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REVIEW PAPER

Clinical practice guidelines for the management of conditions related to traffic collisions: a systematic review by the OPTIMa Collaboration

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Abstract

Objective: To evaluate the methodological quality and synthesize recommendations of evidence-based guidelines for the management of common traffic injuries. *Study design*: We conducted a systematic review and best evidence synthesis of guidelines on musculoskeletal injuries, psychological disorders and mild traumatic brain injuries (MTBI) from 1995 to 2012. Independent reviewers critically appraised eligible guidelines using the Appraisal of Guidelines for Research and Evaluation II (AGREE II) criteria. *Results*: We retrieved 9863 citations. Of those, 16 guidelines were eligible for critical appraisal and eight were scientifically admissible (four targeting whiplash-associated disorders (WAD), one addressing anxiety and three addressing MTBI). The inadmissible guidelines had inadequate literature searches, inexplicit links between evidence and recommendations, and ambiguous recommendations. The literature used to develop most of the admissible guidelines was outdated. Major recommendations included: (1) Advice, education and reassurance for all conditions; (2) Exercise, return-to-activity, mobilization/manipulation, analgesics and avoiding collars for WAD; (3) Psychological first aid, pharmacotherapy and cognitive behavioral therapy as first-line interventions for anxiety; and (4) Monitoring for complications, discharge criteria, advice upon discharge from the emergency room and post-discharge care for MTBI. *Conclusion*: Fifty percent of appraised guidelines were scientifically admissible, but most need updating. Most guidelines focus on WAD and MTBI. Few guidelines make comprehensive recommendations on a wide range of consequences from traffic collisions.

Keywords

Accidents, anxiety, injuries, traffic, traumatic brain injury, whiplash, wounds

History

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➤ Implications for Rehabilitation

- The core components of a program of care designed to manage common traffic injuries (whiplash-associated disorders – WAD, anxiety and mild traumatic brain injuries) should include advice, education and reassurance.
- Depending on the condition, the following specific interventions should be considered: (1) WAD: exercise, early return to activity, mobilization/manipulation, analgesics and avoidance of collars; (2) Anxiety: psychological first aid, pharmacotherapy and cognitive behavioral therapy; and (3) Mild traumatic brain injuries: use of specific discharge criteria (including no factors warranting hospital admission and support structures for subsequent care), education upon discharge from emergency room and post-discharge care (e.g. monitoring for complications, gradual return to normal activity based on tolerance of individual).
- The methodological quality of guidelines varies greatly; therefore, guideline developers need to adhere to established methodological standards and conform to the evaluation criteria outlined in the Appraisal of Guidelines for Research and Evaluation II (AGREE II) instrument.

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Introduction

Most traffic collisions do not lead to fatal outcomes or serious injuries for the people involved [1]. However, musculoskeletal injuries, head injuries and psychological disorders related to

traffic collisions are associated with clinically important pain and disability [2–5]. Epidemiological studies have determined that individuals injured in traffic collisions most commonly suffer from whiplash-associated disorders (WAD), shoulder pain, headaches and/or back pain [6]. These musculoskeletal injuries are frequently associated with mild traumatic brain injuries (MTBI), depressive symptomatology and/or post-traumatic stress disorders [5,7,8]. Although MTBI can be related to various mechanisms of injury (e.g. traffic collisions, falls, sports, assaults), the most common mechanisms of injury are traffic collisions and falls [5].

The majority of individuals injured in traffic collisions recover within weeks to a few months after their injuries [2,7,9]. However, a significant proportion of patients develop persistent pain and disability [4,9,10]. Those injured in traffic collisions have a greater risk of developing troublesome musculoskeletal disorders such as disabling neck pain [11]. Preventing the development of persistent pain and disability in these patients has been challenging for clinicians as few effective treatments are available [12,13]. Moreover, the prognosis for these patients is complex and influenced by initial severity of injury, psychological factors, such as passive coping, compensation factors, and the type and intensity of healthcare use [9]. Clinical guidelines providing support for initial and ongoing clinical decisions on care would be helpful.

Clinical practice guidelines are systematically developed statements designed to assist clinicians in providing quality care to patients [14,15]. Guidelines are intended to reduce the gap between research and practice for clinicians, and assist decisions at the system and population level for policymakers [16,17]. Despite recent growth in popularity, there are concerns about the methodological quality of commonly used guidelines [18]. Systematic reviews have determined that guidelines may have poor methodological quality [16,19–23]. Common flaws include poor methodology, lack of stakeholder involvement and questionable editorial independence [16]. Therefore, serious concerns have been raised about the negative impact of potentially biased guidelines on patient care and health outcomes [16,24–26].

There are many clinical practice guidelines available for the management of common traffic injuries. However, the quality of these guidelines has not been critically appraised. Poor methods in developing guidelines may impact the validity of their recommendations and the quality of patient care [27,28]. In practice, guidelines of poor methodological quality may lead clinicians to consider ineffective, costly or harmful interventions. At the organizational level, it may lead policy makers to use resources on the implementation of poorly developed recommendations. Furthermore, identified barriers to adopting guidelines include lack of understanding on how recommendations were developed, unclear recommendations and inconsistency in recommendations across guidelines [29]. Therefore, a systematic review of these guidelines is needed to assess their methodological quality and help guide appropriate management of individuals with traffic injuries.

The purpose of this systematic review was to critically appraise and synthesize the recommendations of evidence-based clinical practice guidelines for the management of common conditions related to traffic collisions.

Methods

Registration of review

The protocol for our systematic review was registered on PROSPERO (CRD42012002940) and can be accessed at www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42012002940

Literature search

The search strategy was developed in consultation with a health sciences librarian. A second librarian reviewed the search strategy using the Peer Review of Electronic Search Strategies (PRESS) Checklist [30]. The search strategy combined terms relevant to traffic injuries, traffic collisions and guidelines, and included free text words and subject headings specific to each database (Appendix IA and IB). The following databases were searched from 1 January 1995 to 25 October 2012: MEDLINE, EMBASE, CINAHL, PsycINFO, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects (DARE), Cochrane Central Register of Controlled Trials, National Health Services Economic Evaluation Database, Health Technology Assessment Database and the Index to Chiropractic Literature. Reference lists of relevant guidelines were hand searched for supplemental documents relevant to the methodology of that guideline.

We searched the grey literature using the following databases and websites: National Guideline Clearinghouse (Agency for Healthcare Research and Quality), Canadian Medical Association (CMA) Infobase, Guidelines International Network, PEDro, Trip Database, American College of Physicians Clinical Recommendations, Australian Government, National Health and Medical Research Council, Health Services/Technology Assessment Texts (HSTAT), Institute for Clinical Systems Improvement (ISCI), National Institute for Health and Clinical Excellence (NICE) Guidance, NICE Pathways, New Zealand Guidelines Group, Scottish Intercollegiate Guidelines Network (SIGN) and World Health Organization (WHO) guidelines approved by the Guidelines Review Committee. We also contacted regulatory bodies and government agencies of all Canadian provinces and territories to retrieve jurisdiction-specific guidelines, programs of care, treatment protocols, technical reports, legislation, regulations and/or additional guidelines relevant to this review. Finally, we searched Google using free text words related to traffic collisions and guidelines.

Study selection

The following inclusion criteria were used: (1) English language; (2) adults and/or children with common physical, mental or psychological injuries, including WAD grades I-III (Appendix IIA and IIB); (3) related to traffic collisions; (4) guidelines, programs of care or treatment protocols; and (5) included recommendations for therapeutic management. We excluded guidelines that: (1) did not include treatment recommendations; (2) were a summary or copy of previous guidelines; (3) were developed solely on the basis of consensus; or (4) did not conduct a systematic literature search or critical appraisal of the studies that were used to derive recommendations. For psychological injuries, we also excluded guidelines that were not specific to post-collision conditions (e.g. generalized anxiety disorders not related to traffic collisions). Psychological consequences of traffic collisions are considered to have characteristics that are distinct from other types of traumatic events [31]. For example, collision-related trauma frequently involves negligence and results in litigation and/or compensation processes, which may differ from a broader range of trauma (e.g. natural disasters, sporting injuries) [31]. Prevailing compensation and legal factors have been found to be prognostic factors for recovery from WAD [9].

Title and abstract screening

We used a two-stage screening process by random pairs of independent reviewers. First, reviewers independently screened titles and abstracts for eligibility. Where eligibility could not be determined based on the title and abstracts, a second screening

stage was conducted in which reviewers independently reviewed the full text. Disagreements between pairs of reviewers were resolved by discussion to reach consensus. A third reviewer was used to settle disagreements if consensus could not be reached. Authors were contacted if additional information was necessary to determine eligibility.

Critical appraisal of eligible studies

Relevant guidelines were appraised by random pairs of independent reviewers. Independent reviewers appraised guidelines using the Appraisal of Guidelines for Research and Evaluation version II (AGREE II) instrument (Appendix III) [32,33]. The AGREE II instrument is widely used to assess the development and reporting of guidelines. It consists of 23 items in six quality-related domains: scope and purpose, stakeholder involvement, rigor of development, clarity of presentation, applicability and editorial independence of guidelines (Appendix III). Discussions were held between pairs of reviewers to reach consensus on: (1) individual AGREE II items; (2) overall quality of the guideline; (3) whether the guideline was scientifically admissible; and (4) whether modifications to the guideline would be needed for use in specific jurisdictions (e.g. updating the literature, modifying the format of the guideline). Authors were contacted if additional information or clarification was needed to complete the critical appraisal.

Data extraction

One reviewer extracted data from scientifically admissible guidelines into standardized data extraction forms. A second reviewer checked data extracted from each guideline by comparing extracted data with data reported by the guideline.

Data synthesis

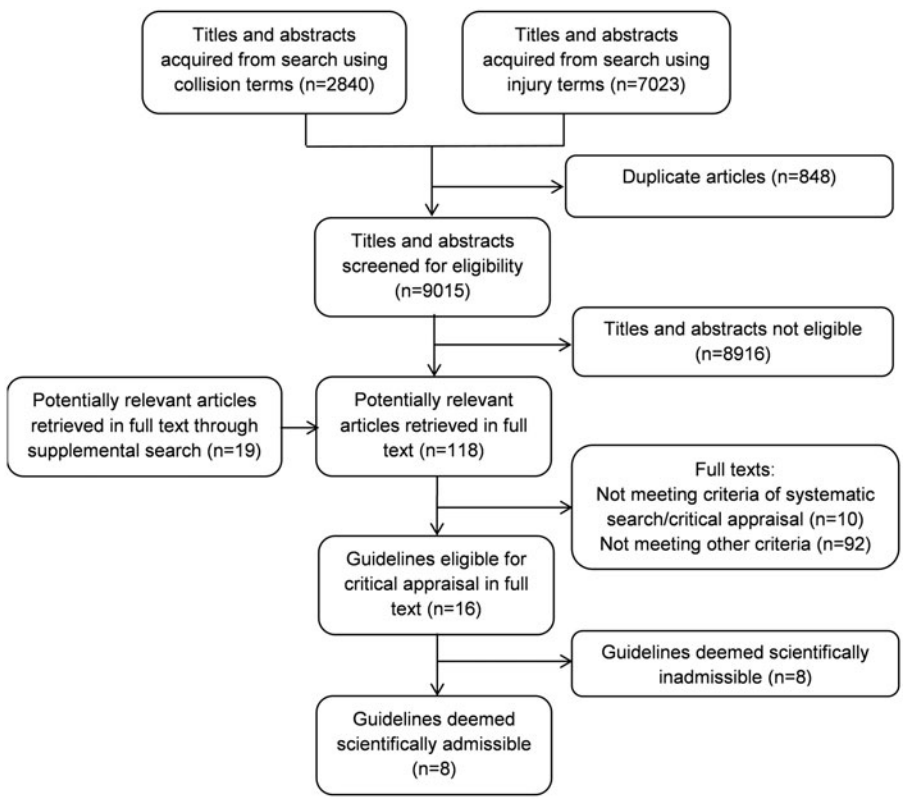
Recommendations from scientifically admissible guidelines were synthesized qualitatively using evidence tables and summary statements. We aimed to summarize the recommendations of admissible guidelines. We did not derive recommendations from the synthesis, but instead descriptively reported their content. Guidelines with poorly conducted systematic searches of the literature (question 7 of AGREE II) or with inadequate methods to critically appraise the evidence (question 9 of AGREE II) were deemed to have fatal flaws and therefore scientifically inadmissible. These criteria are described as fundamental steps to the development of evidence-based guidelines [18]. Although not a fatal flaw, lack of editorial independence from the funding body (question 22 of AGREE II) was considered as an important limitation to the quality of the guideline. The absence of editorial independence would contribute to lower overall guideline quality, since this may suggest poor reporting and a lack of transparency in guideline development [16].

Recommendations from each guideline were organized by specific interventions in a table to facilitate comparisons of recommendations across guidelines. Recommendations of guidelines were classified by interventions that: (1) were recommended; (2) were recommended for consideration; (3) were recommended against; (4) had no evidence to support or refute its use. Recommended interventions by guidelines were interventions that were strongly recommended, recommended without any conditions required, or described as ''should be used''. Interventions recommended for consideration included interventions that may be effective, should be used in combination with another intervention, or can be used given ongoing improvement for the patient.

Results

Our search yielded 9863 citations (Figure 1). We excluded 848 (8.6%) duplicates and screened 9015 titles and abstracts for eligibility. Of those, 8916 (90.4%) did not meet the eligibility criteria. We screened 118 citations using full text and contacted the authors of eight guidelines (5/8 responded) [34–38] to obtain additional information about the scope and development of their guidelines for eligibility. A total of 102 were deemed ineligible. We critically appraised 16 (0.2% of 9863) guidelines [39–54] and

Figure 1. Flow diagram.



during critical appraisal, we contacted the authors of eight guidelines (4/8 responded) [46,53,55,56] to obtain additional information necessary to assess guideline quality. After, eight (0.01%) guidelines were deemed scientifically admissible [39–46]. One of the scientifically admissible guidelines was updated in 2013, so this was also critically appraised and found to be scientifically admissible [57].

Methodological quality

The methodological quality of the relevant guidelines varied considerably (Tables 1 and 2). Overall, most guidelines did not adequately address guideline applicability, particularly regarding facilitators and barriers, resource implication, and monitoring or auditing criteria upon implementation (10/16) [47–49,52, 53,56,58]. Half of the guidelines did not address potential competing interests of the guideline development group (8/16) [40,43,44,46,48,49,52,59].

According to individual AGREE II items, the scientifically inadmissible guidelines had major limitations with: (1) no systematic methods to search for evidence (5/8) [47,49,52,56,59]; (2) no clear description of strengths and limitations of the literature (7/8) [47–50,52,53,59]; (3) no explicit link between recommendations and supporting evidence (4/8) [47,49,53,59] (4) lack of specific and unambiguous recommendations (i.e. lacking detail regarding patient population, intervention or intended outcome) (4/8) [47,49,53,59]; or (5) did not report editorial independence from the funding body, which was considered as an important limitation but not a fatal flaw (5/8) [47–49,53,59].

Eight guidelines had minor limitations, even though they were judged scientifically admissible: (1) did not adequately address applicability domain (3/8) [43,44,46]; or (2) did not report any competing interests of the guideline development group (4/8) [40,43,44,46]. Based on judgment between reviewers regarding the overall guideline quality, it was determined that all admissible guidelines required modifications for use in specific jurisdictions. Guideline modifications primarily included updating the literature, modifying the scope of guideline to include/exclude certain interventions and improving guideline applicability. One guideline was updated within five years of the publication date of the original guideline [57].

Scientifically admissible guidelines

Four of the eight admissible guidelines addressed the management of WAD [40,43,46,54], one addressed the management of anxiety after traffic collisions [44] and three discussed the management of brain injuries (including MTBI) (Table 3) [41,42,45]. All brain injury guidelines targeted the early management of MTBI [41,42,45], and one also addressed the management of persistent MTBI [41]. Most guidelines focused on primary care (7/8) [40–45,54] and/or emergency care (4/8) [41,42,44,45] settings. A description of the recommendations from admissible guidelines is provided below.

Guidelines for grade I–III whiplash-associated disorders

Admissible guidelines on the management of WAD were published in 1995, 2004, 2007 and 2008 [40,43,46,54]. Recommendations pertaining to individual interventions are outlined in Table 4. These recommendations are stratified by stage of recovery (i.e. acute, subacute or chronic) or grade of WAD (i.e. grades I, II or III), based on the individual guideline.

Recommended interventions

All guidelines recommended that the management of patients with acute WAD include education and neck exercises [40,43,46,54]. Most guidelines recommended to include these interventions in the management of subacute and chronic WAD [40,43,46]. One guideline was less supportive and recommended that these interventions can be considered for subacute or chronic WAD [54]. The following were recommended as components of education: (1) emphasis on staying active, acting as usual and promoting mobility [40,43,46,54]; (2) advice on self-management and coping strategies [40,54]; (3) reassurance about the prognosis of neck pain [40,46,54]; and (4) goals around improvement in function [40,43].

Interventions that were recommended for consideration

All guidelines recommended that passive joint mobilization or manipulation can be considered for the management of WAD [40,43,46,54]. Three guidelines recommended that pharmacotherapy (e.g. simple analgesics, non-steroidal anti-inflammatory drugs) can be considered [40,43,46] for the early management of WAD, while one guideline did not discuss pharmacotherapy [54]. For multimodal therapy, one guideline recommended considering this intervention for subacute WAD [54], while other guideline recommended considering this for all grades of WAD [43]. Multimodal therapy was defined as a package of individual treatment modalities (e.g. joint mobilization, relaxation techniques, electrotherapies) that also included exercises and/or advice to stay active [54]. The other two guidelines did not address multimodal therapy.

Interventions that were recommended against

All guidelines recommended against the use of cervical collars in the early management of WAD [40,43,46,54]. One guideline did not address the use of collars in subacute or chronic WAD [54]. Three guidelines recommended against surgery in the early management of WAD [40,43,46]. However, two of these guidelines recommended the consideration of surgery in WAD III with progressive neurological deficits and/or chronic debilitating pain [43,46]. In addition, two guidelines recommended against pharmacological injections for the management of WAD [40,43], one other guideline found no evidence to support or refute its use [46]. One guideline did not include injections or surgery in its scope [54].

Interventions without evidence to support or refute their use

Three guidelines found no evidence for massage in the management of WAD [43,46,54]. However, two guidelines recommended its consideration for acute [40] or subacute WAD [54]. One guideline recommended against its use upon finding no evidence for massage [43]. For acupuncture, two guidelines found no evidence to support or refute its use [46,54], while one guideline recommended considering acupuncture for all grades of WAD [43]. Two guidelines did not find evidence for magnetic necklaces [43,46], and one of these guidelines recommended against its use until there is evidence to support its use [43]. The other guidelines did not address this intervention. For electrical nerve stimulation, two guidelines found no evidence for its use in the management of chronic WAD [54] or in any grades of WAD [46]. One guideline recommended considering electrical nerve stimulation in acute WAD but not in chronic WAD [40], while the remaining guideline did not address this intervention [43].

Guideline for anxiety following traffic collisions

Interventions that were recommended

The Motor Accidents Authority of New South Wales, Australia, published a guideline in 2003 for the management of anxiety

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Table 1. AGREE II ratings[a] of scientifically admissible guidelines.

Items 1–12

GDG, Year	Overall objectives	Health questions	Population	GDG	Views of target population	Target users	Systematic search methods	Selection criteria	Strengths and limitations of evidence	Methods for formulating recommendations	Benefits, side effects, risks	Link between recommendations and evidence
CSP, 2004 [50]	6	6	6	4	5	7	5	6	5	7	5	7
TRACsa, 2008 [36]	6	6	7	7	7	6	7	7	6	7	6	7
ONF, 2008 [37]	7	6	7	7	5	7	6	6	6	7	5	7
ONF, 2013 [57][c]	7	7	7	7	5	7	7	6	6	6	6	7
SIGN, 2009 [38]	7	7	6	6	6	6	4	3	6	6	5	6
MAA (WAD), 2007 [39]	7	7	7	5	1	7	6	7	4	4	4	7
MAA (Anxiety), 2003 [40]	5	5	5	6	1	7	5	3	5	4	6	7
NCCAC, 2007 [41]	7	7	6	6	6	6	6	4	6	6	7	6
QTF, 1995 [42]	5	4	4	6	1	3	6	6	4	3	4	6

Items 13-23

GDG, Year	External review	Procedure for updating	Specific and clear recommendations	Options presented	Key recommendations	Facilitators and barriers	Advice and tools	Resource implication	Monitoring and auditing criteria	Views of the funding body	Competing interests of GDG
CSP, 2004 [54]	6	6	7	7	7	5	6	1	3	7	4
TRACsa, 2008 [40]	7	5	7	7	7	5	7	4	5	1†	1
ONF, 2008 [41]	6	7	7	7	7	1	7	1	4	7	6
ONF, 2013 [57][c]	5	7	7	7	7	4	7	1	3	7	6
SIGN, 2009 [42]	6	5	6	6	7	3	7	5	6	7	5
MAA (WAD), 2007 [43]	5	1	7	7	7	1	4	1	1	7	1
MAA (Anxiety), 2003 [44]	4	5	7	7	7	1	5	1	1	7	1
NCCAC, 2007 [45]	6	7	7	7	7	5	7	7	7	7	7
QTF, 1995 [46]	2	4	6	5	6	2	3	2	1	7	1[b]

[a]Each AGREE II item is rated on a 7-point scale, where 1 = strongly disagree or insufficient information provided and 7 = strongly agree; [b]Rating is based on current information available; [c]An update of the 2008 guideline from the Ontario Neurotrauma Foundation [57].

AGREE – Appraisal of Guidelines for Research and Evaluation; CSP – Chartered Society of Physiotherapists; GDG – Guideline Development Group; MAA - Motor Accidents Authority; MTBI – mild traumatic brain injury; ONF – Ontario Neurotrauma Foundation; NCCAC – National Collaborating Centre for Acute Care; QTF: Québec Task Force; SIGN - Scottish Intercollegiate Guidelines Network; TRACsa - South Australian Trauma Centre for Trauma and Injury Recovery; WAD – whiplash-associated disorders.

Table 2. AGREE II ratings[a] of scientifically inadmissible guidelines.

Items 1-12

GDG, Year	Overall objectives	Health questions	Population	GDG	Views of target population	Target users	Systematic search methods	Selection criteria	Strengths and limitations of evidence	Methods for formulating recommendations	Benefits, side effects, risks	Link between recommendations and evidence
ACOEM, 2011[56]	7	7	7	6	7	7	2	5	5	6	6	7
CCA-CFCREAB-CPG, 2010 [53]	6	4	4	3	2	7	6	4	3	3	5	4
CPO, 2002 [49]	5	6	4	5	1	2	4	6	3	1	7	3
ICAC, 2009 [47]	3	2	2	2	1	4	3	2	1	2	2	1
MAA (MTBI), 2008 [50]	6	5	7	6	6	7	5	6	3	5	6	7
Ottawa Panel, 2012 [58]	5	6	7	6	1	3	3	5	2	2	4	4
Philad-elphia Panel, 2001 [52]	6	5	6	7	1	7	3	7	3	4	3	5
Task Force for PABC, 2004 [48]	6	6	7	4	4	7	5	4	3	2	6	6

Items 13-23

GDG, Year	External review	Procedure for updating	Specific and clear recommendations	Options presented	Key recommendations	Facilitators and barriers	Advice and tools	Resource implication	Monitoring and auditing criteria	Views of the funding body	Competing interests of GDG
ACOEM, 2011 [56]	6	7	6	6	6	1	6	1	1	6	5
CCA-CFCREAB-CPG, 2010 [53]	4	1	4	2	6	4	4	1	1	1†	4
CPO, 2002 [49]	4	4	2	1	5	3	1	1	1	1	1
ICAC, 2009 [47]	5	6	4	4	3	1	3	1	1	1†	6
MAA (MTBI), 2008 [50]	5	5	7	7	7	2	7	1	2	7	7
Ottawa Panel, 2012 [58]	2	1	2	2	2	1	1	1	1	1†	1
Philad-elphia Panel, 2001 [52]	5	1	5	6	6	2	1	1	1	7	1
Task Force for PABC, 2004 [48]	4	4	6	7	3	2	1	1	2	1[b]	1

[a]Each AGREE II item is rated on a 7-point scale, where 1 = strongly disagree or insufficient information provided and 7 = strongly agree; [b]Rating is based on current information available.

ACOEM – American College of Occupational and Environmental Medicine; AGREE – Appraisal of Guidelines for Research and Evaluation; CCA-CFCREAB-CPG – Canadian Chiropractic Association-Canadian Federation of Chiropractic Regulatory and Educational Accrediting Board-Clinical Practice Guideline; CPO – College of Physiotherapists of Ontario; GDG – Guideline Development Group; ICAC – International Chiropractors Association of California; MAA – Motor Accidents Authority; MTBI – mild traumatic brain injury; PABC – Physiotherapy Association of British Columbia.

Table 3. Evidence table for scientifically admissible guidelines.

Title of guideline	Guideline development group, country, year	Search period, study designs included	Target users	Target patient population	Healthcare setting	Treatment recommendations for common traffic injuries
Clinical Guidelines for Best Practice Management of Acute and Chronic Whiplash-Associated Disorders [40]	South Australian Centre for Trauma and Injury Recovery, Australia, 2008	1999 to 2007; Systematic reviews, randomized and quasi-randomized trials (for treatment recommendations)	General practitioners and other health professionals in primary, secondary and tertiary care settings	Adults (>18 years of age) with WAD grades I–IV following traffic collision, acute and subacute (0–12 weeks) and chronic (>12 weeks)	Primary, secondary and tertiary care	Should be undertaken: - Acute WAD: Advice, reassurance, education, exercise - Chronic WAD: Advice, reassurance, exercise May be undertaken: - Acute WAD: Passive joint mobilization/manipulation, passive modalities, pharmacotherapy (non-opioid analgesics, NSAIDs) as adjuncts to care - Chronic WAD: Cognitive behavioural approach, passive joint mobilization/manipulation with exercise, vestibular rehabilitation, radiofrequency neurotomy, subcutaneous sterile water injections Should not be undertaken (without further evidence): - Acute WAD: Collars, surgery (except WAD IV), cervical pillows, injections - Chronic WAD: Injections (except sterile water injections), collars, prescribed rest, surgery, electrotherapy
Clinical Guidelines for the Physiotherapy Management of Whiplash Associated Disorder [54]	The Chartered Society of Physiotherapy, United Kingdom, 2004	1995–2004, systematic reviews, randomized trials	People with WAD, physio-therapists, health professionals involved in care of WAD, educational institutions	Adults (≥16 years of age) with WAD grades 0, I, II, III	Physiotherapy clinics	In acute stage (0–2 weeks post-injury): - Active exercise, education, advice on self-management, return to activity can be recommended (grade A) - Manual mobilization, soft tissue techniques, education about origin of pain, advice about coping strategies, relaxation, TENS may be effective (grade C) - Soft collars are not recommended (grade C) - No evidence to support or refute massage, acupuncture, pulsed electromagnetic therapy (grade C) - Unlikely to be effective: traction, infrared light, interferential therapy, ultrasound, laser (grade C) In subacute stage (2–12 weeks post-injury): - Evidence to support multimodal approach (including postural training, manual techniques, psychological support) (grade A) - Combined manipulation and mobilization, muscle retraining including deep neck flexor activity, education, advice about coping strategies, TENS, massage, soft tissue techniques may help reduce pain and improve function (grade C) - No evidence to support or refute acupuncture (grade C) - Unlikely to be effective: traction, infrared light, interferential therapy, laser, ultrasound (grade C) In chronic stage (>12 weeks post-injury): - Exercise therapy, manipulation and mobilization (may be combined), multidisciplinary psychosocial packages (by trained health professionals, including psychologists) may be effective (grade C) - No evidence to support or refute acupuncture, ultrasound, electromyographic biofeedback, thermotherapy, electrical stimulation, TENS, massage
Guidelines for the Management of Acute Whiplash-Associated Disorders for Health Professionals [43]	Motor Accidents Authority, Australia, 2007	1999 to 2005; Systematic reviews, randomized trials, quasi-randomized trials (for treatment recommendations)	General practitioner or other primary care health professionals in New South Wales	Adults (>18 years of age) with WAD grades I, II, III in the first 12 weeks following traffic collision	Primary care	Recommended: - Reassure, act as usual - Prescribed functional exercises (e.g. return to usual activity), rehabilitation programs (e.g. work alteration) - Exercise (range of motion exercises, muscle re-education) - Pharmacology: simple analgesics (WAD I) - Not routinely recommended (can be considered in conjunction with other therapies, provided there is improvement):

(*continued*)

Table 3. Continued

Title of guideline	Guideline development group, country, year	Search period, study designs included	Target users	Target patient population	Healthcare setting	Treatment recommendations for common traffic injuries
						- Pharmacology: NSAIDs, non-opioid analgesics, opioid analgesics (can be considered for WAD II, III) - Postural advice - Passive joint mobilization or manipulation - Passive modalities (can be considered for WAD II, III) - Traction - Multimodal treatment - Acupuncture - Surgery (can be considered for WAD III with persistent pain not responsive to conservative management or rapidly progressing neurological deficit) Not recommended: - Pharmacology: muscle relaxants and psychopharmacological agents (WAD I–III) - High-dose intravenous methylprednisolone infusion (WAD II, III) - Cervical pillows - Immobilization, prescribed rest (>4 days), collars (>48 h) - Spray and stretch - Intra-articular and intrathecal steroid injections - Epidural steroid injections for WAD I, II - Steroid trigger point injection for patients in acute phase - Magnetic necklaces - Other interventions including Pilates, Feldenkrais, Alexander Technique, massage, homeopathy
Scientific Monograph of the Quebec Task Force on Whiplash-Associated Disorders [46]	Quebec Task Force, Canada, 1995	1980 to 1993; Excluded single case reports, narrative reviews	Not specified	Adults and children with WAD grades I, II, III	Not specified	Recommended: - Reassure about the favourable prognosis of WAD - Encourage early return to usual activities - Use prescription drugs sparingly - Provide manipulative treatment for pain relief and early mobility - Physiotherapy should emphasize return to activity and promote mobility Not recommended: - Soft collars - Prescribed rest should be limited to short duration - Surgery rarely indicated (only for WAD III with progressive/persistent neurologic deficit)
Guidelines for the Management of Anxiety Following Motor Vehicle Accidents [44]	Motor Accidents Authority, Australia, 2003	1996 to 2001; All study designs	General practitioners and other health professionals in New South Wales	Adults with anxiety conditions following traffic collision (primarily acute stress disorder and post-traumatic stress disorder)	Primary care, emergency department	Recommended: - Identify indicators of poor prognosis and have early review and/or referral if present - Provide psychological first aid, i.e. comfort, information, support and meeting immediate practical and emotional needs. It is noted that there is no evidence suggesting early intervention helps prevent subsequent psychopathology - Provide pharmacotherapy for PTSD to alleviate symptoms, treat co-morbid conditions, prevent substance abuse (SSRIs as first option, then consider other antidepressants) - Provide CBT as first option for treating ASD and PTSD (can include assertiveness training) Not recommended as first line intervention: - Supportive counselling - Eye movement desensitization and reprocessing Not recommended:

Clinical Practice Guidelines for Mild Traumatic Brain Injury and Persistent Symptoms [41,57]	Ontario Neurotrauma Foundation, Canada, 2008 (updated in 2013)	2001 to 2008 (update extended to 2013); Excluded non-systematic reviews (e.g. narrative reviews, clinical reviews), letters to editor, editorials without data	Health professionals including family physicians, neurologists, physiatrists, psychiatrists, psychologists, counselors, physio-therapists, occupational therapists, nurses	Adults (≥18 years of age) with mild traumatic brain injury	Emergency care, primary care	- Relaxation training or biofeedback alone - Hypnotherapy - Psychodynamic therapy - One-on-one psychological debriefing Observe hourly in hospital for at least four hours post-injury (grade C) - At four hours post-injury, if the patient has a A-WPTAS score of less than 18, but GCS is 15 and CT scan is normal, use judgment determine whether patient should be discharged (grade C) - If CT is not indicated, discharge may be warranted if there are: (1) no other factors warranting a hospital admission; and (2) support structures for subsequent care (grade C) - Upon discharge, patients receive advice verbally and on a written card. The details of the card should be discussed with the patient and care providers (communicate in other languages or means if necessary) (grade C) - Encourage patients re-presenting to emergency with symptoms to see family physician for follow-up after discharge (grade C) - Patients often experience reduced cognitive functioning post-injury (e.g. recalling material, speed of information processing, concentration, attention), which may take a few days to months before resolving (grade A) - Consider factors including biopsychosocial, contextual and injury factors during management (grade A) - Provide reassurance that recovery is generally over days to a few weeks (grade B), up to 3 months (grade A) - Provide information on common symptoms and management strategies - Advise patients to not drive for at least 24 hours (may require medical reassessment) (grade C) - Follow symptomatic patients every 2–4 weeks from the time of initial contact until no longer symptomatic or until re-assessment (grade C) - Refer patients who have complications or persistent symptoms at 3 months for more comprehensive evaluation (grade A) - Provide multidisciplinary treatment to patients with pre-injury psychiatric difficulties (grade A) - Provide guidance on strategies for managing symptoms and resuming activity (grade A) - Consider referral to specialist services when symptoms persist and fail to respond to treatment (grade C) - Consider risk of depression, other mental health disorders or maladaptive psychological responses to injury during management (grade B) 2013 update: - Significant, prolonged complaints after MTBI should lead primary care providers to consider that many factors may contribute to the persistence of post-concussive symptoms (grade A) - All potential contributing factors should be investigated and a management strategy considered (grade A) - All patients with persistent symptoms should be screened for mental health symptoms and disorders (grade C) - Patients with persistent cognitive symptoms that continue to interfere in daily functioning should be considered for

(*continued*)

Table 3. Continued

Title of guideline	Guideline development group, country, year	Search period, study designs included	Target users	Target patient population	Healthcare setting	Treatment recommendations for common traffic injuries
						referral for neuropsychological assessment (to assist in clarifying appropriate treatment options based on individual patient characteristics and conditions) (grade A) - Individuals with MTBI should be encouraged to gradually return to normal activity (work, physical, school, duty, leisure) based upon their tolerance (grade A)
Early Management of Patients with a Head Injury: A National Clinical Guideline [42]	Scottish Intercollegiate Guidelines Network, United Kingdom, 2009	2001 to 2007; Not specified	Health professionals involved in care of head injuries, including pre-hospital care, general practice, emergency departments, radiology, surgical and critical care specialties, paediatric and rehabilitation services, members of voluntary organizations, patients	Adults and children with mild, moderate and severe head injuries	Pre-hospital, emergency department, primary care, specialty care	Recommended: - Give patients, carers discharge advice/information in formats tailored to their needs (e.g. physical, mental, social) - Review and clarify discharge information with patient and relatives (for adult patients) or parent and carers (for children), ascertaining their understanding of the information - Send immediate discharge document to GP, in advance of a more detailed letter - Notify primary healthcare team, school health team and teachers of children with head injury - Encourage patients and carers seek prompt advice from GP or emergency department by telephone about worrying symptoms or concerns - Provide brief, routine follow-up with advice, education and reassurance that they are likely to recover - Adult patients can be discharged for observation at home with instructions if fully conscious (GCS=15) with no risk or adverse factors - Observation requires a responsible adult who is available and willing to observe for at least 24 h, with access to telephone, medical care and transport home - Each unit should have an agreed protocol for the management of agitation or aggression - Drug treatment should be individually tailored
Head Injury: Triage, Assessment, Investigation and Early Management of Head Injury in Infants, Children and Adults (National Institute for Health and Clinical Excellence Clinical Guideline 56) [45]	National Collaborating Centre for Acute Care, United Kingdom, 2007	1990 to 2007; All study designs	Health professionals in the National Health Service in England and Wales	Infants (<1 year of age), children (1–15 years of age) and adults (≥16 years of age) who present with suspected or confirmed traumatic head injury with or without other major trauma	Emergency department, hospital, primary care	Recommended: - Alert patients and carers that some patients make a quick recovery but go on to experience delayed complications - Inform patients and carers of possible long-term symptoms/disabilities and available services - Include details of support services on patient discharge advice cards (use other formats and/or other languages if necessary) - Public health literature and non-medical sources of advice should encourage patients/carers with concerns to seek immediate medical advice - Information on the nature of head injury, any investigations and patient support organizations should be made available - Do not discharge patient until GCS = 15 - For infants and young children, normal consciousness as assessed by pediatric GCS should be achieved before discharge - Refer to GP (and school nurse or health visitor for children) with letter or email for follow-up within 1 week after discharge - If problems persist, refer from primary care to professional trained in assessment and management of brain injury sequelae

ASD – acute stress disorder; A-WPTAS – Abbreviated Westmead Post-traumatic Amnesia Scale; CBT – cognitive behavioral therapy; GCS – Glasgow Coma Scale; GP – general physician; NSAIDs – non-steroidal anti-inflammatory drugs; PTSD – post-traumatic stress disorder; SSRI – selective serotonin reuptake inhibitor; TENS – transcutaneous electrical nerve stimulation; WAD – whiplash-associated disorder.

following traffic collisions, focusing on acute and post-traumatic stress disorders [44]. None of the other scientifically admissible guidelines addressed the management of post-collision anxiety. This guideline included the recommendation that first-line management should include psychological first aid, pharmacotherapy and cognitive behavioral therapy. The purpose of psychological first aid is to provide comfort, information and support to help patients cope with their injuries. Pharmacotherapy (where selective serotonin reuptake inhibitors are used first, followed by other antidepressants, if needed) was recommended to help: (1) alleviate symptoms (i.e. symptom clusters of arousal, re-experiencing and dissociation); (2) treat co-morbid conditions (i.e. depression, generalized anxiety and phobic disorders); and (3) prevent substance abuse. In addition, cognitive behavioral therapy (including cognitive therapy, exposure therapy and anxiety management) was recommended as a first-line intervention for all patients with anxiety after traffic collisions [44].

Interventions that were recommended against

Supportive counseling and eye movement desensitization and reprocessing were recommended against as first-line interventions for managing anxiety [44]. The use of relaxation training and biofeedback (when not in combination with another intervention), hypnotherapy, psychodynamic therapy and one-on-one psychological debriefing were also recommended against [44].

Guidelines for early management of MTBI

Two guidelines published in 2007 and 2009 addressed the early management of head injuries, including MTBI [42,45], and one guideline published in 2008 (updated in 2013) targeted both early and late management of MTBI [41]. Recommendations for early management pertained to in-hospital management, discharge and transition to at-home/primary care (Table 5).

Interventions that were recommended

One guideline recommended hourly observations until at least four hours post-injury for patients with MTBI first presenting to the emergency department [41]. The other two guidelines did not have recommendations for in-hospital observations specific to MTBI. All three guidelines advised not to consider discharge until patient scores on the Glascow Coma Scale (GCS) equaled 15 for adults with MTBI [41,42,45]. One guideline recommended that normal consciousness (as assessed by the pediatric GCS) should be achieved before discharge for infants and young children with MTBI [45]. The other guidelines did not address discharge for infants or young children with MTBI. One guideline further recommended that at four hours post-injury, there should be: (1) no indication for a computed tomography scan (based on Canadian CT Head Rules [60]); (2) no factors warranting a hospital admission (e.g. drug or alcohol intoxication); and (3) the presence of support structures for subsequent care [41]. Subsequent care requires a responsible adult with access to telephone, medical care and transport home to observe an adult with MTBI for at least 24 h [42]. One guideline advised that clinical judgment concerning discharge would be required if the patient has post-traumatic amnesia four hours post-injury [41]. Post-traumatic amnesia was defined as a score of less than 18 on the Abbreviated Westmead Post-traumatic Amnesia Scale [41]. The other two guidelines did not discuss post-traumatic amnesia specific to patients with MTBI.

Upon discharge, all guidelines recommended providing discharge advice and information to patients and caregivers [41,42,45]. Discharge advice about common symptoms and strategies to manage symptoms and resume activities should be provided verbally in addition to advice cards [41,42]. Advice should be tailored to individuals based on their individual preferences regarding language and communication approach, available resources, and other physical, mental and social needs [41,42,45]. Two guidelines recommended reassuring patients that they are likely to recover within days to a few weeks [41,45]. One guideline further recommended that reassurance and education should be provided within the first week of injury/initial assessment [41]. This guideline suggested that clinicians advise patients with MTBI that they could experience reduced cognitive functioning post-injury, which may take a few days to three months to resolve [41]. Examples of reduced cognitive function included problems with recalling material, speed of information processing, concentration and attention. The other two guidelines did not address reduced cognitive functioning specific to MTBI.

All guidelines advised clinicians to encourage patients to follow up with their physicians about worrisome symptoms or complications upon discharge [41,42,45]. Specifically, two guidelines recommended that emergency room physicians should send immediate discharge documentation to the patient's general physician and recommended a follow-up with the physician within one week of discharge [42,45]. These two guidelines also recommended that primary healthcare teams, school health teams and teachers should be notified of the head injury for children with MTBI [42,45]. This notification should occur within one week of discharge [42,45].

One guideline recommended that patients should be advised to stop driving for at least 24 h upon discharge [41]. A period longer than 24 h is advised if there is loss of good judgment or motor skills, decreased intellectual capacity, post-traumatic seizures or visual impairment [41]. If there are complications, medical re-assessment would be required before patients return to driving [41]. The other two guidelines did not address the issue of driving for patients with MTBI.

Guideline for MTBI after discharge from hospital

The Ontario Neurotrauma Foundation in Ontario, Canada, published a guideline in 2008 for the management of MTBI and persistent symptoms beyond the acute recovery period [41]. Persistent symptoms included post-traumatic headache, sleep disturbances, mental health disorders, cognitive difficulties, balance disorders, vision disorders, and fatigue.

None of the other guidelines addressed management of MTBI after discharge from the hospital. Symptomatic patients should be followed every two to four weeks until symptom resolution or the next reassessment. Referral to a specialized brain injury environment (definition not provided) for more comprehensive evaluation was recommended for patients with: (1) persistent symptoms at three months or (2) comorbidities or identified health or contextual risk factors (e.g. risk of mental health disorders) who did not improve after one month. This guideline recommended the referral to a specialized brain injury environment based on an adaptation of recommendations from another MTBI guideline, which was found inadmissible in our review [50].

Additional considerations were required for individuals who experience persistent symptoms or difficulties [41]. Primary care providers should rule out other contributing or confounding factors with patients experiencing prolonged complaints after MTBI. These factors included certain pre-existing medical conditions, post-injury symptoms, and personal, psychosocial or environmental factors that are associated with poor outcomes post-MTBI. Moreover, patients with pre-injury psychiatric difficulties should be provided with an early referral to a multidisciplinary treatment clinic capable of managing post-MTBI symptoms. A return to work program (including a referral to an occupational therapist) should occur for individuals

Table 4. Recommendations from admissible guidelines for the management of WAD I–III.[a]

	Stage or grade of WAD[b]	Advice, education or reassurance	Return to activity, mobility or exercise	Collars	Joint mobilization or manipulation	Soft tissue therapies	Massage	Simple analgesics	NSAIDs	Opioid or narcotic analgesics	Muscle relaxants	
Chartered Society of Physio-therapists, 2004 [54]	Acute	R	R	RA	RC	RC	NE					
	Sub-acute	RC	RC		RC	RC	RC					
	Chronic		RC		RC		NE					
Motor Accidents Authority, 2007 [43]	WAD I	R	R	RA	RC		RA/NE	R	RC	RA	RA	
	WAD II	R	R	RA	RC		RA/NE	RC	RC	RC	RA	
	WAD III	R	R	RA	RC		RA/NE	RC	RC	RC	RA	
Quebec Task Force, 1995 [46]	WAD I	R	R	RA	RC		NE	RC	RC	NE		
	WAD II	R	R	RA	RC		NE	RC	RC	NE		
	WAD III	R	R	RA	RC		NE	NE	NE	NE		
South Australian Centre for Trauma and Injury Recovery, 2008 [40]	Acute	R	R	RA	RC		RC	RC	RC			
	Chronic	R	R	RA	RC		RA					

	Stage or Grade of WAD	Psychopharmacology	Heat or Ice	TENS	Cervical pillows	Traction	Pulsed electro-magnetic therapy	Short wave diathermy	Infrared light	Interferential therapy	Laser	Ultrasound
Chartered Society of Physio-therapists, 2004 [54]	Acute			RC		RA	NE		RA	RA	RA	RA
	Sub-acute			RC		RA			RA	RA	RA	RA
	Chronic			NE								NE
Motor Accidents Authority, 2007 [43]	WAD I	RA			RA/NE	RC						
	WAD II	RA			RA/NE	RC						
	WAD III	RA			RA/NE	RC						
Quebec Task Force, 1995 [46]	WAD I	NE	NE	NE	NE	NE	RA	NE			NE	NE
	WAD II	NE	NE	NE	NE	NE	RA	NE			NE	NE
	WAD III	NE	NE	NE	NE	NE	RA	NE			NE	NE
South Australian Centre for Trauma and Injury Recovery, 2008 [40]	Acute		RC	RC	RA/NE		RC	RC				RC
	Chronic		RA	RA	RA		RA	RA				RA

	Stage or grade of WAD	Thermo-therapy	Electrical stimulation	EMG biofeedback	Cognitive behavioral therapy	Relaxation techniques	Vestibular rehabilitation	Psychosocial interventions	Spray and stretch	Acupuncture	Magnetic necklaces	
Chartered Society of Physio-therapists, 2004 [54]	Acute					RC				NE		
	Sub-acute									NE		
	Chronic	NE	NE	NE						NE		
Motor Accidents Authority, 2007 [43]	WAD I								RA/NE	RC	RA/NE	
	WAD II								RA/NE	RC	RA/NE	
	WAD III								RA/NE	RC	RA/NE	
Quebec Task Force, 1995 [46]	WAD I		NE					NE		NE	NE	
	WAD II		NE					NE		NE	NE	
	WAD III		NE					NE		NE	NE	
South Australian Centre for Trauma and Injury Recovery, 2008 [40]	Acute		RC									
	Chronic		RA		RC		RC					

	Stage or grade of WAD	Pilates	Feldenkrais	Alexander technique	Homeopathy	Multimodal therapies	Multi-disciplinary psychosocial packages	High Dose intravenous methylprednisolone	Pharmaco-logical injections	Subcutaneous sterile water injections	Radio-frequency neurotomy	Surgery
Chartered Society of Physio-therapists, 2004 [54]	Acute					R						
	Sub-acute						RC					
	Chronic											
Motor Accidents Authority, 2007 [43]	WAD I	RA/NE	RA/NE	RA/NE	RA/NE	RC			RA			RA
	WAD II	RA/NE	RA/NE	RA/NE	RA/NE	RC		RA	RA			RA
	WAD III	RA/NE	RA/NE	RA/NE	RA/NE	RC		RA	RC			RC
Quebec Task Force, 1995 [46]	WAD I								NE	RA		RA
	WAD II								NE	RA		RA
	WAD III								NE	RA		RC
South Australian Centre for Trauma and Injury Recovery, 2008 [40]	Acute								RA/NE			RA
	Chronic								RA	RC	RC	RA

R – Recommended (includes interventions that are strongly recommended); RC – recommended for consideration (includes interventions that may be effective or that are not routinely recommended); RA – recommended against (includes interventions not likely to be effective); NE – no evidence studying the individual intervention specifically in subjects with WAD; WAD – whiplash-associated disorders; EMG – electromyographic.

[a]Empty cells indicate that the intervention was not mentioned in the guideline; [b]Recommendations that were not specific to a stage or grade of WAD were presumed to apply to all stages or grades.

experiencing persistent symptoms or have difficulty once back at work. None of the other admissible guidelines addressed management of MTBI post-discharge.

Additional recommendations for the management of persistent symptoms were made in the update of this guideline (published in 2013) [57]. Key recommendations from this update regarding management were: (1) Significant, prolonged complaints after MTBI should lead primary care providers to consider that many factors may contribute to the persistence of post-concussive symptoms; (2) All potential contributing factors should be investigated and a management strategy considered; (3) All patients with persistent symptoms should be screened for mental health symptoms and disorders; and (4) Patients with persistent cognitive symptoms who continue to interfere in daily functioning should be considered for referral for neuropsychological assessment (to assist in clarifying appropriate treatment options based on individual patient characteristics and conditions). Recommendations were also provided to facilitate return to work and post-secondary activities, including encouraging individuals with MTBI to gradually return to normal activity based on their tolerance. The update reported on a formal evaluation of the guidelines and included changes to make the recommendations more usable and practical [57].

Discussion

We conducted a rigorous search and critical appraisal of the literature to evaluate the methodological quality of recommendations from guidelines for the management of traffic injuries. It was not our aim to accept or reject recommendations of the scientifically admissible guidelines. Most guidelines were outdated and their systematic reviews need to be updated. Sixteen of the identified guidelines were eligible for critical appraisal and eight of these were considered scientifically admissible. The methodological quality of guidelines eligible for critical appraisal varied widely. Guidelines considered inadmissible contained methodological flaws that pertained to: (1) lack of a systematic approach to literature searches; (2) poor descriptions of the strengths and limitations of the literature; (3) lack of explicit links between recommendations and supporting evidence; or (4) ambiguous recommendations (i.e. lacking detail regarding patient population, intervention or intended outcome). These flaws compromised internal validity and they could not be recommended for use as we were not confident in the guideline recommendations.

Most admissible guidelines focused on WAD or MTBI, which is reflective of the common patterns of pain localization after traffic injuries. A cross-sectional analysis of a population-based cohort with auto-insurance claims found that 86 and 72% of respondents reported posterior neck pain or head pain, respectively [6]. All guidelines recommended reassurance and patient education as key components to management regardless of the traffic condition. These management components may stem from the focus on patient-centered care. The Institute of Medicine, the health arm of the United States Academy of Sciences, described patient-centered care as a partnership among practitioners, patients and families [61]. The Institute of Medicine works outside of government to provide unbiased and authoritative advice to decision makers and the public [62]. The rationale for this approach is to respect patients' wants, needs and preferences and ensure patients have the education to participate in decisions concerning their care [61]. All guidelines addressing WAD recommended against the prescription and use of collars. None of the admissible guidelines provide comprehensive recommendations for a range of traffic injuries, even though people in traffic collisions often report physical and psychological conditions. It is

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Table 5. Recommendations from admissible guidelines for the early management of MTBI (in adults).[a]

	In-hospital observation (specific to MTBI)	Discharge criteria of GCS = 15	Additional discharge criteria of no risk or presence of adverse factors	Home support for subsequent care	Discharge advice	Communication with general physician after discharge	seek immediate medical advice with worrisome symptoms	Cease driving for 24 + hours after discharge	Advise patients of likely recovery	Advise patients regarding reduced cognitive functioning	Referral to expert in brain injuries for persistent symptoms
National Collaborating Centre for Acute Care, 2007 [45]		R	R	R	R	R	R				R
Ontario Neurotrauma Foundation, 2008 [41]	R	R	R	R	R	R		R	R	R	R
Scottish Intercollegiate Guidelines Network, 2009 [42]		R	R	R	R	R	R		R		

R – Recommended; [a]Empty cells indicate that the intervention was not mentioned in the guideline.

important to note that the recommendations for the management of MTBI outlined in the scientifically admissible guidelines may not be specific to MTBI secondary to traffic collisions [41,42,45]. The recommendations may be considered for individuals with MTBI from various mechanisms of injury (e.g. traffic collisions, falls, sports). However, it is recognized that traffic collisions and falls are the main causes of MTBI [5].

The need for trustworthiness of guidelines in general has been emphasized, since they are used to guide decisions about patients, practice measures, insurance coverage and reimbursement [18]. Attempts have been made to raise the quality of guideline development in order to improve users' trust in guidelines. The Institute of Medicine and the American Cancer Society have adopted standards for objective, scientifically valid and consistent guideline development [18,63]. Similarly, the AGREE system has provided the most widely accepted standards for appraising quality of guidelines since 2003 [32]. Our systematic review found that the majority (6/8) of inadmissible guidelines were published after 2003. Although AGREE was widely promoted during that period, 50% (8/16) [47–50,52,53,56,59] of our eligible guidelines did not fully use recommended methodology. Our results are similar to a recent study that evaluated 130 randomly selected guidelines and determined that there was poor adherence to Institute of Medicine standards [64]. Kung and co-authors have suggested that concerted efforts from medical societies and government agencies are needed to improve adherence to guideline standards [64]. This would help ensure that guideline developers become familiar with guideline standards and that they meet these standards using objective and transparent methods.

The fundamental aspects of guideline development involve the assembling, evaluating and summarizing of evidence [18]. These aspects include a systematic review and assessment of the quality of evidence [18]. Our systematic review identified a significant proportion of guidelines that failed to satisfy this fundamental requirement. Specifically, we identified 10 guidelines deemed ineligible for review due to the absence of systematic literature searches or critical appraisal methods. Almost 50% more guidelines would meet the selection criteria of our review if these guidelines included these fundamental steps. Furthermore, more than half of the inadmissible guidelines had inadequate systematic literature searches [47,49,52,56] and most inadmissible guidelines had poor critical appraisal methods [47–50,52,53,59]. Critical appraisal methods using a validated tool are recommended to ensure that included studies are of adequate quality and appropriate for use in the guideline [65]. Specifically, these methods assess systematic reviews, randomized trials, cohort studies and/or case-control studies for risks of selection, measurement and confounding bias [66]. Adequate systematic review methods should be performed to help ensure that recommendations accurately reflect the underlying evidence.

Some recommendations varied or conflicted even among admissible guidelines that pertained to the same traffic condition. A number of factors may be influencing these conflicting recommendations. Kung and co-authors determined that fewer than half of reviewed guidelines addressed competing interests [64]. They also determined that over two-thirds of committee chairpersons had conflicts of interest among the competing interests that were reported [64]. We also identified potential competing interests that were not reported, even among guidelines that were deemed admissible. Similarly, Shaneyfelt et al. [21] described the need for judgement around the importance and weight of certain outcomes during guideline development. The priority assigned to outcomes may vary among guideline developers, which was thought to be the reason for conflicting recommendations between certain cancer screening guidelines [21]. Furthermore, it has been suggested that guidelines require

updating at least every five years [64]. The review by Kung et al. [64] determined that less than half of the guidelines they reviewed had been updated within 5.5 years. Half of the relevant guidelines we reviewed (4/8) [43,44,46,54] were outdated past five years based on their literature search dates. One guideline was updated within five years of the original guideline [57]. The influence of competing interests and the need for updating likely played a major role in the inconsistencies found across guideline recommendations.

Implications and future research directions

There are several implications related to the results of our systematic review. Based on the recommendations of admissible guidelines, clinicians should consider: (1) advice, education and reassurance for all traffic injuries; (2) exercise, early return to activity, mobilization/manipulation, analgesic and avoiding collars for WAD; (3) psychological first aid, pharmacotherapy and cognitive behavioral therapy for anxiety; (4) monitoring for complications, discharge criteria, advice upon discharge from the emergency room and post-discharge care for MTBI.

The inadmissible guidelines cannot be recommended for use by clinicians in practice. It is recommended that the authorities responsible for structuring and regulating the care for traffic injuries focus on recommended interventions from the admissible guidelines. They can also use the AGREE II instrument as a valid instrument for evaluating future guidelines in this area.

Future research should focus on developing guidelines of adequate methodological quality for the management of other traffic injuries, including psychological consequences of traffic collisions. The guideline development process should be guided by established methodological standards, such as those outlined by the National Institute for Health and Care Excellence (NICE) and the Scottish Intercollegiate Guidelines Network (SIGN) [66]. Furthermore, future guidelines need to consider study designs other than RCTs, as valid observational studies (cohort and case-control studies) can provide rigorous methodological evidence when formulating recommendations. Few of the existing high-quality guidelines considered the resource implications and implementation issues related to their adoption by clinicians and policy makers. Therefore, future guidelines need to improve this important aspect of guideline development. Finally, it is essential that guidelines include a plan to update their recommendations based on new scientific evidence. In our review, this was particularly important for the guidelines on WAD and anxiety [40,43,44,46,54].

Strengths and limitations

There are strengths to this review. This review used a recommended critical appraisal instrument for evaluating guidelines to maintain high methodological rigor [32]. Prior to the systematic review, all reviewers received standardized training in the critical appraisal of guidelines. In addition, this review serves as the first systematic review and critical appraisal of guidelines for common traffic injuries.

This review also has limitations. First, we searched for English language guidelines for the management of common traffic injuries and may have excluded well conducted and scientifically admissible guidelines published in other languages. However, this is partially supported by evidence suggesting that excluding non-English clinical trials from a previous meta-analysis of controlled trials did not lead to biased results [67]. This result was also found in other systematic reviews studying the effect of language-restrictions in conventional medicine [68–71]. Second, some guidelines were missing details in their methodology. However, we made multiple attempts to contact authors for full versions of guidelines or other relevant information. This was a methodological strength of this review that ensured our screening and critical appraisal was as accurate as possible. We contacted the authors/organizations of 16 guidelines and were unable to receive information for only three guidelines [72–74].

Conclusions

Few admissible guidelines make comprehensive recommendations for the combined management of physical and psychological conditions among individuals injured in traffic collisions. Our review found that inadmissible guidelines had important methodological flaws, particularly in conducting systematic searches and identifying strengths and limitations of evidence. In admissible and inadmissible guidelines, the applicability and editorial independence domains of the AGREE II were poor. Future guideline developers need to improve these domains during guideline development to increase the scientific validity and the acceptability of guideline recommendations. There is an urgent need for the development of a comprehensive guideline that addresses the constellation of physical and psychological conditions following traffic collisions.

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Appendix IA: MEDLINE search strategy – search terms for traffic collisions

(1) MH Practice Guidelines as Topic
(2) MH Guideline Adherence
(3) MH Consensus
(4) MH Clinical Protocols
(5) MH Evidence-Based Medicine
(6) MH Physician's Practice Patterns
(7) MH Health Planning Guidelines
(8) PT Guideline
(9) PT Practice Guideline
(10) PT Consensus Development Conference
(11) appropriateness n5 criteri*
(12) guideline* n5 (clinical or consensus or practice or development or validate* or standard*)
(13) consensus n5 (process or statement*)
(14) evidence-based n5 (approach or guideline* recommendation*)
(15) evidence-informed n5 (guideline* or recommendation* or consensus or position statement*)
(16) practice n5 (guideline* or parameter*)
(17) recommendation n5 statement*
(18) or/1-17
(19) (collision* or crash or crashes or MVC* or road or traffic or accident*) n2 (motor or vehicle* or auto or automobile or car or cars or truck* or bus or buses or traffic or motorcycle*)
(20) MH Accidents, Traffic
(21) MH Motor Vehicles+
(22) or/19-21
(23) 18 and 22
(24) Limit 25 to yr=''1995-Current''
(25) Limit 26 to English language

Appendix IB: MEDLINE search strategy – search terms for traffic injuries

(1) exp Whiplash Injuries/
(2) exp Neck Injuries/
(3) exp Neck Pain/
(4) Neck Muscles/in [Injuries]
(5) exp Cervical Vertebrae/in [Injuries]
(6) exp Radiculopathy/
(7) exp Brachial Plexus Neuropathies/
(8) exp Torticollis/
(9) Headache/
(10) whiplash.ab,ti.
(11) ''neck injur*''.ab,ti.
(12) ''neck pain*''.ab,ti.
(13) ''cervical pain*''.ab,ti.
(14) ''neck ache*''.ab,ti.
(15) ''neckache*''.ab,ti.
(16) ''cervicalgia*''.ab,ti.
(17) ''cervicodynia*''.ab,ti.
(18) ''radiculopath*''.ab,ti.
(19) ''brachial plexus neuropath*''.ab,ti.
(20) torticollis.ab,ti.
(21) ''headache*''.ab,ti.
(22) 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21
(23) exp Practice Guidelines as Topic/
(24) exp Guideline Adherence/
(25) exp Consensus Development Conference/ or exp Consensus/ or exp Consensus Development Conferences as Topic/
(26) exp Clinical Protocols/
(27) exp Evidence-Based Medicine/
(28) exp Health Planning Guidelines/
(29) guideline.pt.
(30) practice guideline.pt.
(31) consensus development conference.pt.
(32) (guideline* adj3 (clinical or consensus or practice or development of validate* or standard*)).ab,ti.

(33) (consensus adj3 (process or statement*)).ab,ti.
(34) (evidence-based adj3 (approach* or guideline* or recommendation* or consensus or position statement*)).ab,ti.
(35) (evidence-informed adj3 (approach* or guideline* or recommendation* or consensus or position statement*)).ab,ti.
(36) (practice adj3 (guideline* or parameter*)).ab,ti.
(37) ''recommendation adj5 statement*''.ab,ti.
(38) 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37
(39) exp Brain Edema/
(40) exp Brain Concussion/
(41) exp Cerebrovascular Trauma/
(42) exp Craniocerebral Trauma/
(43) Coma/
(44) exp Glasgow Coma Scale/
(45) exp Glasgow Outcome Scale/
(46) ((brain* or capitis or Cerebr* or crani* or hemispher* or intercrani* or intra-crani* or skull*) adj4 (contusion* or damag* or fractur* or injur* or trauma* or wound*)).ab,ti.
(47) ((brain* or capitis or Cerebr* or crani* or hemispher* or intercrani* or intra-crani* or skull*) adj4 (bleed* or haematoma* or harmorrhag* or hematoma* or hemorrhag* or pressure)).ab,ti.
(48) (Glasgow adj (coma or outcome) adj (scale* or score*)).ab,ti.
(49) Rancho Los Amigos Scale.ab,ti.
(50) ''diffuse axonal injur*''.ab,ti.
(51) ((brain or cerebral or intracranial) adj3 (edema or oedema or swell*)).ab,ti.
(52) ((coma or concuss* or unconscious* or persistent vegetative state) adj2 (damag* or fractur* or injur* or trauma or wound*)).ab,ti.
(53) (mtbi or mild trauma* injur*).af.
(54) 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53
(55) 22 or 54
(56) 38 and 55
(57) limit 56 to (english language and yr=''2000 -Current'')

Appendix IIA: Definition of common traffic injury

A common traffic injury is defined as any injury arising after a traffic collision that:
(i) produces a physical, mental or psychological impairment for which;
(ii) the scientific evidence indicates that at least 50% of patients will have substantially or fully recovered within four months (we are using time to self-reported recovery for WAD as the reference for recovery).

Conditions that are included, but may not be limited to the following:
(i) Physical impairments: grades I, II and III WAD; cervical, thoracic and lumbar radiculopathy (nerve root injury), grades I and II sprains and strains; rib fractures; contusions, abrasions and skin lacerations all of which do not extend beyond dermis;
(ii) Mental impairments: concussion/mild traumatic brain injury as defined by the American Congress of Rehabilitation Medicine (MTBI is defined as normal structural imaging, a Glasgow Coma Scale of 13 to 15, loss of consciousness of less than 30 min, with altered consciousness <24 h, and post-traumatic amnesia <1 day); and
(iii) Psychological impairments: the psychological impairments included in the Guideline will be finalized following a systematic review of the literature. These impairments may include minor/major depression, acute stress disorder, adjustment disorders and phobias.

Cond itions that are excluded, but may not be limited to the following:
(a) Severe Injuries
(i) Spinal cord injuries;
(ii) Moderate and severe traumatic brain injuries;
(iii) Amputations;
(iv) Blindness;
(v) Injuries resulting in a complete or partial joint dislocation (this definition encompasses the term subluxation which, as defined by the American Academy of Orthopedic Surgeons (AAOS), is a partial or incomplete dislocation of a joint);
(vi) All fractures except for rib fractures.
(b) Pre-existing disabling conditions (which may include the following, as informed by available evidence). The list of pre-existing disabling conditions will be modified as the evidence is reviewed:
(i) Neurological disorders (e.g. cervical spondylotic myelopathy);
(ii) Serious pathologies (e.g. neoplasms, systemic infections);
(iii) Autoimmune arthritis in an uncontrolled state (e.g. rheumatoid arthritis);
(iv) Other autoimmune disorders and type I diabetes due to multiple complications;
(v) Disabling psychiatric conditions (e.g. disabling psychoses).

Appendix IIB: Québec task force classification of grades of whiplash-associated disorders [46]

Grade	Definition
I	Subjects with neck pain and associated symptoms in the absence of objective physical signs
II	Subjects with neck pain and associated symptoms in the presence of objective physical signs and without evidence of neurological involvement
III	Subjects with neck pain and associated symptoms with evidence of neurological involvement including decreased or absent reflexes, decreased or limited sensation or muscular weakness
IV	Subjects with neck pain and associated symptoms with evidence of fracture or dislocation

Appendix III: The AGREE II instrument [32,33]

AGREE II Domains and Items
Domain 1. Scope and purpose
1. The overall objective(s) of the guideline is (are) specifically described.
2. The health question(s) covered by the guideline is (are) specifically described.
3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.
Domain 2. Stakeholder involvement
4. The guideline development group includes individuals from all the relevant professional groups.
5. The views and preferences of the target population (patients, public, etc.) have been sought.
6. The target users of the guideline are clearly defined.
Domain 3. Rigor of development
7. Systematic methods were used to search for evidence.
8. The criteria for selecting the evidence are clearly described.
9. The strengths and limitations of the body of evidence are clearly described.
10. The methods for formulating the recommendations are clearly described.
11. The health benefits, side effects and risks have been considered in formulating the recommendations.
12. There is an explicit link between the recommendations and the supporting evidence.
13. The guideline has been externally reviewed by experts prior to its publication.
14. A procedure for updating the guideline is provided.
Domain 4. Clarity of presentation
15. The recommendations are specific and unambiguous.
16. The different options for management of the condition or health issue are clearly presented.
17. Key recommendations are easily identifiable.

(*continued*)

Continued

AGREE II Domains and Items
Domain 5. Applicability
18. The guideline provides advice and/or tools on how the recommendations can be put into practice.
19. The guideline describes facilitators and barriers to its application.
20. The potential resource implications of applying the recommendations have been considered.
21. The guideline presents monitoring and/or auditing criteria.
Domain 6. Editorial independence
22. The views of the funding body have not influenced the content of the guideline.
23. Competing interests of guideline development group members have been recorded and addressed.

AGREE – Appraisal of Guidelines for Research and Evaluation.