. There is inconsistent information available for youth, families and teachers regarding the return-to-school process. While protocols and resources are available to inform ‘what’ steps to take to return-to-school after sustaining a concussion, resources provide insufficient support on ‘how’ to put these steps into action. To address this gap, ‘SCHOOLFirst’ a user friendly, accessible and evidence-based resource was developed to assist school personnel with supporting students to successfully return-to-school post-concussion.

Objective: The purpose of this study was to evaluate the usability of the SCHOOLFirst resource with school personnel and assess their level of satisfaction with the resource.

Methods: Fifty-six school personnel (36 teachers, 6 school administrators, and 12 ‘other’) completed a survey following a SCHOOLFirst Education Training Workshop where attendees received concussion education and were introduced to and learned how to access and use the SCHOOLFirst resource. The survey consisted of a demographic form, the System Usability Scale (SUS), and a satisfaction questionnaire. Demographic and likert scale data was analyzed using descriptive statistics (i.e. frequencies) and thematic analysis was used for open-ended questions.

Results: A majority of participants reported the resource to be easy to use (69.6%), not complex (62.5%), and felt confident using this resource (83.9%). Participants identified that they were satisfied with the resource (73.2%) and would use it in the future (83.9%). Participants provided positive feedback regarding the SCHOOLFirst return-to-school resource. Some reported that the tool was overwhelming and would benefit from a summarized version to provide a quick reference guide. Overall, participants found the links, videos and potential classroom accommodations within the resource to be helpful.

Conclusion: Participant feedback was used to optimize the SCHOOLFirst resource to ensure that it met the user’s needs. Next steps will be to disseminate the tool so that school personnel feel supported in assisting students with return-to-school post-concussion. This work contributes to efforts to improve students’ successful return-to-school post-concussion and emphasizes that everyone involved in a student’s life has an important role to play in improving post-concussion outcomes.
Psychoemotional Functioning in Asymptomatic Concussed Youth: A Longitudinal Matched Control Study

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Background: While pediatric concussion has been deemed a serious public health concern in Canada, little is known on the lasting psychoemotional sequelae, such as depression and anxiety, above and beyond clinical recovery from symptoms. Research to date has highlighted the impact of prolonged recovery on the development of secondary mental health issues, but little is known regarding how these trends manifest in youth who are asymptomatic and no longer experiencing the acute physical, cognitive and fatigue related effects of concussion. Further, resolution of self-reported post-concussion symptoms has been the main method of determining clinical recovery. The pediatric population experiences longer rates of recovery compared to adults and thus, it is important to better understand changes in youth’s psychoemotional functioning to prevent the development of more serious mental health issues.

Objectives: Utilizing the Beck Depression Inventory-Youth (BDI-Y), the objectives of this study were to: (1) explore the impact of concussion on self-concept, anxiety, depression, anger and disruptive behaviour in youth who are asymptomatic, compared to healthy controls; and (2) investigate the predictive value in using self-reported concussion symptoms to gauge potential changes in psychoemotional functioning along asymptomatic recovery time points.

Methods: This study employed a longitudinal, matched control design. All participants (N=32; concussed= 20; control=12) were between the ages of 10-18 years old (M=14 years, SD=2 years). Concussed youth were followed weekly while symptomatic and completed the Post Concussion Symptom Inventory (PCSI). When youth reported to be asymptomatic/clinically recovered, they completed the BDI-Y and the PCSI at approximately 1- 3- and 6-months following clinical recovery. Raw scores, T-scores, and clinically meaningful cut-offs were derived across the following domains: self-concept, anxiety, depression, anger and disruptive behaviour. Visualizations were carried out to depict change when comparing concussed and control youth across asymptomatic time points. Correlational analyses were employed to explore the predictive value of initial severity in PCSI total score on BDI-Y domains at 1- 3- and 6-months following clinical recovery.

Results: Visual analyses revealed that within concussed participants, increases were found in self-concept from 1-month to 3-months post clinical recovery. Similarly, the largest declines were found within the depression, anxiety, anger and disruptive behaviour domains from 1- to 3- months, compared to control participants who displayed more consistent scores across time points. Further, the severity of the initial PCSI total score post-injury had little predictive value on the BDI-Y domains.

Conclusion: Findings illustrate the presence of declines in negative constructs of psychoemotional function and increases in self-concept. These results underscore the importance of continued clinical follow-up in asymptomatic youth following concussion, as asymptomatic youth still appear to demonstrate a trajectory of recovery in their psychoemotional functioning after reporting clinical resolution of symptoms.
A Comparison of Behavioural Outcomes in Boys and Girls Four Years After Pediatric Mild TBI

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Introduction: Mild traumatic brain injury (mTBI) is one of the most common injuries experienced by children and adolescents. In adolescents, the type and severity of symptoms experienced following mTBI may differ between males and females, possibly due to variations in gonadal hormones (e.g., progesterone) which rapidly increase around puberty. It is unclear if these differences are also observed in younger children. To address this, we compared differences in outcomes for pre-adolescent boys and girls up to 4 years following mTBI.

Methods: This prospective, longitudinal study examined 124 children (mean age 4.2 years at injury [range: 0-11 years]; 64% boys) with mTBI. Parents completed the Behaviour Rating Inventory of Executive Function (BRIEF) and the Strengths and Difficulties Questionnaire (SDQ) at 1, 2 and 4 years post-injury. Analyses were conducted to compare outcomes between boys and girls and to identify predictors of outcomes at 4 years post-injury.

Results: Parent ratings of executive function (BRIEF) and behavioural and emotional functioning (SDQ) showed no significant differences between boys and girls at 1, 2 or 4 years post-injury (all p’s >.05). Similarly, patterns of recovery from 1 to 2 years and 2 to 4 years did not differ between boys and girls (p’s<.05). For the group as a whole, between 1 and 2 years post-injury there were no statistically significant changes in total BRIEF or SDQ scores. From 2 to 4 years parents reported a significant increase in behavioural and emotional difficulties (p<.05) and a significant improvement in executive function (p<.05). Socioeconomic status (SES) and parental anxiety (within 1 month of injury) were significant predictors of 4-year outcomes.

Conclusion: Outcomes related to executive, behavioural and emotional functioning up to 4 years after mTBI do not appear to differ between pre-adolescent boys and girls. Further research examining a wider range of outcomes in children including the post-acute period is needed to determine if sex-specific treatment strategies are warranted. Early interventions with families of low SES and/or high parental anxiety have the potential to improve long term outcomes after mTBI.
Active-8 Your Brain: An Eight-Week Intervention to Increase Physical Activity After Acquired Brain Injury in Adolescence

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Objectives: Clinical work with young people (YP) with an acquired brain injury (ABI) highlighted concerns about reduced levels of physical activity. Despite being very active before their illness or injury, many are unable to participate in the sports they previously enjoyed or find participation more challenging due to physical and cognitive impairments, and ongoing fatigue. This results in decreased fitness, weight gain, and limited exposure to the social and emotional benefits of physical activity. Given the potential gains of regular exercise regarding mood, cognition, fatigue and sleep (e.g. Williamson, Dewey and Steinberg, 2001; Mabbot et al., 2014), it was anticipated that YP with an ABI would benefit from rehabilitative support to increase PA. We describe an eight-week intervention with young people aged 14-18 which aims to increase post-ABI PA levels.

Methods: Four YP aged between 14 and 17 took part in a pilot intervention to increase PA. The YP were provided with Fitbit and requested to track their PA over a two-week baseline period. Participants next completed an 8-week intervention with a clinical psychologist. This included an initial goal setting consultation, followed by weekly phone calls to discuss progress and challenges. Questionnaires were completed by YP and their parents/carers at commencement and at the end of the eight-week period. These explored their mood (Beck Youth Inventories), fatigue (PEDS-QL), illness perceptions and reported levels of physical activity (Physical Activity Questionnaire). This was analysed alongside Fitbit data (including total active minutes, daily steps, and average restful sleep), and qualitative feedback from the YP and their parents/carers.

Results: Early outcome data, including Fitbit and questionnaire data, will be presented, and consideration given to the benefits and challenges of the intervention. All the YP involved in the pilot reported finding the intervention helpful and increased levels of PA were demonstrated. Parents also reported finding the programme valuable.

Conclusions: Initial findings demonstrate the potential value of an intervention aimed at increasing levels of PA in adolescent’s post ABI. A number of benefits were evident, and all participants said they would recommend the intervention to other YP with an ABI. They also expressed a desire to continue to build their levels of PA and were keen to set goals around this. There were some challenges to delivering the intervention, and the pilot demonstrated the particular importance of parental engagement with the intervention. Further exploration of, and research in, this interesting area, including plans for a larger trial using a single case experimental design (SCED), are now in development.
The Natural Course of Activities and Participation in Children and Adolescents up to Six Months After Mild Traumatic Brain Injury and the Relation with Function and Quality of Life

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Introduction: Post-concussive symptoms after Mild Traumatic Brain Injury (MTBI) have been studied thoroughly. As we know, approximately twenty percent of children who have suffered a mild traumatic brain injury may experience long-term consequences, including post-concussive symptoms. Most research focused on outcome on the level of function according to the International Classification of Functioning, Disability and Health (ICF) model. However, little is known about the outcome on the domain of activities and participation in children after MTBI. It is largely unclear what the outcome is on the level of recreational, active physical, social, skill-based, and self-improvement activities at home, in school and in the community. And also, what the course is of outcome on the longer term. It can be hypothesized, however, that the long-term consequences on the level of function, e.g. fatigue and post concussive symptoms, can influence the activities and participation of the children. In addition, restrictions on activities and participation can also be related to the experienced quality of life.

Since activities and participation is an important outcome and studies on these are scarce in children with MTBI, the aim of the present study was to investigate the natural course of activities and participation of children and adolescents up to six months after a mild traumatic brain injury. The second aim was to examine the relation of activities and participation with function and quality of life.

Methods: Activities and participation were measured with the Child and Adolescent Scale of Participation – CASP, and the Children’s Assessment of Participation and Enjoyment – CAPE. Both questionnaires were filled out at 2 weeks, 3 months, and 6 months post-injury. The CASP was filled out by children after MTBI and their parents (N=225). The CASP is a 20-item questionnaire designed specifically to measure participation in children with acquired brain injury, according to the components of the ICF-Child and Youth. The CAPE is a 55-item questionnaire and was filled out by children after MTBI (N=225).

Function was measured with the Health and Behavior Inventory, Child Behavior Checklist, Impact of Event Scale, and Paediatric Quality of Life Inventory – Multidimensional Fatigue Scale. Quality of life was measured with the Paediatric Quality of Life Inventory – Quality of Life Scale. Function and quality of life were both measured at 2 weeks and 6 months post-injury.

Changes in activities and participation over time were investigated with Repeated Measures ANOVA's. In case a significant difference (p <.05) was found between the three moments in time, additional post hoc analyses were performed, using a Wilcoxon signed-rank test to determine where the changes over time had occurred (significant level set at P <.02), based on Levene’s test.

To examine the relation of activities and participation with function and quality of life, correlation coefficients (Pearson r) of the change score between 2 weeks and 6 months were analyzed for activities and participation, function and quality of life.
Results: Currently, the final measurements are taking place. Therefore, the analyses of the abovementioned data from 225 children and adolescents with MTBI will be conducted during the coming months. At the congress in September 2018 in Belfast, we will be able to present the results.
Promoting Well-Being Through Early Dysphagia Intervention After Childhood Brain Injury: Can Speech and Language Therapy Make A Difference?

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Abstract: Acquired swallowing difficulties (dysphagia) after childhood brain injury can be life threatening and life changing. Aspiration of food, drink and saliva within the context of dysphagia and the need for tube feeding and therapeutic interventions including speech and language therapy (SLT) is acknowledged. Less well recognised is the impact that these interventions may have on the promotion of wellbeing for the child and their family as the child adapts their eating and drinking skills to accommodate impairment of muscle coordination, safety and endurance.

Aim: To review the impact of aspiration risk and tube feeding dependency on child and parental wellbeing and identify specific SLT interventions which may be a factor in promoting improvement in wellbeing after childhood brain injury.

Method:
• Retrospective analysis of medical case notes review over a 2-year period.
• All children given a diagnosis of Dysphagia by SLT after traumatic and non-traumatic brain injury included.
• Quantitative data collection: Inclusion of children who scored Initial Impairment and/or Activity score which indicated clinical aspiration risk and/or dependency for tube feeding only, recording (a) SLT dysphagia interventions using ICF BI SLT (2010) framework, (b) initial and final dysphagia scores/descriptors using Therapy Outcome Measures (TOMS Enderby 2016).
• Qualitative data collection: verbal testimonials from children and their families.

Results: 22 children’s case notes were analysed. Type (11=non-traumatic, 11=traumatic), Age (mean=11years, range=1mth–16years), Gender (Male 9:13 Female). Initial 22 TOMS scores indicated aspiration and/or tube feeding dependency with 21/22 (95%) scoring Well-being TOMS indicating high and constant to moderate distress/withdrawal about their dysphagia.

SLT Dysphagia Interventions included: SLT assessment within 24 hours, early oral hygiene and education programme, secretion management, ensure nutrition and hydration, early oral trials for training safe swallow, identifying dietary preferences, ability to participate in social mealtimes, providing support and appropriate information during adjustment period, advice on altered bolus size, textures and swallowing strategies and facilitating family involvement to support child’s dysphagia.

Final TOMS scores indicated 15/22 (68%) children were fully orally feeding (tube removed) with no aspiration risk with 15/15 (100%) scoring Well-being TOMS indicating mild occasional or no inappropriate distress about their dysphagia. Verbal testimonials supported positive findings and insights into why specific SLT interventions promoted well-being.

Conclusion: This study indicates that a high correlation of low well-being as rated by TOMS scale was associated with high clinical risk of aspiration and/or tube feeding dependency at the start of therapy. It demonstrated a need for at least x4 specialist SLT dysphagia interventions to support swallowing
rehabilitation. Well-being TOMS scores for these children improved by 95% in direct correlation with a 68% reduction in clinical aspiration risk and/or tube feeding dependency. Child and parent testimonials help explain the benefits of early swallowing interventions with SLT after childhood brain injury within the acute setting.
Profiles of Executive Functions in Survivors of Pediatric Brain Tumor. A Comprehensive Approach

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Background and Aims: Executive functions (EF) are a collection of distinct but related high-level processes, of major importance during development. They are frequently impaired following childhood brain tumors, with negative consequences on academic achievement and overall independence. However, EF assessment is often incomplete, mainly performance-based and conducted with a limited number of tasks. This study aimed at specifying the nature of the difficulties of pediatric brain tumor survivors, by performing a comprehensive assessment of EF domains, using a combination of performance-based tasks and a daily life questionnaire.

Methods: We used a newly developed test battery (Childhood Executive Functions – FEE), based on Diamonds’ developmental framework of EF (2013), comprised of 10 subtests assessing flexibility, inhibition, working memory, and planning, controlling for lower level processes (i.e. language, visual-spatial skills). Outcome measures allow to distinguish different indicators that contribute to global performance for each subtest (e.g. number of errors, time...). Twenty-seven children treated for various brain tumors and 27 healthy controls (matched for gender, age and parental education and occupation), performed the FEE battery, while parent- and teacher-ratings of the Behavior Rating Inventory of Executive Functions (BRIEF) questionnaire were collected, providing a more ecological and comprehensive view. The association between performance-based and questionnaire-based measures of EF was also examined.

Results: Patients performed significantly worse than controls on some, but not all subtests and outcome measures. Most domains were affected (Inhibition, Flexibility and Planning). The main finding was that overall, patients performed tasks significantly slower than controls, without making significantly more errors. Further, parents and teachers reported significant and extensive difficulties related to the children’s executive functioning in everyday life. Correlations between performance-based tasks and the BRIEF questionnaire were weak and not significant, as most often reported in the literature.

Discussion and Conclusion: This study allowed identification of a specific dysexecutive profile, that should be confirmed in a larger sample of pediatric brain tumor survivors. These findings could lead to improvements in childhood EF assessment, including in other clinical contexts. They could lead to better understanding of EF deficits basis (i.e. the cognitive cost of slow information processing) and their consequences in daily life. More targeted interventions could be developed.
Comprehensive Assessment of Executive Functioning Following Childhood Severe Traumatic Brain Injury: Validation of the FEE Battery

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Background and Aims: Childhood traumatic brain injury (TBI) is the leading cause of death and lifelong acquired disability, especially in terms of cognitive and behavioral impairments. Executive functions are frequently impaired following childhood TBI, with negative consequences on independence and academic achievement. There is a lack of sufficiently standardised developmentally appropriate comprehensive assessments of executive functions, at least in France. The aims of this study were to perform a detailed description of executive functioning following moderate-to-severe childhood TBI, and to study demographic and severity factors influencing outcome, using a newly developed neuropsychological test battery (Childhood Executive Functions – FEE Battery; Roy et al.).

Participants: A convenience sample of children/adolescents aged 7-16 years, referred to a rehabilitation department after a TBI (n=43; 65% boys) was included in the study and was compared to a group of healthy controls, matched for age, gender and parental education and occupation (n=86).

Outcome Measures: The FEE battery, comprised of 12 subtests, was designed to assess the four main executive domains described in Diamond’s developmental model of EF (flexibility, inhibition, working memory and planning), using verbal and non-verbal sub-tests in order to control for lower level processes (i.e. language, visual-spatial skills). It also comprises the parent- and teacher- ratings of the French version the Behavior Rating Inventory of Executive Function (BRIEF) questionnaire. Standardization of the FEE battery is underway, data has been collected in a large sample of almost 1000 children and adolescents aged 7 to 16 years and several validation studies are performed in parallel in different clinical conditions.

Results: In the TBI group, mean age at injury was 9.12 years (SD=4.1), time since injury 1.02 (SD=2.67). The large majority of the sample had sustained severe TBI (n=39; 93%). Mean Glasgow coma scale score was 5.85 (SD=2.06) and mean length of coma was 6 days (SD=11.21) Relatively to the control group, performance in the TBI group was significantly impaired in most of the FEE subtests (all time measures and most error measures), with moderate to large effect sizes. Regarding everyday life, patients were significantly impaired in most BRIEF sub-scales, both in parent- and in teacher reports. Univariate correlations in the TBI group did not yield significant correlations between the FEE subtests or the BRIEF questionnaires on one hand, and socio-economic status, TBI severity, or age at injury on the other hand.

Discussion and Conclusion: Executive functioning is severely altered following severe childhood TBI and is best assessed using a combination of developmentally appropriate neuropsychological tests and behavioral ratings, allowing a comprehensive understanding of children’s executive functions.
Diffusion Tensor Imaging Study of Main Parameters of Diffusion in Mild Traumatic Brain Injury

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Introduction: Standard visualization methods (CT and MRI) are not sensitive to a mild traumatic brain injury (mTBI). Mild TBI causes changes on microstructural level, that could be revealed by means of Diffusion Tensor Imaging (DTI). The aim of this work is to determine the values of main parameters of diffusion, such as FA (fractional anisotropy) and ADC (apparent diffusion coefficient) in mTBI based on DTI data.

Materials and Methods: Subjects: 11 healthy subjects and 11 patients with mTBI (up to 72 hours since injury), aged 13-17. Philips Achieva dStream 3.0T and 32-channel SENSE head coil were used. The standard TBI MRI protocol was applied, including T2-, T1-, FLAIR, SWI and standard DWI. No pathological changes in brain tissue of any subject were found.

DTI was performed in 32 directions (DTI_high_iso). Images were processed in Philips Intellispace Portal client (Fibertrack section). FA and ADC values were obtained by detaching the zones of interest: corpus callosum on sagittal slices, corticospinal structures (corona radiate, brain stem) on axial images and both sides of thalamus on 3D planes. The tracts that conduct nervous impulses to gray matter centers perpendicularly through the denoted regions were built. FA and ADC were calculated for all tracts in all directions. FA and ADC for two thalamus parts in three diffusional directions, corpus callosum in anterior-posterior diffusional direction, right and left corticospinal tracts in head-feet direction were calculated. Mean values of FA and ADC for thalamus and corticospinal tract in were found.

Mann-Whitney criterion (STATISTICA program) was used to define statistical significance of differences between the norm and pathology.

Results: Statistically significant changes detected for FA along the tracts passing through the right thalamus in axial diffusion direction, for ADC along the tracts passing through left thalamus Z axis direction, for mean values of FA and ADC along the pathways passing through the thalamus in the axial diffusional direction. Changes of these parameters along the tracts passing in other directions and through other structures have not been detected.

Discussion: The FA increase as well as the ADC decrease may indicate the inflammatory processes and cytotoxic swelling connected with microstructural and functional disorders of nervous tracts.

The absence of FA changes in transversal direction combined with the significant FA increase in lateral direction is caused by the rise of lateral diffusion velocity relative to transversal velocity and speaks for axonal swelling. It lowers the diffusion coefficient by decreasing the free space for water movement. To sum up, we demonstrated that acute mTBI causes axonal injury in tracts including thalamus, which might serve as a reason of functional disorders observed after the injury.
Speelsbrein (Playfulbrain) – A Book for Parents of Children Aged 0-4 Years with Traumatic Brain Injury Containing Information and Playful Activities That Stimulate Neurocognitive Development

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PlayfulBrain is an innovation in neurocognitive rehabilitation and psycho-education for parents. PlayfulBrain is a book containing information and playful activities that simulate neurocognitive development for parents of children with traumatic brain injury (useful for all ABI) in the age of 0-4 years old. By integrating play in the daily routine of parents and children at home.

Introduction: For children aged 0-4 years with traumatic brain injury (TBI), there are only few programs available in pediatric rehabilitation with attention for psychoeducation focusing on the neurocognitive development (i.e. perception, attention and executive functioning, and memory).

Parents play an important role in the recovery and development of their child with TBI. Raising parents’ awareness for neurocognitive aspects that can be addressed while playing with their child will stimulate their child’s neurocognitive development. Furthermore, it will teach parents that these aspects are important conditions for learning and behavior in later life.

Literature shows that action-based learning is more effective than playing through interactive media like TV, tablet or smart phone in children aged <3 years. However, there are no educational products available that support parents in action-based learning.

Objective: Develop a book for parents of children aged 0-4 with brain injury, with 30 examples of easy playful activities addressing neurocognition and information on the effects of TBI on neurocognitive development

Methods: There were several steps in the development of the book such as:
1) Literature search on usual neurocognitive development in children aged 0-4;
2) Literature search on neurocognitive rehabilitation for children 0-4 with TBI (and ABI);
3) Development of playful activities each addressing one or more aspects of neurocognition;
Activities met the following criteria:
- Activity is action-based
- Activity is situated in daily playing situation
- Activity is based on best practices
- Activity is affordable (i.e. materials are already present at home)
- Activity can easily be integrated in a daily routine without effort
- Activity is tailored at specific age range based on the known developmental steps
4) Developing the informative texts;
The book takes a positive stand, meaning that the emphasis in the book is on playing and whilst stimulating the neurocognitive development of the child instead of on emphasising the detrimental effects of brain injury.
5) Interviewing parents on the content of informative texts and the usefulness of the activities
6) Testing the playful activities in the different age groups;
7) Professional design of the book by hired design company.

Results: The innovation consists of two main products:
1) The informative book ‘Playful Brain’ for parents containing:
   - Informative texts for psychoeducation that raises awareness
   - Examples of playful activities that help parents to play with their child and simultaneously stimulate the different aspects of neurocognitive development.

   The book has many (photo)illustrations that enables parents to play the games at home without receiving therapy or psychoeducation first from health care professionals.

2) A guideline for psychologists that:
   - Describes how the PlayfulBrain book can be used in the contact with parents
   - Allows psychologists to tailor advice to parents which playful activities will be beneficial to their child, if specific test results indicate this

Conclusion and future activities: PlayfulBrain is an innovation neurocognitive rehabilitation and psycho-education for parents with children with TBI (useful for all ABI) in the age of 0-4 years old. By integrating play in the daily routine of parents and children at home, results will sustain over a longer period.

In the future an edition PlayfulBrain will be published for parents of all children (without brain injury) that focusses on prevention of negative effects after seemingly harmless accidents and falls.

Scientific research on the effects of using PlayfulBrain on neurocognitive functioning, and the applicability of PlayfulBrain for parents will be initiated in the near future.
Functional Near-Infrared Spectroscopy Identifies Differences in Cognitive Workload Following Pediatric Concussion Associated with Symptom Provocation

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Introduction: The diagnosis of concussion relies primarily on subjective self-report of symptoms, with multiple available standardized symptom scales used for that purpose. Using only symptoms to diagnose and manage concussion has proven problematic as studies have shown that, while higher acute symptom burden may be related to longer recovery and presumably more severe injury, symptoms can be non-specific to concussion and may be made worse by either cognitive or physical activity or inactivity. In an attempt to make concussion assessment more specific and objective, attention has been turned towards symptom provocation with task performance, which is clinically presumed to be related to concussion injury, with the working hypothesis relating to the inability to handle a particular cognitive or physical workload while injured. Recent studies utilizing fMRI have identified cerebral blood flow (CBF) differences associated with greater physical symptom burden in concussed subjects with symptoms compared to concussed subjects without physical symptoms, as well as increased brain activation with higher reported levels of concussion symptomatology. These studies have associated neuroimaging findings with general symptom status of concussed subjects, without being able to temporally link symptoms with the pathophysiology of the injury state.

In this study, we utilized functional near infrared spectroscopy (fNIRS) that can measure cortical oxygenation changes with battery-operated and wireless sensors in natural clinical settings. We hypothesize that symptom provocation with task performance in concussion, presumably the result of increased cognitive workload, can be temporally and quantitatively linked by fNIRS measures.

Participants: We recruited 114 youth and young adults with concussion, ages 7 to 21 years, median age 15, IQR (14,16), 54% female and; 112 healthy control subjects, ages 10-21 years, median age 15 IQR (14,16), 48% female from a subspecialty referral concussion program and regional secondary schools for this prospective cohort comparison.

Study Design: The subjects performed the King-Devick (KD) test while wearing an fNIRS device consisting of a headband which records anterior prefrontal cortex oxygenation changes with 4 optodes at a 4Hz sampling rate. The KD test is a rapid number naming task that has been shown to identify those with concussion. The main outcome measures were KD completion times, accuracy as measured by errors made, symptom provocation and cortical oxygenation changes during KD testing.

Results: KD times and accuracy (errors) did not distinguish between concussed subjects with symptom provocation and concussed subjects with no symptom provocation with testing. In contrast, fNIRS was able to detect significant task-related activity differences between concussed subjects with and without symptom provocation with KD testing (F1,2559=22.4, p<0.0001). The group with symptom provocation exhibited greater oxygenation change with testing.
Discussion: Based on our data, in particular, clinical data in the form of KD times and accuracy (errors) did not distinguish between those concussed subjects with and without symptom provocation with KD testing. In contrast, fNIRS was able to distinguish concussed subjects who had symptom provocation, in that those with symptom provocation exhibited a pattern of increased cognitive workload compared to those without symptom provocation with the KD task. Due to the high temporal resolution of fNIRS for measuring cortical hemodynamic changes and its utility in assessing real-world task performance in natural clinical environments, our data supports the concept that the physiologic basis for symptom provocation in concussion may be related to cognitive overload. Our concussed subjects with symptom provocation during KD task performance demonstrated greater cognitive workload than those concussed subjects who did not have symptom provocation with KD testing. These results suggest that fNIRS may provide key quantifiable insights related to state characteristics of injured patients with concussion that are not otherwise accessible using conventional clinical metrics or standard symptom report.
The Utility of Pupillary Light Reflex as an Objective Biomarker of Acute Concussion in the Adolescent Athlete

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Purpose: Visual problems and autonomic dysfunction have been well recognized following pediatric concussion. Testing of the pupillary light reflex (PLR) is a simple, non-invasive, and objective approach to examine the autonomic nervous system by accessing the brain pathways. The aim of this study was to objectively evaluate adolescent pupillary responses to a light stimulus after a physician-diagnosed concussion.

Methods: In this on-going prospective cohort study, PLR was assessed in xxx (number) of athletes in the pre-season. Within this cohort, 6 athletes sustained a concussion during their sports season and had post-injury assessments of PLR. The PLR was obtained in response to a brief step-input (0.8 seconds) white light stimulus, group of six adolescent athletes, ages (14 – 17 years) prior to the beginning of their sport season and in a longitudinal manner after concussion. PLR was quantified using the Neuroptics model PLR-300, hand-held pupilometer (stimulus recording duration= 5 seconds, light intensity=150. Pre-set and automated device-generated parameters used for analysis include the minimum and maximum pupil diameter, response amplitude and latency, mean constriction and dilation velocities and the maximum (peak) constriction velocity of the eye in response to a light stimulus. During each visit, three monocular trials were performed in each eye alternatively, and the responses for each eye were subsequently averaged.

Results: Five out of the six concussed adolescents showed response enhancement (25% or greater) following concussion, which decreased during the recovery process (days to weeks post-injury) to pre-injury or below initial pre-injury baseline measurements. Pupillary responsivity was found to be significantly enhanced after concussion compared to baseline measurements, waning over time. Maximum constriction velocity better highlighted the enhancement compared to the baseline pupil diameter.

Conclusions: Preliminary findings suggest autonomic dysfunction related to acute concussion, as identified by changes in the PLR, which wanes over time during recovery. Assessment of dynamic PLR responses has the potential utility as an objective biomarker to aid in concussion diagnosis on the sidelines or in the office, allowing physicians to quantify various static and dynamic parameters of the autonomic nervous system under parasympathetic and sympathetic control after concussion.
Neuropsychological Evaluation of Children in Low Consciousness State After A Severe Traumatic Brain Injury

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Objective: To follow up patterns of cognitive recovery in children (6—17 years of age) at the first four months after a severe traumatic brain injury (TBI).

Material and Methods: Seventeen children with TBI (GCS ≤8) were evaluated with the Coma Recovery Scale-R (CRS). Children were stratified into three groups according to their consciousness recovery. Seven children regained their consciousness completely and were assessed by the Luria Neuropsychological Battery test. Six children remained in the minimally conscious state (MCS) and were tested by the adapted procedure of neuropsychological assessment during the first four months. Four children with low level of consciousness were evaluated with CRS.

Results and Conclusion: The most destroying functions at the early recovery period were the processing speed (neurodynamic of mental activity), executive functions and memory. Children with the anterior cortex damage had the slowest dynamics of recovery. The slower dynamics of consciousness recovery was combined with severe primary damages of visual gnosis, speech and executive functions according to neuropsychological examination. The positive dynamics of consciousness recovery was combined with early behavioral changes and the greater rate of behavioral changes.

Keywords: children, TBI, low consciousness state, neuropsychological approach, cognitive outcome.
Cognitive Outcome and Blood Biomarkers After Severe Traumatic Brain Injury in Children

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Background and Aims: Children with severe traumatic brain injury (sTBI) have different cognitive outcomes from low consciousness state to good recovery and back to school. The aim of this study was to follow up the dynamics of cognitive recovery in children (aged 4–17 years) for the first 12 months after the trauma and to evaluate the level of glial protein S100B, as predictors of long-term cognitive outcome following paediatric sTBI.

Research Design and Methods: 47 children with sTBI (GCS≤ 8) were assessed with the King’s Outcome Scale for Childhood Head Injury (KOSCHI) and follow up in 1,3,6,12 months from the trauma. S100B in serum was measured during the acute phase after sTBI.

Results and Conclusions: The results revealed significant difference between acute S100B serum concentration and the dynamics of recovery. Higher levels of S100B were associated with slower dynamics of cognitive recovery.

Keywords: blood biomarkers, paediatric severe traumatic brain injury, cognitive outcome, S100B
Patterns of Recovery After Mild Traumatic Brain Injury in Children: Behaviour, Cognitive Function, and Health-Related Quality of Life

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Introduction: Traumatic brain injury (TBI) annual incidence rates among 0-14-year olds range from 280-1,300/100,000 population, with 80-90% being mild in severity. Symptoms of mild injury are expected to resolve shortly following injury but can persist for months in some children. The aim of this study was to determine patterns and predictors of children’s recovery over 48 months following mild TBI.

Methods: This prospective, longitudinal study examined 201 children (mean age 7.59 years at injury [range: 1-15 years]; 62% boys) with mild TBI. Parents completed the Pediatric Quality of Life Inventory and Behaviour Assessment System for Children at <14 days, 1, 6, 12 and/or 48 months post-injury. Those children aged >8 years at each assessment completed a computerised cognitive testing battery (CNS-VS). Patterns of recovery over time were determined using multilevel modelling.

Results: Between baseline and 12-months, on average parents reported significantly fewer child externalising (p = .01) and internalising (p = .008) behaviours, and improvements in child adaptability (p = .01), overall cognitive function (p = .04) and total quality of life (p = .001). From 12 to 48-months, child quality of life reduced significantly (p = .003) with no changes in child behaviour or overall cognitive function. Patterns of recovery from baseline to 48 months were associated with child age at injury, gender, and family socio-economic status.

Conclusion: Differences in children’s patterns of recovery over the follow-up period highlight the importance of monitoring early predictors of good and poor recovery, to enable the delivery of targeted interventions.
Acquired Brain Injury Following Acute Demyelinating Encephalomyelitis (ADEM): Three Paediatric Case Reports with Long Term Neuro-Disability

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Acute disseminated encephalomyelitis is a rare immune mediated and demyelinating disease of the central nervous system that usually affects children. It is typically a monophasic disorder presenting with multifocal neurologic symptoms. Its clinical features and prognosis varies across reports, however a long term serious complication such as an acquired brain injury is rare for this condition (1).

We present three cases of children who were diagnosed with ADEM and went on to have significant acquired brain injuries.

The first patient, a 3 and half year old at initial presentation, previously fit and well boy, presented with a 1-week history of feeling unwell. He progressed to demonstrate a fluctuating GCS, lethargy and weakness of his left arm and leg. A radiological diagnosis of ADEM was made, supported by CSF results. Following discharge, this young boy continued to struggle with his balance and frequent falls. His speech was not as fluent as pre-diagnosis and his behaviour became challenging. He requires input from neuropsychology and educational healthcare support.

The second patient, a 4-year-old boy, presented with increasing confusion and decreasing conscious level requiring intubating and ventilating. An MRI brain scan carried out on day 4 of illness demonstrated a picture compatible with ADEM. He was treated with steroids and intravenous immunoglobulins due to his challenging presentation. This child demonstrated signs of speech and language difficulties pre-insult. Following rehabilitation, it was evident that this young boy was developing increasingly difficult behavioural and learning needs. He required a high input from educational psychology and was diagnosed with ADHD, ASD, learning needs and a sleep disorder.

The third patient, a 13-year-old boy, presented with visual difficulties and following an MRI scan was diagnosed with ADEM. Following his acute management, he was rehabilitated and required neuropsychology and educational behavioural input for long term behavioural difficulties.

Complete clinical recovery is more common in children with ADEM and serious complications are rare (2, 3). There is however the small group of patients who suffer from long-term neuropsychological sequelae and may have substantial learning needs following their acquired brain injury. These patients require continuing follow up, extensive educational support and psychological involvement.


Neurophysiological and Functional Changes Induced by incobotulinumtoxinA Injection in Lower Limb Children Spasticity

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In children with congenital or acquired brain injury the development of spasticity and other features of the upper motor neuron syndrome often cause developmental disabilities.

An enhanced stretch reflex is one of the characteristics of muscle spasticity because it is the sign of the increased excitability of a-Motoneuron.

The study of a-Motoneuron provides a useful objective evaluation of the effectiveness of the therapeutic interventions used for the treatment of muscle spasticity. The H reflex of the soleus muscle is the electrophysiological counterpart of the monosynaptic ankle reflex. Variations in its size are considered to reflect segmental motor excitability changes when other influencing factors are kept unchanged.

OnabotulinumtoxinA (Botox; Allergan, Inc, Irvine, CA, USA) and abobotulinumtoxinA (Dysport; Ipsen Pharma, Wrexham, UK) have been widely used in the management of spasticity in children with brain injury in order to reduce hypertonicity and improve functional outcomes enhancing motor skill development.

The purpose of our study was to assess the safety profile and the effectiveness of incobotulinumtoxinA (Xeomin; Merz Pharmaceuticals GmbH, Frankfurt, Germany) on children with lower limbs muscle spasticity, using the same standard dose of onabotulinumtoxinA; and to determine the effects of incobotulinumtoxinA on spasticity through an evaluation of compound muscle action potential (CMAP) amplitude in the injected muscle and soleus H reflex.

Twenty children with spastic hemiplegia, aged between 2 and 7 years old, were enrolled for the study. Efficacy was evaluated based on clinical characteristics (the modified Ashworth scale, goniometry, GMFCS, Observational Gait Scale) and neurophysiological data including: compound motor action potential (cMAP) to tibial nerve stimulation and H/M ratio wave before the treatment and 2 weeks and 1 month after the injection of incobotulinumtoxinA. In all patients, gastrocnemius (medialis and lateralis) and soleus muscles were injected with 5 units/kg pro muscle.

Treatment with incobotulinumtoxinA according to previous study has proven its high clinical efficacy. In all patients, incobotulinumtoxinA injection induced a clear clinical improvement as showed by the reduced spasticity values of the Ashworth scale and functional scale improvement. Clinical data fully matched the changes in neurophysiological data, which were characterized by the reduction H/M wave ratio and by the lower amplitude of target muscle M-response.

Results have shown the safety and the efficacy of incobotulinum toxin A in the treatment of lower limb muscles spasticity in pediatric patients. Neurophysiological and functional outcome are visible already two weeks after the treatment. This precociousness of action of incobotulinumtoxinA can help both the rehabilitative treatment and the choice of orthoses. Furthermore, our results show that cMAP to tibial nerve stimulation and H/M ratio provide a helpful and reliable electrophysiological tool that can be correlated with the other clinical scales to identify motor neuron excitability in lower limb spasticity.
Rehabilitation Intervention for Acquired Brain Injury in Pediatric Patients Through Collaborative Approach

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Aim: To identify collaborative interventions done by the interdisciplinary team in Sultan Bin Abdulaziz Humanitarian City leading to greater patient outcomes.

Methods: Cases were identified through chart reviews from the Pediatric Specialty Program at Sultan Bin Abdulaziz Humanitarian City from 2011-2017.

Results: Being the largest rehabilitation facility in the Middle East, Sultan Bin Abdulaziz Humanitarian City admitted a total of 502 brain injury (traumatic/non-traumatic) pediatric patients for the last 7 years. Upon admission, initial assessment is done by the interdisciplinary team (Physiatrist, Therapist, Nurses, and Psychologist). Once patient is identified with cognitive impairment, they are assessed using Cognitive Assessment for Young Children (CAYC) and Dynamic Occupational Therapy Cognitive Assessment for older children (DOTCA) scale and referred for Cognitive Rehab Therapy. Due to the unique culture of Saudi Arabia, some barriers are identified during the course of treatment such as communication, compliance and educational level of parents/caregivers. Rehabilitation nurse plays a vital role in coordinating patient care, creating a safe environment and serving as a liaison between caregivers, patients and their families through Patient-Centered Care Approach. Rehabilitation nurses are not only charged with supporting patient therapy, but also providing detailed health education - teaching individuals how to manage co-morbidities. SBAHC has an electronic health record that strengthens patient-interdisciplinary team relationship, promotes communication, helps patient know more about their health, and facilitates their active involvement in their own care. It provides stakeholders an opportunity to align their perspective on what counts as patient centered care and how it should be accomplished. Improved adherence to self-care is reflected in the durability of outcomes.

Conclusion:
1. A Parent Educational Hand-out is essential to sustain a positive outcome after discharge.
2. Parent’s level of understanding and compliance to carry over skills is vital to prevent complication.
3. With a team-based approach to rehabilitation and family support, patients have a much better chance of recovery and reintegration to community.
4. Nurses who specialize in caring for patients recovering from acquired brain injuries are the medical support arm of an interdisciplinary care team further strengthening the collaborative care approach.
A Description of the Process of Developing a School Support Programme for Teachers in Ireland

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Special Education in Ireland: The role of NCSE Support Service formerly Special Education Support Service (SESS) is to enhance the quality of learning and teaching in relation to special educational provision. The service co-ordinates, develops and delivers a range of professional development initiatives and support structures for school personnel working with students with special educational needs in mainstream primary and post-primary schools, special schools and special classes.

Brain Injury Support for students: In September 2016 a module was included to provide CPD to teachers to assist in supporting children with brain injury in the classroom.

Following the development of resource materials, the service has provided 3 seminars in Education Centres across Ireland.

Through the NCSE/SESS schools can now apply for in-school support which provides more bespoke training at school staff level.

Beginning in January 2017 the service has provided in-school support to up to 20 schools.

This presentation outlines the evolution of the service and the key considerations in the development of the provision. It explores some of the feedback from the seminars and school visits. It also explores the new model for special education supports in schools and how best this model can support children with brain injury returning to school.

A discussion on some future research opportunities is included in further developing meaningful teacher training opportunities and improving in-school supports in Ireland.
Impaired language ability is a common consequence after childhood acquired brain injury (ABI). The impact on everyday participation can be severe, since language abilities are core skills to manage social communication in daily life.

Three major areas have been pointed out: expressive, receptive and pragmatic language skills. All three areas are commonly affected in children and adolescents with moderate to severe ABI. Expressive problems might involve naming and speed of conversation. Receptive impairments typically affect comprehension difficulties. Pragmatic difficulties can manifest as impaired ability to know how and when it is appropriate to enter a conversation with several participants speaking simultaneously. Also, in the complicated mild cases of ABI, there are frequent reports of impaired language functions affecting social communication.

A study is reported of language functions in 30 adolescents, 19 males and 11 females, with moderate to severe ABI. Mean age at assessment was 14.2 years and mean age at ABI was 12.7 years. Test results from conventional linguistic tests were analysed, as well as interview data based on self-assessments and parental reports.

Results show that adolescents with more severe injuries scored significantly lower on a sentence comprehension test. The same trend was evident in an assessment of word comprehension. Available naming test data showed that a majority of those who performed very low – low average results, and those who had not been able to complete the naming test, all belonged to the group who had the most pragmatic difficulties in daily conversations.

Interview data helped clarify pragmatic difficulties in every-day interactions, in particular difficulties associated with high speed verbal interactions. Fifty percent of the participants reported impaired ability to participate in daily conversations at home or with the family. The number of active speakers, the subject’s ability to take initiative, the ability to take turns in dialogues and language comprehension abilities seemed to be factors of crucial importance for performance in daily conversations.

Conclusion: A mixed methods design investigating language functions seems to be a fruitful clinical approach to understand individual social communication after childhood ABI. The data can be used to tailor interventions in the ongoing rehabilitation process.
Fact or Fiction- What Is the True Story of Return to Activity Protocols for Youth Recovery Post-Concussion: Accelerometry Versus Self-Report

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Return to School (RTS) and Return to Activity /Play (RTA) protocols are the most common approach to concussion management. It has been difficult to determine the effectiveness of these protocols as it hasn't been known if in fact these protocols are adhered to by children and youth. One hundred and thirty nine children aged 5-18 years of age completed a 3 year prospective cohort investigating their recovery trajectories while following RTS and RTA guidelines, with the following objectives: 1) to examine symptom trajectories compared to patterns of RTS and RTA; 2) to determine adherence to RTA/RTS protocols by exploring if symptom measures align with actigraph readings and stage of guideline.

Results: Sample mean age is 13 yrs, 45% male. Fifty-three percent of the participants adhered to the RTS protocol, and 56% to the RTA protocol as measured by symptom profiles and self-reported stage of protocol. However, using accelerometry readings of activity levels throughout the stages only 12 % were adhering to the stages 1 to 3. Significant negative correlations were found between concussion symptoms and RTS/RTA protocols at all time points. Children’s knowledge of protocols and total Post Concussion Symptom Score (PCSS) significantly predicted adherence to RTS and RTA. On average, youth are returning to school with accommodations by 8 days post injury and fully back to school by 1 month with 25% of youth still symptomatic at full return. The average return time to full sport competition is 52 days and 10% are still symptomatic.

Conclusion: Adherence to RTS and RTA protocols is poor with the early stages being the poorest, as youth are much more physically and cognitively active than recommended by stage 1 and 2 of existing concussion management protocols, despite symptom levels. Yet the overall trend of activity increasing as symptoms decrease suggests some level of adherence. Youth return to school faster than they return to sport despite symptom profiles. Adherence with RTS protocols appears to be less than RTA protocols. Children’s knowledge of protocols may be the most important factor in improving adherence during recovery from concussion. Future directions should focus on developing effective protocols that are evidence based, acceptable and easy to follow for children and families. Balancing symptoms with cognitive and physical demands of life participation is still the challenge for each individual child and there is much still to be learned about how much is too much and how much is too little for the best outcome for youth who have sustained a concussive injury.
Neuro-Ophthalmic Visual Impairment in Children (NOVIC) - A Multidisciplinary Model of Care

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Cerebral Visual Impairment (CVI) is the commonest cause of childhood visual impairment in the developed world. Clinicians are increasingly aware of this previously underestimated diagnosis whose incidence is increasing with greater survival of premature babies. These infants contend with multiple systemic complications of early birth and are vulnerable to cerebral insults causing CVI. Additionally, trauma, metabolic disease, cerebral infection and inflammation in otherwise healthy children can result in profound disability with CVI. The child with CVI is therefore a child with a myriad of complex needs.

The concept of CVI is difficult to appreciate. Our conventional idea of vision comprises acuity and visual field, with the influence of the brain’s higher centres proving too elusive to comprehend. In the past, families were left solely with the difficult news that their child had irreversible vision loss, beyond the remit of any intervention. Such visual impairment is inseparable from profound neuro-developmental delay. The idea that these children had visual potential to fulfil was poorly accepted. The pioneering works of Goodale and Milner and Prof Gordon Dutton, have demonstrated that these children indeed have a view of the world, but one so confusing that they can appear apparently oblivious of it. As professionals we need to understand how these children perceive their surroundings and build on these abilities, rather than trying to coax them into our normally sighted world.

In Belfast there was an overwhelming desire from families and health professionals alike to develop a holistic service for this significant patient cohort in a multidisciplinary setting addressing visual concerns, systemic needs and family support. Thus, in February 2015, at Belfast’s Royal Victoria Hospital we launched NOVIC - Neuro-ophthalmic Visual Impairment in Children, a multidisciplinary clinic aiming to address the needs of these children and their families. Our team comprises a group of individuals whose interests are in the paediatric and visual sectors.

Set up without any additional funding, the clinical staff involved gave up 6 of their usual scheduled sessions per year. There are 9 key members of the team:

• A Specialist Paediatric Orthoptist.
• A Consultant Paediatric Ophthalmologist.
• The Regional Head of Optometry
• 2 Paediatric Ophthalmic Nurses.
• The UK’s only Paediatric Eye Clinic Liaison Officer (ECLO, RNIB)
• A Paediatric Occupational Therapist
• A Paediatric Neuro-disability Registrar
• The clinic Secretary

Children are referred to the clinic, usually by allied health professionals or clinicians elsewhere. Reasons for referral vary from clarification of diagnosis, to developing strategies to fulfil visual potential.

The NOVIC clinic visit has 3 sections - preparation prior to the visit, the clinic appointment itself and written feedback following the visit.
We address visual, neurological, daily living and social/emotional needs at one visit. A detailed report of the including strategies to improve vision is sent to families and all professionals involved in that child’s care.

Our findings have informed assessments for housing adjustments and have improved these children’s school experience. We hope to encourage adoption of similar initiatives throughout the province and to aid health professionals managing such children. Medical students, junior doctors, orthoptists and qualified teachers of the visually impaired have attended the clinic to learn from our model and impart their own experience.

In June 2016, NOVIC was awarded the Team of the Year award at the inaugural UK Vision Pioneer Awards. We also were finalists in the Innovation category. The team also won the Innovation in Ophthalmology Category at the Northern Ireland Healthcare Awards in 2017.

NOVIC has successfully deployed a model of multidisciplinary care focusing on the whole child and their family with understanding their vision at its heart.
Is Diffuse Axonal Injury on Susceptibility Weighted Imaging A Biomarker for Executive Impairment?

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Traumatic brain injury (TBI) is a heterogeneous disorder in which diffuse axonal injury (DAI) is an important component contributing to cognitive dysfunction. During adolescence, myelinating axons and developing brain networks are especially vulnerable to acceleration-deceleration forces. Because DAI is widespread and causes disruption of the immature brain’s connectivity, impaired or delayed development of high level cognitive skills can be expected.

We aimed to examine the correlation between the amount of DAI and executive performance in adolescents with TBI. In addition, we investigated if the localization of DAI is decisive in executive outcome measures.

We recruited 18 adolescents with a mean age of 15y8m, averaging 2,5 years after sustaining a moderate-to-severe TBI with documented DAI. Susceptibility Weighted Imaging sequence was administered to localize and count the DAI lesions. The adolescents performed The Stockings of Cambridge (SOC) test and their parents completed the Behavior Rating Inventory of Executive Function (BRIEF) questionnaire to evaluate executive performance and adaptive functioning in daily living. Correlations were computed between the amount of DAI and executive performance, and between the localization of DAI and executive performance.
Age-at-Injury and Sensation-Seeking: Examining the Role of Sensitivity to Reward

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While the persistent nature of childhood head injury has been reliably demonstrated across a number of investigations (e.g., Anderson et al., 2013), further research is needed to examine what factors explain long-term negative outcomes. When a head injury is sustained, rapid acceleration-deceleration forces cause the brain to become mobile within the cranium, leaving the ventromedial prefrontal cortex (vmPFC) highly vulnerable to disruption via the bones at the base of the skull (Morales et al., 2007). Accordingly, injury severity is negatively associated with physiological arousal, such that the dampening effects of severe vmPFC disruption are mirrored in the mild head injury (MHI) population, albeit to a lesser degree (Baker & Good, 2014). This physiological underarousal has also been linked to increased substance use and thrill-seeking behaviour among individuals with a history of MHI (e.g., Alcock et al., 2018), implying that these behaviours may reflect an attempt to boost autonomic activity. Further, reduced sensitivity to punishment has been documented after MHI (Robb & Good, 2015); thus, heightened thrill-seeking may also reflect an inability to anticipate negative consequences.

The current study investigated the effect of age-at-injury and MHI severity on sensation-seeking behaviour in university students. Two-hundred and thirty students (43% MHI) completed self-report questionnaires assessing sensitivity to punishment and reward and risk-taking. Results indicated that injury severity was associated with sensitivity to punishment, such that injuries resulting in a loss of consciousness (LOC) were associated with lower levels of punishment sensitivity compared to MHIs not resulting in a LOC; and both MHI groups exhibited lower sensitivity compared to their non-injured peers. In contrast, MHI status alone was predictive of greater reward sensitivity, while no differences were found between injuries with and without LOC. Age-at-injury was also a significant predictor of sensitivity to reward, whereby students with later-age injuries reported greater reward sensitivity; however, no significant relationship was observed between age-at-injury and punishment sensitivity. Further, age-at-injury accounted for 5.2% of the variance in thrill and adventure seeking on the Sensation Seeking Scale (Zuckerman, 2007) and 8.4% of the variance in erratic lifestyle scores on the Self-Report Psychopathy (SRP-III; Williams, Paulhus & Hare, 2007); students who sustained their injuries later after age 16 experienced greater self-reported risk-taking. Notably, when reward sensitivity was included in the second step of each regression, the relationship between age-at-injury and thrill-seeking, \( \beta = .18 \), and erratic lifestyle, \( \beta = .12 \), was no longer significant, \( p > .05 \). These findings imply that sensation-seeking may serve as a solution to attenuated arousal after injury and individuals with later-age injuries may engage in activities that amplify autonomic levels due to greater reward sensitivity. Further research is needed to examine how injury-related factors, such as age-at-injury, can impact post-injury outcomes.
Executive Functioning Outcome Seven Years After Severe Childhood Traumatic Brain Injury: Results of the Seven-Year Follow-Up of the TGE Cohort

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Background and Aims: Severe childhood traumatic brain injury (TBI) leads to severe and long-standing executive functions deficits, with negative consequences on social participation, academic outcome and later independence and integration in the workforce. The aim of this study was to prospectively study executive functioning, 7-8 years after severe childhood TBI, in comparison with a matched uninjured control group, as well as demographic and medical factors associated with outcome.

Methods: Children (aged 0 – 15 years) consecutively admitted in a single trauma center for severe non-inflicted TBI (Glasgow Coma Scale score ≤8 and/or Injury Severity Score >16) over a 3-year period were included in a prospective longitudinal study. At 7 years post-TBI, executive functions were tested using a combination of computerised tasks (Dual Task, Inhibition and Flexibility subtests of the Test of Attentional Performance -TAP) and the Behavioral Rating of Executive Functions (BRIEF) questionnaire. Full-Scale Intellectual Quotient (FSIQ) was considered in the analyses. Patients were compared to a group of controls, matched for gender, age and parental education level.

Results: Sixty-five of the 81 included children survived (66% boys). At the time of the study, one third of the group had reached adult age (≥18 years). Thirty-nine patients (60%) participated in the study [mean age at injury 7.6 years (SD=4.72); time since injury 7.6 years (SD=1.5); age at assessment 15.3 years (SD=4.46, 7.2-22.2), initial Glasgow Coma Scale: 6; length of coma 6 days (SD=4.8)]. No significant difference was found between participants and non-participants. For 36% of the group, at least one parent had graduated from high school.

In the TBI group, significant impairment was evident for most (8/12) of the TAP outcome measures for divided attention (all p<0.034) and flexibility (2/6; p<0.01), but not for the inhibition subtest. Relative to the control group, BRIEF scores were significantly elevated for all subscales and composite indices in the TBI group [(mean metacognitive index (MI) 58.1 (SD=12.2) versus 49.8 (SD=11.5); p=0.0106); mean Behavior Regulation Index (BRI) 60.8 (SD=18.1) versus 48.8 (SD=8.5); p=0.0027) and mean Global Executive Composite –GEC 60.3 (SD=14.8) versus 50.2 (SD=10.7); p=0.0051)].

Correlations of demographic and medical factors with the TAP subtests was not feasible given the high number of outcome measures. Higher (worse) GEC scores of the BRIEF were correlated with longer length
of coma (r=0.45, p=0.01), but not with parental education, age or age at injury. Finally, MI of the BRIEF was significantly correlated to FSIQ (r=-0.45; p=0.01).

Discussion and Conclusion: Cognitive and behavioural aspects of executive functioning are significantly impaired several years post-severe childhood TBI, with consequences evident on everyday life. They seem to be mostly related to initial TBI severity and to the evolution of intellectual ability. Long-term specific care and follow-up should be systematic.
Social Participation and Navigation (SPAN): Description and Usability Testing of a New Website and Web Application for Adolescents and Young Adults with Acquired Brain Injuries

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Adolescents and emerging young adults with acquired brain injuries (ABI) often experience social participation restrictions. Evidence-based interventions to promote social participation are lacking despite evidence that social participation is critical for successful outcomes across the lifespan. To address this need we developed and pilot-tested an app-based coaching intervention for adolescents and emerging young adults with ABI: Social Participation and Navigation (SPAN). A key limitation of the mobile app that was initially created for SPAN was that it could only be used on iPhones and iPads. Additional challenges were identified with mobile app usability and participants using SPAN tips and information topics. To address these limitations, a new SPAN website and web app was created (July 2017 to February 2018) to enable users to use the app on multiple devices, and to improve overall app usability and knowledge uptake of the tips and topics for multiple stakeholders. Usability testing is currently being conducted and will be completed in May 2018.

Aims: 1) To describe and demonstrate the new SPAN website and web app for use with adolescents and emerging young adults with ABI; 2) To report on results of the usability testing.

Methods: Two usability tests are in different phases of completion. The first study involved graduate students (n=15) with academic knowledge and/or professional experience working with individuals with brain injury. Graduate students had two weeks to review the features and content of the website and use the web app to create a social participation goal, and key steps and timelines needed to implement and achieve the goal. At the end of the two weeks, they completed a Qualtrics web-based usability questionnaire to rate and provide feedback and suggestions about the different website and web app features and content. Data from this study have all been collected and are now being analyzed. The second study involves adolescent and young adult (n=10) traumatic brain injury and brain tumor survivors using the website and web app during a 30-minute one-on-one in-person session with a project coordinator. The project coordinator facilitates and records the session using a usability script, feedback questions and observation notes.

Descriptive statistics and content analyses are being used to examine usability questionnaire data from both studies and observation notes from the in-person sessions with participants with ABI.

Results: Results will include: Frequency of responses to the Qualtrics rating scales focused on clarity, understanding, ease of use, and usefulness specific to features of the website and web app (graduate students); key observations from in-person sessions with participants with ABI; and common feedback and suggestions from all participants.

Conclusions: Future work needed to improve utility, knowledge uptake, and dissemination of the SPAN website and web app will be described.
Follow-Up of Hearing Screening Failure Following Traumatic Brain Injury in Young Children

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Background: A hearing loss is a common consequence of temporal bone trauma that may have special implications in the pediatric population. Early recognition of hearing loss, especially in children, is imperative and can greatly decrease associated morbidity (Bowman et al., 2011). The mechanism of a TBI puts children at risk for hearing loss but there is limited research reporting that describes hearing status of children after TBI. Temporal bone fractures are the most common type of skull base fracture in pediatric trauma. (Perheentupa et al., 2010). Temporal bone fractures can lead to injury to the facial nerve, sensorineural, hearing loss (SNHL), mixed hearing loss, and conductive hearing loss (Frisenda et al. 2015).

Methods: Study participants were enrolled in a prospective longitudinal study investigating the acquisition of cognitive and language skills following TBI in early childhood. Eligible participants were children between the ages of 6-9 years who experienced a TBI or Orthopedic Injury (OI) before age 6 years and their families. Participants attended a testing session that included a battery of cognitive, language and reading measures. Prior to test administration, vision, hearing and articulation screenings were administered. All participants who failed the hearing screening were given a written document to take to their pediatrician for a referral to a complete audiometric assessment. A sub-sample of participants who did not pass the hearing screen on one or more visits was examined. An interview was conducted with available parents and descriptive data was analyzed to develop a profile of these participants. The interview consisted of ten questions and inquired about whether the parents understood the result of the failed hearing screen at the time of the testing visit; if they completed any follow-up with a medical professional; if the child has complained about any problems with his/her ears; and if they have had any additional problems with their ears since the testing session. A mixed methods approach was used to analyze the data collected from the original study and follow-up qualitative interview.

Results: Children in the TBI group had a mean age of 7 years, 6 months, mean length of time since injury of 5.32 years and 80% of the group had a mild TBI. 40% of parents reported they did not understand the hearing screening results and 50% of parents reported they did not follow-up with the pediatrician after receiving the hearing test results stating that their child failed the hearing screen. Of the parents whose children failed the hearing screening and did not seek follow-up care, 20% of parents reported their child has had subsequent ear problems such as: complained about difficult hearing, ringing in ears and ear pain. One parent reported noticing problems with their child’s hearing. In addition, 60% of the parents reported their child has had a history of ear infections since the injury.

Conclusions: Children with TBI have risk for hearing loss following their injury. Education about hearing and potential for hearing loss after TBI should be offered to parents at the time of injury diagnosis. Screening and follow-up audiometric testing is critical to ensure early intervention is accomplished to improve language and learning outcomes following TBI children.
Rehabilitation of Executive Function in Paediatric Traumatic Brain Injury (REPeaT): A Randomized Controlled Trial for Treating Working Memory and Decision-Making

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Background: Difficulties in working memory and decision-making are common post childhood Traumatic Brain Injury (TBI). Despite this, there is a paucity of research pertaining to implementation and effectiveness of interventions to reduce these common difficulties which impact significantly on one’s ability to function independently. One such intervention, Cogmed Working Memory Training Program, has shown success in improving working memory in other childhood clinical populations, but has received little evaluation in the TBI area. This study aims to evaluate whether Cogmed improves working memory and decision-making post childhood TBI and whether these benefits generalize to functional areas.

Method: The study is a randomized controlled trial of the Cogmed (RM version) intervention for children post-TBI. Children aged 7-15 years are initially screened for working memory impairments. Eligible participants are then randomized into either the treatment group (Cogmed) or the active-control group (Lexia). With an online clinician’s weekly support each group trains online for 50 minutes each day, 5 days per week, for 5 consecutive weeks. Outcome neuropsychological and functional assessments are carried out immediately at the completion of the intervention and at 6 months follow-up.

Results: Post-intervention and at 6 months follow-up, we expect Cogmed will address a treatment gap evident for children presenting with working memory and decision-making impairments following TBI, while also improving prospects in other functional areas.

Conclusion: The expected outcome will enhance prospects in education; and improve socialization and overall quality of life in children post-TBI. Our team will then aim at implementation of the intervention program into rehabilitation facilities and community settings.
Service Improvement Project: Evaluation of Effectiveness of Routine Clinical Data to Guide and Evaluate Paediatric Neuropsychological Rehabilitation

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**Background:** The international collaboration of the Common Data Elements (CDE) group recommend best outcome measures for the paediatric ABI population (McCauley et al., 2012). The selection of the CDE measures was intended to improve outcome prediction and measure treatment effects.

Recolo UK Ltd is a provider of privately funded community based neuropsychological rehabilitation for children, young people and young adults. Associates collect data from their assessments and reviews to formulate functional impairments and monitor rehabilitation outcome. Recolo uses measures recommended by the CDE (Gosling, 2015).

**Aim:** To ask, ‘what standard does our service achieve?’ by investigating: consistency with the standard, reliability of data collection, adequacy of measures for formulation, sensitivity to change and factors affecting outcome.

**Method:** Clients have a wide range of brain injury types and severity. Through routine clinical practice, associates collected data of 150 children with brain injury and their families.

**Measures:** PedsQL core and fatigue inventories (child and parent forms), PedsQL family impact module, Family Assessment Device (FAD), Behaviour Rating Inventory of Executive Function (BRIEF), Strengths and Difficulties Questionnaire (SDQ) and Child and Adolescent Scale of Participation (CASP). Data is anonymized for analysis. Data will be evaluated in relation to consistency, reliability and sensitivity using relevant statistical analysis. Nonparametric tests will be used due to the data being ordinal.

As a service evaluation the project does not require ethical approval.

**Results/Findings:** Visual analysis of measures used by Recolo against CDE recommendations will indicate that the dataset is consistent with guidance standard. Comparison of frequency data against the CDE standard will determine how reliably data is being collected. Chi square will be used to analyze observed versus expected frequencies. We will analyze baseline assessment data investigating relationships between child impairment, family functioning and quality of life. Spearman’s correlation will be used to describe these relationships. Change analysis will be performed for data available at assessment and review. This will be at the group and individual case level with CDE measure as dependent variable and time of assessment as independent variable. Wilcoxon tests will be used.

**Discussion and Conclusion:** Strengths and weaknesses of the current dataset will be discussed. Recommendations will be made to improve the database’s psychometric properties, facility of collection, sensitivity and utility for future research. This will allow the organization to continue to improve delivery and outcome measurement.
Understanding and Supporting Important Relationships in the Early Stages of Recovery Following Brain Injury: How Do Peer Events During Inpatient Rehabilitation Impact on Patients' Narratives About Their Friendships?

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Difficulties in social relationships following childhood ABI are well-documented. Formulation of these difficulties is multi-factorial: 1) brain injury related deficits including language, social reasoning, and social communication impairment, or behaviour and emotional regulation issues impact directly on relationships; 2) the child’s experience of a ‘serious illness’ sets them apart from their friends, due to extended hospitalisation, fatigue, accelerated maturity, and the impact of acquired disability on identity and self-image; 3) The context of the ABI may result in trauma symptoms for the child, their family, or their friends, with feelings of guilt or anger influencing interactions; 4) at a broader level, societal attitudes to disability, due to lack of knowledge or experience of brain injury and the lack of true integration of disabled individuals into society will influence relationships.

The multi-disciplinary neurorehabilitation team at Kings College Hospital has responded to this body of research literature as well as to local data about the relative slow recovery of social function in our cohort by putting into place Peer Events to support a child’s friendships through their inpatient rehabilitation.

Feedback collected from events over the past 18 months has demonstrated a positive impact of the session on participants’ understanding of brain injury and their feelings about what has happened to their friend. Patients themselves have also given positive feedback about the events, for example noting that friends have become more protective of them, or recognised the importance of their relationships. However, PEDI data at the time of discharge and 6 and 12 month follow up indicates that social relationships are not back at baseline, in contrast to more significant improvements seen in other domains (McCormick and Loveday, IPBIS conference presentation, 2016).

A more in-depth study of the narratives that adolescent patients tell us about their peer relationships at different stages of recovery from an ABI has been carried out. At an early stage of rehabilitation information is routinely gathered about valued social relationships and networks, and these are reviewed across the inpatient stay.

Changes in these relationships during rehabilitation are explored therapeutically, and visual representations of these relationships are created. Questionnaire data from the PEDI and the SDQ is also gathered. As outlined in the systemic therapy approach, the narrative about patients’ relationships is thereby ‘thickened’, allowing for new outcomes to be considered.
Single Case Experimental Design – A Bridge Between Science and Practice? Feasibility Study 1

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Background: There is a need for good quality evidence in paediatric neurorehabilitation. Single-Case Experimental Designs (SCEDs) are ideal for reporting behavioural interventions due to their flexibility, but the scientific calibre of such studies in the literature is variable (Tate et al. 2008). Being N-of-1 trials, SCED studies can be considered as Level 1 evidence for treatment benefit (OCEBM).

Standards for conducting and reporting SCED studies have improved recently (Evans et al. 2014). Single-Case Reporting Guideline in BEhavioural Interventions (SCRIBE) is a reporting guideline for SCEDs. This will be a helpful guide to build the evidence base with robust studies reflecting real clinical practice.

Aim: To test the feasibility of presenting routine neuropsychological rehabilitation practice as Level 1 evidence.

Method: This is a Single Case Experimental Design (SCED) embedded within a service development context.

Context: Recolo UK Ltd, a provider of community based paediatric neuropsychological rehabilitation for children and young people. The work is litigation funded. A system has been developed to produce routine rehabilitation within Single Case Experimental Designs. Ethics approval for this project was granted by the Psychology Department University of Bath.

SCED: A child with a brain injury referred for neuropsychological rehabilitation received an intervention delivered by an associate psychologist. The intervention was delivered within the normal parameters of the litigation funded rehabilitation.

The procedure involved: a) recruitment, consent and design planning; b) goal setting, intervention and goal review; c) write up and independent evaluation of report.

Participants: The child, their family, associate clinician, research lead, design consultant and independent reviewer.

Results/ Findings: Results include these variables: dependent variables relating to the therapeutic goal, independent rating against Single-Case Reporting Guideline in BEhavioural Interventions (SCRIBE), clinician activity data and costs.

Discussion and Conclusion: Results are discussed in relation to this question: “Is it feasible to report routine neuropsychological rehabilitation practice as Level 1 evidence?” As a feasibility study, limitations of the model, applicability and generalisability of the process are considered.
Neuropsychological Support for a Teenager Following an Air Gun Shot Injury to the Head

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Background: WT was a normally developing 13-year-old boy who sustained an intentional gunshot injury to the head with an air gun. He was brought to A&E by his grandmother and sister with right sided weakness, word finding problems and a small supraorbital wound at the midline. A trauma call was initiated, and Police were informed, who found an air rifle in the shed and blood splattering on the floor. A suicide e-mail written to mum was found. CT head scan found a track of acute haemorrhage and parenchymal disruption extending across the left frontal and parietal regions. Conservative neurosurgical management was recommended.

Acute Stage: Main clinical concerns were expressive language difficulties (e.g. aphasia, dysarthria), weakness on right side arm and suicide risk. A brief neuropsychological assessment identified normal vocabulary and visual reasoning skills, but significant weakness in working memory and verbal comprehension. Speed of information processing was very slow. Implications of these findings included WT’s ability to make informed decisions on verbally presented information and verbally communicating needs. Psychology support was offered to all family members around issues of guilt, self-blame, family dynamics/reorganisation. WT reported no memory for the event and no feelings of low mood.

Post-acute Stage: Discharged after 14 days to parental care with 24-hour supervision, CAMHS and Social Services involvement. No behavioural or emotional concerns, described by mother as “usual-self”. Neuropsychological assessment two months post-injury (13 years 9 months) indicated normal intellectual reasoning skills, but impairments in working memory, processing speed and executive functioning (esp. inhibition, word access and planning). Some recovery of intellectual and working memory skills from the acute stage. Persistent post-traumatic amnesia. WT keen to “go back to normal and not think about what happened”.

Follow-up Stage: WT returned to school (start of Autumn term), he reported being ‘slower’ in English, forgetting to complete homework and being easily distracted in lessons. Strategies to support weaker working memory, executive functioning and processing speed were shared with school. No emotional or social concerns, friends unaware of nature of injury (told them he ‘fell off his bike’). Discharged from CAMHS and Social Services. Bullet had moved to an operable position, but WT and parents reluctant for neurosurgery due to concerns regarding possible side-effects.

Conclusions: WT exhibited selective cognitive deficits in keeping with the trajectory of the air pellet. His lack of emotional affect regarding the incident and apparent lack of insight by parents into the nature of cognitive difficulties raises on-going concerns regarding recovery post-injury and possible future mental health issues, with one-year follow-up planned. This case provides an interesting example of the varied role of neuropsychology in an acute trauma hospital and highlights the importance of both general clinical psychology and specialist neuropsychology skills.
Improving Communication within an Interdisciplinary Team in a Rehabilitation Facility

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Objective: According to the Quality and Safety (QSEN) initiative teamwork and collaboration is one of the core competencies nurses should become effective in. Unclear communication or breakdown in communication can be dangerous when it comes to patient care. The purpose of this project was to look at communication within the team and how relevant information was shared throughout the team in order to have a safe smooth transition to the unit. On occasion patient’s admission were delayed or cancelled due to breakdown in communication and relevant resources not put in place. Fractured communication within a team can critically affect patient care outcomes. It is therefore vital that the exchange of information within teams is crucial and that the information reaches the right person in a timely manner. If individual team members do not effectively communicate, patient safety is at risk (Sutcliffe, Lewton & Rosenthal 2004), therefore the continuity of care can be the end result. Patient and job satisfaction may also be the outcome.

Method: The aim of the project was to develop a communication tool in conjunction with a weekly interdisciplinary waiting list planning meeting in a paediatric rehabilitation programme to ensure that patients have a safe transition from the acute hospital or home to The National Rehabilitation Hospital. Effective liaison with the community and within the team assists admission where all aspects of medical, nursing care and rehabilitation, behavioural management plans etc. are put it place. The complexity of the patient is determined when all documentation is available and pre-admission liaison carried out by the Paediatric Liaison Nurse and possibly IDT members depending on the complexity of the case. The 3 categories are High, Moderate and low, alongside The Rehab Complexity Score.

Benefits: Resources such as equipment, environment controls, accommodation are in place to guarantee a smooth transition. This document is updated constantly ensuring all relevant information is shared and the team have access to this information on a shared drive. Once the communication tool was developed implementation was piloted and led by the Paediatric Liaison Nurse who populated all the information on the document for those patients who were for admission imminently and was updated constantly. A new electronic folder was opened where the IDT could access all the information and add new information as necessary. The document was then incorporated into the waiting list planning and admission meetings.

Conclusion: The benefit of using this communication tool was that each team member had access to the relevant information such as patient needs, hospital and community therapist which facilitates planning the individual’s rehabilitation programme. Building a strong communication strategy can help avoid preventable errors and ensure that teams can concentrate on patient centred care.
The Development of a Paediatric Liaison Nurse within a Rehabilitation Service

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Objectives: The Paediatric Liaison Nurse Service was set up in September 2014 in order to assist paediatric patients with acquired brain, spinal cord injury or other acquired neuro-disability to transition from the acute hospitals on many different sites in the Republic of Ireland to transition to The National Rehabilitation Hospital (NRH) for specialist rehabilitation in order for them to return to their community and live as independently as possible in the aftermath of their injury.

Method: The NRH Paediatric Programme was reviewed with regards to safe transition from the acute setting to rehabilitation unit, medically, psychologically and in terms of their readiness to engage in the intensive rehabilitation programme. Establishment of effective liaison with acute hospitals, families and community teams while children/young people are on the active NRH waiting list while providing a service which optimises quality and continuity of care for paediatric patients within the programme was the main focus. The objectives of quality, access and value were also key.

Benefits: Establishing and maintaining effective liaison with staff in referring hospitals/agencies while acting as an advocate for children with acquired disability and their families benefits the transition from acute hospital/home to NRH. Carrying out pre-admission assessments in referring hospitals and attending IDT Discharge Planning Meetings in pre-admission period hugely beneficial for the following reasons. Having the opportunity of meeting with patients/carers/guardians in referring hospitals pre-admission advising them on NRH Paediatric Programme and system of care while providing expert nursing advice on rehabilitation following an acquired brain injury to parents/carers and also healthcare professionals. Delivery of feedback/updates to NRH Interdisciplinary Team (IDT) at Waiting List Management, admission meetings and weekly conference ensures that all relevant information is shared between the acute and rehabilitation sites. Attaining up to date reports and documents in order for the IDT to plan and deliver rehabilitation in a timely and safe manner while providing a patient profile for the team in order for them to develop an assessment plan and progress to setting goals for each individual’s rehabilitation. Representing the child/young person/family across sites, during the rehabilitation phase and post discharge for further liaison education and follow up reviews.

Conclusion: The Liaison Nurse Service has further developed in the years since being introduced acting as the first point of contact for community services general practitioners etc. for any child encountering problems following discharge from the National Rehabilitation Hospital. Making contact with paediatric patient’s family/carer/guardian following discharge through a telephone call within six weeks post discharge liaison with IDT with regards to these issues and the provision of feedback to other hospitals, GPs, schools or community services.
Putting Families First

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Acquired Brain Injury (ABI) in childhood is a significant public health concern. This is not to ignore the potentially very significant impact that these injuries have for the injured child, but also for the wider family (i.e. parents, siblings & extended family members), as childhood ABI has been described as a family affair. It is vital that families are not seen as passive aspects of the injured child’s recovery environment. An emerging evidence base documents the critical and facilitative role that injured children’s families play in restoration of function, enhancement of child quality of life (QoL) and in their contribution to society in the longer term.

The evidence base in the paediatric health literature documents that family and parent targeted interventions with the aim of enhancing resilience, adjustment, stress reduction and employing problem-solving and family therapies can show improvement in parent stress and child behaviour (McCusker et al., 2012). In the paediatric ABI literature, this is replicated to a degree (Fitzpatrick et al., 2018), with family interventions taking different formats (e.g. curriculum-based parent groups, online forums), delivered by various groups (e.g. statutory services or voluntary service providers) with varying length of involvement.

In light of the evidence base and given local service experience in both the voluntary and statutory sector of delivering family-targeting programmes (e.g. CHIP project, McCusker et al., 2012; Fitzpatrick et al., 2018) Brain Injury Matters and the Psychological Services Department, Belfast Health & Social Care Trust embarked upon the creation and delivery of the Family First Service in conjunction with the Big Lottery Fund NI in 2015. The Family First Service aims to provide families with the skills and understanding necessary to predict, pre-empt and prevent the development of addition difficulties in the wake of an ABI in childhood. In so doing the service aims to help families become authors of their own pathway and also negotiate and navigate through obstacles, barriers and professional misunderstanding/lack of awareness regarding the long-term implications of ABI. It also aims to assist families in orienting themselves to the “new normal” that can arise in the wake of illnesses and injuries that can be traumatising for the families.

This presentation will outline details of the service’s activities to date, including a profile of the families referred (including other involved services), the model of service delivery (including partnership work arrangements), evaluations to date, critical reflections and areas for future development.
Introduction: Swallowing is a complex sensorimotor behaviour involving a coordinated neural interplay at both cortical and subcortical levels. Damage to this swallowing network can lead to swallowing problems (dysphagia). The functional neuroanatomy of recovered swallowing in this population remains uncertain. We have looked for correlations between dysphagia, clinical features and brain lesions in children with congenital or acquired hypoxic-ischemic injury.

Patients and Methods: This case series included 15 patients (sex ratio: 6 female and 9 males, median age at clinical evaluation is 36.5 months, range 196-6 months) admitted to the Neurorehabilitation Unit because of a history of hypoxic-ischemic events. All these patients received an assessment of the degree of dysphagia using the Penetration – Aspiration Scale (PAS) to evaluate gravity of dysphagia, performed a video-fluoroscopy and a cerebral magnetic resonance imaging (all images were obtained by using a 3.0 Magnetum Vision Scanner) with the aim of characterizing the lesion. The median follow up for these patients was 12 months (from September 2016 to October 2017).

Results: All patients presented a severe neuro-disability (spastic quadriplegia, psychomotor delay, muscular hypotonia, oral motor dysfunction in various combination), 8 patients have seizures, 6 patients take drugs that increase drooling (benzodiazepines, levitiracetam). PEG was present in 12 children, tracheostomy was present in 2 patients and no patients needed a mechanical home ventilation. Among these patients 6 were preterm. According to the scale of dysphagia and video-fluoroscopy we have classified them in: severe dysphagia for solids and liquids (7 patients), severe dysphagia for liquid and medium for solids (3 patients), slight dysphagia (1 patient) and oral abilities delay (2 patients). Neuroimaging findings reported: isolated basal ganglia lesions in 6 patients, associated with cortical lesions in 4 patients, bilateral frontal white matter lesions in one and brain stain lesions in another one.

Conclusions: According to our limited cohort we observed that severity of dysphagia is correlated to specific factors such as brain stem lesions, mainly associated with basal ganglia and cortical lesions, epilepsy, severe cognitive and developmental delay. Further comparative studies are needed.
Self- and Informant Reported Psychological Symptoms and Executive Dysfunctions in Adult Survivors of Pediatric Brain Tumors

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Aim: The aim of this study was to investigate psychological symptoms and executive function (EF) among adult survivors of pediatric brain tumor (PBT).

Methods: One hundred and fourteen Norwegian PBT survivors and 170 healthy controls matched for age and gender completed the Adult Self-Rating (ASR) and the Behavior Rating Inventory of Executive Function - Adult Version (BRIEF-A), as well as a questionnaire on demographic information. In the PBT group, 89 informants (mainly biological mothers) completed the informant version of the ASR, i.e. the Adult Behavior Checklist (ABCL), and the informant version of the BRIEF-A.

Results: Significantly more problems were reported by PBT survivors compared to controls on the ASR subscales Somatic Complaints, Thought Problems, Attention Problems, Rule-Breaking Behavior, as well for the composite scales Internalizing Problems, Externalizing Problems, and Total Problems, (p=.000-.021). PBT survivors reported significantly more executive problems compared to controls on the BRIEF-A subscales Shift, Self-Monitor, Initiate, Working Memory, Plan/Organize, and Task Monitor and the composite scales indexing behavioral (BRI) and metacognitive (MI) aspects of EF, as well as the Global Executive Composite score (GEC) (p=.000-.028). Informants reported significantly less problems than the PBT survivors themselves on the ABCL subscales Aggressive Behavior, Rule-breaking Behavior, and Externalizing Problems (p=.002-.030). Informants reported significantly less problems than the PBT survivors themselves on all of the BRIEF-A subscales, except on the subscale Organization of Materials (p=.000-.027). For both self- and informant reported metacognitive and behavioral aspects of EF there were significant differences, with more difficulties reported in the cognitive domain (p=.000).

Conclusions: The present study suggest that even many years after completion of PBT treatment and well into adulthood, survivors still experience significantly higher levels of psychological symptoms and problems with aspects of EF interfering with daily life, compared to their healthy peers. Our findings suggest that it is mainly the cognitive aspects of EF that are affected by PBT and PBT treatment, sooner than the emotional/behavioral aspects of EF, as more patients reported significantly more problems concerning metacognitive than behavioral aspects of executive function on the BRIEF-A scale. Interestingly, informants reported significantly less problems with EF on the BRIEF-A than the PBT survivors did themselves. Given that difficulties with cognitive aspects of EF may be less visible to the surroundings than behavioral difficulties, but more readily experienced by the PBT survivors themselves, this discrepancy in patient-proxy report may support our findings that executive dysfunction experienced by PBT survivors are of a more cognitive than behavioral nature.
Current Approaches and Future Directions to Assessing Participation in Children with Acquired Brain Injury and Cerebral Palsy: A Systematic Review of Measurement Properties

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Background: Acquired brain injury (ABI) and cerebral palsy (CP) are two of the most frequently occurring neurological conditions in paediatric rehabilitation. Children with ABI or CP often experience limitations in participation. Participation is one of the key components of the International Classification of Functioning, Disability and Health (ICF) as well as of the ICF for children and youth (ICF-CY) and is defined as “involvement in a life situation”. Life situations include social relations, community activities, and social play. The interest in participation as the ultimate outcome of rehabilitation is increasing rapidly. In parallel, multiple instruments to adequately assess participation have been and are being developed. When selecting instruments in research and in clinical practice, measurement properties are essential to consider. The aim of the present review was to provide a comprehensive overview of available measures to assess participation after paediatric ABI, and their measurement properties.

Methods: A systematic review was designed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement and the recently published COSMIN (Consensus-based Standards for the selection of health Measurement Instruments) guidelines for systematic reviews of patient-reported outcome measures. The databases PubMed (including MEDLINE), PsycInfo, Embase, and CINAHL were searched until April 2018. Additionally, studies were identified through cross-referencing and by consulting experts in the field.

Results: Results will be presented on 1) which participation instruments are being used in studies with children with ABI and CP, and 2) the measurement properties of these instruments. We will report on content validity, structural validity, internal consistency, cross-cultural validity/measurement invariance, reliability, measurement error, criterion validity, hypotheses testing for construct validity, and responsiveness of the instruments.

Discussion: By combining available information, we will be able to identify the ‘best’ measures in terms of measurement properties. Findings of the present review will be compared to those of recent reviews in other (paediatric) patient populations. Thereby, we will be able to offer concrete guidelines for future research and clinical practice regarding children with paediatric ABI and CP.
The Importance of Early Intervention for Pupils with ABI - Presentation of a Working Model (“Straks”)

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Statped is a national service offering support and counselling in special-needs education to schools and kindergarten, where the local authorities do not have the necessary resources. The services are provided free of charge for the municipality.

For children or adolescents with acquired brain injury (ABI), early initiation is critical for successful transition from hospital back to school. Our hypothesis is that early intervention leads to better coordinated effort between health and school professionals and collaboration between these groups is a key success factor. Children with ABI need supportive educational services such as special education programmes, and often these services are not present when the child or adolescent returns to school. Early intervention will allow schools to prepare and meet the changing needs of a child or adolescent with ABI.

ABI is still considered a low-incidence disability. Therefore, school professionals, typically teachers or psychologists, lack adequate training in how to meet the needs of pupils who have suffered ABI. Further, they often lack knowledge and competence about the consequences of ABI on school performance. Hence counselling is needed to ensure better facilitation and follow-up on return to school after ABI.

Inclusion in mainstream school is an important objective for Norwegian education policy. To ensure better transition and re-entry to school or kindergarten, Statped has launched an early intervention programme offering support as an outreach (low-threshold) service in the municipality. The idea is that there is a close collaboration between health and school professionals already when the child or adolescent is discharged from hospital.

The aim is to offer easy-access counselling and guidance to parents and educational professionals in schools and kindergarten as well as providing knowhow and expertise about ABI and its consequences for children or adolescents. The goal is to obtain a joint understanding of the educational needs and set appropriate educational objectives.

Normally, the Educational-Psychologist Counselling Service (PPT) applies for services from Statped. With this early intervention programme there is an exception to the rule. No application is needed in the initial phase, and parents or teachers can contact Statped directly, which makes support and counselling more accessible at a vulnerable stage of the rehabilitation. In these cases, timing is often of the essence, and Statped has a two-week deadline for initiating the counselling process.

Statped has applied this working model for some time with positive results. The programme contributes to building a bridge between health and education institutions when the pupil is returning to school after ABI. The working model will be presented in the form of a case study of a young adolescent with acquired brain injury after head trauma. A set of best practice guidelines will also be proposed based on our experiences.
Age-Dependent Differences in the Impact of Paediatric Traumatic Brain Injury on Executive Functions: A Prospective Study Using Susceptibility-Weighted Imaging

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Childhood and adolescence are sensitive periods for the development of executive functions (EF, i.e. inhibitory control, working memory, and cognitive flexibility). Age at injury have a significant influence on the impact of traumatic brain injury (TBI) on EF.

The present study investigated 1) whether age at injury differentially affects EF 6 months and 2 years after TBI in children aged 5-15 years, and 2) whether the association between brain lesions and EF depend on age at injury. Children with TBI (n=105) were categorized into four age-at-injury groups based on previous studies and proposed timing of cerebral maturational spurts: early childhood (5-6 years, n=14), middle childhood (7-9 years, n=24), late childhood (10-12 years, n=52), and adolescence (13-15 years, n=15). EF were assessed with performance-based tasks, a global EF performance score and a parent-report of everyday EF. TBI patients’ EF scores 6 months and 2 years post-injury were compared to those of typically developing (TD) controls (n=42). Brain lesions were visualized using susceptibility weighted imaging (SWI). Result indicated that global EF performance 2 years post-injury was lower in children with TBI than TD controls in the early childhood and adolescence group, suggesting particular vulnerability in these age groups. Inhibitory control seemed to be especially affected by TBI, as indicated by differences between children with TBI and TD children in terms of inhibitory control performance in early childhood and everyday EF behaviour across childhood and adolescence at the 2-year assessment. No impairments were found in working memory or cognitive flexibility after TBI.

Given small group sizes, findings from analyses into correlations between EF and SWI lesions should be seen as preliminary evidence. Neuropathology correlated with adolescent everyday EF behaviour 6 months post-injury, and with 2-year global EF performance of children injured during middle childhood. Taken together, the results emphasize the need for long-term follow-up after paediatric TBI during sensitive developmental periods given negative outcomes 2-year post injury. Inhibitory control seems to be particular vulnerable to the impact of TBI. Findings of associations between EF and SWI lesions need to be replicated with larger samples.
Summary: Zoe is a 6-year-old girl with an acquired brain injury resulting in damage to the pons and thalamus. This resulted in functional deficits in: communication, feeding, mobility, transfers, self-care, and school work. Zoe received intensive multidisciplinary input from specialist nursing, physiotherapy, occupational therapy, speech and language therapy, and education from the hospital school. After a block of intensive input, she was fit for discharge however still off her baseline. The team were concerned about her return to a mainstream classroom.

In an effort to support school reintegration the Paediatric ABI team provided:

- Meetings pre-discharge with class teacher, SENCO, and parents to troubleshoot concerns/ manage anxieties before transition.
- A supported school visit with ABI team:
  - Therapy assessment in the classroom environment

By having meetings with school, the ABI team were able to negotiate schools’ participation in her rehabilitation by facilitating visits whilst she was in hospital but also arranging a short visit to school for Zoe and her rehabilitation team. This visit allowed the therapists to see Zoe participate in her day to day activities in her regular environment but also enabled teachers to ask advice and question their participation in her rehabilitation and consider how to adapt specific working patterns around Zoe’s disability. Strategies developed whilst on the visit included:

- Giving Zoe a piece of paper to carry as she walked around the classroom (stabilising her ataxia)
- Zoe’s space on the carpet for group time was changed to being next to a table to allow herself to lower and get up independently
- Commencing the EHCP assessment

It was also important to take this opportunity to get Zoe’s peers involved in Zoe’s therapy this was achieved by allowing time out of class to take the opportunity to welcome Zoe back and ask the ABI team and Zoe any questions they had about why Zoe had been in hospital, this helped them get an understanding of how Zoe had changed but it also gave the service an opportunity to get the peers participating in facilitating her independence at school by thinking about what they could do to encourage Zoe’s rehabilitation. Some of the ideas from the children included:

- Ensuring obstacles on the floor were cleared away,
- Being patient when Zoe is speaking to allow her to respond
- Allowing Zoe time and space to move about

The ABI Team were able to engage teachers and peers to provide Zoe with a supportive environment to develop her independence and reduce the likelihood of social isolation.

Recommendations for Practice:

- Therapists to work alongside teachers and school administrators to help educate on cognitive, social and behavioural issues related to the brain injury suffered (Savage et al, 2001).
• School visits with young person/family and outreach practitioners should be facilitated to see how therapy can be applied in a school setting and support the teachers with reintegration.
• Peer led sessions in school, so they can appropriately learn and understand about the young person’s disability with the intention of encouraging positive peer interaction post injury (Anderson & Catroppa, 2006).

Long-Term Functional Outcome Following Severe Childhood Traumatic Brain Injury: Results of the TGE Cohort

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Background: Childhood traumatic brain injury (TBI) is a leading cause of lifelong acquired disability. It remains difficult to predict long-term functional outcome. The aims of this study were (1) to study the evolution and factors associated to functional outcome over 24 months after childhood severe TBI; (2) to determine how functional status within the first 24 months predicts 7-year intellectual and educational outcome.

Methods: Children (0-15 years) consecutively admitted in a trauma centre following severe accidental TBI over a 3-year period, were included in this prospective longitudinal study (TGE cohort). Assessment was conducted at 1, 3, 12 and 24 months using age-appropriate scales to measure overall disability (paediatric Glasgow Outcome Scale – GOS-Ped), functional outcome (Paediatric Injury Functional Outcome Scale – PIFOS; higher scores indicate worse impairment), intellectual (Wechsler scales) and educational outcome (mainstream school with/without adaptations or special education). At 7 years post-injury, cognitive and educational outcomes were assessed.

Results: Sixty-five children survived [66% boys; mean age at injury 8,1 years; lowest Glasgow Coma Scale (GCS) 6,16 (SD=1,8); length of coma 6,3 days (SD=4,9)]. GOS-Peds indicated severe impairments at 1 month (vegetative state: 8%, good recovery: 6,5%), with significant improvement over time (no vegetative state by 12 months; most children with moderate or severe disability; 25% of “good recovery” by 24 months). All children had some degree of functional impairment in the PIFOS at 1 and 3 months (94,3 and 92,3% at 12 and 24 months). Impairments were severe at 1 month, with rapid improvement at 3 (p<0,0001) and 12 months (p=0,0005), without further significant progress from 12 to 24 months. PIFOS score was highly correlated to length of coma, GOS-Ped scores (p<0,0004), initial GCS (p<0,05) at each time-point, but not to age at injury. In regression analyses, PIFOS score were significantly predicted by length of coma, GCS and parental education at each time point (p<0.05). PIFOS score was highly correlated to full-scale IQ at each time point (p<0,0001), and at 7 years (p<0,004). In the regression model, all PIFOS scores significantly predicted full-scale IQ and type of education at 7 years (p<0,04 at 1-3 months and p<0,004 at 12-24 months).

Conclusion: Severe childhood TBI causes significant long-standing functional impairments, which are particularly severe within the first 3 months, followed by significant improvement by one year. Further, the functional status at 1 and 2 years significantly predicted intellectual and educational outcome at 7 years post-injury. PIFOS appears to be a reliable scale to measure evolution of functional impairment over time and to predict long-term (up to 7 years) clinically meaningful outcomes. All patients should benefit from
personalised long-term follow-up and interventions, with particular attention for those with persistent functional impairment at 1-year post-injury.
Managing Challenges Within Families After an Acquired Brain Injury in Childhood: Are Workshops Better Than Individual Work?

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**Background:** Acquired brain injury (ABI) in childhood has the potential to disturb family functioning, with impacts for the injured child (Limond, Dorris & McMillan, 2009), siblings (Sambuco, Brookes & Lah, 2008) and parents (Jordan & Linden, 2013). Parents of children with an ABI can experience high levels of anxiety and psychological distress in relation to their injured-child’s future and quality of life. They can often struggle to understand changes in their child and advocate effectively for them, especially at times of transition within education (Savage, DePompei, Tyler, & Lash, 2005). For the child with an ABI they can struggle to recognise and/or respond to challenges their injury has presented them with (Tonks, Williams, Frampton, Yates, & Slater, 2007). For the siblings the evolving understanding of differences in their brother or sister can be difficult (Demelleek & Appleton, 2006).

An emergent evidence base demonstrates the effectiveness of family targeting interventions in managing difficulties associated with paediatric issues in general (McCusker et al., 2012) and ABI difficulties specifically (Fitzpatrick et al., 2018). Evaluations in paediatric ABI populations (see Brown et al., 2013; Woods et al., 2014) have varied in terms of: audience, format and venue. Evaluations have demonstrated improvements in parent-reported outcomes, but child-reported improvements have not been equivalent. This has not been entirely surprising as interventions often primarily (or exclusively) target parents. Evaluations (e.g. Fitzpatrick et al., 2018) have suggested that group-based formats may have additional benefits for attendees though this has not been evidentially substantiated.

**Objectives:** This evaluation explored whether group-based workshops (versus standard care) produced any benefits for parents, children with ABI and their siblings.

**Methods:** A repeated measures pre-post design was employed. The workshop groups (i.e. parent, sibling & child with ABI groups) were compared with a standard care comparison groups. These comprised of parents, siblings and children with ABI also attending services, though not engaging with the workshop. Parent outcomes related to parental self-efficacy levels (TOPSE), parental stress levels (PSI-4) and qualitative evaluations. Outcomes from children and siblings related to qualitative evaluations as well as child-reported QoL (KIDSCREEN-27). Three simultaneous workshops were delivered with differing content dependent on the audience (i.e. parents, children with ABI, siblings). Six families took part in the intervention (Parents n= 9; Child with ABI n= 6; Siblings n= 7) and six families continued with standard care individual work.

**Results:** Standard care and workshop groups were compared to evaluate the effectiveness of a family-based workshop in families with children with a history of an ABI. Pre-post comparisons within the workshop group were evaluated in addition to pair wise, between-group, comparisons. Data was collected one-week pre-workshop and following the completion of the workshop.

**Discussion:** Findings will be discussed in the context of previous literature with reference made to methodological, theoretical and service-related considerations. The practical implications of findings will also be outlined.
Glycopirrolate in Children with Neurological Impairment: A Cases Series

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Background: Drooling is the involuntary loss of saliva and oral content of infants. Its persistence implies clinical and social consequences in children with neurological impairment, as dysphagia and respiratory health, socio-emotional development, emotional and work overload for families and caregivers. Salivary glands are controlled by parasympathetic autonomic nervous system. The oral solution of Glycopirrolate is currently the only formulation of an anticholinergic drug approved by the United States Food and Drug Administration (FDA) to treat drooling in children.

Methods: This case series included 27 patients (sex ratio 16/14, median age 6.4 years) treated with Glycopirrolate in a tertiary care hospital dedicated to patients with medical complexity.

Results: All patients presented a severe neuro-disability: 24 patients had spastic quadriplegic cerebral palsy with or without seizures, 6 degenerative encephalopathy, 9 a muscular disease and a genetic disease/congenital syndrome. Tracheostomy was present in 18 patients, while 5 patients needed a mechanical home ventilation. Salivary gland ligation was performed in 9 patients, 11 patients received other treatments for drooling before Glycopirrolate like intradermal scopolamine the median dose was 2 mg/die (1.3 mg/kg/die). At a median follow-up of 6 months from the start of treatment, 14 patients present a subjective drooling reduction (as confirmed by parents and care-givers), only 4 patients stopped the treatment for adverse effects like dry mouth/thick secretions or flushing.

Conclusions: According to our limited experience Glycopirrolate is effective in decreasing drooling in children with neurodevelopmental disabilities. No major side effects were observed. Further prospective and comparative studies are needed.
Experience of Post Traumatic Seizures from a Major Trauma Referral Centre

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**Introduction and Aim:** Traumatic brain injury (TBI) is a common cause of mortality and morbidity in children. Epilepsy following TBI is recognised to be a common cause of acquired epilepsy. Seizures can happen at any stage in the acute period or later. Post traumatic epilepsy (PTE) is diagnosed in patients who develop two or more unprovoked seizures one week following TBI. Severity of injury, skull fracture, intracranial haematoma, early post traumatic seizures are known to be risk factors in developing PTE. We analysed our cohort of TBI patients to look at post traumatic seizures and the risk factors at the time of admission.

**Method:** A retrospective study was undertaken of children admitted to our tertiary trauma care centre with head injury referred to the Acquired Brain Injury service led by Paediatric Neurologist from January 2012 – December 2016. Data was collected from case records on the mechanism of injury, severity of head injury, need for intensive care, neuroprotection, length of ICU stay, immediate, early and late post traumatic seizures. Seizures within 24 hours were classed as early, within a week as early and occurring beyond 1 week as late or post traumatic epilepsy.

**Results:** 301 children were admitted in the period with TBI of which 68 were referred to Paediatric ABI service. There were twice as many males as females. Most patients were between the ages of 5 – 12 years. 84% patients were admitted to Paediatric intensive care unit and 50% of these had full neuroprotection. The average length of ICU stay was 6.6 days. 18 patients had seizures of which 66% children had immediate seizures, 22% early seizures and 11% had late seizures or PTE. Pedestrian in road traffic accident was the most common mechanism of injury the others being fall from height and abusive traumatic head injury. 88% patients who developed seizures needed PICU admission. 15 patients who had seizures had severe TBI with a GCS 3 – 8. All patients referred had either CT or MRI and 82% of patients with seizures had intracranial haematoma. Only 4 patients were discharged home on Phenytoin which was weaned off by 3 months. One patient developed seizures 6 months post incident.

**Conclusion:** Overall rate of Post traumatic epilepsy from this major referral centre was only 0.6% with most seizures being in the immediate period. Majority of patients with seizures had low GCS at admission, needed intensive care and had intracranial haematoma. Prophylactic antiepileptic was not routinely used. All patients had follow up. Only one case developed seizures 6-month post incident. These risk factors similar to previous studies can help in counselling families and planning long term follow up.
Robot Assisted Rehabilitation in Children with Cerebral Palsy

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Robot-mediated therapy (RMT) has been a very active area of research in recent years and it holds much promise for improved outcomes. RMT appears to promote improvement in sensorimotor as well as cognitive processes. The RMT benefits are: 1) it produces a controlled and repeatable therapy experience and 2) it allows quantitative evaluations of kinematics and kinetics to estimate the patient’s progress, while traditional clinical scales permit only qualitative evaluations potentially carried out by diverse therapists. RMT can play a relevant role in the rehabilitation of the upper and lower limb of patients affected by congenital or acquired brain injury by means of task specific exercises. Kwakkel has demonstrated that high-intensity and task-specificity are two of the main features of any successful stroke rehabilitation program. Both of these features are ideally suitable for robotics application. Robotics can be programmed to simulate a variety of tasks affording both high intensity and repeatability, similar to stereotypical patterns employed during therapy. Robotic devices may also be employed to impose novel forms of mechanical manipulation that therapists cannot emulate and adapt to patients’ performance, assisting them as needed during a given motor task. There is a growing consensus that training might have positive impact on cerebral palsy and traumatic brain injury with the reprogramming of spared neural tissue, i.e., a reorganization of the remaining cortical subcortical networks and their descending projections. There is strong evidence that the organization of the brain cortex is dynamic (somato-sensory, visual, acoustic and motor) and it is directly induced by the type and intensity of the activity and context. While this appears to be true in the adult brain, there might be an even bigger window of opportunity during childhood. In children with cerebral palsy (CP) general functional strength training has been shown to improve functional performance. There are many advantages of robotic based rehabilitation as compared to traditional physiotherapy: principally: (i) it provides an intensive and highly repeatable “dosage” of therapy, which can be varied to continuously challenge the patient’s neuromuscular system; (ii) it offers a quantitative and objective evaluation of the outcome for each patient, since the mechatronic devices have built-in sensors that measure different parameters such as force exerted by the subject, smoothness of movement.

Now that RMT has demonstrated its potential, we will use this robotic technology identifying among the multiple variables which ones might have a larger impact on outcomes and influence recovery (e.g., timing, intensity, and duration of therapy; type of task practiced). We expect that ultimately, we will be able to develop a recovery model that will guide the rehabilitation practice of children with acquired or congenital brain injury.
Breastfeeding Malnutrition and Hypernatraemic Dehydration in Newborns – Is There a Role for Paediatric Neuropsychologists?

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Breastfeeding of newborns is reported to have advantages for both physical and psychological well-being, including decreased incidence of infections, improved neurodevelopmental outcomes and a variety of lifelong health benefits. In some cases, inadequate breastfeeding can lead to malnutrition and hypernatraemic dehydration. This potentially fatal condition is associated with cerebral oedema, intracranial haemorrhage, hydrocephalus, and gangrene. Clinical presentation of hypernatraemic dehydration is variable meaning it is notoriously difficult to diagnose, but typically presents around 10 days postnatally. Features range from heightened levels of alertness and hunger, to lethargy and irritability. It is estimated that “breastfeeding failure occurs with approximately 20% of primagravidas (a woman who is pregnant for the first time)” (Rosenbloom 2004), with these cases making up the vast majority of reported cases.

While the impact on physical health from hypernatraemic dehydration is well reported, the longer neurocognitive and quality of life (QoL) outcomes are rarely documented. We present data on the neurocognitive profile of two paediatric cases of hypernatraemic dehydration where significant brain damage had occurred. Neuropsychological assessments (Wechsler Intelligence Scale for Children, Children’s Memory Scale, Rey-Osterrieth Complex Figure Test, Delis-Kaplan Executive Function System and Wechsler Non-Verbal Scale of Ability, Strengths & Difficulties Questionnaire) were administered within the context of a detailed clinical interview. Both children displayed cognitive performance within broad average level but with specific problems identified in working memory and processing speed, as well as immaturity and marked dysexecutive problems reported at home and at school. These profiles are consistent with scan findings of injuries to the brain, including the frontal lobe.

We discuss the potential role for Paediatric Neuropsychologists in educating professionals involved in the care of pregnant women and their young babies regarding the impact of breastfeeding malnutrition and hypernatraemic dehydration on cognitive development and QoL. Education modules would aim to highlight the implications of the potential devastating neuropsychological effects where malnutrition and hypernatraemic dehydration is severe, with the aim of increasing awareness of consequences and reducing the incidence of breastfeeding malnutrition and hypernatraemic dehydration and its potential lifelong neuropsychological effects.
Subdural Empyema: A Paediatric Neuropsychology Case Series

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Background Information: Current neuropsychological literature regarding subdural empyema (the accumulation of pus between the dura and arachnoid mater, linked with sinusitis, mastoiditis and other infections) is limited to five single cases in children and adolescents; we report a further four paediatric cases. Symptom onset is usually abrupt (roughly 1-2 weeks) and may include confusion, lethargy, reduced level of consciousness, hemiparesis and seizures. Treatment involves emergency neurosurgical intervention to remove the pus, followed by antibiotic treatment and monitoring. Acquired brain injury is associated with mass effect and inflammatory reactions, including hydrocephalus, vasospasm and infarction.

Case series: Four subdural empyema cases have been seen across our inpatient and outpatient Paediatric Neuropsychology Services in the past 18 months.

Case 1: 14-year-old male, seen for outpatient neuropsychological assessment 17 months post-diagnosis. Performance was in keeping with an intellectual disability, with associated memory, attention and academic difficulties. Behavioural and emotional difficulties were also reported.

Case 2: 14-year-old male, seen for acute inpatient and post-acute outpatient neuropsychological assessment at 3 weeks and 9 months post-diagnosis. Performance indicated significant speech and language impairment and working memory difficulties, which have largely resolved over time. No reported behavioural or emotional difficulties.

Case 3: 9-year-old male seen for acute inpatient psychological review at 2 weeks post-diagnosis. No reported cognitive, emotional or behavioural difficulties.

Case 4: 8-year-old male, seen for acute inpatient psychological review and post-acute outpatient neuropsychological assessment at 1 week and 5 months post-diagnosis. Behaviour and personality change noted, with no reported cognitive change from pre-morbid functioning.

Conclusions: These cases, along with those previously reported in the literature, suggest that the nature and extent of difficulties varies widely between individuals. Given the often-frontal nature of the collection and injury, neuropsychological deficits tend to include (but are not limited to) executive, language and/or motor difficulties. For most cases follow-up shows improvements by around 6 months or so in these skills relative to acute presentation, but without a return to baseline; some patients experience lasting significant neuropsychological impairment. Some also show associated behavioural and emotional changes. In light of the scarcity of such cases in the literature, it is important that we continue to monitor and draw attention to any patterns of neuropsychological difficulties identified to help inform our clinical practice.
What Do Young People with Acquired Brain Injury Want? Understanding Community Rehabilitation Goal Types and Their Predictors

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Introduction: There is a growing awareness of the importance of contextual and environmental factors in the prognosis and rehabilitation of children and adolescents with Acquired Brain injury (ABI). However, whilst the significance of this is recognised by clinicians and academics, there is less evidence about how this relates to what young people with ABI personally want from community neuropsychological rehabilitation. The International Classification of Functioning, Disability and Health: Children and Youth Version (ICF-CY) has been developed to facilitate consideration of the interrelationship between contextual factors and components of functioning and disability, so provides a helpful framework for analysing neuropsychological rehabilitation goals. Understanding the rehabilitation goals and aspirations of young people with ABI, and how they may differ with time, injury and age, is important when considering service design and delivery. Here we present findings, building on previous work on categorisation of goals, which seek to identify patient-specific predictors of goal types making use of ICF-CY two-level classifications.

Methods: Neuropsychological rehabilitation goals, demographic and brain injury information was extracted from the clinical records of 98 young people who had attended a UK specialist community neurorehabilitation service. The service is state funded within the National Health Service (NHS). Goals were independently coded by two researchers according to the ICF-CY two level classifications. Statistical analysis was performed to assess the distribution of goals according to ICF-CY categories, and to assess for demographic and injury-related predictors of goal type.

Results: 326 neurorehabilitation goals were analysed and allocated 447 ICF-CY codes. There was 90% initial concordance between coders. Activities and Participation (AP) goals were the most common type (52%). Twenty-eight percent of goals were related to Body Functions (BF), 20% were around Environmental Factors (EF) and less than 1% of goals were Body Structure (BS) goals. Goals related to school education (AP) were most commonly identified (60 goals, 18% of total goals), with emotional functioning (BF) second (43 goals, 13% of total goals), support and relationships (EF) third (28 goals, 8% of total goals), and family relationships (AP) forth (22 goals, 7% of total goals). The number of goals related to EF increased significantly with age at assessment (p=0.032), and the period of 5-10 years post-injury was associated with significantly more AP goals (p=0.021). There was no association between gender or the type of brain injury and the distribution of goals across the ICF-CY categories.

Conclusion: Neuropsychological rehabilitation that maintains a strong contextual and environmental focus is not only best practice according to research; it also meets the personal aspirations of the population of young people with ABI. As rehabilitation goals did not differ significantly by type of brain injury, there are implications for service design. The needs of the heterogeneous ABI population may not need to be met in injury-specific services. Community neuropsychological rehabilitation services may wish to ensure they are resourced to focus intervention on Activities and Participation, with increasing consideration for Environmental Factors as a young person progresses through adolescence. The findings of this research support models of community neuropsychological rehabilitation services that combine direct rehabilitative interventions with attention to social context and systemic working across agencies.
A descriptive analysis of the first 152 young people with Acquired Brain Injury seen by the Cambridge Centre for Paediatric Neuropsychological Rehabilitation.

Introduction: Acquired brain injury (ABI) is the leading cause of morbidity and mortality in young people. Multiple factors influence prognosis, but timely interdisciplinary, context-specific and family-focussed post-acute rehabilitation plays an important role in optimising outcome. The Cambridge Centre for Paediatric Neuropsychological Rehabilitation (CCPNR) is a unique specialist community neuropsychological rehabilitation service for young people with ABI based within the UK state funded National Health Service (NHS). Since its establishment in 2009 the interdisciplinary team has provided specialist assessment and rehabilitation of a heterogeneous population of young people with ABI. These young people have complex needs that could not be met through non-specialist mental health, physical health or education support services alone. This study sought to describe the characteristics of these young people. This was intended to help guide future service development, and to increase understanding about the population of young people with ABI in the UK who require specialist neuropsychological rehabilitation.

Methods: This study was undertaken as part of a service evaluation of the Cambridge Centre for Paediatric Neuropsychological Rehabilitation. Demographic, injury and assessment data was collated and analysed for all service users since the start of the service. Assessment data included the parent-rated Strengths and Difficulties Questionnaire (SDQ), Behaviour Rating Inventory of Executive Function (BRIEF), Child and Adolescent Scale of Participation (CASP) and the Pediatric Quality of Life Inventory Family Impact Module (PedsQL FIM).

Results: Data was available for 152 young people, 57% of which were male. 49% of young people had traumatic brain injuries, and 7% had sustained more than one ABI. The average age at injury was 9.18 (SD = 5.44) years, and the average time from injury to referral was 3.07 (SD = 4.17) years, with an average age at assessment of 12.76 (SD = 3.67) years. On the SDQ 51% of parents rated significant concern on the total score, and the most common subscale for concern was the impact subscale, with 76% reporting significant concern. Potentially clinically significant executive dysfunction (+1.5 SD above age-equivalent norm) was seen in 42% to 63% of young people across the different BRIEF subscales. Working Memory, the Behavioural Regulation Index and Emotional Control were the most common areas of dysfunction. As a group the young people showed impairments in participation, with a mean score on the CASP of 79.94 (SD = 15.25). The average score on the PedsQL FIM was 59 (SD = 20.66), with Emotional Functioning, Worry, Communication and Daily Activities showing the lowest health-related quality of life.

Conclusions: The population of young people seen by the service are a highly heterogeneous group in terms of age and types of ABI. This is consistent with previous research. However, on average they present to the service several years after their brain injury, with a combination of difficulties across executive functioning and psychological health and well-being. This impacts significantly on their quality of life and participation and has lifelong implications for their health and social outcomes. Whilst the mental health needs of these
young people are similar to those referred to mental health services in previous studies, the high level of executive dysfunction poses challenges for the application of evidence-based mental health interventions, such as Cognitive Behavioural Therapy. The physical sequelae of the ABI also add further complexity. There is a clear need for these young people to be seen within a specialist ABI service that can address these issues in a context-sensitive and holistic manner. Consequently, this study demonstrates that previous research findings around the high mental health and neuropsychological needs of young people with ABI are reflected in the presenting problems of the young people seen by the CCPNR.
Many children with acquired brain injury (ABI) experience oropharyngeal dysphagia, or swallowing difficulty, with possible deleterious consequences of compromised nutritional intake, aspiration with subsequent respiratory complications, and invariably an impact on their quality of life (Morgan & Ward, 2001). Reported incidence of dysphagia in children with ABI varies considerably, due in part to differences in the timing and method of assessment and the initial level of severity. Available studies report incidence rates of dysphagia in children after a severe TBI is 68-76% (Morgan 2010). To date, there is a paucity of evidence for the treatment of oropharyngeal dysphagia in children with ABI, and thus no clear guidelines or recommendations for clinical practice with this population. Morgan et al (2012) postulate that this could be due to the complex nature of oropharyngeal dysphagia and the child’s underlying neurological impairment, which produce heterogeneous and highly individualised patterns of swallowing difficulty. In the absence of any well-defined current paediatric dysphagia intervention models, the categorisation of feeding rehabilitation interventions (e.g. compensatory or remedial) is based on adult dysphagia literature. There is a culture in Ireland whereby children with dysphagia are treated using compensatory treatment techniques primarily following which their swallow function is monitored. This is largely due to service delivery models which do not easily accommodate intensive dysphagia intervention. Given the evidence of neuroplasticity in children - ‘the young age plasticity privilege’ (Dennis et al, 2013), we need to direct our focus towards maximising the effectiveness of dysphagia rehabilitation and thus the child’s functional abilities. According to Huckabee (2015), ‘rehab works’ but specificity, intensity and frequency are critical variables in recovery and optimal principles for neuroplasticity (Kleim, 2008). Dysphagia rehabilitation doesn’t necessarily mean intensive though – active management can adapt to different service delivery models. In the National Rehabilitation Hospital (NRH) in Ireland, there is a focus on the active management of dysphagia, i.e. the direct treatment of the swallowing disorder, with the primary goal being to ensure safe and efficient swallowing which may allow for the discontinuation of tube feeding. Children need to develop (or re-learn) the appropriate skills before they can be expected to eat successfully again, and that skill level needs to match the demands of the food. Infants and children grow and develop even when they have a chronic condition, which means that swallowing and feeding function can change over time (American Speech-Language-Hearing Association, 2018), especially when therapy techniques designed to alter the swallow physiology are utilised. While evidence-based practice rests on the evidence, clinical acumen and each patient’s desire for results are very defining crucial factors. This presentation will outline the active management approach employed in the NRH and case examples will be used to illustrate clinical practice.
Are Regional Joint Paediatric Neurovascular Clinics Useful?

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Aim: To analyse the demographics and clinical characteristics of patients attending the new regional paediatric neurovascular clinic led by a consultant paediatric neurologist and consultant, paediatric neurosurgeon and to assess the need of contribution by both specialists for such a service

Methods: A retrospective descriptive cross-sectional study was conducted using patient records. Data were extracted using a specifically designed abstraction form. Ten clinics had taken place at the time of analysis and the service had been running since 2015.

Results: A total of 44 patients had attended the clinic, 18 of which have received a genetic diagnosis. Common long-term complications consisted of acquired brain injuries, motor deficits, visual impairment, and epilepsy. 15 of the 44 patients have received neurosurgery, including bilateral pial synangiosis, with 4 patients planned for future surgery.

The families received joint advice on all these issues as well as neurosurgical evaluation. All patients and families expressed increased benefit from the clinic.

The major gains were:
1. Receiving advice from two Separate Consultants/Specialities in one visit- Time saving and reduced need for multiple appointments and offered the opportunity to lessen generation of anxiety in families.

2. The fact that both consultants were present, both of whom had an interest in Neurovascular conditions enabled a consensus of opinion for a plan of action that involved families in the decision making.

3. The clinic is exploring the addition of a Specialist Nurse joining the team- this has been piloted already with excellent reception from families. We are exploring preparing patient information packs for the different classes of conditions, such as Cavernomas, AVMs, Moya-Moya. We aim to create a leaflet for pial synangiosis.

4. The clinics have revealed that a large percentage of the children have acquired brain injury and a knowledge and awareness of the issues around this is an integral part of the skill mix necessary.

5. Similarly and specialist knowledge of Epilepsy and pathways for Epilepsy surgery features highly in skills needed.

Conclusions: Our study provides benchmark demographic and clinical data that may be used for operational planning and further research. Our results highlight the usefulness of a joint paediatric neurovascular clinic.
Case for Diffusion MRI As a Diagnostic Marker: Evidence from Paediatric TBI

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Introduction: Traumatic Brain Injury (TBI) is the leading cause of death and disability in children and can give rise to chronic cognitive and socioemotional difficulties that are often poorly understood. Families frequently have limited treatment options and struggle to understand their child’s ongoing difficulties. Diffuse axonal and vascular injury (DAI & DVI) are common after TBI but are often missed on conventional neuroimaging. Susceptibility Weighted Imaging (SWI) and Diffusion Tensor Imaging (DTI) can be informative ways of detecting DVI and DAI respectively. We will present two cases from a larger study of outcome after paediatric TBI using SWI and DTI to assess DAI and DVI and relate these to cognitive impairment after paediatric TBI.

Methods: We investigated two 16-year-old patients with detailed neuropsychological and imaging assessments. The Magnetic Resonance Imaging (MRI) battery included volumetric T1, SWI and 64-direction DTI. SWI was assessed for evidence of microbleeds and evidence of linear vascular injury. A tract-based approach was taken to the analysis of DTI. Average fractional anisotropy (FA) values were calculated for a range of large white matter tracts. These were then compared to a control sample to provide a Z-statistic statistical estimate tract abnormality.

Results: Patient 1 had a left frontal skull fracture and extradural haematoma identified on CT imaging following head impact in a sporting accident (lowest GCS 15/15 and inpatient admission 2-days). Patient 2 had evidence of DAI on CT imaging and was in hospital for 60 days following a road traffic accident (Lowest GCS 3/15). Assessments were at 6- and 36-months post-injury respectively. Patient 1 showed no cognitive impairment and MRI showed a left frontal contusion that was visible on T1, with no reductions in FA. In contrast, Patient 2 had evidence of executive function and processing speed impairment. MRI showed numerous micro haemorrhages visible on SWI. Reductions in FA were seen within the corpus callosum, right corticospinal tract, inferior fronto-occipital fasciculi, and left inferior longitudinal fasciculus. Whole-brain FA was also reduced.

Discussion: These case studies illustrate the value of advanced imaging in detecting likely DAI and DVI after TBI. Our case with clear cognitive impairments only showed evidence of imaging abnormalities using SWI and DTI measures. Conversely, the case with clear focal injury visible on standard imaging had normal cognitive functioning. This illustrates the pitfalls of relying on conventional imaging and suggests that residual cognitive impairments may be explained by axonal injury that is not detected on standard imaging.

The clinical implications include providing families and young people with more information about their TBI and their ongoing difficulties. This can help health, education and other services to understand why children who look physically well can still be struggling cognitively and how best to meet their needs.
Memory Functioning Following Severe Childhood Traumatic Brain Injury: Results of the TGE Cohort

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Background and Aims: Severe Traumatic Brain Injury (TBI) is the main cause of death and acquired disability in childhood in developed countries. Among cognitive sequelae, memory impairment is frequent and impacts everyday functioning and academic achievement. The aims of this study were: (1) to prospectively measure memory functioning following severe childhood TBI, and its evolution over time; (2) to assess demographic and medical factors associated to memory function and recovery.

Methods: Children (aged 0–15 years; n=65) consecutively admitted in a single trauma center for severe non-inflicted TBI (Glasgow Coma Scale score ≤8 and/or Injury Severity Score >16) over a 3-year period were included in a prospective longitudinal study (TGE cohort). Memory function was assessed using the Children’s Memory Scale (CMS) at 3, 12, 24 months and 7 years post-injury. At 7 years post-injury, those aged 16 years or older were assessed using the Wechsler Memory Scale IV (WMS), and the general memory score from both scales was combined for analyses. Motor deficit was defined by the presence of hemiparesis and/or signs of cerebellar dysfunction upon neurological examination. Socio-economic status (SES) was assessed using highest parental education level.

Results: Memory was assessed in 46 children aged 5-15 years. Significant memory impairment was found at 3 months post-injury (mean general memory (GENM) score =89.1, SD=20.5), with significant improvement at 24 months (GENM score =103.9, SD=25.6), but less so for verbal, learning and attention/concentration abilities. However, at 7 years post-injury, a significant decrement was found (GENM score =83.8, SD=15.5). The GENM score was significantly correlated to initial TBI severity indices such as length of coma (r=0.45, p<0.01; r=0.31, p<0.05 ; r=0.39, p=0.02), Pediatric Traumatic Score (r=0.37, p<0.05; r=0.45, p<0.01; not significant at 7 years) and Injury Severity Score (r=0.31, p<0.05; r=0.35, p<0.05 ; r=0.32, p=0.05) at 3, 24 months and 7 years post-injury respectively. GENM score was strongly correlated to full-scale intellectual quotient at each time point. Female gender was associated with worse memory impairment at 12 months, whereas age at injury and SES were not at any time-point. Furthermore, presence of motor impairment at 3 months post-TBI was correlated with worse memory recovery at 7 years post-TBI [GENM score =88.5 (SD:12.7) with no initial motor deficit, versus GENM score =78.3 (SD:17) with initial motor deficit; p=0.04], probably because this reflects greater injury severity. Finally, the genm score was significantly correlated with less favourable educational outcome.
Conclusion: Memory functioning is significantly impaired following severe childhood TBI; it is mostly influenced by initial TBI severity and subsequently strongly impacts educational outcome. Those patients should benefit from systematic long-term follow-up and adequate interventions post injury.
Evaluation of the Efficacy and Acceptability of the BC Hockey Mandate for Team Officials to Complete the Concussion Awareness Training Tool

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Background: The Concussion Awareness Training Tool (CATT) is a series of online educational modules and resources with the goal of standardizing concussion recognition, diagnosis, treatment, and management (www.cattonline.com). Based upon the established principles of the Consensus Statement on Concussion in Sport, CATT caters to coaches, players/participants, and parents, as well as medical and school professionals.

CATT for parents, players and coaches launched in 2014. Based on established evidence-based research principles, the aim of the CATT is to standardize the protocol for the recognition, response, management, and prevention of concussion. The CATT for Coaches provides up-to-date education concussion training in the form of: • Online course for coaches • The Concussion Response Tool (smartphone accessible and fillable) • The Return to Sport tool • Situational and knowledge-based questions • Frequently asked questions • Printable handouts, related websites, journal articles, and additional resources. Evaluation found parents/coaches demonstrated significant positive change in concussion knowledge (p=0.002) following the CATT training.

In June 2016, BC Hockey mandated CATT training for all on-ice team officials, to be completed prior to the 2016-2017 hockey season.

Aim: To determine whether the CATT training led to positive changes in knowledge around concussion recognition and management among BC Hockey team officials, and to explore the level of interest in mandating the CATT training for the parents of BC Hockey players. Participant feedback will also be used to enhance the CATT website.

Methods: Self-reported retrospective information on the efficacy and acceptability of the CATT training was collected via online survey. Quantitative and qualitative analyses were performed, with selected cross-tabulations.

Results: The survey had a >10% response rate (n=1,593). CATT training led to a significant increase in self-reported concussion knowledge (p<0.001). Mandating CATT training for parents was supported by 68.4% of respondents, with females significantly more in favour males (p<0.02). Further comments included a request for access to a quick reference sheet, checklist, or other form of printed material summarizing the concussion protocol would be valuable, as it could be easily carried on the bench.

Discussion and Conclusions: Sport plays an important role in maintaining mental and physical wellbeing, however, concussion is an under-recognized, -diagnosed and -treated medical condition. CATT addresses this gap by increasing knowledge and awareness among appropriate specific audiences. The BC Hockey mandate for CATT training successfully increased the level of concussion-related knowledge among team officials. Mandating the CATT for parents of BC Hockey players should be strongly considered. This resource supports the implementation of a standardized protocol for the recognition, treatment, and management of sport-related concussions, both in the minor hockey leagues and other sports, in BC.
Standardizing Concussion Treatment and Management: The Online Concussion Awareness and Training Tool (CATT)

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Context: The Concussion Awareness Training Tool (CATT) is a series of online educational modules and resources with the goal of standardizing concussion recognition, diagnosis, treatment, and management. Based upon the established principles of the Consensus Statement on Concussion in Sport and other evidence-based resources, this tool includes e-learning modules for medical professionals, parents, coaches, school professionals, workers and workplaces.

CATT for medical professionals originally launched in 2013, focusing on the recognition and diagnosis of concussion; evaluation found physicians demonstrated significant positive change in concussion practices (p=0.001), and significant change in knowledge by those treating more than 10 concussions per year (p=0.039). The new CATT for medical professionals launched in 2018, addressing current gaps and variations in practice for the initial assessment and management of acute concussion patients in the office setting. CATT for parents and coaches, launched in 2014, speaks to concussion identification and management, with resources including the Smartphone accessible Concussion Response Tool and Questions to Ask Your Doctor; evaluation found parents demonstrated significant positive change in concussion knowledge (p=0.002). CATT for school professionals, launched 2016, includes Return-to-Learn protocol and resources to support teachers, administrators, counsellors and others in the school setting; evaluation found teachers and school administrators demonstrated significant positive change in concussion knowledge (p=0.027). CATT for workers and workplaces, launched in 2018, focuses on concussion management in the adult population.

Objective: To support standardized treatment and management of concussion.

Key Messages: CATT is a comprehensive, evidence-based resource for the standardized treatment and management of concussion. The new e-learning CATT course for medical professionals covers medical assessment for concussion, concussion management, addressing persistent symptoms, and providing medical clearance following recovery. The course is available in both English and French. Beyond medical professionals, CATT also caters to coaches, players/participants, parents and school professionals. New resources for workers and workplaces fill the gap of the treatment and management of non-sport related concussion among the adult population.

To date, over 100 relationships have been developed with organizations and key stakeholders in British Columbia and beyond, >15,000 print resources have been distributed, >30,000 coaches and parents and >3,000 school professionals have completed CATT, and >15 sporting organizations and schools have mandated CATT training.

Discussion and Conclusions: Concussion is an under-recognized, -diagnosed and -treated medical condition, requiring both physical and mental rest. The CATT addresses this gap by increasing knowledge and awareness among appropriate specific audiences (www.cattonline.com). Good concussion management can reduce related health problems and the risk of long-term brain damage, potentially lowering total health care costs among those who are injured.
The Use of Three-Dimensional Multiple Object Tracking as a Mean of Active Rehabilitation in Children that Are Experiencing Prolonged Recovery After Mild Traumatic Brain Injury

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Introduction: Mild traumatic brain injury (mTBI) has a high incidence in physically active youth. While many recover within two weeks of the injury, 30% of individuals will continue to experience symptoms beyond 4 weeks (delayed recovery). Relative rest is predominantly used as a management strategy for these individuals after sustaining this type of injury. However, recent studies demonstrate that prolonged rest might potentially be responsible for adverse effects on youth as they are removed from meaningful activities. For these reasons world leading experts in the field recommend providing rehabilitation strategies that could assist mTBI recovery in youth when symptoms persist, such as active rehabilitation measures (both physical and cognitive). Recent studies suggest that light physical activity could aid in symptom presentation and ultimately recovery. Nevertheless, very little is known on the feasibility and effects of cognitive rehabilitation in a symptomatic pediatric mTBI population. Faubert et al. recently introduced Three-Dimensional Multiple Object Tracking (3D-MOT) in various populations as a mean of training cognition and have demonstrated that cognitive gains achieved through training are predictable and can transfer to real-life activities by stimulating brain plasticity.

Objective: To determine the acceptability of using 3D-MOT with children who experience delayed recovery post-concussion, as well as to explore its impact on symptom resolution.

Participants: 10 youth aged 7 to 17 years old, with mean age 14.61 years, followed for delayed recovery at the Montreal Children’s Hospital’s Trauma Center Concussion Clinic.

Methods: Children were trained over 6 visits using 3D-MOT, every 2 to 7 days. Each visit consisted of 3 reaction time calculations on the task (primary outcome: acceptability), as well as symptom reporting (secondary outcome). In addition, at visit 1 and 6, clinical measures such as balance, coordination, quality of life, self-efficacy and mTBI-specific test battery (ImPACT) were administered.

Results: First, participants were able to complete the sessions and tolerated the task with no adverse events reported through increased symptoms. In addition, participants improved their task-specific reaction time on average by 83%. Tendency for symptom reduction through the course of training was noted (p=0.058). Fatigue levels (PedsQL) were significantly improved (p=0.026), trends for improvements in coordination and ImPACT were noted (p=0.051 and p=0.056 respectively).

Conclusion and Discussion: This first of a kind, exploratory study sets the stage to study the impact of using 3D-MOT training in pediatric symptomatic mTBI patients. Results demonstrate that children who experience delayed recovery after a mTBI can be trained and improve task-specific reaction time trough repetitive trainings using 3D-MOT. This allows us to conclude that training on 3D-MOT is safe in this population and although additional studies are required, this paradigm could potentially aid in mTBI recovery from a clinical standpoint.
Evaluating the Test-Retest Reliability of Strength Assessments for the Management of Concussion in Youth Athletes

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Background: Previous research has found strength deficits following a brain injury. However, little research has explored strength assessments as a potential tool in concussion management. A first step to explore its potential is to establish strong test-retest reliability of the assessments. This is critical as other concussion assessments in youth have not demonstrated adequate reliability in part because of the cognitive and physical maturation that youth undergo during this time period. No studies to date have examined the test-retest reliability of strength assessments for the management of concussion in youth athletes. In addition, the influence of clinically relevant test-retest time intervals used in concussion, sex, and development on test-retest reliability has yet to be explored.

Objectives: This study aims to explore the test-retest reliability of upper and lower body strength measures in youth athletes (10-18 years) and to further investigate the influence of time between reassessments, sex, and development on test-retest reliability.

Methods: A total of 79 healthy youth athletes completed baseline assessments of grip strength (dominant and non-dominant hand) and standing long jump on two separate occasions (0.5 –21.5 months apart). Maximum dominant and non-dominant hand grip strength (kg) and standing long jump (cm) was taken as the highest score of the three trials performed. Reliability was assessed using Intraclass Correlation Coefficients (ICCs) and Reliable Change Indices (RCIs) with correction for practice effects. Change in height between assessments was used as a proxy for development/growth.

Results: ICCs for all assessments ranged from 0.83–0.97 (CI= 0.75-0.98), exceeding clinical reliability standards (ICC >0.7). There was a trend toward decreased reliability with greater time between assessments and with greater change in height. No trends in sex were observed. RCIs revealed only a small percentage of cases (0-1.8%) falling outside the 90% and 95% confidence intervals, demonstrating overall strong reliability for all assessments.

Conclusions/Clinical Implications: This study contributes to the literature by presenting, for the first time, the test-retest reliability of strength assessments in youth athletes. Results indicate that grip strength and standing long jump assessments are reliable in youth athletes 10-18 years across clinically relevant test-retest time intervals, both sexes, and with ongoing development. Our findings help lay the foundation for future sensitivity and specificity exploration of strength assessments to determine its utility for concussion management in youth athletes.
Modern Experimental Training of Socio-Cognitive Deficit in Children with Acquired Brain Injury

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Introduction: Social competence is often impaired in children with acquired brain injury (ABI), but evidence-based rehabilitation has remained undeveloped. Modern multitouch-multiuser tabletop (MMT) platforms create effective learning environments for pediatric social skills remediation. We have previously presented our Structured Model of Neurorehab for Socio-Cognitive Deficit with evaluation and rehabilitation tools (Saard et al, 2017).

Aim: To implement our socio-cognitive deficit rehabilitation model for children with ABI. Specifically, finding out main dysfunctional social components and assessing the effectiveness of intervention protocol using MMT platforms.

Methods: 40 children (30 boys / 10 girls) aged 8-13 years participated in the pilot-study: 30 with ABI - epilepsy, traumatic brain injury (TBI) and/or tic disorder- 10 of whom have completed the whole training (M=11.10 yrs, SD=1.543), 20 are in trainings or in waiting-list group (M=10.69 yrs, SD=1.704) and 10 healthy age-matched control children. At the first meeting, all children performed individual and paired assessments to find out dysfunctional social components. For patients, second evaluations were performed after the intervention period. Interactive computer-based applications were implemented into rehabilitation design: Snowflake application on multitouch-multiuser tabletop and NoProblem application on Diamond Touch Table (DTT).

Results: At baseline (B), patients had noticeably higher deficits in executive functions on BRIEF parents’ questionnaire (M=117, SD=23.594) compared to healthy controls (M=22, SD=18.385). The most impaired components of social skills deficit were emotion recognition, Theory of Mind (ToM) abilities, low cooperation and verbal/non-verbal communication skills and pragmatics (Friendship Observation Scale scores ~25-50% out of 100). In Sentence Completion Task and Spence Anxiety Scale patients reported lack of friends, behavioral problems, bullying, and social anxiety.

Post-training evaluations showed that Snowflake application improved children’s executive and cooperation skills. DTT developed new communication and language skills, metacognitive skills, and coping in social situations. Video modelling on MMT platform and role-plays improved natural communication, social attention, emotional attitude, verbal skills, non-verbal and gestural behaviors, and decreased social anxiety. NEPSY-II showed improvement in Affect Recognition [B=7, SD=5.01 vs outcome (O)=10, SD=5.85], Verbal ToM (B=8, SD=3.06 vs O=10, SD=4.08), and Contextual ToM (B=8, SD=3.15 vs O=11, SD=2.87). Also, ToM Stories test showed improved understanding of Intentional Lying (B=7, SD=2.20 vs O=10, SD=0.50), and Sarcasm (B=6, SD=2.20 vs O=7, SD=2.50).

Conclusion: Our structured model for socio-cognitive deficit neurorehabilitation in children with ABI helps to understand theoretical connections between components of social competence and modern interactive computerized platforms. Trainings based on this model were effective in pediatric social deficit remediation.
MMT interfaces are motivating for children, thus ensuring good compliance. In sum, we provide a rehabilitation model, intervention protocol and practical recommendations in the field of pediatric neurorehabilitation using next-generation devices and encourage therapists to use modern techniques.
The Usage of Electronic Integrated Text Voice Animated Questionnaire (ETIVAQ) in Assessing Quality of Life Among Children with Hydrocephalus

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Background and Aims: The Electronic Integrated Text, Visual and Audio Questionnaire (EITVAQ) was designed towards developing a disease-specific tool to measure child health status from a child’s perspective. EITVAQ’s outcome is anticipated to be positive, introducing a child-friendly health measurement tool. The aim is to check the feasibility of EITVAQ to be completed by children with hydrocephalus. In the future, we envision to complete the validation process to be used widely in clinical practice.

Methods: This is a prospective study that assesses the feasibility of EITVAQ completed by children with hydrocephalus from 8 to 16 years old. The study was conducted from September 2017 to present in the Neurosurgical Outpatient Department, Temple Street, Children University Hospital. Data are compiled for EITVAQ and analysed using Software Package using Statistical Analysis (SPSS).

Results: EITVAQ consists of 31 questions. There was a 100% rate of completion for EITVAQ from 27 participants. The average completion time is five mins. Below are the details of the questionnaire. A value of (5) implies that patients strongly agree with the statement, and a value of (1) suggests strong disagreement with the statement. The mean score among the cohort of participants is 4.01. The two most affected domains are Emotional and Social domains.

Conclusion: In summary, this study supports that EITVAQ is a promising tool to evaluate the quality of life among children with hydrocephalus. In the future, the validated EITVAQ has a great potential to assess the long-term outcome of hydrocephalus patients effectively.
Exoskeleton for Therapeutic Use in Children

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Introduction: A gait exoskeleton is a powered gait orthosis that provides walking ability to a disabled patient who wears it. Marsibionics’s has developed a exoskeleton for therapeutic use in children affected of severe disabling diseases, in order to improve their quality of life and slow down the worsening of their physical condition.

Marsi Bionics develops, produces and commercialises paediatric wearable exoskeletons. Their products are modular lower-limb exoskeletons, ranging from single joint active orthosis to full Trunk-Hip-Knee-Ankle-Foot active orthoses. Marsi Bionics’ exoskeletons make a difference in performance thanks to its patented controllable-stiffness actuation technology. Making use of this technology Marsi Bionics’ exoskeletons personalize the gait therapy, adapting to each patient’s needs. Marsi Bionics’ wearable exoskeletons constitute a technical aid to spatial mobility and also a gait rehabilitation device, targeted to patients affected by neuromuscular diseases, spinal cord injury, and cerebral palsy.

Sant Joan de Déu-Barcelona Children’s Hospital is one of the leading medical centers in Europe for childhood and adolescence and offers a comprehensive and multidisciplinary approach to health care from birth through 21 years of age.

Marsi Bionics and Hospital Sant Joan de Deu have worked together to improve the design of a gait paediatric wearable exoskeleton.

Design: The design is adjustable to the child’s anthropometry. This includes kinematic compatibility with the user, optimization of exoskeleton fixation systems to minimise friction movements, and achievement of adequate pressure patterns on the contact surfaces. The total weight of the exoskeleton is 5 kg (exoskeleton size 1). Critical parts in terms of weight are motors and transmission systems. This size 1 has been tested in paediatric patients in the hospital successfully. Size 2 has to be improving to control correctly the patient’s weight.

Conclusion: Size 1 has been well accepted by paediatric population and their parents. There is the need to overcome some major technical barriers, mainly related to the safety of motion (balance preservation without need of crutches or walkers, stability in different ground profiles and surfaces) and to autonomy, perception and cognitive ability (autonomous operations, requiring of capacity to perceive user physical condition and adapt its response).
Creating Interactive Virtual Reality Metaphors for Social Deficit and Anxiety Remediation in Children with Acquired Brain Injury

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Background: Acquired brain injury (ABI) may affect children’s social development and social skills. Impairment in communication and developing social anxiety can lead to emotional disturbance and social rejection. Virtual Reality (VR) platforms introduce an attractive rehabilitation method, where children can train in safe environments with various simulated real-world metaphors.

Aim: Developing cognitive neurorehabilitation metaphors for social anxiety remediation and training emotion perception in children with ABI using VR technology. Also, we will compare two social rehabilitation methods: VR vs using multi-touch multi-user tables in paired trainings.

Methods: We are enrolling children with ABI -epilepsy, traumatic brain injury (TBI), stroke or tic disorder-aged 8-13 years in our study. We use the HTC Vive VR device with MediqVR software. We have created 10 different VR metaphors for training social communication and social perception skills and decrease social anxiety.

Results: We have created VR metaphors, where children are exposed to other people in different social environments: school, street, restaurant etc. The situations are either neutral (for learning specific skills), socially awkward, embarrassing, funny or emotionally challenged.

Following are examples of 5 out of the 10 created VR metaphors:
1. The patient trips and spills ice cream on stranger’s coat, who does not notice. The child has to tell them, explain the circumstance and apologize.
2. A boy trips on their shoelace, falls and starts to accuse the patient of tripping him over. The child has to calm him down and defend him/herself assertively.
3. A girl has accidentally put her clothes on backward. The child has to react and tell her in an appropriate way.
4. Another pupil keeps disturbing the patient in class when the teacher is not looking (throwing paper balls, making funny faces and sounds at them etc.). The child has to call them to order.
5. Child goes to a movie theater and sees that someone has taken his/her place.

The therapist sees the child’s situation from a computer-screen and can choose different reactions for the other people in VR metaphors and outcomes, based on the patient’s communication. Also, the therapist can attend the situation by speaking to a microphone which the child will hear through headphones as a voice of someone from the VR setting.

After each scenario the outcome of the situation and patient’s emotions and reactions are discussed. Also, metacognitive skills are developed. Afterwards, the patient re-acts the situation once more.
Conclusions: VR metaphors for social anxiety remediation and the rehabilitation of social perception and communication skills are suitable and very motivating for children with ABI. We have started the rehabilitation process and will provide clinicians with evidence-based outcome results and guidance. The advantages of using VR are flexibility, safe environment and precise performance measurement.
Subtle Motor Signs in Children with Chronic Traumatic Brain Injury

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Background: It is well-established that even children with overall good recovery after pediatric traumatic brain injury (TBI) are at risk for higher level cognitive and behavioral dysfunction. Moreover, due to injury to a maturing brain, chronic effects of the injury may depend on the extent of subsequent maturation. Few studies have shown deficits in gross and fine motor skills up to 4 years post-injury. However, there is a lack of research examining developmentally-relevant subtle motor signs such as motor overflow in moderate to severe pediatric TBI. The study aimed to characterize subtle motor signs with an emphasis on motor overflow in children with moderate-severe TBI in the chronic phase of injury.

Methods: Participants included 15 children with moderate (n=7) or severe (n=8) TBI, ages 11–18 years, who had sustained their injury at least 1 year prior to study participation (Range 1–14.5 years since injury), along with 15 age- and gender-matched typically developing controls. Subtle motor signs were examined using the Physical and Neurological Examination of Subtle signs (PANESS). To examine the neural correlates of subtle motor signs, volumetric measures of global (e.g. total cerebral volume) and focal (e.g. motor white matter volume) injury obtained from magnetic resonance imaging were used.

Results: Children with TBI had poorer PANESS performance than the control group on the Total Timed subscore (t(28)= 3.88, p= .001), Gaits and Stations subscore (t(28)= 2.16, p= .04), proximal overflow (t(28)= 3.03, p= .008), and the PANESS total score (t(28)= 3.9, p= .001). While the broadest PANESS scores did not differentiate between injury severity, participants with severe TBI had significantly greater proximal overflow than those with moderate injury (t(7)= 5.46, p=.001). Across all participants, lower PANESS scores were significantly associated with reduced total cerebral and total white matter volume, but not with motor white matter volume.

Conclusion: Children with chronic TBI had greater subtle motor deficits such as reduced balance and motor speed, along with greater proximal motor overflow (extraneous movement on the same side involving larger muscle groups) than controls. Subtle motor signs were associated with more global measures of cortical atrophy as compared to focal measures suggesting that motor deficits in moderate-severe TBI may reflect sequelae of diffuse injury rather than focal motor pathology. The study highlights the importance of neurological examination of subtle motor signs during clinical evaluation of children with chronic TBI and establishes the clinical utility of the PANESS as a measure sensitive to chronic subtle motor signs in this population. The persistence of proximal overflow in older children with TBI suggests a possible maturational lag in motor development during the chronic phase of injury. Further longitudinal research is required to track the developmental trajectory of subtle motor signs following pediatric TBI.
Clinical CT and MRI Findings in Children with Moderate and Severe TBI

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Background: In this prospective cohort study CT findings and traumatic axonal injury (TAI) lesions detected in clinical MRI from the early phase in paediatric moderate and severe TBI were investigated.

Methods: 39 children aged <18 years with moderate (Glasgow Coma Scale [GCS] 9-13) and 30 children with severe TBI (GCS ≤ 8) admitted to a Level 1 trauma centre in Norway; St. Olavs Hospital, Trondheim University Hospital from 2004 to 2014 were prospectively included (n=69). Intracranial pathology on head CT was defined as epidural or subdural haematoma, traumatic subarachnoidal haemorrhage (SAH), contusion or intracerebral hematoma. A subgroup of 42 patients (n=23; 59% of the moderate TBIs and n=19; 63% of severe TBIs) had MRI (at 1.5 T) performed within 35 days (median 8 days) after injury. MRI sequences were T2*GE, FLAIR and DWI. TAI was classified into three stages according to a modified MRI staging based on a neuropathological staging. White matter lesions in the hemispheres and cerebellum were defined as TAI stage 1, lesions in corpus callosum as TAI stage 2 and lesions in the brain stem as TAI stage 3.

Findings: For patients with moderate TBI, fall was the most frequent cause of the injury (49%) and median GCS score was 12. For patients with a severe TBI, road traffic accident was the most frequent cause (60%), and median GCS score was 6. In moderate TBI 62% had intracranial pathology on first head CT and in severe TBI 83% (p=0.05). Significantly more patients with severe TBI had traumatic SAH (53%) than patients with moderate TBI (15%; p=0.001). The frequency of contusions on CT (21% in moderate TBIs, 30% in severe TBIs; p=0.38) or evacuated mass lesion surgery (23% in moderate TBIs, 20% in severe TBIs; p=0.79), were not significantly different. In the moderate TBI subgroup with MRI, TAI lesions were detected in 57%, classified as TAI 1 in 30%, TAI 2 in 22%, TAI 3 in 4%. In severe TBIs TAI lesions were detected in 89% (p=0.02 versus moderate TBI), classified as TAI 1 in 37%, TAI 2 in 11% and TAI 3 in 42%. TAI 3 was more common in severe than moderate TBI (p=0.003).

Interpretation: More children with severe TBI had traumatic SAH than children with moderate TBI. The percentage of patients with contusions was low for both severity groups, and one in five had evacuation of a mass lesion. Although only about half of the children with moderate TBI underwent MRI, more than half of these had TAI lesions. Additionally, almost all children with severe TBI had TAI lesions, nevertheless MRI was only performed in 63%. In summary, use of MRI in paediatric TBI can add valuable information about the extent of TBI.
Global Outcome After Moderate and Severe Traumatic Brain Injury in Children

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Background: Traumatic brain injury (TBI), particularly moderate and severe TBI, is a leading cause of death and disability in children globally. The objective was to report 12 months functional outcome in a complete 10-year cohort of children with moderate and severe TBI.

Methods: All children <18 years with moderate (Glasgow Coma Scale [GCS] score 9-13) or severe TBI (GCS score ≤ 8) admitted to a Level 1 trauma centre; St. Olavs Hospital, Trondheim University Hospital between October 1st to September 30th 2014 were prospectively included. Outcome was measured with the Glasgow Outcome Scale Extended (GOSE) 12 months after injury. GOSE score 1= death, 2= vegetative state, 3 and 4 = severe disability, 5 and 6 = moderate disability and 7 and 8 = good recovery.

Findings: A total of 69 children with moderate (57%, n=39) and severe TBI (43%, n=30) were included. The median GCS score in patients with a moderate and a severe TBI was 12 and 6, respectively. At admission, one child (3%) with moderate TBI had unilateral dilated pupil, whereas four children (13%) with severe TBI had bilateral dilated pupils and five children (17%) with severe TBI had unilateral dilated pupils. The median length of stay (LOS) in the hospital was 5 (range 1-46) in moderate TBI and 16 (range 1-35) in severe TBI. Children with moderate TBI were discharged to home (85%), to other hospitals (10%), to rehabilitation (3%) or other (3%). Children with severe TBI were discharged to home (40%), to other hospitals (37%), to rehabilitation (13%) and 10% died. Valid GOSE scores were obtained in 82% (32/39) of children with moderate TBI and in 93% (28/30) in patients with severe TBI. Median GOSE score was 8 in moderate TBI and 7 in severe TBI. In patients with moderate TBI, and registered outcome, 84% had GOSE score 8 and 16% had GOSE score 7. In patients with severe TBI, and registered outcome, 36% had GOSE score 8, 18% had GOSE score 7, 18% had GOSE score 6, 4% had GOSE score 5, no children had GOSE score 4, 14% had GOSE score 3, no children had a GOSE score 2, and 11% had GOSE score 1.

Interpretation: 12 months after injury all children with moderate TBI had a good recovery and almost all (84%) had GOSE score 8. In comparison, half of the children with severe TBI had a good recovery and almost one in five (18%) had GOSE score 8. Furthermore, there were no children in a vegetative state at 12 months.
Feasibility of the NIHTB-CB to Assess and Track Cognitive Impairments Following Pediatric Acquired Brain Injury

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Introduction: Cognitive impairments are a devastating consequence of acquired brain injury in children. Current pediatric tools for assessing and tracking cognitive impairments are generally time intensive and applicable to a restricted age span. The NIH Toolbox of Neurological and Behavioral Functioning - Cognition Battery (NIHTB-CB) is a standardized, tablet-based cognitive assessment designed to quickly measure reading, vocabulary, episodic memory, working memory, executive functioning, and processing speed. The NIHTB-CB has been normed across the lifespan in the general population and validated in brain injured adults. However, its clinical utility and validity has not yet been demonstrated in brain injured children. The current study examines the feasibility of NIHTB-CB administration in both a pediatric inpatient and day treatment rehabilitation setting.

Methods: We attempted the NIHTB-CB in 40 brain-injured children (13 TBI, 4 cancer, 8 vascular, 5 encephalitis, and 10 other) within the Blythedale Children’s Hospital and the Mt. Pleasant Blythedale Day Hospital. 57% percent of the participants were male. The average age of participants was 13 years old (SD = 3) and ranged from 4 to 18. The range of time since injury was 40% less than 6 months, 11% from 6 to 12 months, 11% from 1 to 2 years, and 38% greater than 2 years.

Results: Of the 40 brain-injured children tested, 35 were able to complete the NIHTB-CB and 25 were able to complete it in one session. The target time to complete the NIHTB-CB is 30 minutes for participants ages 7 - 85 and 20 minutes for ages 3 - 6. The average time to complete the NIHTB-CB for our sample was 36 minutes [SD = 7, 28 to 59 minutes]. Barriers to a full battery completion included both external (scheduling conflicts) and internal (fatigue, attention, and behavioral) limitations. Potential complicating factors include dominant side hemiplegia, English as a second language, and premorbid learning disabilities and/or disorders such as ADHD. Individual subject results comported with clinical assessment of cognitive status. The NIHTB-CB could be administered to children with a wide range of cognitive abilities but required subjects to meet minimal standards for sustained attention and cognitive stamina in order to complete the test within one session and within the targeted time frame.

Discussion: This study demonstrates the feasibility of using the NIHTB-CB in post-acute pediatric inpatient rehabilitation and day treatment clinical settings following acquired brain injury. The NIHTB-CB has the potential to provide a quick, standardized assessment of cognitive function during the rehabilitation process to track progress and inform prognosis and treatment planning. Further studies of NIHTB-CB using larger samples of children will be needed to determine its validity, test-retest capabilities and clinical utility.
Patient and Parent Reported Biopsychosocial Barriers to Concussion Recovery

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Recommendations regarding treatment of concussion in youth have continued to evolve with increased acknowledgement of the psychosocial and environmental factors that affect recovery. Yet, patient self-report of symptoms continues to drive concussion diagnosis and treatment without recognition of the context in which symptoms are reported. The current study examines patient and parent perspectives on how psychosocial and environmental concerns, in addition to physical concerns, serve as barriers to optimal recovery.

Participants were 53 adolescent or young adult patients (m= 15.4 years +/- 3.2, range 10-25; 49% female) who were receiving care at an outpatient sports neurology clinic for a concussion. 53% of patients had a history of two or more concussions.

Participants rated 12 possible barriers to recovery on a Likert scale from 1-5 (1=not at all a barrier, 5=biggest barrier) as well as a survey assessing overall knowledge about concussion and questions of basic demographic information. Mean ratings were calculated for each barrier in the patient and parent groups. A between subjects ANOVA compared each barrier by group, and by gender in the patient group.

Among patients, “pain/discomfort” was the greatest barrier to recovery (m=2.6 +/-1.3), followed by “inability to exercise normally” (m=2.5 +/-1.4), “missed school because of symptoms” (m=2.4 +/-1.5), “worry/fear about possible long term effects of concussion” (m=2.4 +/-1.4), and “missed school because of medical appointments” (m=1.9 +/-1.2). There were no significant differences between patients and parents in mean ratings for each barrier.

The percentage of patients endorsing a “large problem” or “biggest problem” were “pain/discomfort” (26%), “missed school because of symptoms” (28%), and “inability to exercise” (32%). Comparison of means by gender revealed that females were significantly more likely to rate “inability to exercise” as a barrier than males (p=.05). 38% of females and 26% of males rated “inability to exercise” as a “large problem” or “biggest problem.” No other significant gender differences were found.

In rating barriers to concussion recovery, patients describe physical symptoms, restricted participation in life activities, and worry about the injury as similarly burdensome. Treatment for concussion may benefit from increased efforts to guide participation in life activities and support effective coping with worry about recovery.
School and Community-Based Interventions for Paediatric Traumatic Brain Injury: Finding A Way Forward

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Background: Chronic impairment following childhood traumatic brain injury (TBI) can bring with it an increased risk of life changing negative outcomes. Despite the evidence suggesting that these individuals need support, students with mild to moderate TBI are increasingly released from hospital with no plans at all for long-term rehabilitation (Glang et al., 2013). Appropriate support both at school and in the community is limited, with reported gaps in rehabilitation service delivery and demand, especially amongst those identified as requiring additional support (Cronin, 2001; Laatsch et al., 2007; Di Scala, Osberg, & Savage, 1997). Long-term rehabilitative pathways often rely on availability of resources and multi-agency cooperation (Anderson & Catroppa, 2006). This has resulted in schools and the wider community becoming the primary service providers following TBI, making these often siloed providers critical for long-term rehabilitation. The aim of these reviews was to provide a clear and comprehensive view of existing school and community-based intervention programmes which targeted children and adolescents following TBI to assist with this transition and beyond.

Methods: Two comprehensive systematic reviews of school and community-based interventions were conducted across different national contexts. Ten databases were searched up until February 2018. All included studies involved a paediatric clinical population with TBI, and an intentional structured intervention with at least two outcome data points. Risk of bias was rated for each included study.

Results: 33 peer-reviewed studies were identified across both reviews, of these 27 distinct interventions were found. All studies concluded that their intervention seemed to have some level of improvement for persons with TBI, however the quality of the evidence was largely weak and highly variable.

Conclusion: The results suggested some improvement in paediatric outcomes following both school and community-based interventions – indicating that a dual-approach to rehabilitation could assist in long-term monitoring and recovery. However, higher quality evidence is needed to support specific interventions; in the absence of this there is a risk that intervention effectiveness may be confounded by the quality of the research design. Overall, as the effects of paediatric TBI are potentially significant and life-changing, it is essential to ensure appropriate accommodations are being made in schools and the community to maximise young peoples’ chances of the best possible outcome. Understanding the effectiveness and sustainability of interventions is critical to empowering schools and communities to address this hidden epidemic.
What are the Barriers and Facilitators for Establishing an Interdisciplinary Clinical Service for the Management of Mild Traumatic Brain Injury for Kids and Adolescents?

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Objective: We established an interdisciplinary team within a concussion clinic in order to do post-injury assessment, offering treatment for associated dysfunctions and manage of persistent post-concussive symptoms in kids and adolescents.

Results: The Cortex concussion was founded in Quebec City (Canada) in 2011. At this time, it was the first concussion clinic in Canada having a complete interdisciplinary team to assess and manage sports-related concussions. Over the years, barriers and facilitators were faced to upgrade the management of concussions and post-concussion symptoms, based on scientific evidence. The team is actually composed of physicians, neuropsychologists, physical therapists, kinesiologists, athletic therapists and optometrists. Some of the clinicians hold a university position, while other are clinician-scientist or clinicians. When evaluating a concussion, an initial meeting with the patient by a duo of clinicians (neuropsychologist-physical therapist) to do a comprehensive clinical interview followed by a craniocervical and vestibular/ocular-motor screening. The patient will then have neurocognitive testing to gather information about cognitive deficits. These initial sessions give our team an informed management plan. The treatment protocols are individualized to each and every patient. Once a week, the team meets to establish an interdisciplinary management plan to orient patients, including physical treatments, cognitive management of concussion, return-to-learn and return-to-activity. We are having success in managing sports-related concussion in an interdisciplinary setting, giving a patient-centered and evidence-informed service based on clinical excellence.

Conclusions: Developing a strong interdisciplinary clinical team facilitate effective management for sports-related concussions and helps communication within professionals, patient, family and referents. Most important, using a patient-centered comprehensive evidence-informed rehabilitation program with a strong treatment team decreases clinical ambiguity.
SPECS: Seeing Brain Injury Clearly. Psychosocial Training for Professionals Working with Children and Young People with Acquired Brain Injury

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‘SPECS: seeing brain injury clearly’, is an innovative approach to meeting the Social, Physical, Emotional, Cognitive and Spiritual needs of children and young people (CYP) with acquired brain injury (ABI) in order to facilitate their rehabilitation. It also addresses the needs of professionals, families and staff looking after them.

In line with the core principles behind the ICF-CY (WHO, 2007), SPECS is a training package that aims to increase the skills and confidence of professionals working directly with CYP and their families who have been affected by ABI – thus achieving the ultimate aim of increasing meaningful participation in life. It aims to promote psychosocial rehabilitation, reflective practice and self-care in teams.

The Annual Report of the Chief Medical Officer (2012) ‘Our Children Deserve Better’ highlighted the need for professionals to be trained to understand the intricate interplay between psychosocial support, physical recovery, cognitive recovery and thus long-term outcomes.

Psychosocial factors are major predictors of long term outcome in the paediatric ABI population (Ross et al, 2011). Severity of injury does not necessarily compromise quality of life, for instance, severely injured children can have a high quality of life should psychosocial stressors be minimised.

SPECS was made collaboratively with staff and parents of the CYP at The Children’s Trust to ensure all relevant voices were heard. We were enabled to commission valuable input from an external consultant through the award of £2000 from New Look Ltd.

SPECS comprises an introductory (Day 1) and advanced (Day 2) training programme each concentrating on different aspects of psychosocial care, including:
- The importance of being aware of cultural values
- The role of insight
- Adjustment, grief and loss
- Managing expectations and transition
- Complex presentations and situations that challenge us

Delivery of SPECS follows a variety of methods from traditional didactic modes to self-directed study and group reflective tasks.

The key benefits to professionals of SPECS are enhanced awareness, knowledge, confidence and skills to work effectively with CYP and families affected by acquired brain injury. In turn this is anticipated to impact on CYP and families’ well-being and quality of life through:
- Increasing knowledge of acquired brain injury
- Enhancing coping, adjustment and adaptation
- Reducing a sense of isolation
In summary, SPECS supports the notion that comprehensive paediatric neurorehabilitation involves a holistic approach inclusive of cognitive, physical and psychosocial rehabilitation.
Maintaining Relationships and a Sense of Belonging Following an Acquired Brain Injury

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ABI can have a significant impact on a young person’s sense of belonging, particularly due to the effect it can have on a young person’s sense of identity. This is further compounded by other factors such as missed schooling. This presentation will describe evidence-based examples of practice within a neurorehabilitation setting, across a range of ages, that aim to promote young people’s relationships and sense of belonging following an ABI. The presentation will detail how the authors have worked to facilitate inclusion and participation through supporting young people in developing their understanding of their ABI and a narrative around their experience, skills and needs in order to share this with peers, teachers and friends on their return to education.
From Low to High Tech Memory Aids: Supporting A Child with Complex Memory Difficulties at Home, in School and in Their Community. A Parent’s Perspective on Being Supported to Understand the Potential Use of Compensatory Memory Aids

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The ability to lay down new memories has a primary role in children’s learning and well-being. Memory problems that interfere with everyday living are frequently reported in children who have sustained acquired brain injury (ABI), but the potential use of compensatory aids at home and in school is under-researched, particularly in the cohort who have experienced severe memory deficits.

The current presentation relates to a now 14-year-old girl with a background of a hypothalamic pilocytic astrocytoma which was diagnosed when she was aged just 19 months. A complex medical history involving a wide variety of interventions culminated in a 60% resection of her tumour when she was 11 years old. This child suffered resulting permanent short-term memory loss, diabetes insipidus, a significant visual impairment and loss of sensation of thirst. She now presents as a bubbly, fun loving girl who is however heavily reliant on external prompts and cues to support her memory and everyday living. While this girl may recall a certain amount of information immediately and can work and converse well in the ‘here and now’, there is a rapid loss of information after approximately 5 minutes. This presentation will specifically focus on her transition from using low tech strategies such as check-lists, visual reminders, calendars and signs around her home and school to help support her memory to using mainstream and specialist assistive technologies on her smart phone and iPad.

The presenter will reflect the lived experience from a parent and families perspective of being supported by a specialist neuro rehabilitation team in considering strategies to support their child’s complex memory challenges. Video interview will be used to reflect the parent’s perspective. The potential resulting impact of such a significant memory impairment on a child’s academic performance, social participation, emotional wellbeing and development of independence skills is well established in the literature. The current presentation will outline relevant evidence-based literature to support the efficacy of using such compensatory aids.
The SHARED Model – A Systems Approach to Transition Following Childhood ABI

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This presentation will describe the SHARED model, which has been developed by the authors as a systemic framework for supporting transition following childhood ABI. The presentation advocates the "SHARED" theoretical model as a framework for informing the transition of young people following acquired brain injury back to school and community services. Drawing on practice guidelines, research and our own application of the SHARED model, there is growing evidence that applying a systems model to transition for CYP with ABI promotes optimal rehabilitation, wellbeing, adjustment and a sense of school belongingness.
On Boarding of Advance Practice Registered Nurse (APRN) Team Members to Rehabilitation of Traumatic Brain Injury (TBI) Patients

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The American Association of Medical Colleges predicts 110,000 person physician shortage by 2030 (New research reaffirms physician shortage, 2017). As a result, many specialties are finding ways to increase access to rare services by incorporating Advanced Practice Registered Nurses (APRN’s). Adding an APRN who is not trained in the specialty of hire creates a significant learning curve. The process of verifying clinical skills, solidifying the foundation of knowledge and preparing these providers is critical to the success of the clinical practice and to the orientee. The on-boarding process is a multiphase model starting with observation and augmentation of knowledge, process learning, and partnering with members of the care team to understand their unique role.

In the initial phase, observation and augmentation of the fund of knowledge, a 17-week course is outlined to include reading of various journal articles complied by the practice as well as reading of a pre-determined text. Promptly after hire, a week-by-week outline is given to the orientee to include; expectations of bi-weekly power point presentations to cover specific topics that were pre-selected along with expectation of reading materials. Bi-weekly presentations were to be given from the APRN highlighting the delegated topic of significance for the practice. Example topics to include: prognostic factors in new TBI patients, awakening agents, management of concussions, cognitive predictors/neuropsychology, and neurological imaging. Using presentations as the platform serves an immediate purpose of in-depth understanding of the topic, but also serve as a resource in future.

The second phase is learning the processes of a specialty practice, as it is more consultative than a primary care position. Notes need to summarize, educate, and direct care as well as serving as a legal document if needed. With over 75% of practicing APRN’s in primary care roles, charting and billing distinctive to consultative visits are unique and unfamiliar (Nurse practitioners in primary care, 2013). Learning to document care was broken down into core categories; subjective, objective, assessment and plan. Working 1:1 with primary physician to encompass criteria for each category, progressed through core categories as competency was achieved. In addition to real time documentation, additional monthly sessions were held to review billing based on criteria and location of visit, as well as understanding of revenue.

The final phase includes incorporating the APRN into the treatment milieu that includes other types of clinicians. Initially the APRN was introduced to the inter-disciplinary team through video conference highlighting the role of the APRN to encompass; inpatient/outpatient consults with a physician, independent follow ups, signing orders, initiating treatment plans, and procedural assistance. Followed by clinician shadowing days with all members of the care team were scheduled throughout the first three months of hire. Benefits were multipurpose in that the APRN developed understanding of other clinician’s roles, and also gave understanding to the scope in which the APRN would be practicing.

Together this module provides a time line for competency, and the needed training components to successfully on board an APRN. Upon completion the APRN clinician will be prepared to work within their defined role to include; inpatient follow up’s, attending care conferences, prepare the patient for transition to an outpatient with supportive therapy and equipment, as well as reintegration into the community and school. This process represents a best practice model for on-boarding of an APRN was created and used in a
PM&R specialty to provide care for patients with a TBI; however, this model can be manifested to serve any specialty.

Retrain My Brain: The Development of a Cognitive Rehabilitation Pathway for Children and Young People with Acquired Brain Injury

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Objective: Cognitive rehabilitation (CR) has a growing evidence base with some studies showing individual attention training to be feasible. This project aimed to devise a cognitive rehabilitation pathway for children and young people (CYP) with acquired brain injury (ABI) in a post-acute inpatient setting.

Method: A literature review was undertaken, and key ingredients of CR were identified. This informed the development of a conceptual framework for delivering CR by targeting levels of intervention. An interdisciplinary team then devised materials based on the review findings and expert opinion. The pathway was piloted to test feasibility, implement adaptations and introduce selected assessment and screening tools. Feedback from CYP, their relatives and staff informed further development.

Results/Findings: Providing generic interventions was challenging, particularly within group interventions. Specific, individualised approaches were more successful within both group and individual interventions. Participation appeared to be influenced by communication abilities of the CYP, parents’ understanding of brain injury, and varying lengths of placements. Parents and CYP gave positive feedback regarding brain injury education and there was range of feedback provided regarding cognitive rehabilitation as a whole.

Conclusion: Many factors influence the delivery of CR within a heterogeneous paediatric ABI population, including personal, psychological, neurological, systemic, educational, and organisational. Having established that the programme is feasible with an emphasis on individualised adaptations to generic interventions, a larger study is planned to include a wider group of the CYP within the service. This project identified a need for quicker screening tools; and for more sensitive assessments with greater ranges to account for floor and ceiling effects across the population.

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Play is Precious: An Innovative Way to Deliver Neuro-Rehabilitation & Play

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Introduction: This presentation outlines the genesis of a new and innovative child & family-centered interdisciplinary team (IDT) design project. This project is aimed at developing a digital delivery platform to serve as an ABI education resource for families on the use of play in supporting a child or young person’s (CYP) neuro-development.

Play is critical to the healthy growth & development of all children. Play is also a major modality for paediatric neuro-rehabilitation therapists. Ylvisaker et al. (1998) state that “the most natural context for learning and cognitive growth is play”.

This online resource will serve as a model innovative system, service, and support for CYP with ABI and their families, facilitating a shared understanding across home, school, and health.

Whilst Neuro-rehabilitation therapists play a vital role in the recovery trajectory, it’s the families and other everyday people who play an integral role in the generalisation of key strategies across the various domains of functioning which makes a bigger impact in the longer term.

Objectives:
• To equip, educate and empower.
• To maximise each child’s individual skills and abilities through a range of developmentally supportive play-based activities.
• To bring this information together within an accessible interface that uses a unified tone of voice and style to inspire, encourage and support users.

The resource is designed in such a way that each play-based activity may be customised according to specific neuro-rehabilitation targets. The resource will inform regarding:
• WHAT developmentally-supportive play activities to engage the CYP in.
• WHEN to engage in such activities.
• HOW best to execute these activities.
• WHY these activities are beneficial for recovery & neuro-development.

Method:
• To draw on the specialist ABI expertise within the neuro-rehabilitation IDT in developing a range of evidence-based rehabilitation and play activities.
• To harness the expertise that exists within current technologies to develop an online resource, available on desktop and mobile, to facilitate the above.

Conclusion: This Project is ongoing with Phase 1 due for completion by September 2018. The next phase of the project will be to field test and validate the efficacy of this education and play resource with a view to further examining the potential for integrating more specific content around other target needs and exploring the use of additional technologies to enhance service delivery.
It is anticipated that this innovative approach to specialist ABI support and education will serve to enhance the well-being of CYP with ABI, their families, and significant others particularly upon discharge to their home and community environments.
Post-traumatic Stress Symptoms after Pediatric Injury: Are they Related to Prefrontal-Limbic Pathways?

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Physical injury is a major source of acute and chronic stress contributing to chronic problems in physical, cognitive, and/or psychological health areas. Post-traumatic stress symptoms (PTSS) occur in 30 to 50% of children sustaining physical injury. Diffusion tensor imaging (DTI) has been used to characterize changes in brain pathway integrity in patients with traumatic brain injury (TBI) and in patients developing PTSS following diverse traumatic exposures. Prefrontal-limbic circuitry, which mediates emotion regulation and stress response, is known to be highly vulnerable to chronic stress as well as to TBI. We used DTI to investigate connectivity of limbic gray matter (amygdala and hippocampus) and prefrontal cortical (PFC) regions (rostral anterior cingulate and medial orbitalfrontal PFC) implicated in PTSS. We examined 1) the impact of brain and bodily injury on prefrontal-limbic circuitry, and 2) whether tissue microstructure predicted PTSS scores.

Method: Participants ages 8 to 15 with TBI (n=53, 32 males) or extracranial injury (EI) (n=26, 18 males) injured in motorized vehicle incidents were recruited from a Level 1 trauma center as part of a longitudinal prospective study. TBI severity ranged from mild to severe. The Child PTSD Symptom Scale (CPSS) and structural MRI were obtained 2 months after injury. A probabilistic fiber tracking method was used to seed each amygdala and hippocampus and estimate the trajectory of pathways connecting them to each other and to bilateral rostral anterior cingulate and medial orbitalfrontal PFC. Fractional anisotropy (FA) and mean diffusivity (MD), measures of tissue microstructure, were calculated to estimate pathway organization in white matter (FA) and fiber density in hippocampus and amygdala (MD). General linear models adjusting for age compared PTSS and microstructure across the TBI and EI groups. Generalized linear models evaluated the relation of pathway FA and amygdala and hippocampal MD to CPSS subscores.

Results: PTSS scores were similar in the TBI and EI groups. Prefrontal-limbic circuitry microstructure did not differ significantly in the TBI and EI groups in the right or left hemispheres. For both injury groups, higher hyperarousal symptoms were predicted by higher FA of bilateral amygdala to medial orbitalfrontal pathways. Avoidance was related to FA of fibers coursing from the right hippocampus to the amygdala. Emotional numbing was associated specifically with increasing MD of the left hippocampus. Only for the EI group, elevated re-experiencing scores were associated with lower FA in the left hippocampus to amygdala pathway.

Conclusion: The two injury groups, TBI and EI, did not differ in traumatic stress symptoms or prefrontal-limbic tractography measures. Higher hyperarousal, avoidance, re-experiencing, and emotional numbing scores were related to integrity of specific components of prefrontal-limbic circuitry. The experience of being injured was significantly related to PTSS and brain connectivity, whereas the presence of brain injury did not confer additional vulnerability. Our findings support the emotion dysregulation model and suggest that traumatic stress from even a single incident may alter the connectivity of prefrontal structures that inhibit emotional reactivity of limbic structures.
Positive Approaches to Behaviours That Challenge: The Development of a Positive Behaviour Support and Self-Harm Pathway in A Neuro-Rehabilitation Setting

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The presentation will describe the development of a positive behaviour support and self harm pathway in a residential neuro-rehabilitation setting. This pathway has been developed to facilitate staff teams, families and young people in navigating a positive approach to assessment, formulation and management of behaviours that challenge and emotional distress following acquired brain injury.

Rationale: Child brain injury is a major risk factor for developing difficulties with emotional regulation. Challenges with behavioural regulation can also be persistent and continue in children and young people up to 10 years after the injury (Anderson, Godfrey, Rosenfeld and Catroppa, 2012). These difficulties can greatly impede the child’s own progress within their rehabilitation program, with behavioural and social consequences of brain injury seen as contributing to levels of long term family distress. Ylvisaker, Turkstra, Coehlo, Yorkston, Kennedy, Sohlberg and Avery (2007) in a systematic review conclude that positive behaviour support can be considered an evidence based intervention in supporting the needs of young people with acquired brain injury. There is also evidence to suggest that children and young people with developmental disabilities are at greater risk of developing mental health or behavioural needs (Bernard and Turk, 2009; Emerson and Hatton, 2007) and of the need for a positive approach to management.

Children and young people’s acquired cognitive and communication difficulties may also contribute to risk taking or self-harming behaviours. Children and young people may find it harder to put into words how they are feeling due to communication difficulties and may act on these feelings instead. Acquired difficulties with, orientation, emotional regulation and difficulties with attention and impulsivity may also contribute to self-harming behaviours. Other cognitive and communication difficulties may mean that there appears to be a disconnection between a child or young person’s thoughts and their feelings. This can mean that it is harder to predict how they will respond.

Methodology: The Psychology and Nursing team have developed a pathway that facilitates communication between all parties, and ensures that key elements of Positive Behaviour Support are undertaken from point of admission, throughout a young person’s inpatient neurorehabilitation to time of discharge or other provision.

Conclusion: The pathway aims to support staff teams, families and young people in assessing risk by developing a comprehensive formulation around behaviours and emotional needs and then applying positive approaches to intervention.

The formulation adopts a biopsychosocial model, taking into account neuropsychological functioning, pre and post-injury relationships, internal and external triggers and resiliency factors. The support plans aim to highlight preventative support and codes presenting behaviours and interventions through colour coded systems to facilitate teams, families and young people in applying intervention/strategies at various levels according to need. The team are also supported through a defusing and debriefing process to aid reflection and future learning.
This presentation would aim to review the pathway itself and the different levels (red, amber, green) through the use of case studies. We would also describe approaches to risk assessment and tools that have been developed by the team to access young people's views as part of this process and give them ownership of their positive support plans.
Dual Task Assessment During Treadmill Walking for Children and Adolescents with Sport Concussion

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Cerebral concussions may be difficult to assess due to the multiple human body systems involved and the variety of symptoms subtle to detect. Current literature suggests that some gait parameters (GP) are responding well to slight changes for impairment. This research project goal was to determine which parameters are sensitive in a motor-cognitive dual tasking and its anticipatory effects.

Purpose: To identify sensitive GP to detect functional and cognitive alterations in adolescents who have sustained a sport concussion.

Methods: Twenty adolescents aged between 10-17 years old (mean age 13.8 ± 1.7 years) took part to this study and split into the experimental group (n=11) and the control group (n=9). Treadmill walking (TW) was assessed in single and dual task conditions. The task could be cognitive (modified Stroop task, STROOP) or motor (stepping over an automated dynamic obstacle at 0.115 m above the treadmill surface). The STROOP was displayed on a digital tablet placed in front of participant. Five specific conditions were tested: (1) the performance of the cognitive task standing alone (STROOP alone), (2) a TW-only task, (3) a TW task with anticipation of the performance of the cognitive task (walking pre-STROOP), (4) a TW task concomitant with the performance of the cognitive task (walking-STROOP), (5) a TW task with anticipation of the triggering of the dynamic obstacle (pre-obstacle step). Before the experiment of the 5th condition, a demonstration of the moving obstacle was carried out, without however experiencing the crossing movement. The four TW tasks (conditions 2, 3, 4 and 5) were performed at the preferred speed of the participants. ANOVAs were done to determine condition and group effects on specific GP: stride length and duration as well as different variables issued of vertical and anteroposterior foot obstacle clearance. Analyses were done on mean values for these GP and on their inter-gait cycle variability. Statistical tests were corrected for multiple comparisons (Monte Carlo correction).

Results: Significant interaction effects were detected in the case of the contrast between the two anticipation conditions (pre-STROOP and pre-obstacle steps) compared to the dual-task condition (STROOP). Thus, in adolescents with concussion, in comparison with healthy adolescents, the length of stride decreased (F3.48 = 6.38, p <0.01), the duration of the stride increased (F3.48 = 5.24, p <0.01) and the maximum height of foot-ground clearance decreased (F3.48 = 5.28, p <0.01).

Conclusion: This work showed conclusive results and is relevant to detect sensitive GP to disease effects of concussions in a cognitive-motor dual tasking for a better assessment and follow up of adolescents with concussion.
Evaluating Biomarkers as Modifiers of the Neuropsychological Benefits of Computer Cognitive Games Rehabilitation in Ugandan Children Surviving Severe Malaria

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Background: The benefits of computerized cognitive rehabilitation training (CCRT) for alleviating persisting neurocognitive deficits in Ugandan severe malaria survivors may differ according to factors reflecting the acute malaria illness. In this exploratory secondary analysis, we evaluated potential moderating effects of three biomarkers, von Willebrand Factor (vWF), tumor necrosis factor alpha (TNF-α), and Regulated on Activation, Normal T Expressed and Secreted (RANTES) on the CCRT benefits in two cohorts of Ugandan school-aged children: malaria survivors and community controls.

Methods: Biomarkers were assayed from specimens drawn from Ugandan children hospitalized for severe malarial anemia (SMA) or cerebral malaria (CM), as well as from community control children as part of an observational study of the pathogenesis of severe malaria. Approximately 2.5 years later, 150 of the children surviving CM or SMA and 150 non-malaria children 6 to 12 years of age entered a three-arm randomized controlled trial of titrating Captain’s Log CCRT and non-titrating Captain’s Log CCRT against usual care control arm, stratified on malaria exposure. Neuropsychological tests of cognition (Kaufman Assessment Battery for Children - Second Edition, KABC-II), attention (Test of Variables of Attention, TOVA), and behavior (Achenbach Child Behavior Checklist, CBCL) were administered before and after 24 CCRT sessions over a 3-month period, and at one-year follow-up. Moderating effects were explored using trial arm by biomarker level interaction in the linear mixed effects models for two repeated measures of outcomes.

Results: For the severe malaria survivors, children with low vWF or high TNF-α plasma benefited from the non-titrating CCRT on overall KABC cognitive performance. This was not the case for children with high vWF or low TNF-α in plasma, indicating that the intervention effects on the KABC MPI may differ according to the biomarker level. Among CM survivors, moderating effects of CSF levels of TNF-α and RANTES were less pronounced: both titrating and non-titrating CCRTs had benefits reflected by sizable SMDs, however the magnitude of the SMDs was greater at low CSF TNF-α as compared to high, and at high CSF RANTES as compared to low. For the TOVA, there were no statistically significant differences among trial arms at any of the biomarker levels, and the SMDs for the CCRT versus control arm were small with very few exceptions. The only significant interactions of trial arm were with the level of RANTES in plasma (p=.04 for D’prime and p=.02 for commission errors).

In contrast to the findings for the KABC and TOVA, for the behavioral outcomes measured with the CBCL, titrating CCRT showed benefit compared to controls among survivors with low vWF plasma for symptoms of externalizing. Similarly, to the findings for the KABC, survivors with high TNF-α in plasma benefited from the titrating CCRT for symptoms of internalizing (p=.02) and from both titrating and non-titrating CCRT for symptoms of externalizing (p<.01). Also, among children with high plasma RANTES, the differences among three arms were seen for internalizing symptoms (p=.05), with the same pattern of point estimates for the externalizing symptoms that did not reach statistical significance, but with consistently sizable SMDs.
favoring controls over the CCRT interventions. The potential moderating effects of biomarkers noted for the malaria survivors were not present among non-malaria children.

Conclusions: It has been hypothesized that in young children with CM, microvascular sequestration, mitochondrial hyper-metabolism, hemorrhage, and blood-brain barrier disruption, can compromise arterial watershed regions serving the white matter and other major connective pathways of the brain. Our findings indicate that insults to the brain from severe malaria can lead not only to persisting neurocognitive deficits, but also reduced positive neuroplasticity in response to learning and rehabilitative interventions in children years afterward.
The Effect of Anxiety on Cognitive Efficiency During Baseline Concussion Assessment in Adolescent Athletes

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Background: In youth, anxiety is the most prevalent mental illness in the United States, effecting 31.9% of adolescents. During concussion assessment, athletes may experience high levels of anxiety due to concerns such as removal from sport due to injury or the inability to perform in their sport. The cognitive efficiency index has been implemented in a commonly utilized computerized concussion assessment tool (ImPACT ™) to measure the interaction between accuracy and speed of completion during a cognitive task. It is critical to determine the degree to which performance decrements on the cognitive efficiency index reflects anxiety, such that anxiety can be accounted for when examining concussion assessment.

Specific Aim: The aim of this study was to examine the prediction of state and trait anxiety scores on cognitive efficiency within a computerized neuropsychological test battery (ImPACT ™).

Participants: The participants included 75 high school athletes, with a mean age of 15.91±1.33 years. Recruitment and testing occurred prior to their competitive season to establish baseline test scores.

Interventions: All participants were administered annual baseline testing on computerized neuropsychological test battery (ImPACT™) and the State Trait Anxiety Inventory (STAI-Y) to determine cognitive function and levels of anxiety respectively. Using SPSS, a multiple linear regression was calculated to predict cognitive efficiency based on state and trait anxiety.

Results: No significant regression equation was found (F (2,72) = 0.888, p> 0.05), with an R2 of 0.024.

Conclusions: Thirteen percent (n=10) of our participants experienced high state anxiety while nearly half (47%, n=35) endorsed high trait anxiety. While participants endorsed varying levels of anxiety during baseline concussion assessment, it appears that the cognitive efficiency index within ImPACT ™ is not influenced by either trait or state anxiety in adolescent athletes. This preliminary study provides initial evidence that anxiety may not influence cognitive scores. The heightened awareness of concussion in the media creates an environment where adolescent athletes may not assess baseline testing as stressful, thereby reducing the overall effect of anxiety on cognitive performance. However, additional research is recommended to determine the influence of anxiety during post-concussion assessment when stakes may be higher.
Viability of the Coma Recovery Scale-Revised in the Pediatric Intensive Care Unit

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Introduction: Evaluation of disorders of consciousness (DoC) in children is a challenge with minimal guidance present in the literature for therapists. There is no objective measure to communicate and document the severity of injury; however, some clinicians rely on the Glasgow Coma Scale (GCS). GCS is widely used in the Emergency Department as well as the Pediatric Intensive Care Unit (PICU). There are limitations when using the GCS including interrater reliability, difficulty to administer on non-verbal, or intubated, and no guidance to therapists in terms of treatment interventions. In the adult population, the Coma Recovery Scale-Revised (CRS-R) is used often to assess severity of the brain injury by therapists. The CRS-R is a standardized neurobehavioral assessment measure made up of six subscales that assess arousal level, auditory, language comprehension, visuoperception, motor function, oromotor capacity, expressive speech, and communication in patients with DoC. Utilizing components of the CRS-R one is able to generate differential diagnoses for coma, vegetative state, and minimal conscious states that are reliable and valid in the adult population (median age 38, youngest patient 17). There is no evidence that shows use of the CRS-R in the pediatric population <17 years old is possible or has been performed in the PICU. The role of this study is to describe the viability of the CRS-R as an acceptable outcome measure for severe brain injured patients in the PICU.

Methods: Twenty-three patients aged 2 to 20 with GCS of <8 at time of evaluation, brain injury, and DoC admitted to the PICU from October 2015 to April 2018 were tested. Three therapists (2 physical therapists, and 1 occupational therapist) were trained and performed all assessments. When medically appropriate for therapy evaluations, patients who met criteria for possible DoC and a State Behavioral Scale (SBS) score between -3 and +2 had the CRS-R performed and score recorded at initial evaluation, and weekly until they were discharged. Additional notes regarding limitations, and adverse events during administration were recorded.

Results: The scale was administered 38 times over the 30-month time span. Ten patients had follow up testing done at least one week post initial administration. Barriers recorded included high ICP and sedation levels, language center involvement, motor, and communication due to endotracheal tube. Limitations subsequent administrations of the CRS-R included quick progression out of DoC state, change in medical status, and need for increased sedation. No adverse events during test administration was noted.

Discussion: Pediatric patients were able to perform components of the CRS-R while admitted to the PICU. Use of salient objects (toys that were age appropriate) allowed for greater response. Majority of patients were over the age of 11 and further research needs to be done on the lowest age the CRS-R can be performed on due to developmental constraints. Additional studies should be done to look at the role sedation in the pediatric populations plays in time to initial evaluation, administration, and score of the CRS-R.

Conclusion: The CRS-R was successfully administered to pediatric patients while admitted in the Pediatric Intensive Care Unit.
A Novel Rehabilitation Approach for a Child with Acquired Brain and Spinal Cord Injury: A Case Report

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Background: Incidence for a Chiari malformation is estimated to be less than one in 1000 people with characteristic abnormalities noted with downward displacement of cerebellum tonsils. When cerebral spinal fluid (CSF) is compromised by an infection, the symptoms can become life threatening. The infected CSF can cause increased pressure, leading to distension of the cerebellar tonsils, compressing the brainstem tissue and artery systems. While rare in the pediatric population, cerebral vascular accident (CVA) and spinal cord injury (SCI) may occur. Physical therapy (PT) and occupational therapy (OT) during the acute phase of a CVA and SCI is vital to promoting optimal outcomes.

Case Description: Patient was transferred to Pediatric Intensive Care Unit (PICU) with concerns for septic shock from bacterial meningitis. A MRI showed edema and acute infarcts involving bilateral inferior cerebellar hemispheres, vermis, caudal aspect of the medulla, as well as the upper cervical spinal cord at the craniocervical junction, as well as pre-existing Chiari malformation. Due to increases in ICP, she then underwent suboccipital decompression on Day 3 of admission with resection of necrotic areas of the cerebellum. She remained ventilator-dependent in the PICU for 16 days until tracheostomy. She was dependent for all cares and mobility with quadriparesis. Cognition intact for the entirety of admission. Patient was admitted in the PICU for a total of 29 days. PT saw patient for a total of 21 sessions and OT for 17 sessions.

Interventions: Nontraditional intensive care rehabilitation interventions were used to promote patient and family centered care. Family provided patient’s interests and motivators and therapy incorporated patient preferences into interventions. Day 7 of admission OT and PT performed evaluation. Patient had 6 sessions of PT while intubated with an external ventricular drain (EVD) including using the supine cycle ergometer for cycling with lower extremities while supine in bed. Once EVD was removed on day 14, patient was sitting edge of bed daily baking brownies, in lieu of tradition range of motion exercises, and “dancing” with head turn and trunk rotation to promote vestibular integration while ventilator dependent. On day 19, patient had tracheostomy placed which required patient be on bedrest, but she was able to ride the supine cycle ergometer daily for a week until able to get OOB.

Discussion: There is limited literature related to the treatment of children with Chiari malformations and meningitis with subsequent bilateral CVAs and brainstem tissue compression in the PICU. As a result, treatment interventions should be based on clinical presentations focusing on their functional limitations and overall goals, but also should be family and patient-centered. Further research is needed to determine the most effective rehabilitation interventions in the PICU to promote patient and family centered care.

Key Words: Acquired brain injury, occupational therapy, physical therapy, rehabilitation
Theory of Mind Deficits Related to Age-at-Injury Following Mild Head Injury

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Theory of Mind (ToM) refers to the ability to understand others’ mental states (Korucu et al., 2017). After brain injury, affective reasoning is compromised due to ventromedial prefrontal cortex disruption and subsequent reductions in physiological arousal (Heberlein et al., 2008). Difficulties in social situations for persons experiencing head injury have also been reported in studies related to impairments in social recognition skills, such as recognizing other’s emotions (e.g., van Noordt & Good, 2011; Neumann et al. 2016), facial expressions, intentions, and understanding social situations. ToM can mediate the relationship between head injury and subsequent dysregulation in social behaviour. However, due to the sensitive age at which ToM develops, those with a younger age-at-injury may be more severely impacted in terms of empathy and perspective-taking, and therefore face greater problems in social situations compared to those who obtain a head injury later in life. Using a quasi-experimental design, university students completed a series of self-report questionnaires, including the Interpersonal Reactivity Index (IRI; Davis, 1980) as a measure of affective and cognitive ToM, or empathy, and a demographic questionnaire to capture head injury characteristics. Physiological indices of arousal (i.e., electrodermal activation [EDA]) were also recorded.

Students with a history of mild head injury showed significantly lower EDA compared to those without, and those who were older at the time of injury also displayed significantly lower EDA compared to those with a younger age-at-injury, contingent on the severity of injury. In addition, a significant main effect of empathic presentation was found, as well as an interaction between IRI and age, such that affective empathy was significantly lower for both age groups compared to cognitive empathy, F(1, 85) =2.97, p=0.04, but a younger age-at-injury was more likely to preserve cognitive ToM relative to their older cohort. Importantly, this study demonstrates that understanding empathy is challenged in those who have experienced a mild head injury relative to their capacity for perspective-taking. These individuals, in turn, are vulnerable to being less responsive to others’ emotional distress and, therefore, are unable to effectively use this information to guide their behaviour in social situations. Furthermore, consistent with findings of higher physiological arousal compared to their older cohort, those with younger age-at-injury had greater resistance to cognitive compromise, which indicates the presence of protective factors and/or resiliency in the developing brain.
The Association Between Age-at-Injury and Depression in Children and Youth with Mild Head Injury

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Previous research has indicated a significant association between mild head injuries (MHI) acquired at a younger age, physiological underarousal, and adverse life events (e.g., Alcock, Gallant, & Good, 2017). Indeed, up to 90% of individuals report psychiatric-related symptoms post-trauma with the most common symptoms being emotional dysregulation with respect to mood and/or anxiety which serves as a significant barrier to rehabilitation and community reintegration (e.g., Chrisman & Richardson, 2014). Robb and Good (2016) found that young adults who have experienced a MHI tend to present with a depression that typically express more somatic than affective symptoms relative to their no MHI peers; reflective of their physiological underarousal status more so than their mood. Two hundred and seventy-five students (55 men, MA = 19.69; 220 women, MA = 20.69) from a Canadian university completed a series of affect and demographic questionnaires and provided a recording of their electrodermal activation. Thirty-two percent indicated having sustained a previous head injury sufficient to elicit an altered state of consciousness (i.e., including dizziness, nausea, loss of consciousness, etc.).

Results indicate that experiencing a milder injury at an earlier age was associated with being significantly more physiologically aroused than those who had a more severe injury or those who acquired their injury after age 15, \(F(1,85) = 4.02, p = .024, \eta^2 = .05\).

Furthermore, relative to their no MHI cohort, individuals who reported a history of head injury endorsed more somatic (e.g., lowered energy) than affective (i.e., emotive) depressive symptoms; however, those with an earlier age-at-injury endorsed significantly more affective symptoms than those who experienced a MHI after age 15, \(F(1,85) = 4.02, p = .024, \eta^2 = .05\). Overall, these findings indicate both a potential vulnerability for those with an earlier age-at-injury such that they experience more emotional adversity compared to their older cohort, but also a physiological resiliency contingent on the severity of the impact injury.
Health Behaviours in Pediatric Mild Traumatic Brain Injury (mTBI): A Scoping Review

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Background: Mild traumatic brain injuries (mTBI) are a significant health concern among youth, many of whom suffer from various negative outcomes, including impaired cognitive and academic abilities, social impairments, behavioural problems, and mental health issues. Increasing our understanding of how health behaviours play a role in a child’s recovery following a concussion will help inform appropriate management recommendations.

Objective: The objectives of the scoping review were to: 1) assess the scope and nature of existing literature on the association between health behaviours and mTBI outcomes, and 2) identify strengths, weaknesses, and gaps in the current scientific literature. This review focuses on the subset of articles focused on the pediatric population from a larger scoping review.

Methods: Nine databases were systematically searched for research examining the association between health behaviours and mTBI outcomes. Two researchers independently screened abstracts and full texts and extracted data from each article. For the current review, all articles examining only adults or mixed-age populations were excluded.

Results: Of the 8805 abstracts that were screened, 137 studies were included in the larger scoping review, 17 of which examined youth. The review found variability in both study design/quality and time since injury. Eleven articles measured health behaviours and 6 involved health behaviour treatments. The primary health behaviours were physical activity or rest (10/17 articles; measured a range of physical activity levels from sedentary to vigorous), sleep (6/17; measured self-reported sleep quantity, sleep quality, duration, sleep symptoms (i.e. sleeping more or less), and cognitive activity or rest (5/17; measured in levels, low, moderate and high). Adherence to recommendations regarding rest and substance use were examined in single studies. The outcomes examined included post-concussive symptoms (PCS; 12 of 17 studies), recovery (days to return to school/unlimited cognitive work/return to play/average number of days of treatment; 5/17) and cognition (1/17). The relationship of post-injury physical activity (4 negative, 1 positive, 1 no association, 1 mixed results), cognitive activity (5 positive), and sleep (2 positive, 2 non-significant, 3 mixed) to PCS was inconsistent. Three of the health behaviour-outcome associations were limited to one study: 1) cognitive activity and recovery (positive association), 2) substance use and recovery and 3) adherence to recommendations regarding rest and recovery (numbers 2 and 3 both non-significant).

Conclusions: Due to variability in study design, time since injury, measures, and treatments, the relationship of various health behaviours to outcomes of mTBI in youth remains unclear. The existing literature does not provide enough information on health behaviours to determine conclusively their role in recovery for youth with mTBI. In the future, high-quality research examining both pre-injury and post-injury health behaviours and their relationship to outcomes of concussion is needed to inform the management of mTBI in pediatric populations.
Teaching Children with a Traumatic Brain Injury: An Interpretative Phenomenological Analysis

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Background: Following traumatic brain injury (TBI) children often experience cognitive, behavioural, psychosocial and educational difficulties. Although schools are undoubtedly the main service provider for these children, there has been remarkably little research into teachers’ experiences and understanding of educating this population.

Aims: This study aims to explore and describe the lived experience of teachers who have taught children with TBI within a mainstream primary school. This understanding is an important prerequisite for health professionals who advise and liaise with these education providers in formulating rehabilitation and recovery interventions.

Method: This study employs a qualitative method, interpretative phenomenological analysis (IPA), to interpret five semi-structured interviews. Validity measures included independent calibration of themes and subsequent audit of the analysis.

Results: The analysis generated themes of ‘beliefs impacting upon interpretations and behaviour,’ second hand communication and polarisation,’ ‘making sense of variability in performance,’’ ‘psychosocial functioning, something isn’t right’ and ‘unexpected emotional reactions and adaptation to challenges.’

Conclusion: Teachers experience beliefs about the impact of TBI which impact on their interpretation of children’s behaviour and their interactions with them and their families. Teachers of children with TBI were found to experience significant emotional and professional demands and would benefit from targeted intervention and support.
Examination of Cognitive and Functional Neuroimaging Changes after a Season of High School Football

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Objectives: Repetitive head impacts during sport may result in changes on cognitive or functional imaging measures. Most prior work has been conducted in college or professional athletes, with few studies examining younger athletes. We previously reported lower than expected cognitive performance and brain white matter changes in college athletes exposed to repetitive head impacts relative to non-contact athletes after a single season of play. The current study examined a cohort of high school football players to assess whether cognitive or functional neuroimaging alterations could be detected after a single season of play.

Methods: Participants included 33 high school football players and 24 non-contact athlete controls who completed study assessments pre- and post-season, including neuropsychological testing, ImPACT, and a visual-verbal N-back working memory fMRI task at 3T. Cognitive outcome measures were selected based on our published studies in college athletes, and the most challenging working memory condition was examined for the N-back task (3-back>0-back contrast). Football players wore helmets equipped with the Head Impact Telemetry (HIT) System to allow correlation of biomechanical force exposure (BFE) with cognitive outcomes. Demographic data, cognitive performance, and relationships between cognitive and HIT variables were compared using SPSS and R. Image preprocessing and group comparisons (full factorial model) were conducted using SPM8, examining changes in activation within typical working memory circuitry (overall pcrit=0.01, cluster-level puncorr=0.05).

Results: In ANCOVA analyses cognitive performance and brain activation did not significantly differ between groups pre-season. For most measures there were no significant between-group differences in cognitive change scores from pre- to post-season. Non-contact athletes did show significantly greater improvement in phonemic fluency than football players, while football players showed significantly greater improvement in reaction time on a vigilance task (both p<0.05). Using a regression-based z-score approach to determine if a greater percentage of football players relative to non-contact athletes showed poorer than expected performance post-season, there were no significant findings for any cognitive outcome. Likelihood ratio tests did not demonstrate significant relationships between four summary measures of BFE and cognitive outcomes. Interaction analyses demonstrated that at post-season relative to pre-season football players showed reduced working memory-related activation in left frontal and parietal regions relative to non-contact controls.

Conclusions: High school football players did not show significant cognitive changes relative to non-contact controls over the course of one season but demonstrated reduced working memory-related brain activation at post-season relative to pre-season. These findings do not demonstrate clinically meaningful alterations in
daily cognitive functioning attributable to a season of repetitive head impacts in high school football but do suggest that alterations in brain functioning may occur which are detectable by more sensitive techniques such as fMRI. Further work is needed to examine the potential clinical significance of such changes in brain activation.
Rationale for Applying Traumatic Diagnostic Techniques in Atraumatic Paediatric Brain Injury

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Background: As a diagnostic community, we continue to focus our work on children who suffered an acquired/traumatic brain injury (A/TBI) even as we now move towards using the more inclusive term Pediatric Brain Injury (PBI). However, we tend to not focus enough attention on atraumatic brain injuries such as those caused by prenatal alcohol exposure (PAE). Fetal Alcohol Spectrum Disorder (FASD) directly benefits from the application of the diagnostic methods used in PBI. There appears to be a number of areas of overlap with respect to diagnosis and outcome between these diagnoses. Review of both the PBI & FASD literature indicates that there is much to gain from including FASD under PBI; such as specific brain processes affected by very early brain injury; and different developmental trajectories especially as they share the diagnostic gold standard of relying on the support of a multi-disciplinary team.

Methods: Reviewing the PBI literature we devised & updated test lists for diagnosing FASD for different age groups and used them over the last 8 years. The PBI literature and specific training in diagnosing PBI also provided specific techniques (i.e.: use of base rates, understanding variability in outcome, etc.). Using data from within our practice, which specializes in diagnosing all forms of paediatric brain injury, whether prenatal or postnatal or traumatic, or developmental, as well as 2 community based FASD Teams we compare the outcomes, diagnostic processes, and specific tests which best allow the determination of brain injury from PAE in children as young as 2.5 years up to 18 years.

Results: (1) Areas of overlap are more common than expected. (e.g.: sleep problems/disorders, confabulation, etc.). (2) Methods of diagnosis proved to be the same regardless of the cause of the brain injury. (3) Differences between the groups included shedding light on the neurodevelopmental trajectory. (4) Differences in specific recommendations are required.

Conclusion: The diagnosis of PBI has much to teach those diagnosing FASD and vice versa from the particular methods used to understanding some fundamental differences in outcome. Implementing the PBI processes improved our diagnostic acuity and the understanding of the variability in developmental trajectory allowed the development of better recommendations for those with other forms (i.e.: atraumatic) of PBI.
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