



# Quality and Consistency of Guidelines for the Management of Mild Traumatic Brain Injury in the Emergency Department

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## Abstract

**Objectives:** The objective was to provide an overview of the recommendations and quality of evidence-based clinical practice guidelines (CPGs) for the emergency management of mild traumatic brain injury (mTBI), with a view to informing best practice and improving the consistency of recommendations.

**Methods:** Electronic searches of health databases (MEDLINE, EMBASE, The Cochrane Library, PsycINFO), CPG clearinghouse websites, CPG developer websites, and Internet search engines up to January 2010 were conducted. CPGs were included if 1) they were published in English and freely accessible, 2) their scope included the management of mTBI in the emergency department (ED), 3) the date of last search was within the past 10 years (2000 onward), 4) systematic methods were used to search for evidence, and 5) there was an explicit link between the recommendations and the supporting evidence. Four authors independently assessed the quality of the included CPGs using the Appraisal of Guidelines, Research and Evaluation (AGREE) Instrument. The authors extracted and categorized recommendations according to initial clinical assessment, imaging, management, observation, discharge planning, and patient information and follow-up.

**Results:** The search identified 18 potential CPGs, of which six met the inclusion criteria. The included CPGs varied in scope, target population, size, and guideline development processes. Four CPGs were assessed as "strongly recommended." The majority of CPGs did not provide information about the level of stakeholder involvement (mean AGREE standardized domain score = 57%, range = 25% to 81%), nor did they address the organizational/cost implications of applying the recommendations or provide criteria for monitoring and review of recommendations in practice (mean AGREE standardized domain score = 46.6%, range = 19% to 94%). Recommendations were mostly consistent in terms of the use of the Glasgow Coma Scale (GCS) score (adult and pediatric) to assess the level of consciousness, initial assessment criteria, the use of computed tomography (CT) scanning as imaging investigation of choice, and the provision of patient information. The CPGs defined mTBI in a variety of ways and described different rules to determine the need for CT scanning and therefore used different criteria to identify high-risk patients.

**Conclusions:** Higher-quality CPGs for mTBI are consistent in their recommendations about assessment, imaging, and provision of patient information. There is not, however, an agreed definition of mTBI, and the quality of future CPGs could be improved with better reporting of stakeholder involvement, procedures for updating, and greater consideration of the applicability of the recommendations (cost implications, monitoring procedures). Nevertheless, guideline developers may benefit from adapting existing CPGs to their local context rather than investing in developing CPGs de novo.

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Seventy to ninety percent of head injuries presenting to emergency departments (EDs) are classified as mild. This amounts to 900,000 people a year in the United Kingdom<sup>1,2</sup> and 1.275 million in the United States.<sup>3,4</sup> Several definitions of mild traumatic brain injury (mTBI) exist, which includes “an acute brain injury resulting from mechanical energy to the head from external physical force and, to some degree, loss of consciousness, confusion or disorientation, post-traumatic amnesia, focal signs, seizure or intracranial lesion(s) not requiring surgery.”<sup>5,6</sup>

The majority of patients make a full recovery; however, between 5 and 12% have persisting headaches, cognitive deficits, and difficulties with complex tasks.<sup>7,8</sup> Some people with mTBI have difficulty returning to routine daily activities and may be unable to return to work for weeks or months, costing the U.S. economy an estimated \$17 billion a year.<sup>3</sup> As the ED is the main and often only point of medical contact for these patients, ED care may have significant bearing on long-term outcomes for patients who have ongoing problems.

Evidence-based clinical practice guidelines (CPGs) can facilitate physician decision-making, improve patient outcomes, improve efficient use of health resources, and promote management consistency.<sup>9,10</sup> CPGs contain systematically developed statements that include recommendations, strategies, or information that help health care providers and patients make decisions about appropriate health care for specific clinical circumstances.<sup>11</sup> The methods for producing high-quality CPGs are well-established, and there is strong agreement regarding the key elements required in the development process: establishment of a multidisciplinary CPG development group, involvement of consumers, identification of clinical questions or problems, systematic searches, appraisal of research evidence, process for forming CPG recommendations, external consultation, and ongoing review and updating.<sup>12</sup>

As with primary research, the process and methods by which a CPG is developed can affect the quality of the end product. User confidence can be achieved by CPG developers explicitly reporting their methods. The Appraisal of Guidelines, Research and Evaluation (AGREE) Instrument is a validated instrument developed to appraise the quality of CPGs by assessing the CPG development process and how well the process was reported.<sup>13</sup>

In 2004, Peloso et al.<sup>14</sup> published their assessment of the quality of mTBI CPGs in all settings and found that only three of the 41 CPGs could be categorized as evidence-based, and of these, two were based primarily on expert opinion. In 2008, Rusnak et al. published an assessment of four selected TBI CPGs using the AGREE Instrument. While not specific to mTBI, and including only a subset of evidence-based CPGs, Rusnak and colleagues<sup>15</sup> concluded that CPG developers should include a broad spectrum of stakeholders in the development process and consider organizational and financial barriers to the application

of the CPG. The aim of our study was to identify and describe the quality of all evidence-based CPGs for the management on mTBI in the ED setting published in the past 10 years, with a view to informing best practice and improving consistency of recommendations.

## METHODS

### Identification of CPGs

We searched electronic health databases (MEDLINE, EMBASE, The Cochrane Library, PsycINFO), CPG clearinghouse websites, CPG developer websites, and Internet search engines up to January 2010 to identify CPGs on mTBI. Details of the sources searched can be found in Table 1, and the search strategy, in the Data

Table 1  
Electronic Sources Searched to Identify CPGs

Electronic health databases
MEDLINE
EMBASE
The Cochrane Library
PsycINFO
Websites
National Guideline Clearinghouse
National Health and Medical Research Council (NHMRC) (Australia)
NHMRC Clinical Guideline Portal and Emergency Care Portal (Australia)
The National Electronic Library for Health (UK)
Guidelines International Network
Therapeutic Guidelines (Australia)
National Institute for Health and Clinical Excellence (England/Wales)
Medical Journal of Australia Clinical Guidelines (Australia)
Joanna Briggs Institute (Australia)
Guidelines Advisory Committee (Canada)
TRIP database (UK)
Canadian Medical Association Clinical Guidelines (Canada)
Australian College for Emergency Medicine (ACEM) (Australia)
Canadian Association of Emergency Physicians (CAEP) (Canada)
College of Emergency Medicine (UK)
Eastern Association for the Surgery of Trauma (EAST) (United States)
Society of Critical Care Medicine (SCCM) (United States)
Department of Veterans Affairs (Australia)
International Council of Nurses
Nursing Best Practice Guidelines (Canada)
Royal College of Nursing (UK)
American Academy of Pediatrics (United States)
National Health Service (NHS) Evidence (UK)
New Zealand Guidelines Group (New Zealand)
Scottish Intercollegiate Guidelines Network (Scotland)
Brain Trauma Foundation (United States)
American College of Radiology (United States)
American College of Emergency Physicians (United States)
World Health Organization
Australian Government Department of Health and Ageing (Australia)
Australian State Departments of Health and Ageing (Australia)
Internet search engines
Google
Google Scholar
CPG = Clinical Practice Guideline.

Supplement S1 (available as supporting information in the online version of this paper).

### Inclusion and Exclusion Criteria

We included CPGs that were freely accessible, published in English, and met all three of the following criteria:

1. The scope of the CPG specifically focused on, or incorporated recommendations for, the management of mTBI in the emergency care setting. The definition of minor or mild TBI was taken as that specified in the individual CPGs. We excluded CPGs if they focused solely on the management of moderate and/or severe brain injury, penetrating brain injuries, brain damage due to birth trauma, sports concussion treated in non-ED settings, shaken baby syndrome, stroke, or other cerebrovascular or nontraumatic injuries.
2. The date of last search was within the past 10 years (2000 onward). The most up-to-date version of each CPG was assessed. Where several versions of the same CPG existed, the version that included the greatest detail on the CPG development process was assessed.
3. The CPG met minimum "hurdle" quality criteria to be considered an evidence-based CPG (based on items 8 and 12 of the AGREE Instrument): 1) systematic methods were used to search for evidence and 2) there was an explicit link between the recommendations and the supporting evidence.

**Quality Assessment.** Four authors (ET, MB, VP, KP) independently assessed the quality of included CPGs using the AGREE Instrument.<sup>16</sup> The AGREE Instrument assesses whether CPG developers have attempted to minimize all biases that can occur in the CPG development process and whether the process undertaken was explicitly reported.<sup>13</sup> Each CPG was assessed using 23 criteria, grouped into six domains (scope and purpose, stakeholder involvement, methodology, clarity and presentation, applicability, and editorial independence).<sup>13</sup>

The AGREE Instrument does not include criteria for determining whether research studies included within the CPG were critically appraised, a key element in the development of evidence-based CPGs.<sup>12,17</sup> Therefore, in addition to appraisal with the AGREE Instrument, we extracted information about whether valid methods were used to appraise the evidence supporting recommendations included in the CPG.

Consistent with recommended methods for use of the AGREE Instrument, the four authors independently scored each criteria of the AGREE Instrument on a four-point Likert scale: 4 (strongly agree), 3 (agree), 2 (disagree), and 1 (strongly disagree). A total score for each domain was calculated for each author. A standardized domain score was calculated by summing up the total scores for the four authors and standardizing the total as a percentage of the maximum score possible for that domain. Standardized domain score = (obtained score – minimum possible score)/(maximum possible score – minimum possible score). As four authors independently assessed each item, the score for

each item could range from 4 to 16. The four-point Likert scale was used to score the additional criterion of appraisal of studies included in the CPG, and this score was reported separately. Fleiss' kappa statistic<sup>18</sup> was used to determine the inter-rater reliability of the authors.

The lead author (ET) tabulated and analyzed the results. CPGs were categorized according to the AGREE Instrument: "strongly recommended" if over half of the domain scores were >60%, "recommended" if most of the domain scores were >30%, and "not recommended" if most of the domain scores were <30%.<sup>16</sup>

**Extraction and Classification of Recommendations.** Clinical practice guideline recommendations are guiding statements supported by evidence or in the event of no evidence, consensus, that suggest a course of action in clinical practice. For each CPG included in this review, two authors (ET, MB) extracted the evidence-based recommendations and categorized them into the following groups: 1) initial clinical assessment, 2) imaging, 3) management, observation and discharge planning, and 4) patient information and patient follow-up.

## RESULTS

Our search identified 18 CPGs that met the first inclusion criteria (i.e., provided recommendations for the management of mTBI in the ED setting).<sup>19–36</sup> Seven CPGs were excluded as their search was undertaken prior to the year 2000.<sup>19–25</sup> Five CPGs were excluded for not meeting the hurdle quality criteria (inclusion criterion 3).<sup>26–30</sup> Details of excluded CPGs are provided in Table 2A.

Six CPGs met our inclusion criteria (see Table 2B for characteristics of included CPGs). Two CPGs were from Australia,<sup>31,32</sup> two from the United Kingdom,<sup>33,34</sup> one from New Zealand,<sup>35</sup> and one from the United States.<sup>36</sup> Publication dates ranged from 2006 to 2009. Two CPGs had been published for the first time,<sup>31,32</sup> and the remaining four were full or partial updates of existing CPGs. One CPG was partially adapted from an existing CPG.<sup>35</sup> Three CPGs addressed the management of adults and children with head injuries of all severities including mTBI,<sup>33–35</sup> three CPGs specifically addressed the management of adults with head injuries, and two of these focused solely on the management of adults with mTBI.<sup>32,36</sup> The CPGs defined mTBI in a variety of ways (see Table 3). The CPGs varied in the number of members involved in the CPG process (14 to 35 members), length of the CPG (34 to 240 pages), and frameworks used to define the level of evidence and grade of CPG recommendations (Table 2B).

### Quality Assessment

Four CPGs were rated as strongly recommended (majority of domain scores >60%),<sup>32–35</sup> and the remaining two CPGs were recommended (majority of domain scores >30%;<sup>31,36</sup> see Table 4). Although all of the included CPGs scored >30% for four or more of the six AGREE domains, one of the CPGs only just met the recommended criteria by scoring 30.5%.<sup>31</sup> There

Table 2A  
Excluded CPGs

CPG First Author and Year of Publication	Reason for Exclusion
Jagoda 2002 (endorsed by American College of Emergency Physicians [ACEP]) <sup>22</sup> Kamerling 2003 <sup>28</sup>	Date of last search was prior to 2000. Superseded by Jagoda 2009 (ACEP 2009), included in paper. <sup>36</sup> No systematic methods were used to search for evidence. No explicit link between the recommendations and the supporting evidence.
Eastern Association for the Surgery of Trauma 2001 (EAST) <sup>20</sup>	Date of last search was prior to 2000.
Servadei 2001 (Neurotraumatology Committee of the World Federation of Neurosurgical Societies) <sup>25</sup> Ingebrigtsen 2000 (Scandinavian CPG) <sup>21</sup> Royal College of Paediatrics and Child Health 2001 <sup>23</sup>	Date of last search was prior to 2000. Date of last search was prior to 2000. Summary of previously published SIGN guideline, date of last search prior to 2000.
New South Wales Department of Health 2005 <sup>29</sup>	No systematic methods were used to search for evidence. No explicit link between the recommendations and the supporting evidence.
American Academy of Pediatrics 1999 <sup>19</sup>	Date of last search prior to 2000. Superseded by Schutzman 2001 (below). Date of last search prior to 2000.
Schutzman (American Academy of Pediatrics) 2001 <sup>24</sup> American College of Radiology (ACR) 2008: Appropriateness Criteria head trauma <sup>26</sup>	No systematic methods were used to search for evidence. No systematic methods were used to search for evidence.
European Federation of Neurological Societies (EFNS) 2002 <sup>30</sup> Ferreira de Andrade 2001 <sup>27</sup>	No systematic methods were used to search for evidence. No systematic methods were used to search for evidence. No explicit link between the recommendations and the supporting evidence.

CPGs = clinical practice guidelines.

Table 2B  
Characteristics of Included CPGs

CPG Developers	Published/Date of Last Search	Country/Region	Target Population	Scope of CPG	Created/Updated/Adapted	Number of Pages	Number of CPG Development Group Members	Levels of Evidence Used	Grades of Recommendations used
Scottish Intercollegiate Guidelines Network <sup>33</sup>	May 2009/2007	Scotland	Adults and children	All head injury	Update of 2000 version	77	33	SIGN	SIGN
American College of Emergency Physicians/Centers for Disease Control and Prevention <sup>36</sup>	December 2008/2007	United States	Adults (≥16 years)	mTBI	Update of 2002 version	34	14	ACEP (in-house)	ACEP (in-house)
Motor Accident Authority NSW <sup>32</sup>	2008/2007	Australia (NSW)	Adults (>16 years)	mTBI	New	67	16	NHMRC 2005	NHMRC 2005
NSW Institute of Trauma and Injury Management <sup>31</sup>	January 2007/2004	Australia (NSW)	Adults (>16 years)	Closed head injury	New	71	Not stated	NHMRC 1999	NHMRC 1999
New Zealand Guidelines Group <sup>35</sup>	July 2006/2004	New Zealand	Adults and children	All traumatic brain injury	Partial update and adapted from NICE 2003 CPG	240	35	NZGG	NZGG
National Institute for Health and Clinical Excellence <sup>34</sup>	September 2007/2002	England and Wales	Adults and Children	All head injury	Partial update of 2003 version	231	26	SIGN Oxford Centre EBM CRD 2001	2003 (SIGN)

ACEP/CDC = American College of Emergency Physicians/ Centers for Disease Control and Prevention; AGREE = Appraisal of Guidelines, Research and Evaluation; CPGs = clinical practice guidelines; EBM = evidence-based medicine; MAA NSW = Motor Accident Authority New South Wales; NICE = National Institute for Health and Clinical Excellence; NSW ITIM = New South Wales Institute of Trauma and Injury Management; NZGG = New Zealand Guidelines Group; SIGN = Scottish Intercollegiate Guidelines Network; CRD = Centre for Reviews and Dissemination; mTBI = mild traumatic brain injury.

Table 3  
Definitions of mTBI

CPG (reference)	Definition of Mild Traumatic Brain Injury
SIGN (33)	GCS 13–15
NICE (34)	GCS 13–15
NZGG (35)	GCS 13–15 with a duration of PTA <24 hours post injury
ACEP/CDC (36)	GCS 14–15
NSW ITIM (31)	GCS 14–15 with or without loss of consciousness (LOC) or amnesia
MAA NSW (32)	One of the following: confusion of disorientation, LOC <30 minutes, PTA <24 hours and/or transient neurological abnormalities, GCS 14–15 30 minutes post injury or later upon presentation OR GCS 13–15 at 30 minutes post injury or late upon presentation and a normal CT scan

ACEP/CDC = American College of Emergency Physicians/Centers for Disease Control and Prevention; AGREE = Appraisal of Guidelines, Research and Evaluation; CPG = clinical practice guideline; GCS = Glasgow Coma Scale; MAA NSW = Motor Accident Authority New South Wales; mTBI = mild traumatic brain injury; NSW ITIM = New South Wales Institute of Trauma and Injury Management; NICE = National Institute for Health and Clinical Excellence; NZGG = New Zealand Guidelines Group; PTA = posttraumatic amnesia; SIGN = Scottish Intercollegiate Guidelines Network.

were differences in the pattern of domain scores and individual items within the domains (see Tables 4 and 5). Of the six domains, scope and purpose (mean score = 90.4%, range = 80.5% to 94%) and the clarity domain (mean score = 87.2%, range = 75% to 96%) were adequately met by all the CPGs; however, applicability (mean score = 46.6%, range = 19% to 94%) and stakeholder involvement (mean score = 57%, range = 25% to 81%) were poorly addressed. The majority of CPGs scored poorly on the following AGREE criteria: 1) if the CPG was piloted among

users, 2) if there was a procedure for updating the CPG, 3) if potential cost implications of applying the recommendations were considered, and 4) if key review criteria for monitoring and/or audit were included. The majority of the CPGs adequately met the rigor domain (mean score = 75.3%, range = 60.5% to 92%), and all of the CPGs satisfied the additional criterion (whether systematic methods were used to appraise the evidence). There was moderate agreement between authors in the use of the AGREE Instrument to score each CPG (Fleiss  $\kappa$  = 0.41).

**CPG Recommendations**

A table of the extracted evidence-based recommendations with the grades of recommendation (or in the absence of grades, evidence levels) as stated by the CPG is available as Data Supplement S2 (available as supporting information in the online version of this paper) or on request from the corresponding author. A summary of the recommendations is presented below.

**1. Initial Clinical Assessment.** Mild TBI was defined in various ways (see Table 3). All of the CPGs included recommendations on the clinical factors and symptoms that need to be taken into consideration during the initial assessment of the patient in the ED, but differed on characteristics such as the timing of the assessment.

All CPGs recommended assessing the level of consciousness using the Glasgow Coma Scale (GCS) to categorize the severity of head injury. The three CPGs with a scope that covered both children and adults recommended using a pediatric version of the GCS for children and that the assessment should be completed by someone with experience in the management of the younger child.<sup>33–35</sup> Three of the CPGs recommended that posttraumatic amnesia (PTA) should be prospectively measured in the ED;<sup>31,32,35</sup> however, only one of these specified the assessment tool to be used.<sup>32</sup>

Table 4  
Quality assessment of CPGs

CPG	AGREE Standardized Domain Score (Percentage of the Maximum Possible Score for Each Domain)							Recommendation Rating*
	Scope and Purpose	Stakeholder Involvement	Rigor	Clarity	Applicability	Editorial Independence		
SIGN <sup>33</sup>	94	81	90	96	94	75	SR	
ACEP/CDC <sup>36</sup>	92	40	62.5	75	17	50	R	
MAA NSW <sup>32</sup>	92	69	75	92	19	54	SR	
NSW ITIM <sup>31</sup>	92	25	60.5	87.5	30.5	12.5	R	
NZGG <sup>35</sup>	80.5	58	72	79	36	92	SR	
NICE <sup>34</sup>	92	69	92	94	83	87.5	SR	
Mean AGREE score (± SD), % [range] %	90.4 (±4.92) [80.5–94]	57 (±20.9) [25–81]	75.3 (±13.3) [60.5–92]	87.2 (±8.52) [75–96]	46.6 (±33.4) [19–94]	61.8 (±29.6) [12.5–92]		
Median AGREE score, %	92	63.5	73.5	89.8	33.2	64.5		

AGREE = Appraisal of Guidelines, Research and Evaluation; ACEP/CDC = American College of Emergency Physicians/Centers for Disease Control and Prevention; CPGs = clinical practice guidelines; MAA NSW = Motor Accident Authority New South Wales; NICE = National Institute for Health and Clinical Excellence; NSW ITIM = New South Wales Institute of Trauma and Injury Management; NZGG = New Zealand Guidelines Group; SIGN = Scottish Intercollegiate Guidelines Network.  
\*AGREE Instrument: R = recommended; SR = strongly recommended.

Table 5  
Number of CPGs Fulfilling Each Domain

AGREE Domains	AGREE Criteria Items	SIGN	ACEP/CDC	MAA NSW	NSW ITIM	NZGG	NICE	Total n (%) (N = 6)
Scope and purpose	1. The overall objectives(s) of the guideline is (are) specifically described	Y	Y	Y	Y	Y	Y	6 (100)
	2. The clinical question(s) covered by the guideline is (are) specifically described	Y	Y	Y	Y	Y	Y	6 (100)
	3. The patients to whom the guideline is meant to apply are specifically described	Y	Y	Y	Y	Y	Y	6 (100)
Stakeholder involvement	4. The guideline development group includes individuals from all relevant professional groups	Y	Y	Y	N	Y	Y	5 (83)
	5. The patients' views and preferences have been sought	Y	N	Y	N	Y	Y	4 (67)
	6. The target users of the guideline are clearly defined	Y	Y	Y	N	Y	Y	5 (83)
	7. The guideline has been piloted among target users	Y	N	N	N	N	N	1 (17)
Rigor of development	8. Systematic methods were used to search for the evidence	Y	Y	Y	Y	Y	Y	6 (100)
	9. The criteria for selecting the evidence are clearly described	Y	N	Y	Y	N	Y	4 (67)
	10. The methods used for formulating the recommendations are clearly described	Y	Y	Y	N	Y	Y	5 (83)
	11. The health benefits, side effects, and risks have been considered in formulating the recommendations	Y	Y	Y	N	Y	Y	5 (83)
	12. There is an explicit link between the recommendations and the supporting evidence	Y	Y	Y	Y	Y	Y	6 (100)
	13. The guideline has been externally reviewed by experts prior to its publication	Y	Y	Y	N	Y	Y	5 (83)
Clarity and presentation	14. A procedure for updating the guideline is provided	Y	N	N	N	N	Y	2 (33)
	15. The recommendations are specific and unambiguous	Y	Y	Y	Y	Y	Y	6 (100)
	16. The different options for management of the condition are clearly presented	Y	Y	Y	Y	Y	Y	6 (100)
	17. Key recommendations are easily identifiable	Y	Y	Y	Y	Y	Y	6 (100)
Applicability	18. The guideline is supported with tools for application	Y	N	Y	Y	Y	Y	5 (83)
	19. The potential organizational barriers in applying the recommendations have been discussed	Y	N	N	N	Y	Y	3 (50)
	20. The potential cost implications of applying the recommendations have been considered	Y	N	N	N	N	Y	2 (33)
	21. The guideline presents key review criteria for monitoring and/or audit purposes	Y	N	N	N	N	Y	2 (33)
Editorial independence	22. The guideline is editorially independent from its funding body	Y	N	N	N	Y	Y	3 (50)
	23. Conflicts of interest of guideline development members have been recorded	Y	Y	Y	N	Y	Y	5 (83)
Total (n = 23)		23	14	18	10	18	22	
Additional criterion	Systematic methods were used to appraise the evidence that supports recommendations	Y	Y	Y	Y	Y	Y	6 (100)

ACEP/CDC = American College of Emergency Physicians/Centers for Disease Control and Prevention; AGREE = Appraisal of Guidelines, Research and Evaluation; CPGs = clinical practice guidelines; MAA NSW = Motor Accident Authority New South Wales; NICE = National Institute for Health and Clinical Excellence; NSW ITIM = New South Wales Institute of Trauma and Injury Management; NZGG = New Zealand Guidelines Group; SIGN = Scottish Intercollegiate Guidelines Network.

Table 6  
Criteria for Immediate Scanning in Adults

	MAA NSW	NZGG	SIGN	NICE	ACEP/ CDC (LOC or PTA)	ACEP/ CDC (No LOC or PTA)	NSW ITIM
GCS	Y (<15 two hours postinjury)	Y (13 or 14 two hours post injury)	Y (13 or 14 two hours post injury)	Y (<15 two hours postinjury)	Y (<15)	Y (<15)	Y (persistent <15 at 2 hours post)
Skull fracture	Clinical suspicion of skull fracture	Suspected open or depressed or any sign of basal	Basal, depressed, or penetrating injury	Suspected open or depressed or any sign of basal		Y (basilar)	Clinical suspicion of skull fracture
Posttraumatic seizure	Y	Y		Y	Y		Y
Deteriorating/prolonged LOC/GCS	Y (deteriorating GCS or prolonged LOC > 5 minutes)		Y (deteriorating LOC)				Y (deteriorating GCS after 4 hours or prolonged LOC>5 minutes)
Focal neurologic deficit	Y	Y	Y	Y	Y	Y	Y
Headache	Y (persistent severe)		Y (persistent severe)		Y	Y (severe)	Y (persistent, severe)
Vomiting	2 or more	>1	2	>1	Y	Y	2 or more
Amnesia	Anterograde or retrograde >30 mins	>30 mins before event		>30 minutes before event			Anterograde or retrograde >30 minutes
Abbreviated Westmead Post-Traumatic Amnesia Scale (A-WPTAS) score*	Persistent abnormal < 18/18						
Drug and alcohol intoxication	Y				Y		Clinical judgment required
Deficits in short term memory					Y		
Trauma of the clavicle					Y (above)		
Deteriorating condition	Persistent abnormal alertness/behavior/cognition	Y (any)					After 4 hours observation, abnormal mental status and failure to clinically improve
Age > 65 yr	Y	Y (65 or older with LOC or amnesia)		Y (with LOC or amnesia)	Y (>60)	Y	Y (clinical judgment if no other risk factors present)
Coagulopathy	Y	Y (with LOC or amnesia)	Y (LOC, amnesia, neurological feature)	Y (with LOC or amnesia)	Y	Y	Y
High risk/dangerous mechanism of injury	Y	Y (with LOC or amnesia)		Y (with LOC or amnesia)		Y	Clinical judgment required
Multisystem trauma	Y						Clinical judgment required
Known neurosurgery/neurologic impairment	Y						Clinical judgment required
Delayed presentation or re-presentation	Y						Clinical judgment required

\*Abbreviated Westmead Score  
ACEP/CDC = American College of Emergency Physicians/Centers for Disease Control and Prevention; GCS = Glasgow Coma Scale; LOC = loss of consciousness; MAA NSW = Motor Accident Authority New South Wales; NICE = National Institute for Health and Clinical Excellence; NSW ITIM = New South Wales Institute of Trauma and Injury Management; NZGG = New Zealand Guidelines Group; PTA = posttrauma amnesia; SIGN = Scottish Intercollegiate Guidelines Network.

**2. Imaging.** All CPGs recommended computed tomography (CT) imaging as the investigation of choice for the detection of clinically important brain injuries and stated that skull x-rays are not sufficiently sensitive to identify significant intracranial lesions. The importance of determining which patients have a high risk or low risk of intracranial injury to inform the use and timing of CT imaging was discussed in all CPGs. A variety of CT head scanning rules were used in the development of the CPGs, and therefore different combinations of criteria are described to determine which patients are considered high or low risk of intracranial injury and hence appropriate for CT. Table 6 provides an example of the differences in criteria used in each CPG to determine which adult patients should be immediately referred for a CT scan. Differences in the combinations of risk criteria were also observed in the assessment of risk in children.

Five CPGs provided recommendations on imaging in the absence of a CT scanner.<sup>31–35</sup> Three of these CPGs suggested using skull x-rays in adults, in addition to observation, to confirm the presence of skull fractures to inform the decision to refer for a CT scan.<sup>31,33–34</sup>

**3. Management, Observation and Discharge Planning.** The majority of recommendations for ED observation, and the criteria for hospital admission and discharge, were based on expert opinion and consensus. There was, however, consistency in the recommendations for the minimum clinical observation period for patients with mTBI in the ED (4 hours), criteria for hospital admission, and discharge home (negative head CT scan, GCS 15 four hours postinjury, and carer at home). Only one CPG included absence of PTA as a criterion for safe discharge.<sup>32</sup>

**4. Patient Information and Follow-up.** All CPGs emphasized the importance of providing patients with verbal and written information, including details on symptoms, reassurance that symptoms are likely to resolve, and details of support services. Four CPGs recommended that patients with an initial GCS of 13, or those who received a CT scan, should be referred to a general practitioner (GP) at discharge or routinely followed up.<sup>32–35</sup> The same CPGs stated that for all patients discharged following a head injury, a GP or school nurse (for a child with mTBI) should receive a discharge summary or letter informing them of the injury and if any follow-up is planned.<sup>32–35</sup> The two CPGs that did not provide recommendations on patient follow-up only included patients with a GCS 14 or 15.<sup>31,36</sup>

## DISCUSSION

The findings from this study are consistent with those of previous studies in this area<sup>14,15</sup> and studies that have assessed the quality of CPGs in depression<sup>37</sup> and osteoarthritis.<sup>38</sup> The AGREE Instrument is a useful tool for assessing the quality of CPGs; however, its assessment applies only to the CPG development process and how this process is reported, rather than the clinical content of the CPG. We cannot be sure that if a CPG quality

item was not reported, it was not done. The CPGs that were excluded due to a lack of methods reporting might therefore have sound recommendations. However, there is evidence that the quality ratings of the AGREE domains are significant predictors of CPG adoption, CPG endorsements, overall intentions to use the CPG, and overall quality of the CPG.<sup>39</sup>

CPG development is a costly and time-intensive process requiring a large investment by developers. The identification of six high-quality CPGs equates to a large investment in time and resources, especially as only one of the CPGs had been partially adapted from an existing CPG.<sup>35</sup> It is, however, important for CPGs to be applicable to the setting in which they will be used. Adapting recommendations from existing CPGs may be a more cost-effective and resource efficient alternative than producing entire CPGs de novo. A local adaptation framework, such as the one developed by the ADAPTE Working Group, can be used by CPG developers to produce locally applicable CPGs based on pre-existing CPGs.<sup>40</sup>

Clinical practice guideline developers can use the AGREE Instrument as a tool for improving the quality of their CPGs and findings from this study suggest that the quality of CPGs for mTBI can be improved by increasing the involvement of stakeholders and including information on the applicability of the CPG recommendations, including cost implications. Producing high-quality CPGs is only the first step to improving clinical practice, and the effect of these CPGs on patient care largely depends on the implementation of the CPGs into practice and incorporating them into quality improvement initiatives.<sup>41</sup> It is therefore important that resources are not only dedicated to producing CPGs, but also to effective implementation strategies to ensure that the large investment in producing CPGs is not wasted.<sup>42</sup>

## LIMITATIONS

In this study we only included CPGs that were published in peer-reviewed journals and included in databases such as those maintained by the Guidelines International Network. While we may therefore have missed institutional and local guidelines, and those in languages other than English, we have focused on guidelines able to be picked up and adapted by institutions in many parts of the world.

## CONCLUSIONS

We identified six clinical practice guidelines for the ED management of mTBI that were of high quality, and these guidelines were consistent in recommending the use of the GCS to assess the level of consciousness, initial assessment criteria, the use of CT as imaging investigation of choice, and the provision of patient information. Between guidelines, however, there was difference in the definition of mild traumatic brain injury that could affect decisions about CT scanning and assessment for PTA. Furthermore, the clinical practice guidelines rated poorly in domains of applicability and stakeholder involvement. Future clinical practice guidelines could be improved by piloting the CPG

among users, developing and reporting procedures for updating the CPG, discussing potential cost implications of applying the CPG recommendations, and including key review criteria for monitoring and/or audit.

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### Supporting Information

The following supporting information is available in the online version of this paper:

**Data Supplement S1.** Search Strategies.

**Data Supplement S2.** Evidence-based Recommendations\* for the Management of Mild Traumatic Brain Injury (mTBI) in the ED.

The document is in PDF format.

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