



# LIVING GUIDELINE FOR DIAGNOSING AND MANAGING PEDIATRIC CONCUSSION

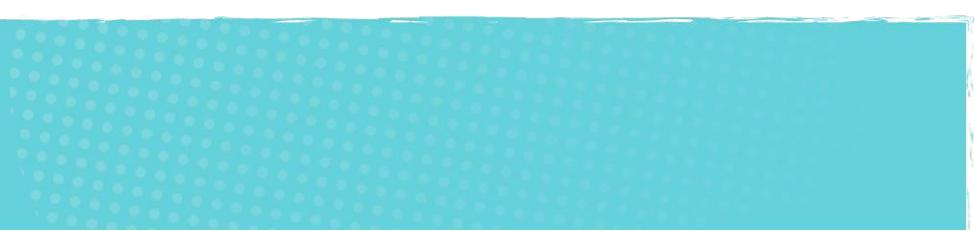
Methodology



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Fondation ontarienne de neurotraumatologie



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# METHODOLOGY: GUIDELINE UPDATE

## Development process

### Guideline Model

The project leaders used the Practice Guidelines Evaluation and Adaptation Cycle (see diagram, below) as the model to evaluate and revise this guideline. The need and rationale for a guideline on pediatric concussion had already been established.

**Practice Guideline Evaluation and Adaptation Cycle**



Adapted from Graham ID, Harrison MB. Evaluation and adaptation of clinical practice guidelines. *Evidence Based Nursing*, 2005;8(3): 68-72. Reproduced with permission from BMJ Publishing Group Ltd.

## Glaser Method of Reaching Consensus

Like the Delphi and nominal group approach, Dr. Edward Glaser and the National Institutes of Health developed a method of reaching consensus in which various levels of participants interact with the main level (a core group that includes the project leader and that chooses its own members internally). The project document is revised internally until considered suitable, and critiqued by healthcare professionals (expert panel members) who have been engaged for their expertise and prominence.

Those comments are included in a redraft until the core group is satisfied with the result. Characteristics of the Glaser method include the degree of support behind the project following a statement by experts of a demonstrated need, the number of organizations and people invited to comment at every stage, and the involvement of a leader who would be called a “knowledge broker” in today’s language.

The Glaser method of reaching consensus was chosen by the project team given the attributed voting and commenting tools and the group-based discussions at the consensus meeting. Where there was uncertainty at any stage, the project leaders sent the text in question to the designated experts for further review.

## Literature Search and Synthesis of Information

The panel agreed to use the definition of concussion provided in the *5<sup>th</sup> Consensus statement on concussion in sport (Berlin, 2016)*.

A comprehensive literature search was performed to identify research that might be relevant to the diagnosis and management of pediatric concussion.

Inclusion criteria:

- Concussion/mild traumatic brain injury (mTBI)
- Age range of 0-18 years (pediatric)
- Evidence published from January 2013-December 2017

Exclusion criteria:

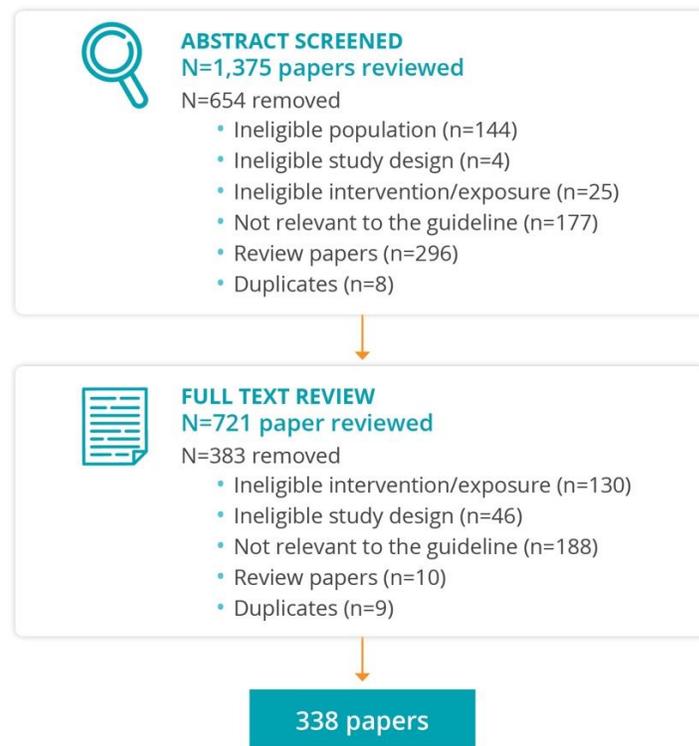
- Adult-only populations;
- Animal studies
- Conference abstracts and papers either not peer-reviewed or that focused on prevention;
- Patients in whom CT or MRI imaging showed structural changes or bleeding

The search strategy was developed by a medical librarian who specializes in information retrieval for systematic reviews (Margaret Sampson, PhD). The search strategy was peer-reviewed using Peer Review of Electronic Search Strategies (PRESS) by a second librarian. The search string did not impose any limits on language or study design. Once accepted, it was used to search the following databases: MEDLINE, Embase, and PsycINFO. The literature search resulted in over 2,272 unique articles and 14 domains of interest. Further information about the search strategy can be found in Appendix 1.

A PGY-6 resident in neurosurgery screened each identified citation as “definitely,” “possibly,” or “clearly not” meeting inclusion criteria using Insight Scope, a software platform intended to conduct scoping and systematic reviews. A research associate with expertise in pediatric concussion performed a review of 100 abstracts to evaluate the quality of the article eligibility screening. In the event of disagreement or uncertainty with the categorization of the reviewer, both consulted the full text and resolved differences. After a further review of the full text of each, the list was narrowed to 338 articles (see diagram, below).

The remaining articles were sorted into 14 domains using Mendeley reference manager, version 1.19. Articles were assigned to panel members with expertise in those domains to assess the quality of the studies and their strength/limitations, determine their applicability to pediatric concussion and assign a level of evidence (General Directions for Clinical Use) to potentially relevant papers.

### Publication Selection Process



## Additional references that helped to inform the domain recommendations

Panel member experts identified a list of 26 additional publications that were not included in the systematic review but whose evidence helped to inform the domain recommendations. Examples include, *“The Sport Concussion Assessment Tool 5th Edition (SCAT5)”*, *“Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin”*, and systematic reviews looking at treatment/rehabilitation following concussion. These references are included in a separate section of the reference list called *“Additional references that helped to inform the domain recommendations”*.

## Modification of Previous Recommendations and Creation of New Tools and Domains

In order to update the previous version of the guideline, evidence published subsequent to the previous guideline was reviewed to address our clinical questions.

- Diagnostic challenges unique to pediatrics, including the decision to obtain fluid biomarkers and/or neuroimaging;
- Potential risk-factors and modifiers for prolonged symptoms;
- Changes in approach to return-to-physical activity for children and adolescents;
- Return-to-school/play recommendations;
- Rehabilitation interventions for vestibular and vision problems;
- Impact on mental health and resiliency;
- Social engagement and academic and participation challenges for children/adolescents.

Each expert domain group considered the previous recommendations and the previous existing level of evidence. If there were discrepancies between older and newer literature, this was managed via consensus conversation weighing the full body of evidence.

## Consensus Meeting

The project team attended a consensus meeting held on October 29-30, 2018 in Toronto, Ontario, Canada. Participants worked in domain groups related to their area of expertise. Groups drafted initial recommendations based on the *“Guidelines to Diagnose and Manage Pediatric Concussion (version 1 - 2014)”* and generated new recommendations.

Recommendations were based on their review of the relevant articles, the level of evidence assigned, or using their clinical expertise if they found no evidence (see *Levels of Evidence* section, above). This was done using the ADAPTE process (a systematic approach for the adaptation of a guideline that was used to develop *“Guidelines to Diagnose and Manage Pediatric Concussion (version 1 - 2014).”* Panel members took into consideration the potential benefits, side effects, and risks when drafting the recommendations. Particularly unique to pediatrics, for example, is the limited approval of drugs such as NSAIDs for pediatric use by

regulatory organizations such as Health Canada and the US Food and Drug Administration, as demonstrated in Tool 6.3: Approved Medications for Pediatric Indications. The recommendations were created using the *Appraisal of Guidelines for REsearch & Evaluation Instrument* (AGREE II) tool as a foundation for content.

### Post-Consensus Meeting: Domain Group Final Recommendation Review

- a. Consensus meeting votes were tabulated and the comments were compiled. Minor edits based on the recorded comments from the meeting were performed.
- b. A revised version of the domain recommendations, the domain vote results, and the domain-specific comments were shared with domain groups via a designated panel member “domain leader” in each of the fourteen domain groups. Panel members in each domain group discussed the recommendations to reach a consensus within their domain group and modified the recommendations and algorithms based on this consensus.
- c. Seventy-two proposed recommendations in the fourteen domains were compiled and prepared for a second-round vote open to all-panel members.

### Final Recommendations and Resource Endorsement:

Guideline recommendations, supporting tools (algorithms), and resource links were refined repeatedly until consensus was reached through an online feedback and voting process (REDCap). Consensus was defined as over 75% of panel members reviewing the recommendation and a required minimum 75% endorsement by the voting panel experts in order to proceed with this guideline change. 40/41 panel experts participated in the review and vote for a total of 2880 individual votes. If a recommendation did not obtain a minimum of 75% consensus, the co-leads and the project coordinator facilitated modification of the recommendation in order to address the open-ended feedback obtained during the voting process. The modified recommendation was then brought to a re-vote.

Voting options included:

- i. Accept
- ii. Accept with revisions
- iii. Disagree
- iv. Not in my area of expertise

100% (72/72) of the recommendations reached >75% consensus to accept (i) or accept with revisions (ii). Of these, 92% (66/72) of recommendations were endorsed to include without revisions (>75% endorsement). Panel members provided 231 comments that included suggestions to improve the content.

## Results of the consensus vote.

Recommendation	Accept (% expert panel members)	Accept with revisions (% expert panel members)	Disagree	Recommendation	Accept (% expert panel members)	Accept with revisions (% expert panel members)	Disagree
1.1	94.9%	5.1%	0.0%	6.12	95.8%	0.0%	2.8%
1.2	87.2%	5.1%	0.0%	7.1	90.9%	3.0%	0.0%
1.3	87.2%	12.8%	0.0%	7.2	97.3%	2.7%	0.0%
1.4	<b>74.4%*</b>	20.5%	0.0%	7.3	91.9%	5.4%	0.0%
2.1	<b>65.7%*</b>	28.6%	0.0%	7.4	84.8%	6.1%	0.0%
2.2	<b>68.4%*</b>	26.3%	0.0%	7.5	91.7%	2.8%	0.0%
2.3	84.6%	12.8%	0.0%	7.6	94.6%	2.7%	0.0%
2.4	81.1%	18.9%	0.0%	7.7	96.9%	0.0%	0.0%
2.5	97.4%	2.6%	0.0%	7.8	89.2%	5.4%	2.8%
2.6	93.9%	6.1%	0.0%	7.9	87.5%	9.4%	2.7%
2.7	86.8%	7.9%	0.0%	7.10	94.6%	0.0%	0.0%
3.1	86.5%	10.8%	0.0%	7.11	100.0%	0.0%	5.4%
3.2	91.9%	5.4%	0.0%	7.12	91.9%	2.7%	0.0%
3.3	<b>72.2%*</b>	27.8%	0.0%	8.1	100.0%	0.0%	2.7%
3.4	94.9%	5.1%	0.0%	8.2	91.2%	5.9%	0.0%
3.5	92.1%	7.9%	0.0%	8.3	97.1%	2.9%	2.7%
3.6	95.0%	2.5%	2.5%	9.1	88.6%	2.9%	0.0%
3.7	94.6%	5.4%	0.0%	10.1	86.1%	11.1%	0.0%
4.1	82.9%	14.3%	2.9%	10.2	97.4%	0.0%	0.0%
4.2	92.1%	2.6%	2.6%	10.3	97.4%	0.0%	2.9%
4.3	97.4%	2.6%	0.0%	10.4	94.7%	2.6%	0.0%
4.4	83.8%	13.5%	2.7%	10.5	<b>64.3%*</b>	32.1%	0.0%
5.1	97.4%	2.6%	0.0%	10.6	86.5%	8.1%	2.6%
5.2	86.8%	10.5%	0.0%	10.7	90.0%	5.0%	2.6%
5.3	94.3%	2.9%	0.0%	10.8	94.9%	2.6%	0.0%
6.1	85.7%	11.4%	2.9%	11.1	94.1%	5.9%	2.7%
6.2	89.2%	5.4%	2.7%	11.2	91.7%	5.6%	0.0%
6.3	89.5%	10.5%	0.0%	11.3	94.6%	2.7%	2.6%
6.4	91.4%	8.6%	0.0%	11.4	86.5%	5.4%	0.0%
6.5	94.7%	2.6%	2.6%	11.5	97.3%	0.0%	2.8%
6.6	89.3%	10.7%	0.0%	12.1	<b>72.2%*</b>	19.4%	0.0%
6.7	81.3%	15.6%	0.0%	12.2	100.0%	0.0%	2.7%
6.8	97.1%	0.0%	0.0%	12.3	97.4%	2.6%	2.7%
6.9	94.4%	2.8%	2.8%	13.1	96.6%	0.0%	0.0%
6.10	89.2%	8.1%	0.0%	13.2	78.6%	14.3%	0.0%
6.11	97.3%	2.7%	0.0%	14.1	92.9%	7.1%	0.0%

Bolded = <75% consensus amongst expert panel members

Numerous panel members suggested that the recommendations be streamlined to reduce redundancy and improve the flow of information. These improvements were implemented and resulted in changes to the numbering of the final version of the recommendations prior to the external review. The final version contains sixty recommendations with numerous sub-recommendations providing further information for guideline users. A summary of these changes and the merged recommendations are shared in the table below. Finally, panel members recommended improving the organization and streamlining the selection of the suggested online tools and resources. In the online guideline version, the recommendations link to a list of potential online tools to consider that are collected in one area on the website.

### Changes to recommendation numbers in response to panel member feedback to streamline the guideline.

Pre-Vote #	Final #						
1.1	unchanged	4.3	unchanged	7.4	7.1	10.7	10.4
1.2	unchanged	4.4	5.1	7.5	7.3	11.1	unchanged
1.3	unchanged	5.1	4.4	7.6	7.2	11.2	11.3
1.4	unchanged	5.2	unchanged	7.7	7.3	11.3	11.2
2.1	unchanged	5.3	unchanged	7.8	7.6	11.4	unchanged
2.2	unchanged	6.1	unchanged	7.9	7.4	11.5	unchanged
2.3	unchanged	6.2	unchanged	7.10	7.2	12.1	unchanged
2.4	unchanged	6.3	6.2	7.11	7.5	12.2	12.5
2.5	unchanged	6.4	6.4/2.5	7.12	7.6	12.3	12.6
2.6	2.7	6.5	2.8	8.1	unchanged	13.1	unchanged
2.7	2.8	6.6	2.6	8.2	unchanged	13.2	unchanged
3.1	unchanged	6.7	6.1	8.3	unchanged	14.1	unchanged
3.2	3.7	6.8	6.3	9.1	unchanged		
3.3	3.1	6.9	6.2	10.1	unchanged		
3.4	3.7	6.10	6.2	10.2	unchanged		
3.5	3.2	6.11	6.5	10.3	10.2		
3.6	3.3	6.12	6.4	10.4	2.8		
3.7	3.6	7.1	unchanged	10.5	10.1		
4.1	unchanged	7.2	unchanged	10.6	10.3		
4.2	unchanged	7.3	2.8	10.7	10.2		

(Pre-Vote #: the original recommendation number that was voted on by the panel, final #: the recommendation # in the final document)

## Additional Specialist Review

Prior to finalizing the guideline, the guideline document was reviewed by an additional pediatric neurologist (expert panel member) and Tool 6.3: [Approved Medications for Pediatric Indications](#) was reviewed by a pediatric pharmacist.

## Evaluation of the First Edition

In an effort to rigorously evaluate the 2014 version of the *Guidelines to Diagnosing and Managing Pediatric Concussion*, a purposive sample of stakeholders (i.e. guideline developers/guideline panel members) were recruited from the list of invitees who attended the October 2018 consensus meeting, to critically appraise the 2014 version. Using the AGREE II tool, these stakeholders rated their level of agreement regarding how the 2014 version addressed the following domains: (1) scope and purpose; (2) stakeholder involvement; (3) rigour of development; (4) clarity of presentation; (5) applicability; (6) editorial independence. Guideline developers/guideline panel members also provided comments, which specifically addressed the strengths, gaps, and limitations.

Note: Data collection for this study is complete and has been stratified according to healthcare profession background and other demographic factors (e.g., years of experience, sex, clinical practice setting). These findings were utilized to streamline implementation approaches to ensure optimal clinical uptake. In taking an integrated knowledge translation approach, results from this study: (1) provided critical feedback on how to address the development and implementation of the new guideline; (2) promoted shared decision making amongst all healthcare backgrounds; and (3) enabled targeted content and dissemination strategies. Ultimately, this study utilized rigorous appraisal techniques to inform the Knowledge Translation team efforts in their phase of guideline development.

A manuscript outlining the process and outcomes of the evaluation of the first edition/2014 version of the *Guidelines to Diagnosing and Managing Pediatric Concussion* is currently under review. Upon acceptance and publication, this section of the website will be updated accordingly.

## Stakeholder Focus Groups

This guideline was developed to help inform the concussion care practices of healthcare professionals across a wide variety of settings. Although healthcare professionals are the primary users of this guideline, the information provided herein may be relevant to other stakeholders including parents, coaches, and teachers. To address the information needs of these stakeholders, focus group sessions were conducted with each stakeholder group. The aim of the focus groups were to:

1. Identify ‘what’ content from the guideline is important to know
2. Determine ‘how’ and in what ‘format’ the information should be shared

Feedback from the focus groups were used to create independent, lay-friendly resources which were reviewed and approved by parents, coaches, and teachers. These resources reflect the information needs of these stakeholders based on the content provided in the guideline and are available as downloadable resources on the website.

## External Review

A final version of the guideline including the methods, recommendations, reference list, and suggested tools, was shared with two external reviewers (who were not involved in the development process). The guideline was finalized based on their feedback.

External reviewers were chosen for their expertise in relevant areas of pediatrics, their role as stakeholders in improving pediatric concussion care and management: **Matt Breiding, PhD, CDR:** Behavioral scientist and lead of the Traumatic Brain Injury Team at the Center of Disease Control (CDC), **Angela Lumba-Brown, MD:** Pediatric emergency medicine physician with expertise in traumatic brain injury; Stanford University.

The role of the external review was to assess the quality of the document and provide feedback with which to finalize its content. Each reviewer received an electronic copy of:

- Draft guideline document (recommendations, methods, reference list, suggested tools and algorithms)
- *Appraisal of Guidelines for REsearch & Evaluation Instrument (AGREE II)* document with the rating scale for scoring;
- Review sheets on which to record their scores in response to AGREE II categories

The external reviewers rated the guideline according to the following categories (See “Summary of Quality Ratings from Reviewers”):

- Scope and purpose ---98%
- Stakeholder involvement ---86%
- Rigour of development ---92%
- Clarity of presentation ---93%
- Applicability ---89%
- Editorial independence ---93%

The external reviewers also rated the overall guideline ---percent for quality. After their specific comments to improve the guideline were addressed, all three external reviewers said they would recommend the document for use as-is.

## Summary of Quality Ratings from Reviewers

Under AGREE II, guidelines are rated on a seven-point scale, where 1 = strongly disagree and 7 = strongly agree. The reviewers' scores were combined and converted into a percentage.

Agree II Domain	Item	%
Scope and purpose	1. The overall objective(s) of the guideline is (are) specifically described.	100
	2. The health question(s) covered by the guideline is (are) specifically described.	93
	3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.	100
Stakeholder involvement	4. The guideline development group includes individuals from all the relevant professional groups.	100
	5. The views and preferences of the target population (patients, public, etc.) have been sought.	64
	6. The target users of the guideline are clearly defined.	93
Rigor of development	7. Systematic methods were used to search for evidence.	93
	8. The criteria for selecting the evidence are clearly described.	93
	9. The strengths and limitations of the body of evidence are clearly described.	86
	10. The methods for formulating the recommendations are clearly described.	93
	11. The health benefits, side effects and risks have been considered in formulating the recommendations.	100
	12. There is an explicit link between the recommendations and the supporting evidence.	71
	13. The guideline has been externally reviewed by experts prior to its publication.	100
	14. A procedure for updating the guideline is provided.	100
Clarity of presentation	15. The recommendations are specific and unambiguous.	93
	16. The different options for management of the condition or health issue are clearly presented.	86
	17. Key recommendations are easily identifiable.	100
Applicability	18. The guideline describes facilitators and barriers to its application.	71
	19. The guideline provides advice and/or tools on how the recommendations can be put into practice.	100
	20. The potential resource implications of applying the recommendations have been considered.	86
	21. The guideline presents monitoring and/ or auditing criteria.	100

Agree II Domain	Item	%
Editorial independence	22. The views of the funding body have not influenced the content of the guideline.	100
	23. Competing interests of guideline development group members have been recorded and addressed.	93
Overall Guideline Assessment	1. Rate the overall quality of this guideline.	86
Overall Guideline Assessment	2. I would recommend this guideline for use.	100%= yes

## Website Review

The website development process engaged web developers, a graphic designer with expertise working in healthcare settings, and a knowledge translation specialist. Best practices associated with web design in alignment with accessibility principles were used to create the website. Website feedback was provided by a multi-healthcare professional stakeholder group before going live to ensure the needs of healthcare professionals, the end-user, were met.

# METHODOLOGY: LIVING GUIDELINE

The ONF has committed to supporting the real-time update of this guideline and any derivative products. This involves the following process:

## 1. Monthly literature search

- A monthly systematic search of the following two databases:
  - a. Medline
  - b. PsycInfo
- The Pediatric Concussion Guideline literature search strategy (a peer-reviewed template) will be used as part of this process.
- Search outputs will undergo preliminary filtering by expert reviewers to eliminate articles that are specific to concussion.

## 2. Article review and screening

- Articles must meet the following inclusion criteria:
  - Level 1: Themes specific to pediatrics; ages 0-18 years old; concussions and mTBI
  - Level 2: mTBI articles related to concussion
  - Level 3: Articles related to treatment and assessment, and align with themes (level 1)
- A dedicated coordinator with knowledge and expertise in this area will conduct screening. A higher-level screening will be completed to ensure that the mTBI are indeed concussions and that the articles relate to treatment, assessment and to relevant domains.
- Transparency of the process will be upheld using the following steps:
  - a. Development of an operations manual to ensure that procedures are transparent.

- b. Use of *InsightScope* (systematic review software) by the coordinator to access the screeners to view the sorting and screening of each paper to ensure proper procedures are followed.
- c. Completion of *InsightScope* training by reviewers to ensure that reviewers understand the task and assess if they are consistent at the task.
  - Provided detailed instructions to guide reviewers
  - Site monitoring to ensure adequate screening

### 3. Inclusion of critical papers

- Critical articles will be evaluated by the qualified project coordinator.
- The coordinator will annotate the articles and designate them into potentially relevant domains.

### 4. Engagement of domain experts

- Critical articles will be forwarded to the appropriated team of expert reviewers specializing in that specific theme/domain. A minimum of quorum of three expert reviewers will be required to proceed to the next step of modifying the recommendation.

### 5. Modification of recommendation

- Modification of the recommendation will be based on the quality of the evidence. The expert reviewers will vote via *InsightScope* (or *REDCap*), and in cases of unanimous decisions, the necessary changes to the recommendations will be made.
- Voting options will include
  - a. No change to the guideline recommendations or the level of evidence
- If there are no changes to the guideline recommendations, no further action will be taken.
  - b. Modify the level of evidence (up or down)
    - If there is a modification to the level of evidence, panellist experts who have indicated that their expertise is relevant to the domain will be contacted to vote. A minimum of 75% endorsement by the panellist experts will be required to proceed with this guideline change.
  - c. Modify the wording of the recommendation(s) (note: the domain experts will work with the research coordinator to suggest new wording).

- If there is minor word changes, a minimum of 75% endorsement by the panellist experts will be required to proceed with this guideline change.
  - If there is major word changes, a minimum of 75% endorsement by the entire team will be required to proceed with this guideline change.
- d. Delete the recommendation(s) entirely
- A minimum of 75% endorsement by the entire team will be required to proceed with this guideline change.
- In the event of disparity across the team, the coordinator will arrange for a teleconference of the content experts to discuss and obtain consensus whether the new evidence should modify the recommendation or not.
  - Once consensus is reached, the living guideline document will be updated.

# APPENDIX 1. SEARCH STRATEGY

The search strategy developed for the initial guidelines included six bibliometric databases, MEDLINE, Embase, PsycInfo, CINAHL, SportDiscus and the Cochrane Central Register of Controlled Trials (CENTRAL). As well, TripDatabase was searched for existing guidelines. This search covered the period from the inception of each database to the end of April 2013. An update was performed in December 2017. At that time the search was refined after examining the contribution of unique material provided by each source. MEDLINE, Embase, PsycINFO, and CINAHL were updated. In preparation for a final update, each included study from the 2017 update was tested to determine if it was indexed in MEDLINE and found by the MEDLINE search.<sup>1</sup> Source databases for the remaining records were determined. Based on these results, the final update was made in MEDLINE and PsycINFO.

The following databases were covered in this search: : MEDLINE including In-Process & Other Non-Indexed Citations 1946- updated to June 14, 2019), Embase (1947 to updated to Week 51 2017), PsycINFO (1806 to June Week 2 2019) and Cochrane Central Register of Controlled Trials (CENTRAL, Issue 1, March 2013) using the Ovid interface, CINAHL was updated to Dec 22, 2017 and SPORTDiscus was searched May 5, 2013 , using the EbscoHost interface (database dates not given).

The MEDLINE search strategy was developed by a librarian experienced in systematic review searching, and peer-reviewed by another librarian, using the PRESS standard.<sup>2</sup> The MEDLINE search was then adapted for the other database. Searches were limited to English, no study design limits were applied. The search strategies for each database are presented in Appendix 1.

## Acknowledgments

We thank Margaret Sampson, MLIS, PhD, AHIP (Children's Hospital of Eastern Ontario) for developing the electronic search strategies, and Ruth Foxlee, Information Specialist, Cochrane Editorial Unit, for peer review of the MEDLINE search strategy.

## Search Strategy References

1. Sampson M, Mcgowan J. Inquisitio validus Index Medicus : A simple method of validating MEDLINE systematic review searches. Res Synth Methods. 2011 Jun 16;2(2):103–9.
2. Mcgowan, J., Sampson, M. & Lefebvre, C., 2010. An Evidence Based Checklist for the Peer Review of Electronic Search Strategies (PRESS EBC). Evidence Based Library and Information Practice, 5(1), pp.149–154.

## Medline

1. exp Brain Concussion/
2. Post-Concussion Syndrome/
3. (concuss\$ or postconcuss\$).tw.
4. (commotio cerebri or post traumatic encephalopathy).tw.
5. ((post commotion or post contusion or post head injury) adj2 syndrome\*).tw.
6. ((mild or minor or minimal) adj (traumatic brain or tbi)).tw.
7. mtbi.tw.
8. exp Brain Injuries/
9. ((post or persistent or unresolved or delayed) adj4 (brain or skull or head or injury)).mp.
10. 8 and 9
11. or/1-7,10
12. (((severe or moderate) adj2 (head or brain or traumatic or tbi)) not (mild or minor)).ti.
13. 11 not 12
14. 13 and (child\* or adolescent or infan\*).mp.
15. 14 not (animal/ not human/)
16. limit 15 to english
17. limit 27 to yr="1985 -Current"

## Embase

1. Brain Concussion/ or Concussion/
2. Post-Concussion Syndrome/
3. (concuss\$ or postconcuss\$).tw.
4. (commotio cerebri or post traumatic encephalopathy).tw.
5. ((Post commotion or post contusion or post head injury) adj2 syndrome\$).tw.
6. ((mild or minor or minimal) adj (traumatic brain or tbi)).tw.
7. mtbi.tw.
8. exp Brain Injury/
9. ((post or persistent or unresolved or delayed) adj4 (brain or skull or head or injury)).mp.
10. (((severe or moderate) adj2 (head or brain or traumatic or tbi)) not (mild or minor)).ti.

11. (8 and 9) not 10
12. or/1-7,11
13. 12 and (child\* or adolescent or infan\*).mp.
14. exp animals/ or exp invertebrate/ or animal experiment/ or animal model/ or animal tissue/ or animal cell/ or nonhuman/
15. 14 not exp human/
16. 13 not 15
17. limit 16 to english
18. limit 17 to yr="1985 -Current"

## CINAHL

(MH "Brain Concussion+" OR TX concuss\* or postconcuss\* OR TX commotio cerebri OR TX post traumatic encephalopathy OR post head injury N3 syndrome\* or post contusion N3 syndrome\* or post commotion N3 syndrome\* OR TX Mild traumatic brain or TX minor traumatic brain or TX minimal traumatic brain or TX mild tbi or TX minor tbi or TX minimal tbi OR TX mtbi) AND ( child\* or adolescent or infan\* )

**Limiters** - Published Date from: 19850101-20141231; English Language

## PsycInfo

1. brain concussion/
2. (concuss\* or postconcuss\*).tw.
3. (commotio cerebri or post traumatic encephalopathy).tw.
4. ((post commotion or post contusion or post head injury) adj2 syndrome\*).tw.
5. ((mild or minor or minimal) adj (traumatic brain or tbi)).tw.
6. mtbi.tw.
7. traumatic brain injury/
8. ((post or persistent or unresolved or delayed) adj4 (brain or skull or head or injury)).mp.
9. 7 and 8
10. or/1-6,9
11. limit 10 to (childhood or adolescence <13 to 17 years>)
12. (Infan\* or newborn\* or new-born\* or perinat\* or neonat\* or baby or baby\* or babies or toddler\* or minors or minors\* or boy or boys or boyfriend or boyhood or girl\* or kid or kids or child or child\* or children\* or schoolchild\* or schoolchild).mp. or school child.ti,ab. or school child\*.ti,ab. or (adolescen\* or juvenil\* or youth\* or teen\* or under\*age\* or pubescen\*).mp. or exp pediatrics/ or (pediatric\* or paediatric\* or peadiatric\*).mp. or school.ti,ab. or school\*.ti,ab. or (prematu\* or preterm\*).mp.
13. 10 and 12

14. 11 or 13
15. limit 14 to english language
16. limit 15 to yr="1985 -Current"

## SportDiscus

(DE "BRAIN -- Concussion" OR DE "POSTCONCUSSION syndrome" )

Limiters - Published Date: 19850101-20141231; Language: English; Publication Type: Journal Article, Serial publication

## TRIP

#1 ("m\* traumatic brain injury")

#2 (concussion)

#3 (pediatric\* or paediatric\* or child\* or adolesc\*) from:1985

search in full document

Guidelines selected

## CENTRAL

1. (concuss\$ or postconcuss\$).tw.
2. (commotio cerebri or post traumatic encephalopathy).tw.
3. ((post commotion or post contusion or post head injury) adj2 syndrome\*).tw.
4. mtbi.tw.
5. or/1-4
6. (Infan\* or newborn\* or new-born\* or perinat\* or neonat\* or baby or baby\* or babies or toddler\* or minors or minors\* or boy or boys or boyfriend or boyhood or girl\* or kid or kids or child or child\* or children\* or schoolchild\* or schoolchild).mp. or school child.ti,ab. or school child\*.ti,ab. or (adolescen\* or juvenil\* or youth\* or teen\* or under\*age\* or pubescen\*).mp. or exp pediatrics/ or (pediatric\* or paediatric\* or peadiatric\*).mp. or school.ti,ab. or school\*.ti,ab. or (premat\* or preterm\*).mp.
7. 5 and 6
8. limit 7 to yr="1985 -Current"
9. (3 non-English records were removed in Reference Manager)