Concussion in Winnipeg's Children and Youth: An Analysis of CHIRPP Data to Inform Return to Play and Learn Clinical Practice and the Pan Am Concussion Clinic for Children and Youth

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BACKGROUND

Definition and Prevalence of Concussions

Concussion is defined as a “complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces” (1). This results in acute onset of short-lived neurological impairment that typically resolves spontaneously. From 2005 to 2010, approximately 23,000 Manitobans were diagnosed with a concussion and 30% occurred among 14-18 year olds (2). Concussion related emergency room visits at all American children’s hospitals have doubled between 2001 and 2010, likely due to better awareness in the significance and consequences of concussion (3).

The measurement and monitoring of concussion symptoms are a fundamental component of management guidelines (1,4,5). Typical symptoms are headache, dizziness, nausea/vomiting, light and sound sensitivity (physical); attention and concentration difficulties, memory problems, confusion, speech or language difficulties (cognitive); and irritability, depression, and anxiety (behavioral) (6-9). Although many concussed youth will reach full neurological recovery within 1-2 weeks, 20-30% will have persistent signs and symptoms after three weeks (10,11) and are at risk for further co-morbidities, including poor academic performance (12-14). Persistent symptoms lasting more than three months are referred to as Post Concussive Syndrome (PCS). PCS can lead to chronic disability or social and work/school difficulties (15) and can have a profound impact on health-related quality of life (HRQOL).

Concussion and Physical Activity

The cornerstone of concussion management is physical and cognitive rest followed by the gradual re-introduction of physical activity at an intensity that does not evoke or exacerbate concussion symptoms (4,5,16). About half of all pediatric concussions occur during sport (17) and thus, return-to-play (RTP) guidelines have been developed to allow for the systematic, safe return to sports (18). While RTP guidelines have been the focus of extensive research and debate among concussion experts, very little focus has been paid to safely returning youth to their primary vocation - school.

Concussion and the Classroom

There are no evidence-based Return-to-Learn (RTL) guidelines (18) to guide graduated return to school participation, even though the majority of concussions occur among students, where returning to school truly should be the first priority. Cognitive rest refers to avoiding tasks that require attention or concentration, such as school work, until symptoms resolve. Adolescents will likely find it challenging to refrain from enjoyable activities, such as watching television, texting, reading, and playing video games. The Canadian Paediatric Society recommends a gradual return to school with progressively more time in the classroom provided school participation does not exacerbate symptoms (19). They recommend increased time to write exams and not requiring students to make up missed assignments or tests as this opposes cognitive rest. Students, teachers, and school administrators should work collaboratively to modify workloads to avoid exacerbation of symptoms or impede recovery (20). Although such recommendations exist, no study has examined their impact on school performance.

Very few studies have examined how concussion affects academic performance. High school athletes who sustained two or more concussions had a significantly lower four-point grade point average than athletes with no history of concussion (21). This study did not include pre-concussion measures of academic performance and or adjust for confounders. Students with PCS missed approximately twice as many school days than those whose symptoms resolved (11). About 80% of students reported PCS during cognitive exertion one month after injury but only 40% reported symptom exacerbation during physical exertion (22). Overall 43% of students restricted their physical activity but only 3% restricted cognitive activity. Returning to pre-concussion academic performance is particularly important for high school students as they prepare to apply to post-secondary institutions and scholarships.

PROJECT AIM AND OBJECTIVES

This project will use the Winnipeg Children's Hospital subset of the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) database to undertake injury surveillance related to concussions. The aim of this project is to describe local concussion epidemiology in order to inform and improve concussion management. This will be achieved: 1) by describing local concussion epidemiology for Winnipeg children/youth presenting to the Children's Hospital Emergency Department (the Winnipeg CHIRPP site), and 2) by describing current concussion management practices from the perspectives of parents and Children's Hospital Emergency Department (ED) physicians.

The first objective of the project, describing concussion epidemiology, involves a CHIRPP analysis of concussions and their distribution in Winnipeg children/youth over a recent three-year period (2009-2011). Local concussion epidemiology will be used in the planning of the recently launched Pan Am concussion clinic for children and youth (e.g. age/sex distribution, volume) and for planning future concussion-related studies. Understanding the distribution of concussions between organized and informal sports, and the distribution by specific sports, will inform and target concussion outreach education.

The second objective, describing concussion management, involves (1) a survey of parents with a child/youth diagnosed with concussion and consenting to follow-up as per the CHIRPP form, and (2) a survey of the Children's Hospital Pediatric Emergency Medicine (PEM) physicians and (3) an analysis of the CHIRPP disposition codes for children diagnosed with concussion. The surveys will provide parents' and physicians' perspectives on the ED management of concussion, specifically regarding Return to Play/Learn counselling, compliance/difficulties with these guidelines, and follow-up. The CHIRPP disposition codes provide additional information regarding follow-up plans.

RESEARCH QUESTIONS

1. What are the characteristics of children/youth diagnosed with concussion at the Children's Hospital Emergency Department (number/distribution by month, age and sex distribution, sport/activity implicated, diagnoses, disposition)?

2. What resources and guidelines are being used by Children's Hospital Emergency Department physicians (return to play, return to learn, follow-up and referrals)?

3. What do families recall being told/provided at the ED regarding concussion management at home (return to play, return to learn, follow-up and referrals)?

4. What difficulties or barriers are experienced by families in complying with concussion management at home guidelines (return to play, return to learn, follow-up and referrals)?

METHODS/DESIGN

CHIRPP Analysis

The main focus of this study is concussion. The CHIRPP definition of concussion is as follows. **Concussion:** Signifies the essential process of an impact (not specific to the brain). A *cerebral* concussion is defined as "a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces" resulting "in the rapid onset of short-lived impairment of neurological function that resolves spontaneously." Concussion does not result in a structural injury to the brain; rather, the injury is at the functional level. Concussion may be sustained by a direct blow to the head, face or neck, or by an impact elsewhere on the body that transmits an impulsive force to the head. (CHIRPP System Guide Training Edition, July 30, 2010)

Eligible cases include children/youth with any injury to the head (any nature of injury) at Children's Hospital during from 2009 to 2011 using the Winnipeg CHIRPP database.

The variables required to answer the proposed study's research questions are:

- *Number of head injuries and concussions*: *Specified head injury*; other head injury specified by nature of injury, INCL intracranial injury, concussion, minor head injury; eye, inner ear injury; foreign body in eye/ear, nose (Code 135); *Concussion* (Code 42). The distribution of diagnosis by age will be documented.

- *Concussion occurrences by time* (*month, day of week, time of day*, *season*): Derived from DD-MMM-YYYY format in database.

- *Age* distribution of the patients: Derived from the patient's date of birth. Age categories may be defined after preliminary analyses if clear break-points are evident. The age at which concussion (vs minor head injury) begins to be diagnosed will be analyzed, as well as the mean age (+/- SD) for both diagnoses.

- *Sex* (0 = *Unknown*; 1 = *Male*; 2 = *Female*).

- *Severity of concussion* categorized by *minor severity* (Codes 200, 300, 400), *moderate severity* (Codes 500 and 600), *severe* (Code 700), or *fatal* (Code 900).

- *Cause of concussion/ associated risk factors*, reflected by the patient having participated in an *organized sport* (Code 41), *informal sport* (Code 42), or *unspecified* (Code 43 = Sports, not specified).

- *Specified activity* during the time of concussion; SPORTS > Team Sports (Codes 1111 – 1126), Individual Sports (Codes 1131 – 1145).

- *Site of occurrence* during the time of concussion; AREA is used to further specify within a general location where the injury event occurred. Note. There are specific locations to choose a more specific area from (Room or area, Structure, Part of Building/ Structure, Parts of Grounds, site, street, Sports related areas, Body of water, Residual categories, Unknown). Unique codes may be issued for analysis.

Other than the principal investigator (Lynne Warda), Kathleen Dubberley, Research Analyst, and the two co-investigators will be analysing the data. The data will be used for 6-12 months for analysis, report writing, and dissemination. However, if publications based on the findings are undertaken, access to the database for an additional three years will be required. Protocols in accordance with the Public Health Information Act (PHIA) and local ethics and WRHA privacy policies will be followed to ensure the data remain secure.

Parent Survey
Eligible families include those with a child diagnosed with concussion (per the CHIRPP form) and identified on the CHIRPP form as consenting to follow-up. A consecutive sample of current (2014) CHIRPP forms meeting these criteria will be used to define the sample. Families will be contacted until 100 families are reached and complete an interview. The parent telephone survey will document parental recall of return to learn and play counselling and resources provided in the ED, whether their child received follow-up appointments and what type of medical professional managed their child's care in follow-up. Parents will also be asked if their child had difficulty complying with return to learn or play guidelines or in receiving the recommended follow-up.

Physician Survey
Eligible physicians include those currently in part- or full-time practice at the Children's Emergency Department. This electronic (survey monkey) survey will document current practice with respect to return to play, return to learn, follow-up and referrals, including specific resources provided.

The statistical analysis plan using the abovementioned CHIRPP and survey data is primarily descriptive in nature. Concussion and survey data will be analyzed using Microsoft Excel and/or Microsoft ACCESS. Cross-tabulations will be generated to display the proportions of the study variables of interest. Chi-square analysis will be used to detect any significant differences between proportions of interest.

LIMITATIONS

CHIRPP data do not represent all ED visits for child/ youth concussions in Winnipeg as some children are treated at other Winnipeg hospital EDs and clinics, however almost 50,000 children are treated at this site annually. The CHIRPP database also under-represents critically and fatally injured children.

SIGNIFICANCE

There are a number of potential implications of the proposed CHIRPP project. First, describing concussion epidemiology amongst Winnipeg's children/youth will assist in the planning and evaluation of services provided in the ED and at the new Pan Am concussion clinic. Gaining a better understanding of the rates and characteristics of concussions in order to educate and share knowledge on the topic of concussions and their associated risk factors can also be used to motivate communities to increase or continue promotional efforts, educate the public and provide timely information about concussions to the media. Thus, the application of the current study's results would also improve the care of children/youth presenting to the ED with concussion, by parents, medical professionals, and the community at large.

DISSEMINATION OF RESEARCH FINDINGS

The research team will develop a dissemination plan that considers the following audiences:

Winnipeg Children's Hospital Emergency Department (ED) – The results will be presented at the Section of Emergency Medicine monthly rounds for PEM faculty and trainees for discussion regarding local concussion epidemiology, current practice with respect to *Return to Play/Learn* counseling/resources used and MD follow-up recommendations. A lay-friendly research summary will be distributed and posted for all ED staff. Staff will be invited to examine *Return to /Play Learn* resources currently in use and to provide feedback regarding standardizing discharge information for concussions.

Pan Am Concussion Clinic – A research report will be presented to the clinic management team and clinicians. The Head of the Department of Pediatrics, Section Head of PEM, Nursing Director for Children's Hospital and Nursing Manager for Children's ED will also be invited to this meeting. These individuals have been involved in the planning and launch of the concussion clinic.

Sports/Recreation groups – The Sport Medicine and Science Council of Manitoba, Recreation Connections Manitoba and the Active and Safe Kids Manitoba Coalition will be invited to collaborate with the research team to develop a plan to communicate the results to teams, coaches, families, and players. The nature of these communications will depend on the results (e.g., age distribution, sports/activities most commonly implicated, school versus community locations, etc.). Therefore, these groups will be invited to a meeting to consider the results and their implications for management of concussion in the community.

General public – Once the results are finalized a press release will be issued alerting players and families about the importance of *Return to Play/Learn* guidelines. The local epidemiology (CHIRPP) and other sources of Manitoba concussion data will be used to describe the context for the issue.

Publication – The results will be prepared for publication in a peer-reviewed journal and conference(s).

BUDGET	
Program Analyst - Total of 150.0 hours - Wage: $35.32/hour + 15.5 (13% benefits + 2.5% payroll levy)	$4895
Study expenses: in-kind, provided by IMPACT - Photocopying and mailing surveys, report formatting, production and dissemination, office supplies.	$500
Professional services: in-kind, provided by IMPACT - Supervision by Dr. Lynne Warda, Medical Director	$3000
Total provided by CHIRPP **Total In-kind** **STUDY TOTAL**	**$4895** **$3500** **$8395**

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